



# Open Source Used In Debug-container elpaso

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In your requests please include the following reference number 78EE117C99-2812803066

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### A. HISTORY OF THE SOFTWARE

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <http://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <http://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations (now Zope Corporation, see <http://www.zope.com>). In 2001, the Python Software Foundation (PSF, see <http://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation is a sponsoring member of the PSF.

All Python releases are Open Source (see <http://www.opensource.org> for the Open Source Definition). Historically, most, but not all, Python releases have also been GPL-compatible; the table below summarizes the various releases.

| Release        | Derived from | Year      | Owner      | GPL-compatible? (1) |
|----------------|--------------|-----------|------------|---------------------|
| 0.9.0 thru 1.2 |              | 1991-1995 | CWI        | yes                 |
| 1.3 thru 1.5.2 | 1.2          | 1995-1999 | CNRI       | yes                 |
| 1.6            | 1.5.2        | 2000      | CNRI       | no                  |
| 2.0            | 1.6          | 2000      | BeOpen.com | no                  |
| 1.6.1          | 1.6          | 2001      | CNRI       | yes (2)             |
| 2.1            | 2.0+1.6.1    | 2001      | PSF        | no                  |
| 2.0.1          | 2.0+1.6.1    | 2001      | PSF        | yes                 |
| 2.1.1          | 2.1+2.0.1    | 2001      | PSF        | yes                 |
| 2.2            | 2.1.1        | 2001      | PSF        | yes                 |
| 2.1.2          | 2.1.1        | 2002      | PSF        | yes                 |
| 2.1.3          |              |           |            |                     |

|       |       |           |     |     |
|-------|-------|-----------|-----|-----|
| 2.1.2 | 2002  | PSF       | yes |     |
| 2.2.1 | 2.2   | 2002      | PSF | yes |
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| 2.3   | 2.2.2 | 2002-2003 | PSF | yes |
| 2.3.1 | 2.3   | 2002-2003 | PSF | yes |
| 2.3.2 | 2.3.1 | 2002-2003 | PSF | yes |
| 2.3.3 | 2.3.2 | 2002-2003 | PSF | yes |
| 2.3.4 | 2.3.3 | 2004      | PSF | yes |
| 2.3.5 | 2.3.4 | 2005      | PSF | yes |
| 2.4   | 2.3   | 2004      | PSF | yes |
| 2.4.1 | 2.4   | 2005      | PSF | yes |
| 2.4.2 | 2.4.1 | 2005      | PSF | yes |
| 2.4.3 | 2.4.2 | 2006      | PSF | yes |
| 2.4.4 | 2.4.3 | 2006      | PSF | yes |
| 2.5   | 2.4   | 2006      | PSF | yes |
| 2.5.1 | 2.5   | 2007      | PSF | yes |
| 2.5.2 | 2.5.1 | 2008      | PSF | yes |
| 2.5.3 | 2.5.2 | 2008      | PSF | yes |
| 2.6   | 2.5   | 2008      | PSF | yes |
| 2.6.1 | 2.6   | 2008      | PSF | yes |
| 2.6.2 | 2.6.1 | 2009      | PSF | yes |
| 2.6.3 | 2.6.2 | 2009      | PSF | yes |
| 2.6.4 | 2.6.3 | 2009      | PSF | yes |
| 2.6.5 | 2.6.4 | 2010      | PSF | yes |
| 3.0   | 2.6   | 2008      | PSF | yes |
| 3.0.1 | 3.0   | 2009      | PSF | yes |
| 3.1   | 3.0.1 | 2009      | PSF | yes |
| 3.1.1 | 3.1   | 2009      | PSF | yes |
| 3.1.2 | 3.1   | 2010      | PSF | yes |
| 3.2   | 3.1   | 2010      | PSF | yes |

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(2) According to Richard Stallman, 1.6.1 is not GPL-compatible, because its license has a choice of law clause. According to CNRI, however, Stallman's lawyer has told CNRI's lawyer that 1.6.1 is "not incompatible" with the GPL.

Thanks to the many outside volunteers who have worked under Guido's direction to make these releases possible.

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=====

Distutils2 Contributors

=====

The Distutils2 project was started by Tarek Ziad and is currently maintained by ric Araujo. Many people have contributed to the project.

distlib has started off using some of the code from distutil2.

If you're making a patch, please add your name below in alphabetical order, and welcome into the Fellowship of the Packaging!

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Metadata-Version: 1.0

Name: setuptools

Version: 0.6c9

Summary: Download, build, install, upgrade, and uninstall Python packages -- easily!

Home-page: <http://pypi.org/pypi/setuptools>

Author: Phillip J. Eby

Author-email: [distutils-sig@python.org](mailto:distutils-sig@python.org)

License: PSF or ZPL

Description: =====

Installing and Using Setuptools

=====

.. contents:: \*\*Table of Contents\*\*

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Installation Instructions  
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Windows

=====

Install setuptools using the provided ``.exe`` installer. If you've previously installed older versions of setuptools, please delete all ``setuptools\*.egg`` and ``setuptools.pth`` files from your system's ``site-packages`` directory (and any other ``sys.path`` directories) FIRST.

If you are upgrading a previous version of setuptools that was installed using an ``.exe`` installer, please be sure to also *uninstall that older version* via your system's "Add/Remove Programs" feature, BEFORE installing the newer version.

Once installation is complete, you will find an ``easy\_install.exe`` program in your Python ``Scripts`` subdirectory. Be sure to add this directory to your ``PATH`` environment variable, if you haven't already done so.

RPM-Based Systems

=====

Install setuptools using the provided source RPM. The included ``.spec`` file assumes you are installing using the default ``python`` executable, and is not

specific to a particular Python version. The ``easy\_install`` executable will be installed to a system ``bin`` directory such as ``/usr/bin``.

If you wish to install to a location other than the default Python installation's default ``site-packages`` directory (and ``\$prefix/bin`` for scripts), please use the ``.egg``-based installation approach described in the following section.

Cygwin, Mac OS X, Linux, Other

=====

1. Download the appropriate egg for your version of Python (e.g. ``setuptools-0.6c9-py2.4.egg``). Do NOT rename it.
2. Run it as if it were a shell script, e.g. ``sh setuptools-0.6c9-py2.4.egg``. Setuptools will install itself using the matching version of Python (e.g. ``python2.4``), and will place the ``easy\_install`` executable in the default location for installing Python scripts (as determined by the standard distutils configuration files, or by the Python installation).

If you want to install setuptools to somewhere other than ``site-packages`` or your default distutils installation locations for libraries and scripts, you may include EasyInstall command-line options such as ``--prefix``, ``--install-dir``, and so on, following the ``.egg`` filename on the same command line. For example::

```
sh setuptools-0.6c9-py2.4.egg --prefix=~
```

You can use ``--help`` to get a full options list, but we recommend consulting the `EasyInstall manual`\_ for detailed instructions, especially the section on custom installation locations`\_.

.. \_EasyInstall manual: <http://peak.telecommunity.com/DevCenter/EasyInstall>  
.. \_the section on custom installation locations: <http://peak.telecommunity.com/DevCenter/EasyInstall#custom-installation-locations>

Cygwin Note

-----

If you are trying to install setuptools for the **Windows** version of Python (as opposed to the Cygwin version that lives in ``/usr/bin``), you must make sure that an appropriate executable (``python2.3``, ``python2.4``, or ``python2.5``) is on your **Cygwin** ``PATH`` when invoking the egg. For example, doing the following at a Cygwin bash prompt will install setuptools

for the **\*\*Windows\*\*** Python found at ``C:\Python24``:

```
ln -s /cygdrive/c/Python24/python.exe python2.4
PATH=.:$PATH sh setuptools-0.6c9-py2.4.egg
rm python2.4
```

## Downloads

=====

All setuptools downloads can be found at the project's home page in the Python Package Index`. Scroll to the very bottom of the page to find the links.

.. the project's home page in the Python Package Index: <http://pypi.org/pypi/setuptools>

In addition to the PyPI downloads, the development version of ``setuptools`` is available from the `Python SVN sandbox`, and in-development versions of the `0.6 branch` are available as well.

.. 0.6 branch: <http://svn.python.org/projects/sandbox/branches/setuptools-0.6/#egg=setuptools-dev06>

.. Python SVN sandbox: <http://svn.python.org/projects/sandbox/trunk/setuptools/#egg=setuptools-dev>

-----

## Using

### Setuptools and EasyInstall

-----

Here are some of the available manuals, tutorials, and other resources for learning about Setuptools, Python Eggs, and EasyInstall:

- \* `The EasyInstall user's guide and reference manual`\_
- \* `The setuptools Developer's Guide`\_
- \* `The pkg\_resources API reference`\_
- \* `Package Compatibility Notes`\_ (user-maintained)
- \* `The Internal Structure of Python Eggs`\_

Questions, comments, and bug reports should be directed to the `distutils-sig mailing list`. If you have written (or know of) any tutorials, documentation, plug-ins, or other resources for setuptools users, please let us know about them there, so this reference list can be updated. If you have working, \*tested\* patches to correct problems or add features, you may submit them to the `setuptools bug tracker`\_.

.. setuptools bug tracker: <http://bugs.python.org/setuptools/>

.. Package Compatibility Notes: <http://peak.telecommunity.com/DevCenter/PackageNotes>

.. The Internal Structure of Python Eggs: <http://peak.telecommunity.com/DevCenter/EggFormats>

.. The setuptools Developer's Guide: <http://peak.telecommunity.com/DevCenter/setuptools>

.. \_The pkg\_resources API reference: <http://peak.telecommunity.com/DevCenter/PkgResources>  
.. \_The EasyInstall user's guide and reference manual: <http://peak.telecommunity.com/DevCenter/EasyInstall>  
.. \_distutils-sig mailing list: <http://mail.python.org/pipermail/distutils-sig/>

-----  
Credits  
-----

\* The original design for the ``egg`` format and the ``pkg\_resources`` API was co-created by Phillip Eby and Bob Ippolito. Bob also implemented the first version of ``pkg\_resources``, and supplied the OS X operating system version compatibility algorithm.

\* Ian Bicking implemented many early "creature comfort" features of easy\_install, including support for downloading via Sourceforge and Subversion repositories. Ian's comments on the Web-SIG about WSGI application deployment also inspired the concept of "entry points" in eggs, and he has given talks at PyCon and elsewhere to inform and educate the community about eggs and setuptools.

\* Jim Fulton contributed time and effort to build automated tests of various aspects of ``easy\_install``, and supplied the doctests for the command-line ``.exe`` wrappers on Windows.

\* Phillip J. Eby is the principal author and maintainer of setuptools, and first proposed the idea of an importable binary distribution format for Python application plug-ins.

\* Significant parts of the implementation of setuptools were funded by the Open Source Applications Foundation, to provide a plug-in infrastructure for the Chandler PIM application.

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## 1.3 bridgeutils 1.7.1-r2

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# 1.5 util-linux 2.41-r9

## 1.5.1 Available under license :

```
NR START  END SECTORS SIZE NAME UUID
1  32 7679   7648 3.7M   8f8378c0-01
2 7680 16383   8704 4.3M   8f8378c0-02
5 7936 12799   4864 2.4M
6 12544 16127   3584 1.8M
# Automatically generated by apkbuild-cpan, template 4
# Contributor: Valery Kartel <valery.kartel@gmail.com>
# Maintainer: Celeste <cielesti@protonmail.com>
maintainer="Celeste <cielesti@protonmail.com>"
pkgname=perl-bsd-resource
pkgver=1.2911
pkgrel=10
#_pkgreal is used by apkbuild-cpan to find modules at MetaCpan
_pkgreal=BSD-Resource
pkgdesc="Perl extension implements the BSD process resource limit functions"
url="https://metacpan.org/release/BSD-Resource/"
```

```

arch="all"
license="Artistic-2.0 OR LGPL-2.0"
depends="perl"
makedepends="perl-dev"
subpackages="$pkgname-doc"
source="https://cpan.metacpan.org/authors/id/J/JH/JHI/BSD-Resource-$pkgver.tar.gz"
builddir="$srcdir/$_pkgreal-$pkgver"

build() {
    export CFLAGS=$(perl -MConfig -E 'say $Config{ccflags}')
    PERL_MM_USE_DEFAULT=1 perl -I. Makefile.PL \
        INSTALLDIRS=vendor \
        NO_PACKLIST=1 \
        NO_PERLLOCAL=1
    make
}

check() {
    export CFLAGS=$(perl -MConfig -E 'say $Config{ccflags}')
    make test
}

package() {
    make DESTDIR="$pkgdir" install
}

sha512sums="
d0032d41c7c0468ed1c6d8f57b885f6cb97a5039d754c8cb60b2067daedaf53bd15fb6561a3d0f828df16dfa5417f663b
8065ba65f4fea16dc9262728b3b6b85
    BSD-Resource-1.2911.tar.gz
"

```

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# Contributor: Maxim Karasev <begs@disroot.org>

# Maintainer: mio <miyopan@e.email>

pkgname=bsd-games

pkgver=3.3

pkgrel=2

pkgdesc="traditional text mode games from BSD"

url="https://bsd-games.sourceforge.io/"

arch="all"

license="BSD-3-Clause"

install="\$pkgname.post-install"

makedepends="ncurses-dev coreutils" # configure causes busybox expr error

subpackages="\$pkgname-doc"

source="https://sourceforge.net/projects/bsd-games/files/bsd-games-\$pkgver.tar.gz  
0001-bsd-games-scores-dir.patch  
"

options="!check" # no tests

build() {

# some GNU autoconf options are ignored, but it works

./configure \

--build=\$CBUILD \

--host=\$CHOST \

--prefix=/usr \

--sysconfdir=/etc \

--mandir=/usr/share/man \

--sourcedir=/usr/share/\$pkgname

make

}

package() {

```

make DESTDIR="$pkgdir" install
install -Dm644 LICENSE "$pkgdir"/usr/share/licenses/bsd-games/LICENSE
}

sha512sums="
aaf36d09d4fe68514a5c279063d7e77a9a9a84c447037cba974b29faa07eb80c2aab2379d0699c196b5c27ffe1b2bb2c6
8d3390143e0e62d5e3d210ccfb61294
  bsd-games-3.3.tar.gz
e1def0d4835a877242c4173fae862e278a7858738e0bacacbb045a42bcabec2aa7c72d000bbd2421ce35fe66cdc1f52c0
577b7e278029ca5ed50f7aab22319f6 0001-bsd-games-scores-dir.patch
"

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# Maintainer: Natanael Copa <ncopa@alpinelinux.org>
pkgname=libart-lgpl
pkgver=2.3.21
pkgrel=8
pkgdesc="A library for high-performance 2D graphics"
url="https://www.levien.com/libart/"
arch="all"
options="!check" # No test suite.
license="LGPL-2.0-or-later"
subpackages="$pkgname-dev"
source="https://download.gnome.org/sources/libart-lgpl/2.3/libart-lgpl-$pkgver.tar.bz2"
"

builddir="$srcdir"/libart-lgpl-$pkgver

prepare() {
  update_config_sub
  default_prepare
}

build() {
  ./configure \
  --build=$CBUILD \
  --host=$CHOST \
  --prefix=/usr
  make

```

```
}
```

```
package() {  
    make DESTDIR="$pkgdir" install  
}
```

```
sha512sums="8a632a6a4da59e5e8c02ec2f5a57e36d182b325b46513765425e5f171ff9ae326af1b133725beba28f7e7  
6654309e001aee9bace727b5b4c8589405256a3c020 libart_lgpl-2.3.21.tar.bz2"
```

```
mini_sendmail - accept email on behalf of real sendmail
```

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```
/*
```

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```

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# Maintainer: Kevin Daudt <kdaudt@alpinelinux.org>
pkgname=spdx-licenses
pkgver=3.26.0
pkgrel=0
pkgdesc="Various data formats for the SPDX License List"
url="https://spdx.org/"
arch="noarch"
options="!check" # no test suite
license="CC-BY-3.0"
source="license-list-data-$pkgver.tar.gz::https://github.com/spdx/license-list-data/archive/v$pkgver.tar.gz"
builddir="$srcdir/license-list-data-$pkgver"
subpackages="$pkgname-list"

_types="html json rdfa rdft rdfturtle rdfxml template text"

for type in $_types; do
    subpackages="$subpackages $pkgname-$type:_subpkg"
done

package() {
    mkdir -p "$pkgdir"
}

_subpkg() {
    local type=${subpkgname/$pkgname-/}
    pkgdesc="$pkgdesc ($type)"
    install_if="$pkgname=$pkgver-r$pkgrel"
    mkdir -p "$subpkgdir"/usr/share/spdx
    cp -r "$builddir"/$type "$subpkgdir"/usr/share/spdx/
}

list() {
    pkgdesc="$pkgdesc (licence list)"
    mkdir -p "$subpkgdir"/usr/share/spdx
    local i; for i in "$builddir"/text/*.txt;
    do
        local license=${i##*/}
        echo ${license%.*} >> "$subpkgdir"/usr/share/spdx/license.lst
    done
}

sha512sums="
67e618d4642dfe4f366935d9514d6f7941d3711e77c49bc1b340ac572d36015981b8f10c72a9f80f1d83e132ae7e5093c
0155e0c0e786e4777ee16d1cb7b885a license-list-data-3.26.0.tar.gz
"

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```



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The Kohonen neural network code for color optimization was written by Anthony Dekker.

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"X-Splines: A Spline Model Designed for the End User" by C. Blanc and C. Schlick, Proceedings of SIGGRAPH'95  
<http://dept-info.labri.u-bordeaux.fr/~schlick/DOC/sig1.html>  
# Contributor: Dhruvin Gandhi <contact@dhruvin>  
# Maintainer: Patrycja Rosa <alpine@ptrcnull.me>  
pkgname=py3-license-expression  
\_pkgname=license\_expression  
pkgver=30.4.1  
pkgrel=0  
pkgdesc="Library to parse, compare, simplify and normalize license expressions"  
url="https://github.com/nexB/license-expression"  
arch="noarch"  
license="Apache-2.0"  
depends="python3 py3-boolean.py"  
makedepends="py3-setuptools py3-setuptools\_scm py3-gpep517 py3-wheel"  
checkdepends="py3-pytest py3-pytest-xdist"  
subpackages="\$pkgname-pyc"  
source="https://files.pythonhosted.org/packages/source/l/\_pkgname/\_pkgname-\$pkgver.tar.gz"  
builddir="\$srcdir/\$\_pkgname-\$pkgver"

```
build() {  
    gpep517 build-wheel \  
        --wheel-dir .dist \  
        --output-fd 3 3>&1 >&2  
}
```

```

}

check() {
python3 -m venv --clear --without-pip --system-site-packages .testenv
.testenv/bin/python3 -m installer .dist/*.whl
.testenv/bin/python3 -m pytest
}

package() {
python3 -m installer -d "$pkgdir" \
.dists/*.whl
}

sha512sums="
114c630f098939757e49187e35b4e54883266a2ee9ca283724992420ef4c860f9606a8342da0ab74d93627c10805f312
fda3f699cbc7c4fbd47a71e220440fb0
license_expression-30.4.1.tar.gz
"

```

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```
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# Contributor: Fabian Affolter <fabian@affolter-engineering.ch>  
# Maintainer: Fabian Affolter <fabian@affolter-engineering.ch>  
pkgname=py3-flake8-copyright  
\_pkgname=flake8-copyright  
pkgver=0.2.4  
pkgrel=3  
pkgdesc="Extension for flake8 which checks for copyrights"  
options="!check" # No testsuite  
url="https://github.com/savoirfairelinux/flake8-copyright"  
arch="noarch"  
license="MIT"

```

depends="py3-flake8 py3-setuptools"
makedepends="py3-gpep517 py3-wheel"
subpackages="$pkgname-pyc"
source="https://files.pythonhosted.org/packages/source/${_pkgname:0:1}/${_pkgname}/${_pkgname}-${pkgver}.tar.gz"
builddir="$srcdir"/$_pkgname-$pkgver

replaces="py-flake8-copyright"          # Backwards compatibility
provides="py-flake8-copyright=$pkgver-r$pkgrel" # Backwards compatibility

build() {
    gpep517 build-wheel \
        --wheel-dir .dist \
        --output-fd 3 3>&1 >&2
}

package() {
    gpep517 install-wheel --destdir "$pkgdir" \
        .dist/*.whl
}

sha512sums="
a6ab47e1bb715618f075c51f398e18180404871b3b0faf1c2d30701d5203db6bc23771bf22ffb5bafcd8ee856b9b64237
b316bd503ae7dceed6ca284ccd5a74d
    flake8-copyright-0.2.4.tar.gz
"

/* $NetBSD: tree.h,v 1.20 2013/09/14 13:20:45 joerg Exp $ */
/* $OpenBSD: tree.h,v 1.13 2011/07/09 00:19:45 pirofti Exp $ */
/* Modified by Void Linux. */
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*/

```

```

#ifndef _SYS_TREE_H_
#define _SYS_TREE_H_

```

```

#ifdef __GNUC__
#define __GNUC_PREREQ__(x, y) \
    ((__GNUC__ == (x) && __GNUC_MINOR__ >= (y)) || \
     (__GNUC__ > (x)))
#else
#define __GNUC_PREREQ__(x, y) 0
#endif

```

```

#if __GNUC_PREREQ__(2, 7) || defined(__lint__)
#define _sys_tree_h_unused __attribute__((__unused__))
#else
#define _sys_tree_h_unused /* delete */
#endif

```

```

/*

```

```

* This file defines data structures for different types of trees:
* splay trees and red-black trees.
*
* A splay tree is a self-organizing
* data structure. Every operation
* on the tree causes a splay to happen. The splay moves the requested
* node to the root of the tree and partly rebalances it.
*
* This has the benefit that request locality causes faster lookups as
* the requested nodes move to the top of the tree. On the other hand,
* every lookup causes memory writes.
*
* The Balance Theorem bounds the total access time for m operations
* and n inserts on an initially empty tree as  $O((m + n) \lg n)$ . The
* amortized cost for a sequence of m accesses to a splay tree is  $O(\lg n)$ ;
*
* A red-black tree is a binary search tree with the node color as an
* extra attribute. It fulfills a set of conditions:
* - every search path from the root to a leaf consists of the
*   same number of black nodes,
* - each red node (except for the root) has a black parent,
* - each leaf node is black.
*
* Every operation on a red-black tree is bounded as  $O(\lg n)$ .

```

\* The maximum height of a red-black tree is  $2\lg(n+1)$ .

\*/

```
#define SPLAY_HEAD(name, type) \
struct name { \
    struct type *sph_root; /* root of the tree */ \
}
```

```
#define SPLAY_INITIALIZER(root) \
{ NULL }
```

```
#define SPLAY_INIT(root) do { \
    (root)->sph_root = NULL; \
} while (/*CONSTCOND*/ 0)
```

```
#define SPLAY_ENTRY(type) \
struct { \
    struct type *spe_left; /* left element */ \
    struct type *spe_right; /* right element */ \
}
```

```
#define SPLAY_LEFT(elm, field) (elm)->field.spe_left
#define SPLAY_RIGHT(elm, field) (elm)->field.spe_right
#define SPLAY_ROOT(head) (head)->sph_root
#define SPLAY_EMPTY(head) (SPLAY_ROOT(head) == NULL)
```

```
/* SPLAY_ROTATE_{LEFT,RIGHT} expect that tmp hold SPLAY_{RIGHT,LEFT} */
#define SPLAY_ROTATE_RIGHT(head, tmp, field) do { \
    SPLAY_LEFT((head)->sph_root, field) = SPLAY_RIGHT(tmp, field); \
    SPLAY_RIGHT(tmp, field) = (head)->sph_root; \
    (head)->sph_root = tmp; \
} while (/*CONSTCOND*/ 0)
```

```
#define SPLAY_ROTATE_LEFT(head, tmp, field) do { \
    SPLAY_RIGHT((head)->sph_root, \
    field) = SPLAY_LEFT(tmp, field); \
    SPLAY_LEFT(tmp, field) = (head)->sph_root; \
    (head)->sph_root = tmp; \
} while (/*CONSTCOND*/ 0)
```

```
#define SPLAY_LINKLEFT(head, tmp, field) do { \
    SPLAY_LEFT(tmp, field) = (head)->sph_root; \
    tmp = (head)->sph_root; \
    (head)->sph_root = SPLAY_LEFT((head)->sph_root, field); \
} while (/*CONSTCOND*/ 0)
```

```
#define SPLAY_LINKRIGHT(head, tmp, field) do { \
    SPLAY_RIGHT(tmp, field) = (head)->sph_root; \
```

```

tmp = (head)->sph_root;    \
(head)->sph_root = SPLAY_RIGHT((head)->sph_root, field); \
} while (/*CONSTCOND*/ 0)

#define SPLAY_ASSEMBLE(head, node, left, right, field) do { \
    SPLAY_RIGHT(left, field) = SPLAY_LEFT((head)->sph_root, field); \
    SPLAY_LEFT(right, field) = SPLAY_RIGHT((head)->sph_root, field); \
    SPLAY_LEFT((head)->sph_root, field) = SPLAY_RIGHT(node, field); \
    SPLAY_RIGHT((head)->sph_root, field) = SPLAY_LEFT(node, field); \
} while (/*CONSTCOND*/ 0)

/* Generates prototypes and inline functions */

#define
SPLAY_PROTOTYPE(name, type, field, cmp) \
void name##_SPLAY(struct name *, struct type *); \
void name##_SPLAY_MINMAX(struct name *, int); \
struct type *name##_SPLAY_INSERT(struct name *, struct type *); \
struct type *name##_SPLAY_REMOVE(struct name *, struct type *); \
\
/* Finds the node with the same key as elm */ \
static __inline struct type * \
name##_SPLAY_FIND(struct name *head, struct type *elm) \
{ \
    if (SPLAY_EMPTY(head)) \
        return(NULL); \
    name##_SPLAY(head, elm); \
    if ((cmp)(elm, (head)->sph_root) == 0) \
        return (head->sph_root); \
    return (NULL); \
} \
\
static __inline _sys_tree_h_unused struct type * \
name##_SPLAY_NEXT(struct name *head, struct type *elm) \
{ \
    name##_SPLAY(head, elm); \
    if (SPLAY_RIGHT(elm, field) != NULL) { \
        elm = SPLAY_RIGHT(elm, field); \
        while (SPLAY_LEFT(elm, field) != NULL) { \
            elm = SPLAY_LEFT(elm, field); \
        } \
    } \
    else \
        elm = NULL; \
    return (elm); \
} \
\
static _sys_tree_h_unused __inline struct type * \

```



```

name##_SPLAY_MIN_MAX(struct name *head, int val) \
{ \
    name##_SPLAY_MINMAX(head, val); \
    return (SPLAY_ROOT(head)); \
}

/* Main splay operation.
 * Moves node close to the key of elm to top
 */

#define SPLAY_GENERATE(name, type, field, cmp) \
struct type * \
name##_SPLAY_INSERT(struct name *head, struct type *elm) \
{ \
    if (SPLAY_EMPTY(head)) { \
        SPLAY_LEFT(elm, field) = SPLAY_RIGHT(elm, field) = NULL; \
    } else { \
        int __comp; \
        name##_SPLAY(head, elm); \
        __comp = (cmp)(elm, (head)->sph_root); \
        if (__comp < 0) { \
            SPLAY_LEFT(elm, field) = SPLAY_LEFT((head)->sph_root, field); \
            SPLAY_RIGHT(elm, field) = (head)->sph_root; \
            SPLAY_LEFT((head)->sph_root, field) = NULL; \
        } else if (__comp > 0) { \
            SPLAY_RIGHT(elm, \
field) = SPLAY_RIGHT((head)->sph_root, field); \
            SPLAY_LEFT(elm, field) = (head)->sph_root; \
            SPLAY_RIGHT((head)->sph_root, field) = NULL; \
        } else \
            return ((head)->sph_root); \
    } \
    (head)->sph_root = (elm); \
    return (NULL); \
} \
\
struct type * \
name##_SPLAY_REMOVE(struct name *head, struct type *elm) \
{ \
    struct type *__tmp; \
    if (SPLAY_EMPTY(head)) \
        return (NULL); \
    name##_SPLAY(head, elm); \
    if ((cmp)(elm, (head)->sph_root) == 0) { \
        if (SPLAY_LEFT((head)->sph_root, field) == NULL) { \
            (head)->sph_root = SPLAY_RIGHT((head)->sph_root, field); \
        } else { \
            __tmp = SPLAY_RIGHT((head)->sph_root, field); \
            (head)->sph_root = SPLAY_LEFT((head)->sph_root, field); \

```

```

    name##_SPLAY(head, elm); \
    SPLAY_RIGHT((head)->sph_root, field) = __tmp; \
} \
return (elm); \
} \
return (NULL); \
} \
\
void \
name##_SPLAY(struct
name *head, struct type *elm) \
{ \
    struct type __node, *__left, *__right, *__tmp; \
    int __comp; \
\
    SPLAY_LEFT(&__node, field) = SPLAY_RIGHT(&__node, field) = NULL;\
    __left = __right = &__node; \
\
    while ((__comp = (cmp)(elm, (head)->sph_root)) != 0) { \
        if (__comp < 0) { \
            __tmp = SPLAY_LEFT((head)->sph_root, field); \
            if (__tmp == NULL) \
                break; \
            if ((cmp)(elm, __tmp) < 0){ \
                SPLAY_ROTATE_RIGHT(head, __tmp, field); \
                if (SPLAY_LEFT((head)->sph_root, field) == NULL)\
                    break; \
            } \
            SPLAY_LINKLEFT(head, __right, field); \
        } else if (__comp > 0) { \
            __tmp = SPLAY_RIGHT((head)->sph_root, field); \
            if (__tmp == NULL) \
                break; \
            if ((cmp)(elm, __tmp) > 0){ \
                SPLAY_ROTATE_LEFT(head, __tmp, field); \
                if (SPLAY_RIGHT((head)->sph_root, field) == NULL)\
                    break; \
            } \
            SPLAY_LINKRIGHT(head, __left, field); \
        } \
    } \
    SPLAY_ASSEMBLE(head,
    &__node, __left, __right, field); \
} \
\
/* Splay with either the minimum or the maximum element \
* Used to find minimum or maximum element in tree. \
*/ \

```

```

void name##_SPLAY_MINMAX(struct name *head, int __comp) \
{ \
    struct type __node, *__left, *__right, *__tmp; \
    \
    SPLAY_LEFT(&__node, field) = SPLAY_RIGHT(&__node, field) = NULL; \
    __left = __right = &__node; \
    \
    while (1) { \
        if (__comp < 0) { \
            __tmp = SPLAY_LEFT((head)->sph_root, field); \
            if (__tmp == NULL) \
                break; \
            if (__comp < 0){ \
                SPLAY_ROTATE_RIGHT(head, __tmp, field); \
                if (SPLAY_LEFT((head)->sph_root, field) == NULL) \
                    break; \
            } \
            SPLAY_LINKLEFT(head, __right, field); \
        } else if (__comp > 0) { \
            __tmp = SPLAY_RIGHT((head)->sph_root, field); \
            if (__tmp == NULL) \
                break; \
            if (__comp > 0) { \
                SPLAY_ROTATE_LEFT(head, __tmp, field); \
                if (SPLAY_RIGHT((head)->sph_root, \
field) == NULL) \
                    break; \
            } \
            SPLAY_LINKRIGHT(head, __left, field); \
        } \
    } \
    SPLAY_ASSEMBLE(head, &__node, __left, __right, field); \
}

```

```

#define SPLAY_NEGINF -1

```

```

#define SPLAY_INF 1

```

```

#define SPLAY_INSERT(name, x, y) name##_SPLAY_INSERT(x, y)

```

```

#define SPLAY_REMOVE(name, x, y) name##_SPLAY_REMOVE(x, y)

```

```

#define SPLAY_FIND(name, x, y) name##_SPLAY_FIND(x, y)

```

```

#define SPLAY_NEXT(name, x, y) name##_SPLAY_NEXT(x, y)

```

```

#define SPLAY_MIN(name, x) (SPLAY_EMPTY(x) ? NULL \

```

```

    : name##_SPLAY_MIN_MAX(x, SPLAY_NEGINF))

```

```

#define SPLAY_MAX(name, x) (SPLAY_EMPTY(x) ? NULL \

```

```

    : name##_SPLAY_MIN_MAX(x, SPLAY_INF))

```

```

#define SPLAY_FOREACH(x, name, head) \

```

```

    for ((x) = SPLAY_MIN(name, head); \

```

```

(x) != NULL;    \
(x) = SPLAY_NEXT(name, head, x))

/* Macros that define a red-black tree */
#define RB_HEAD(name, type)    \
struct name {                  \
    struct type *rbh_root; /* root of the tree */ \
}

#define RB_INITIALIZER(root)    \
{                                \
    NULL }

#define RB_INIT(root) do {      \
    (root)->rbh_root = NULL;    \
} while (/*CONSTCOND*/ 0)

#define RB_BLACK 0
#define RB_RED 1
#define RB_ENTRY(type)        \
struct {                        \
    struct type *rbe_left; /* left element */ \
    struct type *rbe_right; /* right element */ \
    struct type *rbe_parent; /* parent element */ \
    int rbe_color; /* node color */ \
}

#define RB_LEFT(elm, field) (elm)->field.rbe_left
#define RB_RIGHT(elm, field) (elm)->field.rbe_right
#define RB_PARENT(elm, field) (elm)->field.rbe_parent
#define RB_COLOR(elm, field) (elm)->field.rbe_color
#define RB_ROOT(head) (head)->rbh_root
#define RB_EMPTY(head) (RB_ROOT(head) == NULL)

#define RB_SET(elm, parent, field) do { \
    RB_PARENT(elm, field) = parent; \
    RB_LEFT(elm, field) = RB_RIGHT(elm, field) = NULL; \
    RB_COLOR(elm, field) = RB_RED; \
} while (/*CONSTCOND*/ 0)

#define RB_SET_BLACKRED(black, red, field) do { \
    RB_COLOR(black, field) = RB_BLACK; \
    RB_COLOR(red, field) \
    = RB_RED; \
} while (/*CONSTCOND*/ 0)

#ifndef RB_AUGMENT
#define RB_AUGMENT(x) do {} while (/*CONSTCOND*/ 0)

```

```

#endif

#define RB_ROTATE_LEFT(head, elm, tmp, field) do { \
    (tmp) = RB_RIGHT(elm, field); \
    if ((RB_RIGHT(elm, field) = RB_LEFT(tmp, field)) != NULL) { \
        RB_PARENT(RB_LEFT(tmp, field), field) = (elm); \
    } \
    RB_AUGMENT(elm); \
    if ((RB_PARENT(tmp, field) = RB_PARENT(elm, field)) != NULL) { \
        if ((elm) == RB_LEFT(RB_PARENT(elm, field), field)) \
            RB_LEFT(RB_PARENT(elm, field), field) = (tmp); \
        else \
            RB_RIGHT(RB_PARENT(elm, field), field) = (tmp); \
    } else \
        (head)->rbh_root = (tmp); \
    RB_LEFT(tmp, field) = (elm); \
    RB_PARENT(elm, field) = (tmp); \
    RB_AUGMENT(tmp); \
    if ((RB_PARENT(tmp, field))) \
        RB_AUGMENT(RB_PARENT(tmp, field)); \
} while (/*CONSTCOND*/ 0)

#define RB_ROTATE_RIGHT(head, elm, tmp, field) do { \
    (tmp) = RB_LEFT(elm, field); \
    if ((RB_LEFT(elm, field) = RB_RIGHT(tmp, field)) \
        != NULL) { \
        RB_PARENT(RB_RIGHT(tmp, field), field) = (elm); \
    } \
    RB_AUGMENT(elm); \
    if ((RB_PARENT(tmp, field) = RB_PARENT(elm, field)) != NULL) { \
        if ((elm) == RB_LEFT(RB_PARENT(elm, field), field)) \
            RB_LEFT(RB_PARENT(elm, field), field) = (tmp); \
        else \
            RB_RIGHT(RB_PARENT(elm, field), field) = (tmp); \
    } else \
        (head)->rbh_root = (tmp); \
    RB_RIGHT(tmp, field) = (elm); \
    RB_PARENT(elm, field) = (tmp); \
    RB_AUGMENT(tmp); \
    if ((RB_PARENT(tmp, field))) \
        RB_AUGMENT(RB_PARENT(tmp, field)); \
} while (/*CONSTCOND*/ 0)

/* Generates prototypes and inline functions */
#define RB_PROTOTYPE(name, type, field, cmp) \
    RB_PROTOTYPE_INTERNAL(name, type, field, cmp,)
#define RB_PROTOTYPE_STATIC(name, type, field, cmp) \
    RB_PROTOTYPE_INTERNAL(name, type, field, cmp, _sys_tree_h_unused static)

```

```

#define RB_PROTOTYPE_INTERNAL(name, type, field, cmp, attr) \
attr void name##_RB_INSERT_COLOR(struct name *, struct
type *); \
attr void name##_RB_REMOVE_COLOR(struct name *, struct type *, struct type *);\
attr struct type *name##_RB_REMOVE(struct name *, struct type *); \
attr struct type *name##_RB_INSERT(struct name *, struct type *); \
attr struct type *name##_RB_FIND(struct name *, struct type *); \
attr struct type *name##_RB_NFIND(struct name *, struct type *); \
attr struct type *name##_RB_NEXT(struct type *); \
attr struct type *name##_RB_PREV(struct type *); \
attr struct type *name##_RB_MINMAX(struct name *, int); \
\

/* Main rb operation.
* Moves node close to the key of elm to top
*/
#define RB_GENERATE(name, type, field, cmp) \
RB_GENERATE_INTERNAL(name, type, field, cmp,)
#define RB_GENERATE_STATIC(name, type, field, cmp) \
RB_GENERATE_INTERNAL(name, type, field, cmp, _sys_tree_h_unused static)
#define RB_GENERATE_INTERNAL(name, type, field, cmp, attr) \
attr void \
name##_RB_INSERT_COLOR(struct name *head, struct type *elm) \
{ \
struct type
*parent, *gparent, *tmp; \
while ((parent = RB_PARENT(elm, field)) != NULL && \
RB_COLOR(parent, field) == RB_RED) { \
gparent = RB_PARENT(parent, field); \
if (parent == RB_LEFT(gparent, field)) { \
tmp = RB_RIGHT(gparent, field); \
if (tmp && RB_COLOR(tmp, field) == RB_RED) { \
RB_COLOR(tmp, field) = RB_BLACK; \
RB_SET_BLACKRED(parent, gparent, field);\
elm = gparent; \
continue; \
} \
if (RB_RIGHT(parent, field) == elm) { \
RB_ROTATE_LEFT(head, parent, tmp, field);\
tmp = parent; \
parent = elm; \
elm = tmp; \
} \
RB_SET_BLACKRED(parent, gparent, field); \
RB_ROTATE_RIGHT(head, gparent, tmp, field); \
} else { \
tmp = RB_LEFT(gparent, field); \
if (tmp && RB_COLOR(tmp, field) == RB_RED) { \

```

```

    RB_COLOR(tmp, field) = RB_BLACK; \
    RB_SET_BLACKRED(parent, gparent, field);\
    elm = gparent; \
    continue; \
} \
if (RB_LEFT(parent, field) == elm)
{ \
    RB_ROTATE_RIGHT(head, parent, tmp, field);\
    tmp = parent; \
    parent = elm; \
    elm = tmp; \
} \
    RB_SET_BLACKRED(parent, gparent, field); \
    RB_ROTATE_LEFT(head, gparent, tmp, field); \
} \
} \
RB_COLOR(head->rbh_root, field) = RB_BLACK; \
} \
\
attr void \
name##_RB_REMOVE_COLOR(struct name *head, struct type *parent, struct type *elm) \
{ \
    struct type *tmp; \
    while ((elm == NULL || RB_COLOR(elm, field) == RB_BLACK) && \
        elm != RB_ROOT(head)) { \
        if (RB_LEFT(parent, field) == elm) { \
            tmp = RB_RIGHT(parent, field); \
            if (RB_COLOR(tmp, field) == RB_RED) { \
                RB_SET_BLACKRED(tmp, parent, field); \
                RB_ROTATE_LEFT(head, parent, tmp, field);\
                tmp = RB_RIGHT(parent, field); \
            } \
            if ((RB_LEFT(tmp, field) == NULL || \
                RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) && \
                (RB_RIGHT(tmp, field) == NULL || \
                RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK)) {\
                RB_COLOR(tmp, field) = RB_RED; \
                elm = parent; \
                parent = RB_PARENT(elm, field); \
            } else { \
                if (RB_RIGHT(tmp, field) == NULL || \
                    RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK) {\
                    struct type *oleft; \
                    if ((oleft = RB_LEFT(tmp, field)) \
                        != NULL) \
                        RB_COLOR(oleft, field) = RB_BLACK;\
                    RB_COLOR(tmp, field) = RB_RED; \

```

```

    RB_ROTATE_RIGHT(head, tmp, oleft, field);\
    tmp = RB_RIGHT(parent, field);\
} \
RB_COLOR(tmp, field) = RB_COLOR(parent, field);\
RB_COLOR(parent, field) = RB_BLACK;\
if (RB_RIGHT(tmp, field)) \
    RB_COLOR(RB_RIGHT(tmp, field), field) = RB_BLACK;\
RB_ROTATE_LEFT(head, parent, tmp, field);\
elm = RB_ROOT(head); \
break; \
} \
} else { \
    tmp = RB_LEFT(parent, field); \
    if (RB_COLOR(tmp, field) == RB_RED) { \
        RB_SET_BLACKRED(tmp, parent, field);\
        RB_ROTATE_RIGHT(head, parent, tmp, field);\
        tmp
= RB_LEFT(parent, field); \
    } \
    if ((RB_LEFT(tmp, field) == NULL || \
        RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) &&\
        (RB_RIGHT(tmp, field) == NULL || \
        RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK)) {\
        RB_COLOR(tmp, field) = RB_RED; \
        elm = parent; \
        parent = RB_PARENT(elm, field); \
    } else { \
        if (RB_LEFT(tmp, field) == NULL || \
            RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) {\
            struct type *oright; \
            if ((oright = RB_RIGHT(tmp, field)) \
                != NULL) \
                RB_COLOR(oright, field) = RB_BLACK;\
            RB_COLOR(tmp, field) = RB_RED; \
            RB_ROTATE_LEFT(head, tmp, oright, field);\
            tmp = RB_LEFT(parent, field); \
        } \
        RB_COLOR(tmp, field) = RB_COLOR(parent, field);\
        RB_COLOR(parent, field) = RB_BLACK; \
        if (RB_LEFT(tmp, field)) \
            RB_COLOR(RB_LEFT(tmp, field), field) = RB_BLACK;\
        RB_ROTATE_RIGHT(head, parent, tmp, field);\
        elm = RB_ROOT(head); \
        break; \
    } \
} \
} \
} \
if

```



```

(elm)    \
    RB_COLOR(elm, field) = RB_BLACK; \
}      \
    \
attr struct type *    \
name##_RB_REMOVE(struct name *head, struct type *elm) \
{      \
    struct type *child, *parent, *old = elm; \
    int color;    \
    if (RB_LEFT(elm, field) == NULL) \
        child = RB_RIGHT(elm, field); \
    else if (RB_RIGHT(elm, field) == NULL) \
        child = RB_LEFT(elm, field); \
    else {      \
        struct type *left; \
        elm = RB_RIGHT(elm, field); \
        while ((left = RB_LEFT(elm, field)) != NULL) \
            elm = left; \
        child = RB_RIGHT(elm, field); \
        parent = RB_PARENT(elm, field); \
        color = RB_COLOR(elm, field); \
        if (child) \
            RB_PARENT(child, field) = parent; \
        if (parent) { \
            if (RB_LEFT(parent, field) == elm) \
                RB_LEFT(parent, field) = child; \
            else \
                RB_RIGHT(parent, field) = child; \
            RB_AUGMENT(parent); \
        } else \
            RB_ROOT(head)
= child; \
    if (RB_PARENT(elm, field) == old) \
        parent = elm; \
    (elm)->field = (old)->field; \
    if (RB_PARENT(old, field)) { \
        if (RB_LEFT(RB_PARENT(old, field), field) == old)\
            RB_LEFT(RB_PARENT(old, field), field) = elm;\
        else \
            RB_RIGHT(RB_PARENT(old, field), field) = elm;\
        RB_AUGMENT(RB_PARENT(old, field)); \
    } else \
        RB_ROOT(head) = elm; \
    RB_PARENT(RB_LEFT(old, field), field) = elm; \
    if (RB_RIGHT(old, field)) \
        RB_PARENT(RB_RIGHT(old, field), field) = elm; \
    if (parent) { \
        left = parent; \

```

```

do { \
    RB_AUGMENT(left); \
} while ((left = RB_PARENT(left, field)) != NULL); \
} \
goto color; \
} \
parent = RB_PARENT(elm, field); \
color = RB_COLOR(elm, field); \
if (child) \
    RB_PARENT(child, field) = parent; \
if (parent) { \
    if (RB_LEFT(parent, field) == elm) \
        RB_LEFT(parent, field) = child; \
    else \
        RB_RIGHT(parent,
field) = child; \
    RB_AUGMENT(parent); \
} else \
    RB_ROOT(head) = child; \
color: \
if (color == RB_BLACK) \
    name##_RB_REMOVE_COLOR(head, parent, child); \
return (old); \
} \
\
/* Inserts a node into the RB tree */ \
attr struct type * \
name##_RB_INSERT(struct name *head, struct type *elm) \
{ \
    struct type *tmp; \
    struct type *parent = NULL; \
    int comp = 0; \
    tmp = RB_ROOT(head); \
    while (tmp) { \
        parent = tmp; \
        comp = (cmp)(elm, parent); \
        if (comp < 0) \
            tmp = RB_LEFT(tmp, field); \
        else if (comp > 0) \
            tmp = RB_RIGHT(tmp, field); \
        else \
            return (tmp); \
    } \
    RB_SET(elm, parent, field); \
    if (parent != NULL) { \
        if (comp < 0) \
            RB_LEFT(parent, field) = elm; \
        else \

```

```

    RB_RIGHT(parent, field) = elm; \
    RB_AUGMENT(parent); \
} else \
    RB_ROOT(head) = elm; \
name##_RB_INSERT_COLOR(head,
elm); \
return (NULL); \
} \
\
/* Finds the node with the same key as elm */ \
attr struct type * \
name##_RB_FIND(struct name *head, struct type *elm) \
{ \
    struct type *tmp = RB_ROOT(head); \
    int comp; \
    while (tmp) { \
        comp = cmp(elm, tmp); \
        if (comp < 0) \
            tmp = RB_LEFT(tmp, field); \
        else if (comp > 0) \
            tmp = RB_RIGHT(tmp, field); \
        else \
            return (tmp); \
    } \
    return (NULL); \
} \
\
/* Finds the first node greater than or equal to the search key */ \
attr struct type * \
name##_RB_NFIND(struct name *head, struct type *elm) \
{ \
    struct type *tmp = RB_ROOT(head); \
    struct type *res = NULL; \
    int comp; \
    while (tmp) { \
        comp = cmp(elm, tmp); \
        if (comp < 0) { \
            res = tmp; \
            tmp = RB_LEFT(tmp, field); \
        } \
        else if (comp > 0) \
            tmp = \
RB_RIGHT(tmp, field); \
        else \
            return (tmp); \
    } \
    return (res); \
} \

```

```

    \
/* ARGSUSED */    \
attr struct type *    \
name##_RB_NEXT(struct type *elm)    \
{    \
    if (RB_RIGHT(elm, field)) {    \
        elm = RB_RIGHT(elm, field);    \
        while (RB_LEFT(elm, field))    \
            elm = RB_LEFT(elm, field);    \
    } else {    \
        if (RB_PARENT(elm, field) &&    \
            (elm == RB_LEFT(RB_PARENT(elm, field), field)))    \
            elm = RB_PARENT(elm, field);    \
        else {    \
            while (RB_PARENT(elm, field) &&    \
                (elm == RB_RIGHT(RB_PARENT(elm, field), field)))    \
                elm = RB_PARENT(elm, field);    \
            elm = RB_PARENT(elm, field);    \
        }    \
    }    \
    return (elm);    \
}    \
    \
/* ARGSUSED */    \
attr struct type *    \
name##_RB_PREV(struct type *elm)    \
{    \
    if (RB_LEFT(elm, field)) {    \
        elm = RB_LEFT(elm, field);    \
        while (RB_RIGHT(elm, field))    \
            elm = RB_RIGHT(elm, field);    \
    }    \
    else {    \
        if (RB_PARENT(elm, field) &&    \
            (elm == RB_RIGHT(RB_PARENT(elm, field), field)))    \
            elm = RB_PARENT(elm, field);    \
        else {    \
            while (RB_PARENT(elm, field) &&    \
                (elm == RB_LEFT(RB_PARENT(elm, field), field)))    \
                elm = RB_PARENT(elm, field);    \
            elm = RB_PARENT(elm, field);    \
        }    \
    }    \
    return (elm);    \
}    \
    \
attr struct type *    \
name##_RB_MINMAX(struct name *head, int val)    \

```

```

{
    \
    struct type *tmp = RB_ROOT(head); \
    struct type *parent = NULL; \
    while (tmp) {
        \
        parent = tmp; \
        if (val < 0) \
            tmp = RB_LEFT(tmp, field); \
        else \
            tmp = RB_RIGHT(tmp, field); \
    } \
    return (parent); \
}

#define RB_NEGINF -1
#define RB_INF 1

#define RB_INSERT(name, x, y) name##_RB_INSERT(x, y)
#define RB_REMOVE(name, x, y) name##_RB_REMOVE(x, y)
#define RB_FIND(name, x, y) name##_RB_FIND(x, y)
#define RB_NFIND(name, x, y) name##_RB_NFIND(x,
y)
#define RB_NEXT(name, x, y) name##_RB_NEXT(y)
#define RB_PREV(name, x, y) name##_RB_PREV(y)
#define RB_MIN(name, x) name##_RB_MINMAX(x, RB_NEGINF)
#define RB_MAX(name, x) name##_RB_MINMAX(x, RB_INF)

#define RB_FOREACH(x, name, head) \
    for ((x) = RB_MIN(name, head); \
        (x) != NULL; \
        (x) = name##_RB_NEXT(x))

#define RB_FOREACH_FROM(x, name, y) \
    for ((x) = (y); \
        ((x) != NULL) && ((y) = name##_RB_NEXT(x), (x) != NULL); \
        (x) = (y))

#define RB_FOREACH_SAFE(x, name, head, y) \
    for ((x) = RB_MIN(name, head); \
        ((x) != NULL) && ((y) = name##_RB_NEXT(x), (x) != NULL); \
        (x) = (y))

#define RB_FOREACH_REVERSE(x, name, head) \
    for ((x) = RB_MAX(name, head); \
        (x) != NULL; \
        (x) = name##_RB_PREV(x))

#define RB_FOREACH_REVERSE_FROM(x, name, y) \
    for ((x) = (y); \

```

```
((x) != NULL) && ((y) = name##_RB_PREV(x), (x) != NULL); \
(x) = (y))
```

```
#define RB_FOREACH_REVERSE_SAFE(x, name,
head, y) \
for ((x) = RB_MAX(name, head); \
((x) != NULL) && ((y) = name##_RB_PREV(x), (x) != NULL); \
(x) = (y))
```

```
#endif /* _SYS_TREE_H_ */
```

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```

/*
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 * it what you wish.
 */
#ifndef UTIL_LINUX_PT_BSD_H
#define UTIL_LINUX_PT_BSD_H

#define BSD_MAXPARTITIONS 16
#define BSD_FS_UNUSED 0

#ifndef BSD_DISKMAGIC
# define BSD_DISKMAGIC ((uint32_t) 0x82564557)
#endif

#define BSD_LINUX_BOOTDIR "/usr/ucb/mdec"

#if defined (__alpha__) || defined (__powerpc__) || \
    defined (__ia64__) || defined (__hppa__)
# define BSD_LABELSECTOR 0
# define BSD_LABELOFFSET 64
#else
# define BSD_LABELSECTOR 1
# define BSD_LABELOFFSET 0
#endif

#define BSD_BBSIZE      8192 /* size of boot area, with label */
#define BSD_SBSIZE      8192 /* max size of fs superblock */

struct bsd_disklabel {
    uint32_t d_magic; /* the magic number */
    int16_t d_type; /* drive type */
    int16_t d_subtype; /* controller/d_type specific */
    char d_typename[16]; /* type name, e.g. "eagle" */
    char d_packname[16]; /* pack identifier */

    /* disk geometry: */
    uint32_t d_secsize; /*
     # of bytes per sector */
    uint32_t d_nsectors; /* # of data sectors per track */
    uint32_t d_ntracks; /* # of tracks per cylinder */
    uint32_t d_ncylinders; /* # of data cylinders per unit */
    uint32_t d_secpercyl; /* # of data sectors per cylinder */
    uint32_t d_secperunit; /* # of data sectors per unit */

    /*
     * Spares (bad sector replacements) below
     * are not counted in d_nsectors or d_secpercyl.
     * Spare sectors are assumed to be physical sectors

```

```

* which occupy space at the end of each track and/or cylinder.
*/
uint16_t d_sparespertrack; /* # of spare sectors per track */
uint16_t d_sparespercyl; /* # of spare sectors per cylinder */

/*
* Alternate cylinders include maintenance, replacement,
* configuration description areas, etc.
*/
uint32_t d_acylinders; /* # of alt. cylinders per unit */

/* hardware characteristics: */
/*
* d_interleave, d_trackskew and d_cylskew describe perturbations
* in the media format used to compensate for a slow
controller.
* Interleave is physical sector interleave, set up by the formatter
* or controller when formatting. When interleaving is in use,
* logically adjacent sectors are not physically contiguous,
* but instead are separated by some number of sectors.
* It is specified as the ratio of physical sectors traversed
* per logical sector. Thus an interleave of 1:1 implies contiguous
* layout, while 2:1 implies that logical sector 0 is separated
* by one sector from logical sector 1.
* d_trackskew is the offset of sector 0 on track N
* relative to sector 0 on track N-1 on the same cylinder.
* Finally, d_cylskew is the offset of sector 0 on cylinder N
* relative to sector 0 on cylinder N-1.
*/
uint16_t d_rpm; /* rotational speed */
uint16_t d_interleave; /* hardware sector interleave */
uint16_t d_trackskew; /* sector 0 skew, per track */
uint16_t d_cylskew; /* sector 0 skew, per cylinder */
uint32_t d_headswitch; /* head switch time, usec */
uint32_t d_trkseek; /*
track-to-track seek, usec */
uint32_t d_flags; /* generic flags */
uint32_t d_drivedata[5]; /* drive-type specific information */
uint32_t d_spare[5]; /* reserved for future use */
uint32_t d_magic2; /* the magic number (again) */
uint16_t d_checksum; /* xor of data incl. partitions */

/* filesystem and partition information: */
uint16_t d_npartitions; /* number of partitions in following */
uint32_t d_bbsize; /* size of boot area at sn0, bytes */
uint32_t d_sbsize; /* max size of fs superblock, bytes */

struct bsd_partition { /* the partition table */

```



```

uint32_t p_size;      /* number of sectors in partition */
uint32_t p_offset;    /* starting sector */
uint32_t p_fsize;     /* filesystem basic fragment size */
uint8_t p_fstype; /* filesystem type, see below */
uint8_t p_frag; /* filesystem fragments per block */
uint16_t p_cpg;      /* filesystem cylinders per group */
} __attribute__((packed))
d_partitions[BSD_MAXPARTITIONS]; /* actually may be more */
} __attribute__((packed));

/* d_type values: */
#define BSD_DTYPE_SMD 1 /* SMD, XSMD; VAX hp/up */
#define BSD_DTYPE_MSCP 2 /* MSCP */
#define BSD_DTYPE_DEC 3 /* other DEC (rk, rl) */
#define BSD_DTYPE_SCSI 4 /* SCSI */
#define BSD_DTYPE_ESDI 5 /* ESDI interface */
#define BSD_DTYPE_ST506 6 /* ST506 etc. */
#define BSD_DTYPE_HPIB 7 /* CS/80 on HP-IB */
#define BSD_DTYPE_HPFL 8 /* HP Fiber-link */
#define BSD_DTYPE_FLOPPY 10 /* floppy */

/* d_subtype values: */
#define BSD_DSTYPE_INDOSPART 0x8 /* is inside dos partition */
#define BSD_DSTYPE_DOSPART(s) ((s) & 3) /* dos partition number */
#define BSD_DSTYPE_GEOMETRY 0x10 /* drive params in label */

/*
 * Filesystem type and version.
 * Used to interpret other filesystem-specific
 * per-partition information.
 */
#define BSD_FS_UNUSED 0 /* unused */
#define BSD_FS_SWAP 1 /* swap */
#define BSD_FS_V6 2 /* Sixth Edition */
#define BSD_FS_V7
    3 /* Seventh Edition */
#define BSD_FS_SYSV 4 /* System V */
#define BSD_FS_V71K 5 /* V7 with 1K blocks (4.1, 2.9) */
#define BSD_FS_V8 6 /* Eighth Edition, 4K blocks */
#define BSD_FS_BSDFFS 7 /* 4.2BSD fast file system */
#define BSD_FS_BSDLFS 9 /* 4.4BSD log-structured file system */
#define BSD_FS_OTHER 10 /* in use, but unknown/unsupported */
#define BSD_FS_HPFS 11 /* OS/2 high-performance file system */
#define BSD_FS_ISO9660 12 /* ISO-9660 filesystem (cdrom) */
#define BSD_FS_ISOFS BSD_FS_ISO9660
#define BSD_FS_BOOT 13 /* partition contains bootstrap */
#define BSD_FS_ADOS 14 /* AmigaDOS fast file system */

```

```

#define BSD_FS_HFS 15 /* Macintosh HFS */
#define BSD_FS_ADVFS 16 /* Digital Unix AdvFS */

/* this is annoying, but it's also the way it is :( */
#ifdef __alpha__
#define BSD_FS_EXT2 8 /* ext2 file system */
#else
#define BSD_FS_MSDFS 8 /* MS-DOS file system */
#endif

/*
 * flags shared by various drives:
 */
#define BSD_D_REMOVABLE 0x01 /*
removable media */
#define BSD_D_ECC 0x02 /* supports ECC */
#define BSD_D_BADSECT 0x04 /* supports bad sector forw. */
#define BSD_D_RAMDISK 0x08 /* disk emulator */
#define BSD_D_CHAIN 0x10 /* can do back-back transfers */
#define BSD_D_DOSPART 0x20 /* within MSDOS partition */

#endif /* UTIL_LINUX_PT_BSD_H */

```

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man/humanize\_number.3bsd  
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## 1.9 python-requests 2.32.3

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## 1.12 elfutils 0.193-r0

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```

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```
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```

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## 1.13 valgrind 3.25.1-r1

### 1.13.1 Available under license :

```
head 1.1;
branch 1.1.1;
access;
symbols
VALGRIND_2_0_REALLY:1.1.1.1.0.12
VALGRIND_20030725:1.1.1.1
VALGRIND_20030716:1.1.1.1
VALGRIND_1_9_5:1.1.1.1
VALGRIND_2_0_BRANCH:1.1.1.1.0.10
VALGRIND_1_9_4:1.1.1.1
HEAD_post_dir_restructure:1.1.1.1
VALGRIND_1_0_3:1.1.1.1
```

VALGRIND\_1\_0\_2:1.1.1.1  
VALGRIND\_1\_0\_1:1.1.1.1  
ERASER:1.1.1.1.0.8  
VALGRIND\_1\_0\_0:1.1.1.1  
VALGRIND\_1\_0\_BRANCH:1.1.1.1.0.6  
DIDUCE:1.1.1.1.0.4  
NEWMEM:1.1.1.1.0.2  
BEFORE\_CACHEGRIND:1.1.1.1  
start:1.1.1.1  
vendor:1.1.1;  
locks; strict;  
comment @# @;

1.1  
date 2002.03.22.01.27.57; author sewardj; state Exp;  
branches  
1.1.1.1;  
next ;

1.1.1.1  
date 2002.03.22.01.27.57; author sewardj; state Exp;  
branches;  
next ;

desc  
@@

1.1  
log  
@Initial revision  
@  
text  
@ GNU GENERAL PUBLIC LICENSE  
Version 2, June 1991

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@

1.1.1.1

log

@Import (snapshot 20020317 + Frederic Gobry's autoconf work).

@

text

@@

## 1.14 expat 2.7.3-r0

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# 1.15 more-itertools 10.3.0

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cmd/krb5/kadmin/server/ipropld\_svc.c  
cmd/krb5/kproplog/kproplog.c  
cmd/krb5/slave/kpropd\_rpc.c  
lib/gss\_mechs/mech\_krb5/et/kdb5\_err.c  
lib/gss\_mechs/mech\_spnego/mech/gssapiP\_spnego.h  
lib/gss\_mechs/mech\_spnego/mech/spnego\_mech.c  
lib/krb5/kadm5/kadm\_host\_srv\_names.c  
lib/krb5/kdb/kdb\_convert.c  
lib/krb5/kdb/kdb\_hdr.h  
lib/krb5/kdb/kdb\_log.c  
lib/krb5/kdb/kdb\_log.h  
lib/libgss/g\_accept\_sec\_context.c  
lib/libgss/g\_acquire\_cred.c  
lib/libgss/g\_canon\_name.c  
lib/libgss/g\_compare\_name.c  
lib/libgss/g\_context\_time.c  
lib/libgss/g\_delete\_sec\_context.c  
lib/libgss/g\_dsp\_name.c  
lib/libgss/g\_dsp\_status.c  
lib/libgss/g\_dup\_name.c  
lib/libgss/g\_exp\_sec\_context.c  
lib/libgss/g\_export\_name.c  
lib/libgss/g\_glue.c  
lib/libgss/g\_imp\_name.c  
lib/libgss/g\_imp\_sec\_context.c  
lib/libgss/g\_init\_sec\_context.c  
lib/libgss/g\_initialize.c  
lib/libgss/g\_inquire\_context.c  
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lib/libgss/g\_inquire\_names.c  
lib/libgss/g\_process\_context.c  
lib/libgss/g\_rel\_buffer.c  
lib/libgss/g\_rel\_cred.c  
lib/libgss/g\_rel\_name.c  
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lib/libgss/g\_unseal.c  
lib/libgss/g\_userok.c  
lib/libgss/g\_utils.c  
lib/libgss/g\_verify.c  
lib/libgss/gssd\_pname\_to\_uid.c  
uts/common/gssapi/include/gssapi\_err\_generic.h

uts/common/gssapi/include/mechglueP.h

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lib/gssapi/mechglue/g\_accept\_sec\_context.c  
lib/gssapi/mechglue/g\_acquire\_cred.c  
lib/gssapi/mechglue/g\_canon\_name.c  
lib/gssapi/mechglue/g\_compare\_name.c  
lib/gssapi/mechglue/g\_context\_time.c  
lib/gssapi/mechglue/g\_delete\_sec\_context.c  
lib/gssapi/mechglue/g\_dsp\_name.c  
lib/gssapi/mechglue/g\_dsp\_status.c  
lib/gssapi/mechglue/g\_dup\_name.c  
lib/gssapi/mechglue/g\_exp\_sec\_context.c  
lib/gssapi/mechglue/g\_export\_name.c  
lib/gssapi/mechglue/g\_glue.c  
lib/gssapi/mechglue/g\_imp\_name.c

lib/gssapi/mechglue/g\_imp\_sec\_context.c  
lib/gssapi/mechglue/g\_init\_sec\_context.c  
lib/gssapi/mechglue/g\_initialize.c  
lib/gssapi/mechglue/g\_inquire\_context.c  
lib/gssapi/mechglue/g\_inquire\_cred.c  
lib/gssapi/mechglue/g\_inquire\_names.c  
lib/gssapi/mechglue/g\_process\_context.c  
lib/gssapi/mechglue/g\_rel\_buffer.c  
lib/gssapi/mechglue/g\_rel\_cred.c  
lib/gssapi/mechglue/g\_rel\_name.c  
lib/gssapi/mechglue/g\_rel\_oid\_set.c  
lib/gssapi/mechglue/g\_seal.c  
lib/gssapi/mechglue/g\_sign.c  
lib/gssapi/mechglue/g\_store\_cred.c  
lib/gssapi/mechglue/g\_unseal.c  
lib/gssapi/mechglue/g\_userok.c  
lib/gssapi/mechglue/g\_utils.c  
lib/gssapi/mechglue/g\_verify.c  
lib/gssapi/mechglue/gssd\_pname\_to\_uid.c  
lib/gssapi/mechglue/mglueP.h  
lib/gssapi/mechglue/oid\_ops.c  
lib/gssapi/spnego/gssapiP\_spnego.h  
lib/gssapi/spnego/spnego\_mech.c

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including  
the following new or changed files:

include/iprop\_hdr.h  
kadmin/server/ipropd\_svc.c  
lib/kdb/iprop.x  
lib/kdb/kdb\_convert.c  
lib/kdb/kdb\_log.c  
lib/kdb/kdb\_log.h  
lib/krb5/error\_tables/kdb5\_err.et  
kprop/kpropd\_rpc.c  
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#### A. HISTORY OF THE SOFTWARE

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <https://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <https://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

All

Python releases are Open Source (see <https://opensource.org> for the Open Source Definition). Historically, most, but not all, Python releases have also been GPL-compatible; the table below summarizes the various releases.

| Release        | Derived from | Year      | Owner      | GPL-compatible? (1) |
|----------------|--------------|-----------|------------|---------------------|
| 0.9.0 thru 1.2 |              | 1991-1995 | CWI        | yes                 |
| 1.3 thru 1.5.2 | 1.2          | 1995-1999 | CNRI       | yes                 |
| 1.6            | 1.5.2        | 2000      | CNRI       | no                  |
| 2.0            | 1.6          | 2000      | BeOpen.com | no                  |
| 1.6.1          | 1.6          | 2001      | CNRI       | yes (2)             |
| 2.1            | 2.0+1.6.1    | 2001      | PSF        | no                  |
| 2.0.1          | 2.0+1.6.1    | 2001      | PSF        | yes                 |
| 2.1.1          | 2.1+2.0.1    | 2001      | PSF        | yes                 |
| 2.1.2          | 2.1.1        | 2002      | PSF        | yes                 |
| 2.1.3          | 2.1.2        | 2002      | PSF        | yes                 |
| 2.2 and above  | 2.1.1        | 2001-now  |            |                     |
| PSF            | yes          |           |            |                     |

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(2) According to Richard Stallman, 1.6.1 is not GPL-compatible, because its license has a choice of law clause. According to CNRI, however, Stallman's lawyer has told CNRI's lawyer that 1.6.1 is "not incompatible" with the GPL.

Thanks to the many outside volunteers who have worked under Guido's direction to make these releases possible.

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## Contributors

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- Chris McDonough, 2011/02/16

- Wichert Akkerman, 2012/02/02

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## A. HISTORY OF THE SOFTWARE

=====

Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <http://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <http://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations (now Zope Corporation, see <http://www.zope.com>). In 2001, the Python Software Foundation (PSF, see <http://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation is a sponsoring member of the PSF.

All Python releases are Open Source (see <http://www.opensource.org> for the Open Source Definition). Historically, most, but not all, Python releases have also been GPL-compatible; the table below summarizes the various releases.

| Release        | Derived<br>from | Year      | Owner      | GPL-<br>compatible? (1) |
|----------------|-----------------|-----------|------------|-------------------------|
| 0.9.0 thru 1.2 |                 | 1991-1995 | CWI        | yes                     |
| 1.3 thru 1.5.2 | 1.2             | 1995-1999 | CNRI       | yes                     |
| 1.6            | 1.5.2           | 2000      | CNRI       | no                      |
| 2.0            | 1.6             | 2000      | BeOpen.com | no                      |
| 1.6.1          | 1.6             | 2001      | CNRI       | yes (2)                 |
| 2.1            | 2.0+1.6.1       | 2001      | PSF        | no                      |
| 2.0.1          | 2.0+1.6.1       | 2001      | PSF        | yes                     |
| 2.1.1          | 2.1+2.0.1       | 2001      | PSF        | yes                     |
| 2.2            | 2.1.1           | 2001      | PSF        | yes                     |
| 2.1.2          | 2.1.1           | 2002      | PSF        | yes                     |
| 2.1.3          |                 |           |            |                         |
| 2.1.2          | 2002            | PSF       | yes        |                         |
| 2.2.1          | 2.2             | 2002      | PSF        | yes                     |
| 2.2.2          | 2.2.1           | 2002      | PSF        | yes                     |
| 2.2.3          | 2.2.2           | 2003      | PSF        | yes                     |
| 2.3            | 2.2.2           | 2002-2003 | PSF        | yes                     |
| 2.3.1          | 2.3             | 2002-2003 | PSF        | yes                     |
| 2.3.2          | 2.3.1           | 2002-2003 | PSF        | yes                     |
| 2.3.3          | 2.3.2           | 2002-2003 | PSF        | yes                     |
| 2.3.4          | 2.3.3           | 2004      | PSF        | yes                     |
| 2.3.5          | 2.3.4           | 2005      | PSF        | yes                     |
| 2.4            | 2.3             | 2004      | PSF        | yes                     |
| 2.4.1          | 2.4             | 2005      | PSF        | yes                     |
| 2.4.2          | 2.4.1           | 2005      | PSF        | yes                     |
| 2.4.3          | 2.4.2           | 2006      | PSF        | yes                     |
| 2.4.4          | 2.4.3           | 2006      | PSF        | yes                     |
| 2.5            | 2.4             | 2006      | PSF        | yes                     |
| 2.5.1          | 2.5             | 2007      | PSF        | yes                     |
| 2.5.2          | 2.5.1           | 2008      | PSF        | yes                     |
| 2.5.3          | 2.5.2           | 2008      | PSF        | yes                     |
| 2.6            | 2.5             | 2008      | PSF        | yes                     |
| 2.6.1          | 2.6             | 2008      | PSF        | yes                     |
| 2.6.2          | 2.6.1           | 2009      | PSF        | yes                     |
| 2.6.3          | 2.6.2           | 2009      | PSF        | yes                     |
| 2.6.4          | 2.6.3           | 2009      | PSF        | yes                     |
| 2.6.5          | 2.6.4           | 2010      | PSF        | yes                     |
| 2.7            | 2.6             | 2010      | PSF        | yes                     |

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| 2.3.3          | 2.3.2        | 2002-2003 | PSF        | yes                 |

|       |       |      |     |     |
|-------|-------|------|-----|-----|
| 2.3.4 | 2.3.3 | 2004 | PSF | yes |
| 2.3.5 | 2.3.4 | 2005 | PSF | yes |
| 2.4   | 2.3   | 2004 | PSF | yes |
| 2.4.1 | 2.4   | 2005 | PSF | yes |
| 2.4.2 | 2.4.1 | 2005 | PSF | yes |
| 2.4.3 | 2.4.2 | 2006 | PSF | yes |
| 2.4.4 | 2.4.3 | 2006 | PSF | yes |
| 2.5   | 2.4   | 2006 | PSF | yes |
| 2.5.1 | 2.5   | 2007 | PSF | yes |
| 2.5.2 | 2.5.1 | 2008 | PSF | yes |
| 2.5.3 | 2.5.2 | 2008 | PSF | yes |
| 2.6   | 2.5   | 2008 | PSF | yes |
| 2.6.1 | 2.6   | 2008 | PSF | yes |
| 2.6.2 | 2.6.1 | 2009 | PSF | yes |
| 2.6.3 | 2.6.2 | 2009 | PSF | yes |
| 2.6.4 | 2.6.3 | 2009 | PSF | yes |
| 2.6.5 | 2.6.4 | 2010 | PSF | yes |
| 3.0   | 2.6   | 2008 | PSF | yes |
| 3.0.1 | 3.0   | 2009 | PSF | yes |
| 3.1   | 3.0.1 | 2009 | PSF | yes |
| 3.1.1 | 3.1   | 2009 | PSF | yes |
| 3.1.2 | 3.1   | 2010 | PSF | yes |
| 3.2   | 3.1   | 2010 | PSF | yes |

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Packager: bdist_wheel
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@macro copyrightend{  
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@comment node-name, next, previous, up  
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AES in libhcrypto

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rijndael-alg-fst.c

@version 3.0 (December 2000)

Optimised ANSI C code for the Rijndael cipher (now AES)

@author Vincent Rijmen <vincent.rijmen@esat.kuleuven.ac.be>

@author Antoon Bosselaers <antoon.bosselaers@esat.kuleuven.ac.be>

@author Paulo Barreto <paulo.barreto@terra.com.br>

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DES core in libcrypto

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```
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e) Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

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Version 3, 29 June 2007

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```
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```

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## 1.29 sqlite 3.49.2-r1

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- \* All of the test cases and testing code in the [test/ directory](https://sqlite.org/src/tree/test?type=tree&expand)
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-----

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```
> ~~~  
./configure && make  
~~~
```

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```
> ~~~  
rm -rf configure autosetup autoconf  
~~~
```

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-----  
autosetup - A build environment "autoconfigurator"

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## 1.30 libmnl 1.0.5-r2

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file\_io/unix/mktemp.c, strings/apr\_strings.c:

```
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From network\_io/unix/inet\_ntop.c, network\_io/unix/inet\_pton.c:

```
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```

From dso/aix/dso.c:

```
* Based on libdl (dlfcn.c/dlfcn.h) which is
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```

From strings/apr\_strnatcmp.c,  
include/apr\_strings.h:

```
strnatcmp.c -- Perform 'natural order' comparisons of strings in C.
Copyright (C) 2000 by Martin Pool <mbp@humbug.org.au>
```

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From  
strings/apr\_snprintf.c:

```
*  
* cvt - IEEE floating point formatting routines.  
*   Derived from UNIX V7, Copyright(C) Caldera International Inc.  
*
```

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## 1.44 pcre2 10.46-r0

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# Maintainer: Natanael Copa <ncopa@alpinelinux.org>

pkgname=alpine-keys

pkgver=2.5

pkgrel=0

pkgdesc="Public keys for Alpine Linux packages"

url="https://alpinelinux.org"

# we install arch specific keys to /etc so we cannot do arch=noarch

arch="all"

license="MIT"

replaces="alpine-base"

## 1.46 distro 1.9.0

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## 1.47 tcptraceroute 1.5\_beta7-r4

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## 1.49 wireshark 4.4.7-r0

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Installing Wireshark on FreeBSD/OpenBSD/NetBSD/DragonFly BSD

=====

1. Berkeley Packet Filter (BPF) requirement
2. Running Wireshark as a non-root user

For general installation instructions, see the INSTALL file, along with the Developer's Guide located at <https://www.wireshark.org/docs/> and in the doc/ directory. Additional BSD specific notes and requirements follow.

1. Berkeley Packet Filter (BPF) requirement

-----

In order to capture packets (with Wireshark/TShark, tcpdump, or any other packet capture program) on a BSD system, your kernel must have the Berkeley Packet Filter mechanism enabled. The default kernel configurations in recent versions of BSD systems have this enabled already. To verify the bpf device is present, look in the /dev directory:

```
ls -l /dev/bpf*
```

You should see one or more bpf devices listed similar to this:

```
crw----- 1 root wheel
0, 90 Aug 10 21:05 /dev/bpf0
crw----- 1 root wheel 0, 91 Aug 10 21:05 /dev/bpf1
```

Packet-capturing programs will pick the first bpf device that's not in use. Recent versions of most BSDs will create bpf devices as needed, so you don't have to configure the number of devices that will be available.

## 2. Running wireshark as a non-root user

-----  
Since the bpf devices are read-only by the owner (root), you normally have to run packet capturing programs such as Wireshark as root. It is safer to run programs as a non-root user if possible. To run Wireshark as a non-root user, you must change the permissions on the bpf device(s). If you are the only user that needs to use Wireshark, the easiest way is to change the owner of each bpf device to your username. You can also add the read/write ability to the group (typically wheel) and add users that need to use Wireshark to the wheel group. Check your operating system's documentation on how to make permanent these changes as they are often reset upon reboot; if /dev is implemented with devfs, it might be possible to configure devfs to create all bpf devices owned by a particular user and/or group and with particular permissions. In FreeBSD 6.0 and later this can be done by creating an /etc/devfs.rules file with content such as

```
[localrules=10]
add path 'bpf*' {mode and permissions}
```

where "mode and permissions" can include clauses such as

```
mode {octal permissions}
```

to set the permissions on the device (e.g., "mode 0660" to set the permissions to rw-rw-r--),

```
user {user}
```

to set the user who owns the device, or

```
group {group}
```

to set the group that owns the device and adding a line such as

```
devfs_system_ruleset=localrules
```

to /etc/rc.conf. For example, an /etc/devfs.rules file with

```
[localrules=10]
add path 'bpf*' mode 0660 group wheel
```

```

will grant read and write permissions on all BPF devices to all users in
the "wheel" group.
/* packet-epl.h
* Routines for "Ethernet POWERLINK 2.0" dissection
* (Ethernet POWERLINK V2.0 Communication Profile Specification Draft Standard Version 1.2.0)
*
* A dissector for:
* Wireshark - Network traffic analyzer
* By Gerald Combs <gerald@wireshark.org>
* Copyright 1999 Gerald Combs
*
* SPDX-License-Identifier: GPL-2.0-or-later
*/

```

```

#ifndef __EPL_H_
#define __EPL_H_

```

```

#include <epan/address.h>
#include <epan/wmem_scopes.h>
#include <epan/range.h>

```

```

struct epl_datatype;

```

```

struct profile {
    uint16_t id;
    uint8_t nodeid;
    address node_addr;

```

```

    uint32_t vendor_id;
    uint32_t product_code;

```

```

    wmem_map_t *objects;
    wmem_allocator_t *scope, *parent_scope;
    wmem_map_t *parent_map;

```

```

    char *name;
    char *path;
    void *data;
    unsigned cb_id;
    wmem_array_t *TPDO; /* CN->MN */
    wmem_array_t *RPDO; /* MN->CN */

```

```

    struct profile *next;
};

```

```

enum { OD_ENTRY_SCALAR = 7, OD_ENTRY_ARRAY = 8, OD_ENTRY_RECORD = 9 };

```

```

struct od_entry {
    uint16_t idx;

```

```

/* This is called the ObjectType in the standard,

* but this is too easy to be mistaken with the
* DataType.
* ObjectType specifies whether it's a scalar or
* an aggregate
*/
uint16_t type_class;
char name[64];
/* Called DataType by the standard,
* Can be e.g. Unsigned32
*/
const struct epl_datatype *type;
uint64_t value;
};
#define OD_ENTRY_INITIALIZER { 0, 0, { 0 }, 0, 0 }

struct subobject {
    range_admin_t range;
    struct od_entry info;
};
#define SUBOBJECT_INITIALIZER { RANGE_ADMIN_T_INITIALIZER, OD_ENTRY_INITIALIZER }

typedef struct epl_wmem_iarray epl_wmem_iarray_t;

struct object {
    struct od_entry info;
    epl_wmem_iarray_t *subindices;
};

struct profile;

const struct epl_datatype *epl_type_to_hf(const char *name);

static inline gboolean
subobject_equal(const void *_a, const void *_b)
{
    const struct od_entry *a = &((const struct subobject*)_a)->info;
    const struct od_entry *b = &((const struct subobject*)_b)->info;

    return a->type_class == b->type_class
        && a->type == b->type
        && g_str_equal(a->name,
            b->name);
}

struct profile *epl_xdd_load(struct profile *profile, const char *xml_file);

```

```

void epl_eds_init(void);
struct profile *epl_eds_load(struct profile *profile, const char *eds_file);

struct object *epl_profile_object_add(struct profile *profile, uint16_t idx);
struct object *epl_profile_object_lookup_or_add(struct profile *profile, uint16_t idx);

bool epl_profile_object_mapping_add(struct profile *profile, uint16_t idx, uint8_t subindex, uint64_t mapping);
bool epl_profile_object_mappings_update(struct profile *profile);

range_admin_t * epl_wmem_iarray_find(epl_wmem_iarray_t *arr, uint32_t value);
bool epl_wmem_iarray_is_empty(epl_wmem_iarray_t *iarr);
bool epl_wmem_iarray_is_sorted(epl_wmem_iarray_t *iarr);

#define EPL_OBJECT_MAPPING_SIZE ((unsigned)sizeof (uint64_t))

#define CHECK_OVERLAP_ENDS(x1, x2, y1, y2) ((x1) < (y2) && (y1) < (x2))
#define CHECK_OVERLAP_LENGTH(x, x_len, y, y_len) \
CHECK_OVERLAP_ENDS((x), (x) + (x_len), (y), (y) + (y_len))

#endif

```

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## 1.50 sysstat 12.7.6-r1

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### 1.55.1 Available under license :

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```
/opt/cola/permits/2660733757_1759915527.765318/0/ca-certificates-20250911-r0-tar-gz/usr/share/ca-
certificates/mozilla/HARICA_TLS_RSA_Root_CA_2021.crt-----BEGIN CERTIFICATE-----
/opt/cola/permits/2660733757_1759915527.765318/0/ca-certificates-20250911-r0-tar-gz/usr/share/ca-
certificates/mozilla/QuoVadis_Root_CA_2.crt-----BEGIN CERTIFICATE-----
/opt/cola/permits/2660733757_1759915527.765318/0/ca-certificates-20250911-r0-tar-gz/usr/share/ca-
certificates/mozilla/TWCA_Global_Root_CA.crt-----BEGIN CERTIFICATE-----
/opt/cola/permits/2660733757_1759915527.765318/0/ca-certificates-20250911-r0-tar-gz/usr/share/ca-
certificates/mozilla/TrustAsia_TLS_RSA_Root_CA.crt-----BEGIN CERTIFICATE-----
```

Found in path(s):

\*

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```
-----BEGIN CERTIFICATE-----
MIIFWjCCA0KgAwIBAgISEdK7udcjGJ5AXwqdLdDfJWfRMA0GCSqGSIb3DQEBAUA
MEYx CzAJBgNVBAYTAkJFMRkwFwYDVQQKEExBHbG9iYWxTaWduIG52LXNhMRwwGgYD
VQQDExNHbG9iYWxTaWduIFJvb3QgUjQ2MB4XDTE5MDMyMDAwMDAwMFoXDTQ2MDMy
MDAwMDAwMFowRjELMAkGA1UEBhMCQkUxGTAXBgNVBAoTEEdsb2JhbFNpZ24gbnYt
c2ExHDAaBgNVBAMTE0dsb2JhbFNpZ24gUm9vdCBSNDYwgglhMA0GCSqGSIb3DQEB
AQUAA4ICDwAwggIKAoICAQCsrHQy6LNl5brtQyYdpokNRbopiLKkHWPd08EsCvEJ
OaFV6Wc0dwXu5FUdUiXSE2te4R2pt32JmI8Nnp8semNgQB+msLZ4j5lUlgHYruQG
vGIFaHa/r6gjA7aUD7xubMLL1aa7DOn2wQL7Id5m3RerdELv8HQvJfTqa1VbkNud
316HCkd7rRlr+/fKYIje2sGP1q7Vf9Q8g+7XFkyDRTNrJ9CG0Bwta/OrffGFqfUo
0q3v84RLHif8E6M6cqJaESvWJ3En7YEtbWaBkoe0G1h6zD8K+kZPTXhc+CtI4wSE
```

y132tGqzZfxCnlEmIyDLPRT5ge1lFgBPGmSXZgjPjHvjK8Cd+RTyG/FWaha/LIWF  
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vouXsXgxT7PntgMTzlSdriVZzH81Xwj3QEUxCp6  
-----END  
CERTIFICATE-----

Found in path(s):

\*

/ca-certificates-20250911-r0-tar-gz/usr/share/ca-certificates/mozilla/GlobalSign\_Root\_R46.crt

## 1.56 libidn 2.3.7-r0

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package:

name: py3-license-expression

version: "30.4.4"

epoch: 1

description: license-expression is a comprehensive utility library to parse, compare, simplify and normalize license expressions (such as SPDX license expressions) using boolean logic.

copyright:

- license: Apache-2.0

dependencies:

provider-priority: 0

vars:

pypi-package: license-expression

import: license\_expression

data:

- name: py-versions



items:

3.10: '310'  
3.11: '311'  
3.12: '312'  
3.13: '313'

environment:

contents:

packages:

- py3-supported-build-base

pipeline:

- uses: git-checkout

with:

repository: <https://github.com/nexB/license-expression>

tag: v\${{package.version}}

expected-commit: a3c00c09986bcca1240afd5b1844b56de3f581c1

subpackages:

- range: py-versions

name: py\${{range.key}}-\${{vars.pypi-package}}

description: python\${{range.key}} version of \${{vars.pypi-package}}

dependencies:

provider-priority: \${{range.value}}

provides:

- \${{package.name}}  
- py3-\${{vars.pypi-package}}

runtime:

- py\${{range.key}}-boolean.py

pipeline:

- uses: py/pip-build-install

with:

python: python\${{range.key}}

- uses: strip

test:

pipeline:

- uses: python/import

with:

python: python\${{range.key}}

imports: |

import \${{vars.import}}

- name: py3-supported-\${{vars.pypi-package}}

description: meta package providing \${{vars.pypi-package}} for supported python versions.

dependencies:

runtime:

- py3.10-\${{vars.pypi-package}}  
- py3.11-\${{vars.pypi-package}}

- py3.12-`{{vars.pypi-package}}`
- py3.13-`{{vars.pypi-package}}`

test:

pipeline:

- uses: test/metapackage

test:

pipeline:

- uses: python/import

with:

imports: |

import `{{vars.import}}`

update:

enabled: true

github:

identifier: nexB/license-expression

strip-prefix: v

package:

name: libart-lgpl

version: 2.3.21

epoch: 2

description: A library for high-performance 2D graphics

copyright:

- license: LGPL-2.0-or-later

environment:

contents:

packages:

- autoconf
- automake
- build-base
- busybox
- ca-certificates-bundle
- libtool

pipeline:

- uses: fetch

with:

expected-sha256: fdc11e74c10fc9ffe4188537e2b370c0abacca7d89021d4d303afdf7fd7476fa

uri: <https://download.gnome.org/sources/libart-lgpl/2.3/libart-lgpl-{{package.version}}.tar.bz2>

- runs: |

libtoolize --force && aclocal && autoconf --force && automake --add-missing

- runs: autoreconf -vif

- uses: autoconf/configure

```

with:
  opts: |
    --disable-static

- uses: autoconf/make

- uses: autoconf/make-install

- uses: strip

subpackages:
- name: libart-lgpl-dev
  pipeline:
    - uses: split/dev
  dependencies:
    runtime:
      - libart-lgpl
  description: libart-lgpl dev
  test:

  pipeline:
    - runs: |
        libart2-config --version
    - uses: test/pkgconf
    - uses: test/tw/ldd-check

update:
  enabled: true
  release-monitor:
    identifier: 21864

test:
  pipeline:
    - uses: test/tw/ldd-check
package:
  name: go-licenses
  version: "2.0.1"
  epoch: 2 # CVE-2025-61729
  description: A lightweight tool to report on the licenses used by a Go package and its dependencies. Highlight!
  Versioned external URL to licenses can be found at the same time.
  copyright:
    - license: Apache-2.0

  pipeline:
    - uses: git-checkout
    with:
      repository: https://github.com/google/go-licenses
      tag: v${{package.version}}

```

expected-commit: 3e084b0caf710f7bfead967567539214f598c0a2

- uses: go/build

with:

modroot: .

packages: .

output: go-licenses

update:

enabled: true

github:

identifier: google/go-licenses

strip-prefix: v

test:

pipeline:

# AUTOGENERATED

- runs: |

go-licenses --help

issuer: https://accounts.google.com

# staging-enforce: ci-license-checka7daalc99klekq@staging-enforce-cd1e.iam.gserviceaccount.com  
(111508570611001124410)

# prod-images: TODO

subject\_pattern: "(111508570611001124410)"

permissions:

checks: write

pull\_requests: write # need to comment on PRs

# 1.60 iptables 1.8.11-r1

## 1.60.1 Available under license :

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## 1.61 ipvsadm 1.31-r3

### 1.61.1 Available under license :

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ipvsadm - Version 1.14 - 11th January 2001

This is free software. See below for details.

ipvsadm is a utility to administer the IP virtual server services offered by the Linux kernel with IP virtual server support.

This version of ipvsadm requires IPVS module v0.0.5 for kernel 2.4 or later. Check out the Linux Virtual Server Project home page on the World Wide Web:

<http://www.LinuxVirtualServer.org/>

or

<http://www.Linux-VS.org/>

for the most recent information and original sources about ipvsadm.

To make, make sure your Linux kernel is already patched with IPVS and "make menuconfig" or "make xconfig" to setup the right compiling options, see the README of the virtual server patch for detail, then simply type make in the source directory.

Install to your liking. We suggest the following pathnames:

/sbin/ipvsadm

/usr/man/man8/ipvsadm.8

This will be done automatically when calling

make install

in the

source directory.

Wensong Zhang <[wensong@linuxvirtualserver.org](mailto:wensong@linuxvirtualserver.org)>

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## 1.62 fping 5.3-r0

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- \* Improved main loop: David Schweikert <david@schweikert.ch>
- \* Debian Merge, TOS settings: Tobi Oetiker <tobi@oetiker.ch>
- \* Bugfixes, byte order & senseful seq.-numbers: Stephan Fuhrmann (stephan.fuhrmann AT 1und1.de)
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Packaged-By: Domenico Andreoli <cavok@debian.org>

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Original-Source-Location: <http://www.packetfactory.net/libnet/>

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## 1.68 iptraf-ng 1.2.2-r0

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## 1.69 lua 5.4.7-r0

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```
@Ci{$Id: manual.of $}
@C{[(-----)}
@manual{

@sect1{@title{Introduction}}
```

Lua is a powerful, efficient, lightweight, embeddable scripting language. It supports procedural programming, object-oriented programming, functional programming,

data-driven programming, and data description.

Lua combines simple procedural syntax with powerful data description constructs based on associative arrays and extensible semantics.

Lua is dynamically typed,  
runs by interpreting bytecode with a register-based  
virtual machine,  
and has automatic memory management with  
a generational garbage collection,  
making it ideal for configuration, scripting,  
and rapid prototyping.

Lua is implemented as a library, written in `clean C`,  
the common subset of `standard C` and `C++`.

The Lua distribution includes a host program called `lua`,  
which uses the Lua library to offer  
a complete,  
standalone Lua interpreter,  
for interactive or batch use.

Lua is intended to be used both as a powerful, lightweight,  
embeddable scripting language for any program that needs one,  
and as a powerful but lightweight and efficient stand-alone language.

As an extension language, Lua has no notion of a `main` program:  
it works `embedded` in a host client,  
called the `embedding program` or simply the `host`.  
(Frequently, this host is the stand-alone `lua` program.)

The host program can invoke functions to execute a piece of Lua code,  
can write and read Lua variables,  
and can register `C functions` to be called by Lua code.

Through the use of `C functions`, Lua can be augmented to cope with  
a wide range of different domains,  
thus creating customized programming languages sharing a syntactical framework.

Lua is free software,  
and is provided as usual with no guarantees,  
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The implementation described in this manual is available  
at  
Lua's official web site, `www.lua.org`.

Like any other reference manual,  
this document is dry in places.

For a discussion of the decisions behind the design of Lua,  
see the technical papers available at Lua's web site.

For a detailed introduction to programming in Lua,  
see Roberto's book, `Programming in Lua`.

}

```
@C{-----}  
@sect1{basic| @title{Basic Concepts}
```

```
@simplesect{
```

This section describes the basic concepts of the language.

```
}
```

```
@sect2{TypesSec| @title{Values and Types}
```

Lua is a dynamically typed language.

This means that

variables do not have types; only values do.

There are no type definitions in the language.

All values carry their own type.

All values in Lua are first-class values.

This means that all values can be stored in variables,  
passed as arguments to other functions, and returned as results.

There are eight @x{basic types} in Lua:

@def{nil}, @def{boolean}, @def{number},

@def{string},

@def{function}, @def{userdata},

@def{thread}, and @def{table}.

The type @emph{nil} has one single value, @nil,

whose main property is to be different from any other value;

it often represents the absence of a useful value.

The type @emph{boolean} has two values, @false and @true.

Both @nil and @false make a condition false;

they are collectively called @def{false values}.

Any other value makes a condition true.

Despite its name,

@false is frequently used as an alternative to @nil,

with the key difference that @false behaves

like a regular value in a table,

while a @nil in a table represents an absent key.

The type @emph{number} represents both

integer numbers and real (floating-point) numbers,

using two @x{subtypes}: @def{integer} and @def{float}.

Standard Lua uses 64-bit integers and double-precision (64-bit) floats,

but you can also compile Lua so that it

uses 32-bit integers and/or single-precision (32-bit) floats.

The option with 32 bits for both integers and floats  
is particularly  
attractive  
for small machines and embedded systems.  
(See macro `@id{LUA_32BITS}` in file `@id{luaconf.h}`.)

Unless stated otherwise,  
any overflow when manipulating integer values `@def{wrap around}`,  
according to the usual rules of two-complement arithmetic.  
(In other words,  
the actual result is the unique representable integer  
that is equal modulo  $2^M$  to the mathematical result,  
where  $M$  is the number of bits of the integer type.)

Lua has explicit rules about when each subtype is used,  
but it also converts between them automatically as needed `@see{coercion}`.  
Therefore,  
the programmer may choose to mostly ignore the difference  
between integers and floats  
or to assume complete control over the representation of each number.

The type `@emph{string}` represents immutable sequences of bytes.  
`@index{eight-bit clean}`  
Lua is 8-bit clean:  
strings can contain any 8-bit value,  
including `@x{embedded zeros}` (`@Char{0}`).  
Lua is also encoding-agnostic;  
it makes no assumptions about the contents  
of a string.  
The length of any string in Lua must fit in a Lua integer.

Lua can call (and manipulate) functions written in Lua and  
functions written in C `@see{functioncall}`.  
Both are represented by the type `@emph{function}`.

The type `@emph{userdata}` is provided to allow arbitrary `@N{C data}` to  
be stored in Lua variables.  
A userdata value represents a block of raw memory.  
There are two kinds of userdata:  
`@emphx{full userdata}`,  
which is an object with a block of memory managed by Lua,  
and `@emphx{light userdata}`,  
which is simply a `@N{C pointer}` value.  
Userdata has no predefined operations in Lua,  
except assignment and identity test.  
By using `@emph{metatables}`,  
the programmer can define operations for full userdata values  
`@see{metatable}`.



Userdata values cannot be created or modified in Lua, only through the @N{C API}. This guarantees the integrity of data owned by the host program and @N{C libraries}.

The type @def{thread} represents independent threads of execution and it is used to implement coroutines @see{coroutine}. Lua threads are not related to operating-system threads. Lua supports coroutines on all systems, even those that do not support threads natively.

The type @emph{table} implements @x{associative arrays}, that is, @x{arrays} that can have as indices not only numbers, but any Lua value except @nil and @x{NaN}. (@emphx{Not a Number} is a special floating-point value used by the @x{IEEE 754} standard to represent undefined numerical results, such as @T{0/0}.) Tables can be @emph{heterogeneous}; that is, they can contain values of all types (except @nil). Any key associated to the value @nil is not considered part of the table. Conversely, any key that is not part of a table has an associated value @nil.

Tables are the sole data-structuring mechanism in Lua; they can be used to represent ordinary arrays, lists, symbol tables, sets, records, graphs, trees, etc. To represent @x{records}, Lua uses the field name as an index. The language supports this representation by providing @id{a.name} as syntactic sugar for @T{a["name"]}. There are several convenient ways to create tables in Lua @see{tableconstructor}.

Like indices, the values of table fields can be of any type. In particular, because functions are first-class values, table fields can contain functions. Thus tables can also carry @emph{methods} @see{func-def}.

The indexing of tables follows the definition of raw equality in the language. The expressions @T{a[i]} and @T{a[j]} denote the same table element if and only if @id{i} and @id{j} are raw equal (that is, equal without metamethods). In particular, floats with integral values

are equal to their respective integers  
(e.g., `@T{1.0 == 1}`).  
To avoid ambiguities,  
any float used as a key that is equal to an integer  
is converted to that integer.  
For instance, if you write `@T{a[2.0] = true}`,  
the actual key inserted into the table will be the integer `@T{2}`.

Tables, functions, threads, and (full) userdata values are `@emph{objects}`:  
variables  
do not actually `@emph{contain}` these values,  
only `@emph{references}` to them.  
Assignment, parameter passing, and function returns  
always manipulate references to such values;  
these operations do not imply any kind of copy.

The library function `@Lid{type}` returns a string describing the type  
of a given value `@seeF{type}`.

}

`@sect2{globalenv| @title{Environments and the Global Environment}`

As we will discuss further in `@refsec{variables}` and `@refsec{assignment}`,  
any reference to a free name  
(that is, a name not bound to any declaration) `@id{var}`  
is syntactically translated to `@T{_ENV.var}`.  
Moreover, every chunk is compiled in the scope of  
an external local variable named `@id{_ENV}` `@see{chunks}`,  
so `@id{_ENV}` itself is never a free name in a chunk.

Despite the existence of this external `@id{_ENV}` variable and  
the translation of free names,  
`@id{_ENV}` is a completely regular name.  
In particular,  
you can define new variables and parameters with that name.  
Each reference to a free  
name uses the `@id{_ENV}` that is  
visible at that point in the program,  
following the usual visibility rules of Lua `@see{visibility}`.

Any table used as the value of `@id{_ENV}` is called an `@def{environment}`.

Lua keeps a distinguished environment called the `@def{global environment}`.  
This value is kept at a special index in the C registry `@see{registry}`.  
In Lua, the global variable `@Lid{_G}` is initialized with this same value.  
(`@Lid{_G}` is never used internally,

so changing its value will affect only your own code.)

When Lua loads a chunk,  
the default value for its `@id{_ENV}` variable  
is the global environment `@seeF{load}`.  
Therefore, by default,  
free names in Lua code refer to entries in the global environment  
and, therefore, they are also called `@def{global variables}`.  
Moreover, all standard libraries are loaded in the global environment  
and some functions there operate on that environment.  
You can use `@Lid{load}` (or `@Lid{loadfile}`)  
to load a chunk with a different environment.  
(In C,  
you have to load the chunk and then change the value  
of its first upvalue; see `@See{lua_setupvalue}`.)

}

`@sect2{error| @title{Error Handling}`

Several operations in Lua can `@emph{raise}` an error.  
An error interrupts the normal flow of the program,  
which can continue by `@emph{catching}` the error.

Lua code can explicitly raise an error by calling the  
`@Lid{error}` function.  
(This function never returns.)

To catch errors in Lua,  
you can do a `@def{protected call}`,  
using `@Lid{pcall}` (or `@Lid{xpcall}`).  
The function `@Lid{pcall}` calls a given function in `@def{protected mode}`.  
Any error while running the function stops its execution,  
and control returns immediately to `@id{pcall}`,  
which returns a status code.

Because Lua is an embedded extension language,  
Lua code starts running by a call  
from `@N{C code}` in the host program.  
(When you use Lua standalone,  
the `@id{lua}` application is the host program.)  
Usually, this call is protected;  
so, when an otherwise unprotected error occurs during  
the compilation  
or execution of a Lua chunk,  
control returns to the host,  
which can take appropriate measures,  
such as printing an error message.

Whenever there is an error,  
an @def{error object}  
is propagated with information about the error.  
Lua itself only generates errors whose error object is a string,  
but programs can generate errors with  
any value as the error object.  
It is up to the Lua program or its host to handle such error objects.  
For historical reasons,  
an error object is often called an @def{error message},  
even though it does not have to be a string.

When you use @Lid{xpcall} (or @Lid{lua\_pcall}, in C)  
you can give a @def{message handler}  
to be called in case of errors.  
This function is called with the original error object  
and returns a new error object.  
It is called before the error unwinds the stack,  
so that it can gather more information about the error,  
for instance by inspecting the stack and creating a stack traceback.  
This message handler is still protected by the  
protected call;  
so, an error inside the message handler  
will call the message handler again.  
If this loop goes on for too long,  
Lua breaks it and returns an appropriate message.  
The message handler is called only for regular runtime errors.  
It is not called for memory-allocation errors  
nor for errors while running finalizers or other message handlers.

Lua also offers a system of @emph{warnings} @seeF{warn}.  
Unlike errors, warnings do not interfere  
in any way with program execution.  
They typically only generate a message to the user,  
although this behavior can be adapted from C @seeC{lua\_setwarnf}.

}

@sect2{metatable| @title{Metatables and Metamethods}}

Every value in Lua can have a @emph{metatable}.  
This @def{metatable} is an ordinary Lua table  
that defines the behavior of the original value  
under certain events.  
You can change several aspects of the behavior  
of a value by setting specific fields in its metatable.  
For instance, when a non-numeric value is the operand of an addition,

Lua

checks for a function in the field `@idx{__add}` of the value's metatable.

If it finds one,

Lua calls this function to perform the addition.

The key for each event in a metatable is a string

with the event name prefixed by two underscores;

the corresponding value is called a `@def{metavalue}`.

For most events, the metavalue must be a function,

which is then called a `@def{metamethod}`.

In the previous example, the key is the string `@St{__add}`

and the metamethod is the function that performs the addition.

Unless stated otherwise,

a metamethod can in fact be any `@x{callable value}`,

which is either a function or a value with a `@idx{__call}` metamethod.

You can query the metatable of any value

using the `@Lid{getmetatable}` function.

Lua queries metamethods in metatables using a raw access `@seeF{rawget}`.

You can replace the metatable of tables

using the `@Lid{setmetatable}` function.

You cannot change the metatable of other types from Lua code,

except by using the `@link{debuglib|debug library}`.

Tables

and full userdata have individual metatables,

although multiple tables and userdata can share their metatables.

Values of all other types share one single metatable per type;

that is, there is one single metatable for all numbers,

one for all strings, etc.

By default, a value has no metatable,

but the string library sets a metatable for the string type `@see{strlib}`.

A detailed list of operations controlled by metatables is given next.

Each event is identified by its corresponding key.

By convention, all metatable keys used by Lua are composed by

two underscores followed by lowercase Latin letters.

`@description{`

`@item{@idx{__add}|`

the addition (`@T{+}`) operation.

If any operand for an addition is not a number,

Lua will try to call a metamethod.

It starts by checking the first operand (even if it is a number);

if that operand does not define a metamethod for `@idx{__add}`,

then Lua will check the second operand.

If Lua can find a metamethod,  
it calls the metamethod with the two  
operands as arguments,  
and the result of the call  
(adjusted to one value)  
is the result of the operation.  
Otherwise, if no metamethod is found,  
Lua raises an error.  
}

@item{@idx{\_\_sub}|  
the subtraction (@T{-}) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_mul}|  
the multiplication (@T{\*}) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_div}|  
the division (@T{/}) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_mod}|  
the modulo (@T{%}) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_pow}|  
the exponentiation (@T{^}) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_unm}|  
the negation (unary @T{-}) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_idiv}|  
the floor division (@T{//}) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_band}|  
the bitwise AND (@T{&}) operation.  
Behavior similar to the addition operation,

except that Lua will  
try a metamethod  
if any operand is neither an integer  
nor a float coercible to an integer @see{coercion}.  
}

@item{@idx{\_\_bor}|  
the bitwise OR (@T{||}) operation.  
Behavior similar to the bitwise AND operation.  
}

@item{@idx{\_\_bxor}|  
the bitwise exclusive OR (binary @T{~}) operation.  
Behavior similar to the bitwise AND operation.  
}

@item{@idx{\_\_bnot}|  
the bitwise NOT (unary @T{~}) operation.  
Behavior similar to the bitwise AND operation.  
}

@item{@idx{\_\_shl}|  
the bitwise left shift (@T{<<}) operation.  
Behavior similar to the bitwise AND operation.  
}

@item{@idx{\_\_shr}|  
the bitwise right shift (@T{>>}) operation.  
Behavior similar to the bitwise AND operation.  
}

@item{@idx{\_\_concat}|  
the concatenation (@T{..}) operation.  
Behavior similar to the addition operation,  
except that Lua will try a metamethod  
if any operand is neither a string nor a number  
(which is always coercible to a string).  
}

@item{@idx{\_\_len}|  
the length (@T{#}) operation.  
If the object is not a string,  
Lua will try its  
metamethod.  
If there is a metamethod,  
Lua calls it with the object as argument,  
and the result of the call  
(always adjusted to one value)

is the result of the operation.  
If there is no metamethod but the object is a table,  
then Lua uses the table length operation @see{len-op}.  
Otherwise, Lua raises an error.  
}

@item{@idx{\_\_eq}|  
the equal (@T{==}) operation.  
Behavior similar to the addition operation,  
except that Lua will try a metamethod only when the values  
being compared are either both tables or both full userdata  
and they are not primitively equal.  
The result of the call is always converted to a boolean.  
}

@item{@idx{\_\_lt}|  
the less than (@T{<}) operation.  
Behavior similar to the addition operation,  
except that Lua will try a metamethod only when the values  
being compared are neither both numbers nor both strings.  
Moreover, the result of the call is always converted to a boolean.  
}

@item{@idx{\_\_le}|  
the less equal (@T{<=}) operation.  
Behavior similar to the less than operation.  
}

@item{@idx{\_\_index}|  
The  
indexing access operation @T{table[key]}.  
This event happens when @id{table} is not a table or  
when @id{key} is not present in @id{table}.  
The metavalue is looked up in the metatable of @id{table}.

The metavalue for this event can be either a function, a table,  
or any value with an @idx{\_\_index} metavalue.  
If it is a function,  
it is called with @id{table} and @id{key} as arguments,  
and the result of the call  
(adjusted to one value)  
is the result of the operation.  
Otherwise,  
the final result is the result of indexing this metavalue with @id{key}.  
This indexing is regular, not raw,  
and therefore can trigger another @idx{\_\_index} metavalue.  
}



@item{@idx{\_\_newindex}|

The indexing assignment @T{table[key] = value}.

Like the index event,

this event happens when @id{table} is not a table or

when @id{key} is not present in @id{table}.

The metavalue is looked up in the metatable of @id{table}.

Like with indexing,

the metavalue for this event can be either a function,

a table,

or any value with an @idx{\_\_newindex} metavalue.

If it is a function,

it is called with @id{table}, @id{key}, and @id{value} as arguments.

Otherwise,

Lua repeats the indexing assignment over this metavalue

with the same key and value.

This assignment is regular, not raw,

and therefore can trigger another @idx{\_\_newindex} metavalue.

Whenever a @idx{\_\_newindex} metavalue is invoked,

Lua does not perform the primitive assignment.

If needed,

the metamethod itself can call @Lid{rawset}

to do the assignment.

}

@item{@idx{\_\_call}|

The call operation @T{func(args)}.

This event happens when Lua tries to call a non-function value

(that is, @id{func} is not a function).

The metamethod is looked up in @id{func}.

If present,

the metamethod is called with @id{func} as its first argument,

followed by the arguments of the original call (@id{args}).

All results of the call

are the results of the operation.

This is the only metamethod that allows multiple results.

}

}

In addition to

the previous list,

the interpreter also respects the following keys in metatables:

@idx{\_\_gc} @see{finalizers},

@idx{\_\_close} @see{to-be-closed},

@idx{\_\_mode} @see{weak-table},

and @idx{\_\_name}.

(The entry `@idx{__name}`,  
when it contains a string,  
may be used by `@Lid{tostring}` and in error messages.)

For the unary operators (negation, length, and bitwise NOT),  
the metamethod is computed and called with a dummy second operand,  
equal to the first one.

This extra operand is only to simplify Lua's internals  
(by making these operators behave like a binary operation)  
and may be removed in future versions.  
For most uses this extra operand is irrelevant.

Because metatables are regular tables,  
they can contain arbitrary fields,  
not only the event names defined above.  
Some functions in the standard library  
(e.g., `@Lid{tostring}`)  
use other fields in metatables for their own purposes.

It is a good practice to add all needed metamethods to a table  
before setting it as a metatable of some object.

In  
particular, the `@idx{__gc}` metamethod works only when this order  
is followed `@see{finalizers}`.

It is also a good practice to set the metatable of an object  
right after its creation.

}

`@sect2{GC| @title{Garbage Collection}`

`@simplesect{`

Lua performs automatic memory management.  
This means that  
you do not have to worry about allocating memory for new objects  
or freeing it when the objects are no longer needed.  
Lua manages memory automatically by running  
a `@def{garbage collector}` to collect all `@emph{dead}` objects.  
All memory used by Lua is subject to automatic management:  
strings, tables, userdata, functions, threads, internal structures, etc.

An object is considered `@def{dead}`  
as soon as the collector can be sure the object  
will not be accessed again in the normal execution of the program.  
(`@Q{Normal execution}` here excludes finalizers,  
which can resurrect dead objects `@see{finalizers}`,  
and excludes also operations using the debug library.)

Note that the time when the collector can be sure that an object is dead may not coincide with the programmer's expectations. The only guarantees are that Lua will not collect an object that may still be accessed in the normal execution of the program, and it will eventually collect an object that is inaccessible from Lua. (Here, `@emph{inaccessible from Lua}` means that neither a variable nor another live object refer to the object.) Because Lua has no knowledge about `@N{C code}`, it never collects objects accessible through the registry `@see{registry}`, which includes the global environment `@see{globalenv}`.

The garbage collector (GC) in Lua can work in two modes: incremental and generational.

The default GC mode with the default parameters are adequate for most uses. However, programs that waste a large proportion of their time allocating and freeing memory can benefit from other settings. Keep in mind that the GC behavior is non-portable both across platforms and across different Lua releases; therefore, optimal settings are also non-portable.

You can change the GC mode and parameters by calling `@Lid{lua_gc} @N{in C}` or `@Lid{collectgarbage}` in Lua. You can also use these functions to control the collector directly (e.g., to stop and restart it).

}

`@sect3{incmode| @title{Incremental Garbage Collection}`

In incremental mode, each GC cycle performs a mark-and-sweep collection in small steps interleaved with the program's execution.

In this mode, the collector uses three numbers to control its garbage-collection cycles: the `@def{garbage-collector pause}`, the `@def{garbage-collector step multiplier}`, and the `@def{garbage-collector step size}`.

The garbage-collector pause controls how long the collector waits before starting a new cycle.

The collector starts a new cycle when the use of memory hits `@M{n%}` of the use after the previous collection. Larger values make the collector less aggressive. Values equal to or less than 100 mean the collector will not wait to start a new cycle. A value of 200 means that the collector waits for the total memory in use to double before starting a new cycle. The default value is 200; the maximum value is 1000.

The garbage-collector step multiplier controls the speed of the collector relative to memory allocation, that is, how many elements it marks or sweeps for each kilobyte of memory allocated. Larger values make the collector more aggressive but also increase the size of each incremental step. You should not use values less than 100, because they make the collector too slow and can result in the collector never finishing a cycle. The default value is 100; the maximum value is 1000.

The garbage-collector step size controls the size of each incremental step, specifically how many bytes the interpreter allocates before performing a step. This parameter is logarithmic: A value of `@M{n}` means the interpreter will allocate `@M{2@sp{n}}` bytes between steps and perform equivalent work during the step. A large value (e.g., 60) makes the collector a stop-the-world (non-incremental) collector. The default value is 13, which means steps of approximately `@N{8 Kbytes}`.

}

@sect3{genmode| @title{Generational Garbage Collection}

In generational mode, the collector does frequent `@emph{minor}` collections, which traverses only objects recently created. If after a minor collection the use of memory is still above a limit, the collector does a stop-the-world `@emph{major}` collection, which traverses all objects. The generational mode uses two parameters: the `@def{minor multiplier}` and the `@def{the major multiplier}`.

The minor multiplier controls the frequency of minor collections.  
 For a minor multiplier `@M{x}`,  
 a new minor collection will be done when memory  
 grows `@M{x%}` larger than the memory in use after the previous major  
 collection.  
 For instance, for a multiplier of 20,  
 the collector will do a minor collection when the use of memory  
 gets 20% larger than the use after the previous major collection.  
 The default value is 20; the maximum value is 200.

The  
 major multiplier controls the frequency of major collections.  
 For a major multiplier `@M{x}`,  
 a new major collection will be done when memory  
 grows `@M{x%}` larger than the memory in use after the previous major  
 collection.  
 For instance, for a multiplier of 100,  
 the collector will do a major collection when the use of memory  
 gets larger than twice the use after the previous collection.  
 The default value is 100; the maximum value is 1000.

}

`@sect3{finalizers| @title{Garbage-Collection Metamethods}`

You can set garbage-collector metamethods for tables  
 and, using the `@N{C API}`,  
 for full userdata `@see{metatable}`.  
 These metamethods, called `@def{finalizers}`,  
 are called when the garbage collector detects that the  
 corresponding table or userdata is dead.  
 Finalizers allow you to coordinate Lua's garbage collection  
 with external resource management such as closing files,  
 network or database connections,  
 or freeing your own memory.

For an object (table or userdata) to be finalized when collected,  
 you  
 must `@emph{mark}` it for finalization.  
`@index{mark (for finalization)}`  
 You mark an object for finalization when you set its metatable  
 and the metatable has a `@idx{__gc}` metamethod.  
 Note that if you set a metatable without a `@idx{__gc}` field  
 and later create that field in the metatable,  
 the object will not be marked for finalization.

When a marked object becomes dead,

it is not collected immediately by the garbage collector.  
Instead, Lua puts it in a list.  
After the collection,  
Lua goes through that list.  
For each object in the list,  
it checks the object's `@idx{__gc}` metamethod:  
If it is present,  
Lua calls it with the object as its single argument.

At the end of each garbage-collection cycle,  
the finalizers are called in  
the reverse order that the objects were marked for finalization,  
among those collected in that cycle;  
that is, the first finalizer to be called is the one associated  
with the object marked last in the program.  
The execution of each finalizer may occur at any  
point during  
the execution of the regular code.

Because the object being collected must still be used by the finalizer,  
that object (and other objects accessible only through it)  
must be *@emph{resurrected}* by `Lua.@index{resurrection}`  
Usually, this resurrection is transient,  
and the object memory is freed in the next garbage-collection cycle.  
However, if the finalizer stores the object in some global place  
(e.g., a global variable),  
then the resurrection is permanent.  
Moreover, if the finalizer marks a finalizing object for finalization again,  
its finalizer will be called again in the next cycle where the  
object is dead.  
In any case,  
the object memory is freed only in a GC cycle where  
the object is dead and not marked for finalization.

When you close a state `@seeF{lua_close}`,  
Lua calls the finalizers of all objects marked for finalization,  
following the reverse order that they were marked.  
If any finalizer marks objects for collection during that phase,  
these marks have no effect.

#### Finalizers

cannot yield nor run the garbage collector.  
Because they can run in unpredictable times,  
it is good practice to restrict each finalizer  
to the minimum necessary to properly release  
its associated resource.

Any error while running a finalizer generates a warning;

the error is not propagated.

}

@sect3{weak-table| @title{Weak Tables}

A @def{weak table} is a table whose elements are  
@def{weak references}.

A weak reference is ignored by the garbage collector.

In other words,

if the only references to an object are weak references,  
then the garbage collector will collect that object.

A weak table can have weak keys, weak values, or both.

A table with weak values allows the collection of its values,  
but prevents the collection of its keys.

A table with both weak keys and weak values allows the collection of  
both keys and values.

In any case, if either the key or the value is collected,  
the whole pair is removed from the table.

The weakness of a table is controlled by the  
@idx{\_\_mode}  
field of its metatable.

This metavalue, if present, must be one of the following strings:

@St{k}, for a table with weak keys;

@St{v}, for a table with weak values;

or @St{kv}, for a table with both weak keys and values.

A table with weak keys and strong values  
is also called an @def{ephemeron table}.

In an ephemeron table,

a value is considered reachable only if its key is reachable.

In particular,

if the only reference to a key comes through its value,  
the pair is removed.

Any change in the weakness of a table may take effect only  
at the next collect cycle.

In particular, if you change the weakness to a stronger mode,  
Lua may still collect some items from that table  
before the change takes effect.

Only objects that have an explicit construction  
are removed from weak tables.

Values, such as numbers and @x{light @N{C functions}},  
are not subject to garbage collection,

and therefore are not removed from weak tables  
(unless their associated values are collected).

Although strings  
are subject to garbage collection,  
they do not have an explicit construction and  
their equality is by value;  
they behave more like values than like objects.  
Therefore, they are not removed from weak tables.

Resurrected objects  
(that is, objects being finalized  
and objects accessible only through objects being finalized)  
have a special behavior in weak tables.  
They are removed from weak values before running their finalizers,  
but are removed from weak keys only in the next collection  
after running their finalizers, when such objects are actually freed.  
This behavior allows the finalizer to access properties  
associated with the object through weak tables.

If a weak table is among the resurrected objects in a collection cycle,  
it may not be properly cleared until the next cycle.

}

}

@sect2{coroutine| @title{Coroutines}

Lua supports coroutines,  
also called @emphx{collaborative multithreading}.  
A coroutine in Lua represents an independent thread of execution.  
Unlike threads in multithread  
systems, however,  
a coroutine only suspends its execution by explicitly calling  
a yield function.

You create a coroutine by calling @Lid{coroutine.create}.  
Its sole argument is a function  
that is the main function of the coroutine.  
The @id{create} function only creates a new coroutine and  
returns a handle to it (an object of type @emph{thread});  
it does not start the coroutine.

You execute a coroutine by calling @Lid{coroutine.resume}.  
When you first call @Lid{coroutine.resume},  
passing as its first argument  
a thread returned by @Lid{coroutine.create},  
the coroutine starts its execution by  
calling its main function.  
Extra arguments passed to @Lid{coroutine.resume} are passed



as arguments to that function.  
After the coroutine starts running,  
it runs until it terminates or `@emph{yields}`.

A coroutine can terminate its execution in two ways:  
normally, when its main function returns  
(explicitly or implicitly, after the last instruction);  
and abnormally, if there is an unprotected  
error.

In case of normal termination,  
`@Lid{coroutine.resume}` returns `@true`,  
plus any values returned by the coroutine main function.  
In case of errors, `@Lid{coroutine.resume}` returns `@false`  
plus the error object.  
In this case, the coroutine does not unwind its stack,  
so that it is possible to inspect it after the error  
with the debug API.

A coroutine yields by calling `@Lid{coroutine.yield}`.  
When a coroutine yields,  
the corresponding `@Lid{coroutine.resume}` returns immediately,  
even if the yield happens inside nested function calls  
(that is, not in the main function,  
but in a function directly or indirectly called by the main function).  
In the case of a yield, `@Lid{coroutine.resume}` also returns `@true`,  
plus any values passed to `@Lid{coroutine.yield}`.  
The next time you resume the same coroutine,  
it continues its execution from the point where it yielded,  
with the call to `@Lid{coroutine.yield}` returning any extra  
arguments passed to `@Lid{coroutine.resume}`.

Like `@Lid{coroutine.create}`,  
the  
`@Lid{coroutine.wrap}` function also creates a coroutine,  
but instead of returning the coroutine itself,  
it returns a function that, when called, resumes the coroutine.  
Any arguments passed to this function  
go as extra arguments to `@Lid{coroutine.resume}`.  
`@Lid{coroutine.wrap}` returns all the values returned by `@Lid{coroutine.resume}`,  
except the first one (the boolean error code).  
Unlike `@Lid{coroutine.resume}`,  
the function created by `@Lid{coroutine.wrap}`  
propagates any error to the caller.  
In this case,  
the function also closes the coroutine `@seeF{coroutine.close}`.

As an example of how coroutines work,  
consider the following code:

```

@verbatim{
function foo (a)
  print("foo", a)
  return coroutine.yield(2*a)
end

co = coroutine.create(function (a,b)
  print("co-body", a, b)
  local r = foo(a+1)
  print("co-body", r)
  local r, s = coroutine.yield(a+b, a-b)
  print("co-body", r, s)
  return b, "end"
end)

print("main", coroutine.resume(co, 1, 10))
print("main", coroutine.resume(co,
  "r"))
print("main", coroutine.resume(co, "x", "y"))
print("main", coroutine.resume(co, "x", "y"))
}

```

When you run it, it produces the following output:

```

@verbatim{
co-body 1    10
foo    2
main   true  4
co-body r
main   true  11  -9
co-body x    y
main   true  10   end
main   false cannot resume dead coroutine
}

```

You can also create and manipulate coroutines through the C API:  
 see functions @Lid{lua\_newthread}, @Lid{lua\_resume},  
 and @Lid{lua\_yield}.

}

}

```

@C{-----}
@sect1{language| @title{The Language}

```

```

@simplesect{

```

This section describes the lexis, the syntax, and the semantics of Lua.

In other words,  
this section describes  
which tokens are valid,  
how they can be combined,  
and what their combinations mean.

Language constructs will be explained using the usual extended BNF notation,  
in which

`@N{@bnfrep{@rep{a}}` means 0 or more `@rep{a}`'s, and  
`@N{@bnfopt{@rep{a}}` means an  
optional `@rep{a}`.

Non-terminals are shown like `@bnfNter{non-terminal}`,

keywords are shown like `@rw{kword}`,

and other terminal symbols are shown like `@bnfter{=}`.

The complete syntax of Lua can be found in `@refsec{BNF}`  
at the end of this manual.

}

`@sect2{lexical| @title{Lexical Conventions}`

Lua is a `@x{free-form}` language.

It ignores spaces and comments between lexical elements (`@x{tokens}`),  
except as delimiters between two tokens.

In source code,

Lua recognizes as spaces the standard ASCII whitespace  
characters space, form feed, newline,  
carriage return, horizontal tab, and vertical tab.

`@def{Names}`

(also called `@def{identifiers}`)

in Lua can be any string of Latin letters,

Arabic-Indic digits, and underscores,

not beginning with a digit and

not being a reserved word.

Identifiers are used to name variables, table fields, and labels.

The following `@def{keywords}` are reserved  
and cannot be used as names:

`@index{reserved words}`

`@verbatim{`

and    break    do    else    elseif  
end

false   for    function goto   if    in

local   nil    not    or    repeat   return

then    true    until   while

}

Lua is a case-sensitive language:

@id{and} is a reserved word, but @id{And} and @id{AND} are two different, valid names.

As a convention,

programs should avoid creating

names that start with an underscore followed by

one or more uppercase letters (such as @Lid{\_VERSION}).

The following strings denote other @x{tokens}:

```
@verbatim{
+   -   *   /   %   ^   #
&   ~   |   <<  >>  //
==  ~=  <=  >=  <   >   =
(   )   {   }   [   ]   ::
;   :   ,   .   ..  ...
}
```

A @def{short literal string}

can be delimited by matching single or double quotes,

and can contain the following C-like escape sequences:

@Char{a} (bell),

@Char{b} (backspace),

@Char{f} (form feed),

@Char{n} (newline),

@Char{r} (carriage return),

@Char{t} (horizontal tab),

@Char{v} (vertical tab),

@Char{\\} (backslash),

@Char{\"}

(quotation mark [double quote]),

and @Char{'} (apostrophe [single quote]).

A backslash followed by a line break

results in a newline in the string.

The escape sequence @Char{z} skips the following span

of whitespace characters,

including line breaks;

it is particularly useful to break and indent a long literal string

into multiple lines without adding the newlines and spaces

into the string contents.

A short literal string cannot contain unescaped line breaks

nor escapes not forming a valid escape sequence.

We can specify any byte in a short literal string,

including @x{embedded zeros},

by its numeric value.

This can be done

with the escape sequence @T{x@rep{XX}},

where @rep{XX} is a sequence of exactly two hexadecimal digits,

or with the escape sequence `@T{\@rep{ddd}}`,  
where `@rep{ddd}` is a sequence of up to three decimal digits.  
(Note that if a decimal escape sequence is to be followed by a digit,  
it must be expressed using exactly three digits.)

The `@x{UTF-8}` encoding  
of a `@x{Unicode}` character  
can be inserted in a literal string with  
the escape sequence `@T{\u{@rep{XXX}}}`  
(with mandatory enclosing braces),  
where `@rep{XXX}` is a sequence of one or more hexadecimal digits  
representing the character code point.  
This code point can be any value less than `@M{2@sp{31}}`.  
(Lua uses the original UTF-8 specification here,  
which is not restricted to valid Unicode code points.)

Literal strings can also be defined using a long format  
enclosed by `@def{long brackets}`.  
We define an `@def{opening long bracket of level @rep{n}}` as an opening  
square bracket followed by `@rep{n}` equal signs followed by another  
opening square bracket.  
So, an opening long bracket of `@N{level 0}` is written as `@T{[[, @C{]]}`  
an opening long bracket of `@N{level 1}` is written as `@T{[=[, @C{]]}`  
and so on.  
A `@emph{closing long bracket}` is defined similarly;  
for instance,  
a closing long bracket of `@N{level 4}` is written as `@C{[[ @T{]===}]}`.  
A `@def{long literal}` starts with an opening long bracket  
of any level and  
ends at the first closing long bracket of the same level.  
It can contain any text except a closing bracket of the same level.  
Literals in this bracketed form can run for several lines,  
do not interpret any escape sequences,  
and ignore long brackets of any other level.  
Any kind of end-of-line sequence  
(carriage return, newline, carriage return followed by newline,  
or newline followed by carriage return)  
is converted to a simple newline.  
When the opening long bracket is immediately followed by a newline,  
the newline is not included in the string.

As an example, in a system using ASCII  
(in which `@Char{a}` is coded `@N{as 97}`,  
newline is coded `@N{as 10}`, and `@Char{1}` is coded `@N{as 49}`),  
the five literal strings below denote the same string:  
`@verbatim{`  
`a = 'alo\n123''`  
`a = "alo\n123\"`

```

a = "\97lo\10\04923"
a = [[alo
123"]]
a = [=[
alo
123"]]=]
}

```

Any byte in a literal string not explicitly affected by the previous rules represents itself. However, Lua opens files for parsing in text mode, and the system's file functions may have problems with some control characters. So, it is safer to represent binary data as a quoted literal with explicit escape sequences for the non-text characters.

A `@def{numeric constant}` (or `@def{numeral}`) can be written with an optional fractional part and an optional decimal exponent, marked by a letter `@Char{e}` or `@Char{E}`. Lua also accepts `@x{hexadecimal constants}`, which start with `@T{0x}` or `@T{0X}`. Hexadecimal constants also accept an optional fractional part plus an optional binary exponent, marked by a letter `@Char{p}` or `@Char{P}` and written in decimal. (For instance, `@T{0x1.fp10}` denotes 1984, which is `@M{0x1f / 16}` multiplied by `@M{2@sp{10}}.`)

A numeric constant with a radix point or an exponent denotes a float; otherwise, if its value fits in an integer or it is a hexadecimal constant, it denotes an integer; otherwise (that is, a decimal integer numeral that overflows), it denotes a float. Hexadecimal numerals with neither a radix point nor an exponent always denote an integer value; if the value overflows, it `@emph{wraps around}` to fit into a valid integer.

Examples of valid integer constants are

```

@verbatim{
3 345 0xff 0xBEBADA
}

```

Examples of valid float constants are

```
@verbatim{
3.0  3.1416  314.16e-2  0.31416E1  34e1
0x0.1E  0xA23p-4  0X1.921FB54442D18P+1
}
```

A `@def{comment}` starts with a double hyphen (`@T{--}`) anywhere outside a string.

If the text immediately after `@T{--}` is not an opening long bracket, the comment is a `@def{short comment}`, which runs until the end of the line.

Otherwise, it is a `@def{long comment}`, which runs until the corresponding closing long bracket.

```
}
```

```
@sect2{variables| @title{Variables}}
```

Variables are places that store values.

There are three kinds of variables in Lua:

global variables, local variables, and table fields.

A single name can denote a global variable or a local variable (or a function's formal parameter,

which is a particular kind of

local variable):

```
@Produc{
@producname{var}@producbody{@bnfNter{Name}}
}
```

`@bnfNter{Name}` denotes identifiers `@see{lexical}`.

Any variable name is assumed to be global unless explicitly declared as a local `@see{localvar}`.

`@x{Local variables}` are `@emph{lexically scoped}`:

local variables can be freely accessed by functions

defined inside their scope `@see{visibility}`.

Before the first assignment to a variable, its value is `@nil`.

Square brackets are used to index a table:

```
@Produc{
@producname{var}@producbody{prefixexp @bnfter{[] exp @bnfter{[]}}
}
```

The meaning of accesses to table fields can be changed via metatables

`@see{metatable}`.

The syntax `@id{var.Name}` is just syntactic sugar for

```
@T{var["Name"]};
```

```
@Produc{
```

```
@producname{var}@producbody{prefixexp @bnfter{.} @bnfNter{Name}}
}
```

An access to a global variable `@id{x}`  
is equivalent to `@id{_ENV.x}`.

Due to the way that chunks are compiled,  
the variable `@id{_ENV}` itself is never global `@see{globalenv}`.

```
}
```

```
@sect2{stats| @title{Statements}}
```

```
@simplesect{
```

Lua

supports an almost conventional set of `@x{statements}`,  
similar to those in other conventional languages.

This set includes

blocks, assignments, control structures, function calls,  
and variable declarations.

```
}
```

```
@sect3{@title{Blocks}}
```

A `@x{block}` is a list of statements,  
which are executed sequentially:

```
@Produc{
@producname{block}@producbody{@bnfrep{stat}}
}
```

Lua has `@def{empty statements}`  
that allow you to separate statements with semicolons,  
start a block with a semicolon  
or write two semicolons in sequence:

```
@Produc{
@producname{stat}@producbody{@bnfter{;}}
}
```

Both function calls and assignments  
can start with an open parenthesis.

This possibility leads to an ambiguity in Lua's grammar.  
Consider the following fragment:

```
@verbatim{
a = b + c
(print or io.write)('done')
}
```

The grammar could see this fragment in two ways:

```
@verbatim{
```



```
a = b + c(print or io.write)('done')
```

```
a = b + c; (print or io.write)('done')
}
```

The current parser always sees such constructions in the first way,

interpreting

the open parenthesis

as the start of the arguments to a call.

To avoid this ambiguity,

it is a good practice to always precede with a semicolon statements that start with a parenthesis:

```
@verbatim{
;(print or io.write)('done')
}
```

A block can be explicitly delimited to produce a single statement:

```
@Produc{
@producname{stat}@producbody{@Rw{do} block @Rw{end}}
}
```

Explicit blocks are useful

to control the scope of variable declarations.

Explicit blocks are also sometimes used to add a `@Rw{return}` statement in the middle of another block `@see{control}`.

```
}
```

```
@sect3{chunks| @title{Chunks}}
```

The unit of compilation of Lua is called a `@def{chunk}`.

Syntactically,

a chunk is simply a block:

```
@Produc{
@producname{chunk}@producbody{block}
}
```

Lua handles a chunk as the body of an anonymous function with a variable number of arguments

`@see{func-def}`.

As such, chunks can define local variables, receive arguments, and return values.

Moreover, such anonymous function is compiled as in the scope of

an external local variable called `@id{_ENV}` `@see{globalenv}`.

The resulting function always has `@id{_ENV}` as its only external variable, even if it does not use that variable.

A chunk can be stored in a file or in a string inside the host program.

To execute a chunk,

Lua first *loads* it,

precompiling the chunk's code into instructions for a virtual machine,

and then Lua executes the compiled code

with an interpreter for the virtual machine.

Chunks can also be precompiled into binary form;

see the program `luac` and the function `string.dump` for details.

Programs in source and compiled forms are interchangeable;

Lua automatically detects the file type and acts accordingly *load*.

}

*Assignment*

Lua allows *multiple assignments*.

Therefore, the syntax for assignment

defines a list of variables on the left side

and a list of expressions on the right side.

The elements in both lists are separated by commas:

*Production*

*production*{stat}*production*{varlist

*bnfter*{=} explist

*production*{varlist}*production*{var *bnfrep*{*bnfter*{,} var}}

*production*{explist}*production*{exp *bnfrep*{*bnfter*{,} exp}}

}

Expressions are discussed in *See*{expressions}.

Before the assignment,

the list of values is *adjusted* to the length of

the list of variables *multires*.

If a variable is both assigned and read

inside a multiple assignment,

Lua ensures that all reads get the value of the variable

before the assignment.

Thus the code

*verbatim*{

i = 3

i, a[i] = i+1, 20

}

sets `a[3]` to 20, without affecting `a[4]`

because the `i` in `a[i]` is evaluated (to 3)

before it is assigned 4.

Similarly, the line

*verbatim*{

x, y = y, x

```

}
exchanges the values of @id{x} and @id{y},
and
@verbatim{
x, y, z = y, z, x
}
cyclically permutes the values of @id{x}, @id{y}, and @id{z}.

```

Note that this guarantee covers only accesses syntactically inside the assignment statement. If a function or a metamethod called during the assignment changes the value of a variable, Lua gives no guarantees about the order of that access.

An assignment to a global name `@T{x = val}` is equivalent to the assignment `@T{_ENV.x = val} @see{globalenv}`.

The meaning of assignments to table fields and global variables (which are actually table fields, too) can be changed via metatables `@see{metatable}`.

```

}

```

```

@sect3{control| @title{Control Structures}
The control structures
@Rw{if}, @Rw{while}, and @Rw{repeat} have the usual meaning and
familiar syntax:
@index{while-do statement}
@index{repeat-until statement}
@index{if-then-else statement}
@Produc{
@producname{stat}@produciblebody{@Rw{while} exp @Rw{do} block @Rw{end}}
@producname{stat}@produciblebody{@Rw{repeat} block @Rw{until} exp}
@producname{stat}@produciblebody{@Rw{if} exp @Rw{then} block
@bnfrep{@Rw{elseif} exp @Rw{then} block}
@bnfoft{@Rw{else} block} @Rw{end}}
}

```

Lua also has a `@Rw{for}` statement, in two flavors `@see{for}`.

The `@x{condition expression}` of a control structure can return any value.

Both

`@false` and `@nil` test false.

All values different from `@nil` and `@false` test true.

In particular, the number 0 and the empty string also test true.

In the `@Rw{repeat}@En@Rw{until}` loop,  
the inner block does not end at the `@Rw{until}` keyword,  
but only after the condition.  
So, the condition can refer to local variables  
declared inside the loop block.

The `@Rw{goto}` statement transfers the program control to a label.

For syntactical reasons,

labels in Lua are considered statements too:

```
@index{goto statement}
```

```
@index{label}
```

```
@Produc{
```

```
@producname{stat}@producbody{@Rw{goto} Name}
```

```
@producname{stat}@producbody{label}
```

```
@producname{label}@producbody{@bnfter{::} Name @bnfter{::}}
```

```
}
```

A label is visible in the entire block where it is defined,  
except inside nested functions.

A goto can jump to any visible label as long as it does not  
enter into the scope of a local variable.

A label should not be declared

where a label with the same name is visible,

even if this other label has been declared in an

enclosing block.

The `@Rw{break}` statement terminates the execution of a

`@Rw{while}`, `@Rw{repeat}`, or `@Rw{for}` loop,

skipping to the next statement after the loop:

```
@index{break statement}
```

```
@Produc{
```

```
@producname{stat}@producbody{@Rw{break}}
```

```
}
```

A `@Rw{break}` ends the innermost enclosing loop.

The `@Rw{return}` statement is used to return values

from a function or a chunk

(which is handled as an anonymous function).

```
@index{return statement}
```

Functions can return more than one value,

so the syntax for the `@Rw{return}` statement is

```
@Produc{
```

```
@producname{stat}@producbody{@Rw{return} @bnfopt{explist} @bnfopt{@bnfter{;}}}
```

```
}
```

The `@Rw{return}` statement can only be written

as the last statement of a block.

If it is necessary to `@Rw{return}` in the middle of a block,

then an explicit inner block can be used,  
as in the idiom `@T{do return end}`,  
because now `@Rw{return}` is the last statement in its (inner) block.

```
}
```

```
@sect3{for| @title{For Statement}
```

```
@index{for statement}
```

The `@Rw{for}` statement has two forms:

one

numerical and one generic.

```
@sect4{@title{The numerical @Rw{for} loop}
```

The numerical `@Rw{for}` loop repeats a block of code while a  
control variable goes through an arithmetic progression.

It has the following syntax:

```
@Produc{  
@producname{stat}@producbody{@Rw{for} @bnfNter{Name} @bnfter{=}  
exp @bnfter{,} exp @bnfopt{@bnfter{,} exp} @Rw{do} block @Rw{end}}  
}
```

The given identifier (`@bnfNter{Name}`) defines the control variable,  
which is a new variable local to the loop body (`@emph{block}`).

The loop starts by evaluating once the three control expressions.

Their values are called respectively

the `@emph{initial value}`, the `@emph{limit}`, and the `@emph{step}`.

If the step is absent, it defaults `@N{to 1}`.

If both the initial value and the step are integers,

the loop is done with integers;

note that the limit may not be an integer.

Otherwise, the three values are converted to

floats and the loop is done with floats.

Beware of floating-point accuracy in this case.

After that initialization,

the

loop body is repeated with the value of the control variable

going through an arithmetic progression,

starting at the initial value,

with a common difference given by the step.

A negative step makes a decreasing sequence;

a step equal to zero raises an error.

The loop continues while the value is less than

or equal to the limit

(greater than or equal to for a negative step).

If the initial value is already greater than the limit  
(or less than, if the step is negative),  
the body is not executed.

For integer loops,  
the control variable never wraps around;  
instead, the loop ends in case of an overflow.

You should not change the value of the control variable  
during the loop.

If you need its value after the loop,  
assign it to another variable before exiting the loop.

}

@sect4{@title{The generic @Rw{for} loop}

The generic @Rw{for} statement works over functions,  
called @def{iterators}.

On each iteration, the iterator function is called to produce a new value,  
stopping when this new  
value is @nil.

The generic @Rw{for} loop has the following syntax:

```
@Produc{
@producname{stat}@producbody{@Rw{for} namelist @Rw{in} explist
    @Rw{do} block @Rw{end}}
@producname{namelist}@producbody{@bnfNter{Name} @bnfrep{@bnfter{,} @bnfNter{Name}}
}
```

A @Rw{for} statement like

```
@verbatim{
for @rep{var_1}, @Cdots, @rep{var_n} in @rep{explist} do @rep{body} end
}
```

works as follows.

The names @rep{var\_i} declare loop variables local to the loop body.

The first of these variables is the @emph{control variable}.

The loop starts by evaluating @rep{explist}  
to produce four values:

an @emph{iterator function},  
a @emph{state},  
an initial value for the control variable,  
and a @emph{closing value}.

Then, at each iteration,

Lua calls the iterator function with two arguments:  
the state and the control variable.

The results from this call are then assigned to the loop variables, following the rules of multiple assignments @see{assignment}. If the control variable becomes @nil, the loop terminates. Otherwise, the body is executed and the loop goes to the next iteration.

The closing value behaves like a to-be-closed variable @see{to-be-closed}, which can be used to release resources when the loop ends. Otherwise, it does not interfere with the loop.

You should not change the value of the control variable during the loop.

```
}
}
```

@sect3{funcstat| @title{Function Calls as Statements}  
To allow possible side-effects, function calls can be executed as statements:

```
@Produc{
@producname{stat}@producbody{functioncall}
}
```

In this case, all returned values are thrown away. Function calls are explained in @See{functioncall}.

```
}
```

@sect3{localvar| @title{Local Declarations}  
@x{Local variables} can be declared anywhere inside a block. The declaration can include an initialization:

```
@Produc{
@producname{stat}@producbody{@Rw{local} attnamelist @bnfopt{@bnfter{=} explist}}
@producname{attnamelist}@producbody{
@bnfNter{Name} attrib @bnfrep{@bnfter{,} @bnfNter{Name} attrib}}
}
```

If present, an initial assignment has the same semantics of a multiple assignment @see{assignment}. Otherwise, all variables are initialized with @nil.

Each variable name may be postfixed by an attribute (a name between angle brackets):

```
@Produc{
@producname{attrib}@producbody{@bnfopt{@bnfter{<} @bnfNter{Name} @bnfter{>}}}
```

}

There are two possible attributes:

@id{const}, which declares a @x{constant variable},

that is, a variable that cannot be assigned to  
after its initialization;

and @id{close}, which declares a to-be-closed variable @see{to-be-closed}.

A list of variables can contain at most one to-be-closed variable.

A chunk is also a block @see{chunks},

and so local variables can be declared in a chunk outside any explicit block.

The visibility rules for local variables are explained in @See{visibility}.

}

@sect3{to-be-closed| @title{To-be-closed Variables}}

A to-be-closed variable behaves like a constant local variable,  
except that its value is @emph{closed} whenever the variable  
goes

out of scope, including normal block termination,  
exiting its block by @Rw{break}/@Rw{goto}/@Rw{return},  
or exiting by an error.

Here, to @emph{close} a value means

to call its @idx{\_\_close} metamethod.

When calling the metamethod,

the value itself is passed as the first argument

and the error object that caused the exit (if any)

is passed as a second argument;

if there was no error, the second argument is @nil.

The value assigned to a to-be-closed variable

must have a @idx{\_\_close} metamethod

or be a false value.

(@nil and @false are ignored as to-be-closed values.)

If several to-be-closed variables go out of scope at the same event,  
they are closed in the reverse order that they were declared.

If there is any error while running a closing method,  
that error is handled like an error in the regular code  
where the variable was defined.

After an error,

the other pending closing methods will still be called.

If a coroutine yields and is never resumed again,  
some variables may



never go out of scope,  
and therefore they will never be closed.  
(These variables are the ones created inside the coroutine  
and in scope at the point where the coroutine yielded.)  
Similarly, if a coroutine ends with an error,  
it does not unwind its stack,  
so it does not close any variable.  
In both cases,  
you can either use finalizers  
or call `@Lid{coroutine.close}` to close the variables.  
However, if the coroutine was created  
through `@Lid{coroutine.wrap}`,  
then its corresponding function will close the coroutine  
in case of errors.

```
}
```

```
}
```

```
@sect2{expressions| @title{Expressions}}
```

```
@simplesect{
```

The basic expressions in Lua are the following:

```
@Produc{
@producname{exp}@producbody{prefixexp}
@producname{exp}@producbody{@Rw{nil} @Or @Rw{false} @Or @Rw{true}}
@producname{exp}@producbody{@bnfNter{Numeral}}
@producname{exp}@producbody{@bnfNter{LiteralString}}
@producname{exp}@producbody{functiondef}
@producname{exp}@producbody{tableconstructor}
@producname{exp}@producbody{@bnfter{...}}
@producname{exp}@producbody{exp
binop exp}
@producname{exp}@producbody{unop exp}
@producname{prefixexp}@producbody{var @Or functioncall @Or
@bnfter{() exp @bnfter{}}}
}
```

Numerals and literal strings are explained in `@See{lexical}`;  
variables are explained in `@See{variables}`;  
function definitions are explained in `@See{func-def}`;  
function calls are explained in `@See{functioncall}`;  
table constructors are explained in `@See{tableconstructor}`.  
Vararg expressions,  
denoted by three dots (`@Char{...}`), can only be used when  
directly inside a variadic function;  
they are explained in `@See{func-def}`.

Binary operators comprise arithmetic operators @see{arith}, bitwise operators @see{bitwise}, relational operators @see{rel-ops}, logical operators @see{logic}, and the concatenation operator @see{concat}.

Unary operators comprise the unary minus @see{arith}, the unary bitwise NOT @see{bitwise}, the unary logical @Rw{not} @see{logic}, and the unary @def{length operator} @see{len-op}.

}

```
@sect3{arith|
@title{Arithmetic Operators}
Lua supports the following @x{arithmetic operators}:
@description{
@item{@T{+}|addition}
@item{@T{-}|subtraction}
@item{@T{*}|multiplication}
@item{@T{/}|float division}
@item{@T{//}|floor division}
@item{@T{%}|modulo}
@item{@T{^}|exponentiation}
@item{@T{-}|unary minus}
}
```

With the exception of exponentiation and float division, the arithmetic operators work as follows:

If both operands are integers, the operation is performed over integers and the result is an integer.

Otherwise, if both operands are numbers, then they are converted to floats, the operation is performed following the machine's rules for floating-point arithmetic (usually the @x{IEEE 754} standard), and the result is a float.

(The string library coerces strings to numbers in arithmetic operations; see @See{coercion} for details.)

Exponentiation and float division (@T{/}) always convert their operands to floats and the result is always a float.

Exponentiation uses the @ANSI{pow}, so that it works for non-integer exponents too.

Floor division (`@T{//}`) is a division that rounds the quotient towards minus infinity, resulting in the floor of the division of its operands.

Modulo is defined as the remainder of a division that rounds the quotient towards minus infinity (floor division).

In case of overflows in integer arithmetic, all operations `@emphx{wrap around}`.  
}

@sect3{bitwise| @title{Bitwise Operators}  
Lua supports the following `@x{bitwise operators}`:  
@description{  
@item{@T{&}|bitwise AND}  
@item{@T{@VerBar}|bitwise OR}  
@item{@T{~}|bitwise exclusive OR}  
@item{@T{>>}|right shift}  
@item{@T{<<}|left shift}  
@item{@T{~}|unary bitwise NOT}  
}

All bitwise operations convert its operands to integers  
`@see{coercion}`,  
operate on all bits of those integers,  
and result in an integer.

Both right and left shifts fill the vacant bits with zeros.  
Negative displacements shift to the other direction;  
displacements with absolute values equal to or higher than  
the  
number of bits in an integer  
result in zero (as all bits are shifted out).  
}

@sect3{coercion| @title{Coercions and Conversions}  
Lua provides some automatic conversions between some  
types and representations at run time.  
Bitwise operators always convert float operands to integers.  
Exponentiation and float division  
always convert integer operands to floats.  
All other arithmetic operations applied to mixed numbers  
(integers and floats) convert the integer operand to a float.  
The C API also converts both integers to floats and  
floats to integers, as needed.  
Moreover, string concatenation accepts numbers as arguments,

besides strings.

In a conversion from integer to float,  
if the integer value has an exact representation as a float,  
that is the result.

Otherwise,  
the conversion gets the nearest higher or  
the nearest lower representable value.  
This kind of conversion never fails.

The conversion from float to integer  
checks whether the float has an exact representation as an integer  
(that  
is, the float has an integral value and  
it is in the range of integer representation).  
If it does, that representation is the result.  
Otherwise, the conversion fails.

Several places in Lua coerce strings to numbers when necessary.  
In particular,  
the string library sets metamethods that try to coerce  
strings to numbers in all arithmetic operations.  
If the conversion fails,  
the library calls the metamethod of the other operand  
(if present) or it raises an error.  
Note that bitwise operators do not do this coercion.

It is always a good practice not to rely on the  
implicit coercions from strings to numbers,  
as they are not always applied;  
in particular, `@T{"1"==1}` is false and `@T{"1"<1}` raises an error  
`@see{rel-ops}`.  
These coercions exist mainly for compatibility and may be removed  
in future versions of the language.

A string is converted to an integer or a float  
following its syntax and the rules of the Lua lexer.  
The string may have also leading and trailing whitespaces and a sign.  
All

conversions from strings to numbers  
accept both a dot and the current locale mark  
as the radix character.  
(The Lua lexer, however, accepts only a dot.)  
If the string is not a valid numeral,  
the conversion fails.

If necessary, the result of this first step is then converted  
to a specific number subtype following the previous rules  
for conversions between floats and integers.

The conversion from numbers to strings uses a non-specified human-readable format.

To convert numbers to strings in any specific way, use the function `@Lid{string.format}`.

}

`@sect3{rel-ops| @title{Relational Operators}`

Lua supports the following `@x{relational operators}`:

`@description{`

`@item{@T{==}|equality}`

`@item{@T{~=}|inequality}`

`@item{@T{<}|less than}`

`@item{@T{>}|greater than}`

`@item{@T{<=}|less or equal}`

`@item{@T{>=}|greater or equal}`

`}`

These operators always result in `@false` or `@true`.

Equality (`@T{==}`) first compares the type of its operands.

If the types are different, then the result is `@false`.

Otherwise,

the values of the operands are compared.

Strings are equal if they have the same byte content.

Numbers are equal if they denote the same mathematical value.

Tables, userdata, and threads

are compared by reference:

two objects are considered equal only if they are the same object.

Every time you create a new object

(a table, a userdata, or a thread),

this new object is different from any previously existing object.

A function is always equal to itself.

Functions with any detectable difference

(different behavior, different definition) are always different.

Functions created at different times but with no detectable differences

may be classified as equal or not

(depending on internal caching details).

You can change the way that Lua compares tables and userdata

by using the `@idx{__eq}` metamethod `@see{metatable}`.

Equality comparisons do not convert strings to numbers

or vice versa.

Thus, `@T{"0"]==0}` evaluates to `@false`,

and `@T{t[0]}` and `@T{t["0"]}` denote different

entries in a table.

The operator `@T{~=}` is exactly the negation of equality (`@T{==}`).

The order operators work as follows.

If both arguments are numbers,  
then they are compared according to their mathematical values,  
regardless of their subtypes.

Otherwise, if both arguments are strings,  
then their values are compared according to the current locale.  
Otherwise, Lua tries to call the `@idx{__lt}` or the `@idx{__le}`  
metamethod `@see{metatable}`.

A comparison `@T{a > b}` is translated to `@T{b < a}`  
and `@T{a >= b}` is translated to `@T{b <= a}`.

Following the `@x{IEEE 754}` standard,  
the special value `@x{NaN}` is considered neither less than,  
nor equal to, nor greater than any value, including itself.

}

`@sect3{logic| @title{Logical Operators}`

The `@x{logical operators}` in Lua are

`@Rw{and}`, `@Rw{or}`, and `@Rw{not}`.

Like the control structures `@see{control}`,  
all logical operators consider both `@false` and `@nil` as false  
and anything else as true.

The negation operator `@Rw{not}` always returns `@false` or `@true`.

The conjunction

operator `@Rw{and}` returns its first argument

if this value is `@false` or `@nil`;

otherwise, `@Rw{and}` returns its second argument.

The disjunction operator `@Rw{or}` returns its first argument

if this value is different from `@nil` and `@false`;

otherwise, `@Rw{or}` returns its second argument.

Both `@Rw{and}` and `@Rw{or}` use `@x{short-circuit evaluation}`;

that is,

the second operand is evaluated only if necessary.

Here are some examples:

`@verbatim{`

`10 or 20 --> 10`

`10 or error() --> 10`

`nil or "a" --> "a"`

`nil and 10 --> nil`

`false and error() --> false`

`false and nil --> false`

`false or nil --> nil`

10 and 20 --> 20

}

}

@sect3{concat| @title{Concatenation}

The string `@x{concatenation}` operator in Lua is denoted by two dots (`@Char{..}`).

If both operands are strings or numbers, then the numbers are converted to strings in a non-specified format `@see{coercion}`.

Otherwise, the `@idx{__concat}` metamethod is called `@see{metatable}`.

}

@sect3{len-op|

@title{The Length Operator}

The length operator is denoted by the unary prefix operator `@T{#}`.

The length of a string is its number of bytes.  
(That is the usual meaning of string length when each character is one byte.)

The length operator applied on a table returns a `@x{border}` in that table.

A `@def{border}` in a table `@id{t}` is any non-negative integer that satisfies the following condition:

```
@verbatim{
(border == 0 or t[border] ~= nil) and
(t[border + 1] == nil or border == math.maxinteger)
}
```

In words,

a border is any positive integer index present in the table that is followed by an absent index,

plus two limit cases:

zero, when index 1 is absent;

and the maximum value for an integer, when that index is present.

Note that keys that are not positive integers do not interfere with borders.

A table with exactly one border is called a `@def{sequence}`.

For instance, the table `@T{{10, 20, 30, 40, 50}}` is a sequence, as it has only one border (5).

The table `@T{{10, 20, 30, nil, 50}}` has two borders (3 and 5),

and therefore it is not a sequence.

(The `@nil` at index 4 is called a `@emphx{hole}`.)

The table `@T{{nil, 20, 30, nil, nil, 60, nil}}`  
has three borders (0, 3, and 6),  
so it is not a sequence, too.  
The table `@T{{}}` is a sequence with border 0.

When `@id{t}` is a sequence,  
`@T{#t}` returns its only border,  
which corresponds to the intuitive notion of the length of the sequence.  
When `@id{t}` is not a sequence,  
`@T{#t}` can return any of its borders.  
(The exact one depends on details of  
the internal representation of the table,  
which in turn can depend on how the table was populated and  
the memory addresses of its non-numeric keys.)

The computation of the length of a table  
has a guaranteed worst time of `@M{O(log n)}`,  
where `@M{n}` is the largest integer key in the table.

A program can modify the behavior of the length operator for  
any value but strings through the `@idx{__len}` metamethod `@see{metatable}`.

}

`@sect3{prec| @title{Precedence}`  
`@x{Operator precedence}` in Lua follows  
the table below,  
from lower to higher priority:

```
@verbatim{
or
and
< > <= >= ~= ==
|
~
&
<< >>

..
+ -
* / // %
unary operators (not # - ~)
^
}
```

As usual,  
you can use parentheses to change the precedences of an expression.  
The concatenation (`@Char{..}`) and exponentiation (`@Char{^}`)  
operators are right associative.  
All other binary operators are left associative.



}

@sect3{tableconstructor| @title{Table Constructors}

Table @x{constructors} are expressions that create tables.

Every time a constructor is evaluated, a new table is created.

A constructor can be used to create an empty table

or to create a table and initialize some of its fields.

The general syntax for constructors is

@Produc{

@producname{tableconstructor}@producbody{@bnfter{@Open} @bnfopt{fieldlist} @bnfter{@Close}}

@producname{fieldlist}@producbody{field @bnfrep{fieldsep field} @bnfopt{fieldsep}}

@producname{field}@producbody{@bnfter{[] exp @bnfter{[]} @bnfter{=} exp @Or

@bnfNter{Name} @bnfter{=} exp @Or exp}

@producname{fieldsep}@producbody{@bnfter{,} @Or @bnfter{;}}

}

Each field of the form @T{[exp1] = exp2} adds to the new table an entry with key @id{exp1} and value @id{exp2}.

A field of the form @T{name = exp} is equivalent to

@T{["name"] = exp}.

Fields of the form @id{exp} are equivalent to

@T{[i] = exp}, where @id{i} are consecutive integers starting with 1;

fields in the other formats do not affect this counting.

For example,

@verbatim{

a = { [f(1)] = g; "x", "y"; x = 1, f(x), [30] = 23; 45 }

}

is equivalent to

@verbatim{

do

local t = { }

t[f(1)] = g

t[1] = "x" -- 1st exp

t[2] = "y" -- 2nd exp

t.x = 1 -- t["x"] = 1

t[3] = f(x) -- 3rd exp

t[30] = 23

t[4] = 45 -- 4th exp

a = t

end

}

The order of the assignments in a constructor is undefined.

(This order would be relevant only when there are repeated keys.)

If the last field in the list has the form @id{exp}

and the expression  
is a multires expression,  
then all values returned by this expression enter the list consecutively  
`@see{multires}`.

The field list can have an optional trailing separator,  
as a convenience for machine-generated code.

}

`@sect3{functioncall| @title{Function Calls}`  
A `@x{function call}` in Lua has the following syntax:  
`@Produc{`  
`@producname{functioncall}@producbody{prefixexp args}`  
`}`

In a function call,  
first `@bnfNter{prefixexp}` and `@bnfNter{args}` are evaluated.  
If the value of `@bnfNter{prefixexp}` has type `@emph{function}`,  
then this function is called  
with the given arguments.  
Otherwise, if present,  
the `@bnfNter{prefixexp} @idx{__call}` metamethod is called:  
its first argument is the value of `@bnfNter{prefixexp}`,  
followed by the original call arguments  
`@see{metatable}`.

The form  
`@Produc{`  
`@producname{functioncall}@producbody{prefixexp @bnfter{:} @bnfNter{Name} args}`  
`}`  
can be used to emulate methods.  
A call `@T{v:name(@rep{args})}`  
is syntactic sugar for `@T{v.name(v,@rep{args})}`,  
except that `@id{v}`  
is evaluated only once.

Arguments have the following syntax:  
`@Produc{`  
`@producname{args}@producbody{@bnfter{(} @bnfopt{explist} @bnfter{)}}}`  
`@producname{args}@producbody{tableconstructor}`  
`@producname{args}@producbody{@bnfNter{LiteralString}}`  
`}`

All argument expressions are evaluated before the call.

A call of the form `@T{f{@rep{fields}}}` is  
syntactic sugar for `@T{f({@rep{fields}})}`;  
that is, the argument list is a single new table.

A call of the form `@T{f'@rep{string}'}`  
(or `@T{f"@rep{string}"}` or `@T{f[[@rep{string}]}}`)

is syntactic sugar for `@T{f('@rep{string}')};`  
that is, the argument list is a single literal string.

A call of the form `@T{return @rep{functioncall}}` not in the scope of a to-be-closed variable is called a `@def{tail call}`.

Lua implements `@def{proper tail calls}`

(or `@def{proper tail recursion}`):

In a tail call,

the called function reuses the stack entry of the calling function.

Therefore, there is no limit on the number of nested tail calls that a program can execute.

However,

a tail call erases any debug information about the calling function.

Note that a tail call only happens with a particular syntax, where the `@Rw{return}` has one single function call as argument, and it is outside the scope of any to-be-closed variable.

This syntax makes the calling function return exactly the returns of the called function, without any intervening action.

So, none of the following examples are tail calls:

```
@verbatim{
return (f(x))      -- results adjusted to 1
return 2 * f(x)    -- result multiplied by 2
return x, f(x)     -- additional results
f(x); return       -- results discarded
return x or f(x)   -- results adjusted to 1
}

}
```

`@sect3{func-def| @title{Function Definitions}`

The syntax for function definition is

```
@Produc{
@producname{functiondef}@producbody{@Rw{function} funcbody}
@producname{funcbody}@producbody{@bnfter{() @bnfopt{parlist} @bnfter{}} block @Rw{end}}
}
```

The following syntactic sugar simplifies function definitions:

```
@Produc{
@producname{stat}@producbody{@Rw{function}
funcname funcbody}
@producname{stat}@producbody{@Rw{local} @Rw{function} @bnfNter{Name} funcbody}
@producname{funcname}@producbody{@bnfNter{Name} @bnfrep{@bnfter{.} @bnfNter{Name}}}
@bnfopt{@bnfter{:} @bnfNter{Name}}}
}
```

The statement

```
@verbatim{
function f () @rep{body} end
}
```

translates to

```
@verbatim{
f = function () @rep{body} end
}
```

The statement

```
@verbatim{
function t.a.b.c.f () @rep{body} end
}
```

translates to

```
@verbatim{
t.a.b.c.f = function () @rep{body} end
}
```

The statement

```
@verbatim{
local function f () @rep{body} end
}
```

translates to

```
@verbatim{
local f; f = function () @rep{body} end
}
```

not to

```
@verbatim{
local f = function () @rep{body} end
}
```

(This only makes a difference when the body of the function contains references to @id{f}.)

A function definition is an executable expression, whose value has type @emph{function}.

When Lua precompiles a chunk, all its function bodies are precompiled too, but they are not created yet.

Then, whenever Lua executes the function definition, the function is @emph{instantiated} (or @emph{closed}). This function instance, or @emph{closure}, is the final value of the expression.

Parameters act as local variables that are initialized with the argument values:

```
@Produc{
@producname{parlist}@producbody{namelist @bnfopt{@bnfter{,} @bnfter{...}} @Or
@bnfter{...}}
}
```

When a Lua function is called,

it adjusts its list of `@x{arguments}` to the length of its list of parameters `@see{multires}`, unless the function is a `@def{variadic function}`, which is indicated by three dots (`@Char{...}`) at the end of its parameter list.

A variadic function does not adjust its argument list; instead, it collects all extra arguments and supplies them to the function through a `@def{vararg expression}`, which is also written as three dots.

The value of this expression is a list of all actual extra arguments, similar to a function with multiple results `@see{multires}`.

As an example, consider the following definitions:

```
@verbatim{
function
  f(a, b) end
function g(a, b, ...) end
function r() return 1,2,3 end
}
```

Then, we have the following mapping from arguments to parameters and to the vararg expression:

```
@verbatim{
CALL      PARAMETERS

f(3)      a=3, b=nil
f(3, 4)   a=3, b=4
f(3, 4, 5) a=3, b=4
f(r(), 10) a=1, b=10
f(r())    a=1, b=2

g(3)      a=3, b=nil, ... --> (nothing)
g(3, 4)   a=3, b=4,  ... --> (nothing)
g(3, 4, 5, 8) a=3, b=4,  ... --> 5 8
g(5, r())  a=5, b=1,  ... --> 2 3
}
```

Results are returned using the `@Rw{return}` statement `@see{control}`.

If control reaches the end of a function without encountering a `@Rw{return}` statement, then the function returns with no results.

`@index{multiple return}`

There is a system-dependent limit on the number of values that a function may return.

This limit is guaranteed to be greater than 1000.

The `@emphx{colon}` syntax

is used to emulate `@def{methods}`,  
adding an implicit extra parameter `@idx{self}` to  
the function.

Thus, the statement

```
@verbatim{  
function t.a.b.c:f (@rep{params}) @rep{body} end  
}
```

is syntactic sugar for

```
@verbatim{  
t.a.b.c.f = function (self, @rep{params}) @rep{body} end  
}  
  
}
```

`@sect3{multires| @title{Lists of expressions, multiple results,  
and adjustment}`

Both function calls and vararg expressions can result in multiple values.  
These expressions are called `@def{multires expressions}`.

When a multires expression is used as the last element  
of a list of expressions,  
all results from the expression are added to the  
list of values produced by the list of expressions.

Note that a single expression  
in a place that expects a list of expressions  
is the last expression in that (singleton) list.

These are the places where Lua expects a list of expressions:

`@description{`

`@item{A @rw{return} statement,  
for instance @T{return e1, e2, e3} @see{control}.}`

`@item{A table constructor,  
for instance @T{{e1, e2, e3}} @see{tableconstructor}.}`

`@item{The arguments of a function call,  
for  
instance @T{foo(e1, e2, e3)} @see{functioncall}.}`

`@item{A multiple assignment,  
for instance @T{a , b, c = e1, e2, e3} @see{assignment}.}`

`@item{A local declaration,  
for instance @T{local a , b, c = e1, e2, e3} @see{localvar}.}`

`@item{The initial values in a generic @rw{for} loop,`

for instance `@T{for k in e1, e2, e3 do ... end} @see{for}.`

}

In the last four cases,  
the list of values from the list of expressions  
must be `@emph{adjusted}` to a specific length:  
the number of parameters in a call to a non-variadic function  
`@see{func-def}`,  
the number of variables in a multiple assignment or  
a local declaration,  
and exactly four values for a generic `@rw{for}` loop.  
The `@def{adjustment}` follows these rules:  
If there are more values than needed,  
the extra values are thrown away;  
if there are fewer values than needed,  
the list is extended with `@nil`'s.  
When the list of expressions ends with a multiresult expression,  
all results from that expression enter the list of values  
before the adjustment.

When

a multiresult expression is used  
in a list of expressions without being the last element,  
or in a place where the syntax expects a single expression,  
Lua adjusts the result list of that expression to one element.  
As a particular case,  
the syntax expects a single expression inside a parenthesized expression;  
therefore, adding parentheses around a multiresult expression  
forces it to produce exactly one result.

We seldom need to use a variadic expression in a place  
where the syntax expects a single expression.  
(Usually it is simpler to add a regular parameter before  
the variadic part and use that parameter.)  
When there is such a need,  
we recommend assigning the variadic expression  
to a single variable and using that variable  
in its place.

Here are some examples of uses of multiresult expressions.

In all cases, when the construction needs  
`@Q{the n-th result}` and there is no such result,  
it uses a `@nil`.

```
@verbatim{
print(x, f())    -- prints x and all results from f().
print(x, (f()))  -- prints
x and the first result from f().
print(f(), x)    -- prints the first result from f() and x.
```

```

print(1 + f())  -- prints 1 added to the first result from f().
local x = ...   -- x gets the first vararg argument.
x,y = ...       -- x gets the first vararg argument,
                -- y gets the second vararg argument.
x,y,z = w, f()  -- x gets w, y gets the first result from f(),
                -- z gets the second result from f().
x,y,z = f()     -- x gets the first result from f(),
                -- y gets the second result from f(),
                -- z gets the third result from f().
x,y,z = f(), g() -- x gets the first result from f(),
                -- y gets the first result from g(),
                -- z gets the second result from g().
x,y,z = (f())   -- x gets the first result from f(), y and z get nil.
return f()      -- returns all results from f().
return x, ...   -- returns x and all received vararg arguments.
return x,y,f()
    -- returns x, y, and all results from f().
{f()}          -- creates a list with all results from f().
{...}          -- creates a list with all vararg arguments.
{f(), 5}       -- creates a list with the first result from f() and 5.
}

}

}

```

@sect2{visibility| @title{Visibility Rules}

@index{visibility}

Lua is a lexically scoped language.

The scope of a local variable begins at the first statement after its declaration and lasts until the last non-void statement of the innermost block that includes the declaration.

(@emph{Void statements} are labels and empty statements.)

Consider the following example:

@verbatim{

```

x = 10          -- global variable
do             -- new block
  local x = x   -- new 'x', with value 10
  print(x)      --> 10
  x = x+1
do             -- another block
  local x = x+1 -- another 'x'
  print(x)      --> 12
end
print(x)       --> 11
end
print(x)       --> 10 (the global one)

```



}

Notice

that, in a declaration like `@T{local x = x}`,  
the new `@id{x}` being declared is not in scope yet,  
and so the second `@id{x}` refers to the outside variable.

Because of the `@x{lexical scoping}` rules,  
local variables can be freely accessed by functions  
defined inside their scope.

A local variable used by an inner function is called an `@def{upvalue}`  
(or `@emphx{external local variable}`, or simply `@emphx{external variable}`)  
inside the inner function.

Notice that each execution of a `@Rw{local}` statement  
defines new local variables.

Consider the following example:

```
@verbatim{
a = {}
local x = 20
for i = 1, 10 do
  local y = 0
  a[i] = function () y = y + 1; return x + y end
end
}
```

The loop creates ten closures  
(that is, ten instances of the anonymous function).  
Each of these closures uses a different `@id{y}` variable,  
while all of them share the same `@id{x}`.

}

}

`@C{-----}`

`@sect1{API| @title{The Application Program Interface}}`

`@simplesect{`

`@index{C`  
`API}`

This section describes the `@N{C API}` for Lua, that is,  
the set of `@N{C functions}` available to the host program to communicate  
with Lua.

All API functions and related types and constants  
are declared in the header file `@defid{lua.h}`.

Even when we use the term @Q{function},  
any facility in the API may be provided as a macro instead.  
Except where stated otherwise,  
all such macros use each of their arguments exactly once  
(except for the first argument, which is always a Lua state),  
and so do not generate any hidden side-effects.

As in most @N{C libraries},  
the Lua API functions do not check their arguments  
for validity or consistency.  
However, you can change this behavior by compiling Lua  
with the macro @defid{LUA\_USE\_APICHECK} defined.

The Lua library is fully reentrant:  
it has no global variables.  
It keeps all information it needs in a dynamic structure,  
called the @def{Lua state}.

Each Lua state has one or more threads,  
which correspond to independent,  
cooperative lines of execution.  
The type @Lid{lua\_State} (despite its name) refers to a thread.  
(Indirectly, through the thread, it also refers to the  
Lua state associated to the thread.)

A pointer to a thread must be passed as the first argument to  
every function in the library, except to @Lid{lua\_newstate},  
which creates a Lua state from scratch and returns a pointer  
to the @emph{main thread} in the new state.

}

@sect2{@title{The Stack}

@simplesect{

Lua uses a @emph{virtual stack} to pass values to and from C.  
Each element in this stack represents a Lua value  
(@nil, number, string, etc.).  
Functions in the API can access this stack through the  
Lua state parameter that they receive.

Whenever Lua calls C, the called function gets a new stack,  
which is independent of previous stacks and of stacks of  
@N{C functions} that are still active.  
This stack initially contains any arguments to the @N{C function}  
and it is where the @N{C function} can store temporary

Lua values and must push  
its results  
to be returned to the caller @seeC{lua\_CFunction}.

For convenience,  
most query operations in the API do not follow a strict stack discipline.  
Instead, they can refer to any element in the stack  
by using an @emph{index}:@index{index (API stack)}  
A positive index represents an absolute stack position,  
starting @N{at 1} as the bottom of the stack;  
a negative index represents an offset relative to the top of the stack.  
More specifically, if the stack has @rep{n} elements,  
then @N{index 1} represents the first element  
(that is, the element that was pushed onto the stack first)  
and  
@N{index @rep{n}} represents the last element;  
@N{index @num{-1}} also represents the last element  
(that is, the element at @N{the top})  
and index @M{-n} represents the first element.

}

@sect3{stacksize| @title{Stack Size}}

When you interact with the Lua API,  
you are responsible for ensuring consistency.  
In particular,  
@emph{you are responsible for controlling stack overflow}.  
When you call any  
API function,  
you must ensure the stack has enough room to accommodate the results.

There is one exception to the above rule:  
When you call a Lua function  
without a fixed number of results @seeF{lua\_call},  
Lua ensures that the stack has enough space for all results.  
However, it does not ensure any extra space.  
So, before pushing anything on the stack after such a call  
you should use @Lid{lua\_checkstack}.

Whenever Lua calls C,  
it ensures that the stack has space for  
at least @defid{LUA\_MINSTACK} extra elements;  
that is, you can safely push up to @id{LUA\_MINSTACK} values into it.  
@id{LUA\_MINSTACK} is defined as 20,  
so that usually you do not have to worry about stack space  
unless your code has loops pushing elements onto the stack.  
Whenever necessary,

you can use the function `@Lid{lua_checkstack}`  
to ensure that the stack has enough space for pushing new elements.

}

`@sect3{@title{Valid and Acceptable Indices}`

Any function in the API that receives stack indices  
works only with `@emphx{valid`  
indices} or `@emphx{acceptable indices}`.

A `@def{valid index}` is an index that refers to a  
position that stores a modifiable Lua value.  
It comprises stack indices `@N{between 1}` and the stack top  
(`@T{1 @leq abs(index) @leq top}`)  
`@index{stack index}`  
plus `@def{pseudo-indices}`,  
which represent some positions that are accessible to `@N{C code}`  
but that are not in the stack.  
Pseudo-indices are used to access the registry `@see{registry}`  
and the upvalues of a `@N{C function}` `@see{c-closure}`.

Functions that do not need a specific mutable position,  
but only a value (e.g., query functions),  
can be called with acceptable indices.  
An `@def{acceptable index}` can be any valid index,  
but it also can be any positive index after the stack top  
within the space allocated for the stack,  
that is, indices up to the stack size.  
(Note that 0 is never an acceptable index.)  
Indices to upvalues `@see{c-closure}` greater than the real number  
of upvalues in the current `@N{C function}` are also acceptable (but invalid).  
Except  
when noted otherwise,  
functions in the API work with acceptable indices.

Acceptable indices serve to avoid extra tests  
against the stack top when querying the stack.  
For instance, a `@N{C function}` can query its third argument  
without the need to check whether there is a third argument,  
that is, without the need to check whether 3 is a valid index.

For functions that can be called with acceptable indices,  
any non-valid index is treated as if it  
contains a value of a virtual type `@defid{LUA_TNONE}`,  
which behaves like a nil value.

}

@sect3{constchar|@title{Pointers to strings}

Several functions in the API return pointers ( $@T\{\text{const char}^*\}$ ) to Lua strings in the stack.

(See @Lid{lua\_pushfstring}, @Lid{lua\_pushlstring},

@Lid{lua\_pushstring}, and @Lid{lua\_tolstring}.

See also @Lid{luaL\_checklstring}, @Lid{luaL\_checkstring}, and @Lid{luaL\_tolstring} in the auxiliary library.)

In general,

Lua's garbage collection can free or move internal memory and then invalidate pointers to internal strings.

To allow a safe use of these pointers,

the API guarantees that any pointer to a string in a stack index is valid while the string value at that index is not removed from the stack.

(It can be moved to another index, though.)

When the index is a pseudo-index (referring to an upvalue), the pointer is valid while the corresponding call is active and the corresponding upvalue is not modified.

Some functions in the debug interface

also return pointers to strings,

namely @Lid{lua\_getlocal}, @Lid{lua\_getupvalue},

@Lid{lua\_setlocal}, and @Lid{lua\_setupvalue}.

For these functions, the pointer is guaranteed to be valid while the caller function is active and the given closure (if one was given) is in the stack.

Except for these guarantees,

the garbage collector is free to invalidate any pointer to internal strings.

}

}

@sect2{c-closure| @title{C Closures}

When a  $@N\{\text{C function}\}$  is created,

it is possible to associate some values with it,

thus creating a  $@def\{ @N\{\text{C closure}\} \}$

@seeC{lua\_pushcclosure};

these

values are called  $@def\{\text{upvalues}\}$  and are accessible to the function whenever it is called.

Whenever a `@N{C function}` is called,  
 its upvalues are located at specific pseudo-indices.  
 These pseudo-indices are produced by the macro  
`@Lid{lua_upvalueindex}`.  
 The first upvalue associated with a function is at index  
`@T{lua_upvalueindex(1)}`, and so on.  
 Any access to `@T{lua_upvalueindex(@rep{n})}`,  
 where `@rep{n}` is greater than the number of upvalues of the  
 current function  
 (but not greater than 256,  
 which is one plus the maximum number of upvalues in a closure),  
 produces an acceptable but invalid index.

A `@N{C closure}` can also change the values  
 of its corresponding upvalues.

}

`@sect2{registry| @title{Registry}}`

Lua provides a `@def{registry}`,  
 a predefined table that can be used by any `@N{C code}` to  
 store whatever Lua values it needs to store.  
 The registry table is always accessible at pseudo-index  
`@defid{LUA_REGISTRYINDEX}`.  
 Any `@N{C library}` can store data into  
 this table,  
 but it must take care to choose keys  
 that are different from those used  
 by other libraries, to avoid collisions.  
 Typically, you should use as key a string containing your library name,  
 or a light userdata with the address of a `@N{C object}` in your code,  
 or any Lua object created by your code.  
 As with variable names,  
 string keys starting with an underscore followed by  
 uppercase letters are reserved for Lua.

The integer keys in the registry are used  
 by the reference mechanism `@seeC{luaL_ref}`  
 and by some predefined values.  
 Therefore, integer keys in the registry  
 must not be used for other purposes.

When you create a new Lua state,  
 its registry comes with some predefined values.  
 These predefined values are indexed with integer keys  
 defined as constants in `@id{lua.h}`.  
 The following constants are defined:

```
@description{
@item{@defid{LUA_RIDX_MAINTHREAD}}| At this index the registry has
the main thread of the state.
(The main thread is the one created together with the state.)
}
```

```
@item{@defid{LUA_RIDX_GLOBALS}}|
  At this index the registry has
the @x{global environment}.
}
}
}
```

```
@sect2{C-error|@title{Error Handling in C}}
```

```
@simplesect{
```

Internally, Lua uses the C @id{longjmp} facility to handle errors.  
 (Lua will use exceptions if you compile it as C++;  
 search for @id{LUA\_THROW} in the source code for details.)  
 When Lua faces any error,  
 such as a @x{memory allocation error} or a type error,  
 it @emph{raises} an error;  
 that is, it does a long jump.  
 A @emphx{protected environment} uses @id{setjmp}  
 to set a recovery point;  
 any error jumps to the most recent active recovery point.

Inside a @N{C function} you can raise an error explicitly  
 by calling @Lid{lua\_error}.

Most functions in the API can raise an error,  
 for instance due to a @x{memory allocation error}.  
 The documentation for each function indicates whether  
 it can raise errors.

If an error happens outside any protected environment,  
 Lua calls a @def{panic function} (see @Lid{lua\_atpanic})  
 and then calls @T{abort},  
 thus  
 exiting the host application.  
 Your panic function can avoid this exit by  
 never returning  
 (e.g., doing a long jump to your own recovery point outside Lua).

The panic function,  
 as its name implies,

is a mechanism of last resort.

Programs should avoid it.

As a general rule,

when a `@N{C function}` is called by Lua with a Lua state,

it can do whatever it wants on that Lua state,

as it should be already protected.

However,

when C code operates on other Lua states

(e.g., a Lua-state argument to the function,

a Lua state stored in the registry, or

the result of `@Lid{lua_newthread}`),

it should use them only in API calls that cannot raise errors.

The panic function runs as if it were a `@x{message handler} @see{error}`;

in particular, the error object is on the top of the stack.

However, there is no guarantee about stack space.

To push anything on the stack,

the panic function must first check the available space `@see{stacksize}`.

}

`@sect3{statuscodes|@title{Status Codes}`

Several functions

that report errors in the API use the following

status codes to indicate different kinds of errors or other conditions:

`@description{`

`@item{@defid{LUA_OK} (0)| no errors.}`

`@item{@defid{LUA_ERRRUN}| a runtime error.}`

`@item{@defid{LUA_ERRMEM}|`

`@x{memory allocation error}.`

For such errors, Lua does not call the `@x{message handler}`.

}

`@item{@defid{LUA_ERRERR}| error while running the @x{message handler}.`

`@item{@defid{LUA_ERRSYNTAX}| syntax error during precompilation.}`

`@item{@defid{LUA_YIELD}| the thread (coroutine) yields.}`

`@item{@defid{LUA_ERRFILE}| a file-related error;`

e.g., it cannot open or read the file.}

}



These constants are defined in the header file @id{lua.h}.

```
}  
  
}
```

@sect2{continuations|@title{Handling Yields in C}}

Internally, Lua uses the C @id{longjmp} facility to yield a coroutine. Therefore, if a @N{C function} @id{foo} calls an API function and this API function yields (directly or indirectly by calling another function that yields), Lua cannot return to @id{foo} any more, because the @id{longjmp} removes its frame from the @N{C stack}.

To avoid this kind of problem, Lua raises an error whenever it tries to yield across an API call, except for three functions: @Lid{lua\_yieldk}, @Lid{lua\_callk}, and @Lid{lua\_pcallk}. All those functions receive a @def{continuation function} (as a parameter named @id{k}) to continue execution after a yield.

We need to set some terminology to explain continuations. We have a @N{C function} called from Lua which we will call the @emph{original function}. This original function then calls one of those three functions in the C API, which we will call the @emph{callee function}, that then yields the current thread. This can happen when the callee function is @Lid{lua\_yieldk}, or when the callee function is either @Lid{lua\_callk} or @Lid{lua\_pcallk} and the function called by them yields.

Suppose the running thread yields while executing the callee function. After the thread resumes, it eventually will finish running the callee function. However, the callee function cannot return to the original function, because its frame in the @N{C stack} was destroyed by the yield. Instead, Lua calls a @def{continuation function}, which was given as an argument to the callee function. As the name implies, the continuation function should continue the task of the original function.

As an illustration, consider the following function:

@verbatim{

```

int original_function (lua_State *L) {
...   /* code 1 */
status = lua_pcall(L, n, m, h); /* calls Lua */
...   /* code 2 */
}
}

```

Now we want to allow

the Lua code being run by @Lid{lua\_pcall} to yield.

First, we can rewrite our function like here:

```

@verbatim{
int k (lua_State *L, int status, lua_KContext ctx) {
...   /* code 2 */
}
}

```

```

int original_function (lua_State *L) {
...   /* code 1 */
return k(L, lua_pcall(L, n, m, h), ctx);
}
}

```

In the above code,

the new function @id{k} is a

@emph{continuation function} (with type @Lid{lua\_KFunction}),  
which

should do all the work that the original function  
was doing after calling @Lid{lua\_pcall}.

Now, we must inform Lua that it must call @id{k} if the Lua code  
being executed by @Lid{lua\_pcall} gets interrupted in some way  
(errors or yielding),

so we rewrite the code as here,

replacing @Lid{lua\_pcall} by @Lid{lua\_pcallk}:

```

@verbatim{
int original_function (lua_State *L) {
...   /* code 1 */
return k(L, lua_pcallk(L, n, m, h, ctx2, k), ctx1);
}
}

```

Note the external, explicit call to the continuation:

Lua will call the continuation only if needed, that is,

in case of errors or resuming after a yield.

If the called function returns normally without ever yielding,

@Lid{lua\_pcallk} (and @Lid{lua\_callk}) will also return normally.

(Of course, instead of calling the continuation in that case,

you can do the equivalent work directly inside the original function.)

Besides the Lua state,

the continuation function has two other parameters:

the final status of the call and the context value

(@id{ctx}) that  
 was passed originally to @Lid{lua\_pcallk}.  
 Lua does not use this context value;  
 it only passes this value from the original function to the  
 continuation function.  
 For @Lid{lua\_pcallk},  
 the status is the same value that would be returned by @Lid{lua\_pcallk},  
 except that it is @Lid{LUA\_YIELD} when being executed after a yield  
 (instead of @Lid{LUA\_OK}).  
 For @Lid{lua\_yieldk} and @Lid{lua\_callk},  
 the status is always @Lid{LUA\_YIELD} when Lua calls the continuation.  
 (For these two functions,  
 Lua will not call the continuation in case of errors,  
 because they do not handle errors.)  
 Similarly, when using @Lid{lua\_callk},  
 you should call the continuation function  
 with @Lid{LUA\_OK} as the status.  
 (For @Lid{lua\_yieldk}, there is not much point in calling  
 directly the continuation function,  
 because @Lid{lua\_yieldk} usually does not return.)

Lua treats the continuation function as if it were the original function.  
 The continuation function receives the same Lua stack  
 from the original  
 function,  
 in the same state it would be if the callee function had returned.  
 (For instance,  
 after a @Lid{lua\_callk} the function and its arguments are  
 removed from the stack and replaced by the results from the call.)  
 It also has the same upvalues.  
 Whatever it returns is handled by Lua as if it were the return  
 of the original function.

}

@sect2{@title{Functions and Types}}

Here we list all functions and types from the @N{C API} in  
 alphabetical order.

Each function has an indicator like this:

@apii{o,p,x}

The first field, @T{o},  
 is how many elements the function pops from the stack.  
 The second field, @T{p},  
 is how many elements the function pushes onto the stack.  
 (Any function always pushes its results after popping its arguments.)  
 A field in the form @T{x|y} means the function can push (or pop)

`@T{x}` or `@T{y}` elements,  
 depending on the situation;  
 an interrogation mark `@Char{?}` means that  
 we cannot know how many elements the function pops/pushes  
 by looking only at its arguments.  
 (For  
   instance, they may depend on what is in the stack.)  
 The third field, `@T{x}`,  
 tells whether the function may raise errors:  
`@Char{-}` means the function never raises any error;  
`@Char{m}` means the function may raise only out-of-memory errors;  
`@Char{v}` means the function may raise the errors explained in the text;  
`@Char{e}` means the function can run arbitrary Lua code,  
 either directly or through metamethods,  
 and therefore may raise any errors.

```

@APIEntry{int lua_absindex (lua_State *L, int idx);|
@apii{0,0,-}

```

Converts the `@x{acceptable index}` `@id{idx}`  
 into an equivalent `@x{absolute index}`  
 (that is, one that does not depend on the stack size).

```

}

```

```

@APIEntry{
typedef void * (*lua_Alloc) (void *ud,
                             void *ptr,
                             size_t osize,
                             size_t nsize);|

```

The type of the `@x{memory-allocation function}` used by Lua states.  
 The allocator function must provide a  
 functionality similar to `@id{realloc}`,  
 but not exactly the  
 same.

Its arguments are

`@id{ud}`, an opaque pointer passed to `@Lid{lua_newstate}`;  
`@id{ptr}`, a pointer to the block being allocated/reallocated/freed;  
`@id{osize}`, the original size of the block or some code about what  
 is being allocated;  
 and `@id{nsize}`, the new size of the block.

When `@id{ptr}` is not `@id{NULL}`,  
`@id{osize}` is the size of the block pointed by `@id{ptr}`,  
 that is, the size given when it was allocated or reallocated.

When @id{ptr} is @id{NULL},  
 @id{osize} encodes the kind of object that Lua is allocating.  
 @id{osize} is any of  
 @Lid{LUA\_TSTRING}, @Lid{LUA\_TTABLE}, @Lid{LUA\_TFUNCTION},  
 @Lid{LUA\_TUSERDATA}, or @Lid{LUA\_TTHREAD} when (and only when)  
 Lua is creating a new object of that type.  
 When @id{osize} is some other value,  
 Lua is allocating memory for something else.

Lua assumes the following behavior from the allocator function:

When @id{nsiz} is zero,  
 the allocator must behave like @id{free}  
 and then return @id{NULL}.

When @id{nsiz} is not zero,  
 the allocator must behave  
 like @id{realloc}.  
 In particular, the allocator returns @id{NULL}  
 if and only if it cannot fulfill the request.

Here is a simple implementation for the @x{allocator function}.  
 It is used in the auxiliary library by @Lid{luaL\_newstate}.

```
@verbatim{
static void *l_alloc (void *ud, void *ptr, size_t osize,
                      size_t nsiz) {
    (void)ud; (void)osize; /* not used */
    if (nsiz == 0) {
        free(ptr);
        return NULL;
    }
    else
        return realloc(ptr, nsiz);
}
}
```

Note that @N{ISO C} ensures  
 that @T{free(NULL)} has no effect and that  
 @T{realloc(NULL,size)} is equivalent to @T{malloc(size)}.

```
@APIEntry{void lua_arith (lua_State *L, int op);|
@api{2|1,1,e}
```

Performs an arithmetic or bitwise operation over the two values  
 (or one, in the case of negations)  
 at the top of the stack,

with the value on the top being the second operand,  
pops these values, and pushes the result of the operation.  
The function follows the semantics of the corresponding Lua  
operator  
(that is, it may call metamethods).

The value of `@id{op}` must be one of the following constants:

`@description{`

```
@item{@defid{LUA_OPADD}| performs addition (@T{+})}
@item{@defid{LUA_OPSUB}| performs subtraction (@T{-})}
@item{@defid{LUA_OPMUL}| performs multiplication (@T{*})}
@item{@defid{LUA_OPDIV}| performs float division (@T{/})}
@item{@defid{LUA_OPIDIV}| performs floor division (@T{//})}
@item{@defid{LUA_OPMOD}| performs modulo (@T{%})}
@item{@defid{LUA_OPPOW}| performs exponentiation (@T{^})}
@item{@defid{LUA_OPUNM}| performs mathematical negation (unary @T{-})}
@item{@defid{LUA_OPBNOT}| performs bitwise NOT (@T{~})}
@item{@defid{LUA_OPBAND}| performs bitwise AND (@T{&})}
@item{@defid{LUA_OPBOR}| performs bitwise OR (@T{|})}
@item{@defid{LUA_OPBXOR}| performs bitwise exclusive OR (@T{~})}
@item{@defid{LUA_OPSHL}| performs left shift (@T{<<})}
@item{@defid{LUA_OPSHR}| performs right shift (@T{>>})}
```

}

}

```
@APIEntry{lua_CFunction lua_atpanic (lua_State *L, lua_CFunction
panicf);|
@apii{0,0,-}
```

Sets a new panic function and returns the old one @see{C-error}.

}

```
@APIEntry{void lua_call (lua_State *L, int nargs, int nresults);|
@apii{nargs+1,nresults,e}
```

Calls a function.

Like regular Lua calls,

`@id{lua_call}` respects the `@idx{__call}` metamethod.

So, here the word `@Q{function}`

means any callable value.

To do a call you must use the following protocol:

first, the function to be called is pushed onto the stack;

then, the arguments to the call are pushed

in direct order;  
that is, the first argument is pushed first.  
Finally you call `@Lid{lua_call};`  
`@id{nargs}` is the number of arguments that you pushed onto the stack.  
When the function returns,  
all arguments and the function value are popped  
and the call results are pushed onto the stack.  
The number of results is adjusted to `@id{nresults}`,  
unless `@id{nresults}` is `@defid{LUA_MULTRET}`.  
In this case, all results from the function are pushed;  
Lua takes care that the returned values fit into the stack space,  
but  
it does not ensure any extra space in the stack.  
The function results are pushed onto the stack in direct order  
(the first result is pushed first),  
so that after the call the last result is on the top of the stack.

Any error while calling and running the function is propagated upwards  
(with a `@id{longjmp}`).

The following example shows how the host program can do the  
equivalent to this Lua code:

```
@verbatim{
a = f("how", t.x, 14)
}

Here it is @N{in C}:
@verbatim{
lua_getglobal(L, "f");           /* function to be called */
lua_pushliteral(L, "how");       /* 1st argument */
lua_getglobal(L, "t");           /* table to be indexed */
lua_getfield(L, -1, "x");        /* push result of t.x (2nd arg) */
lua_remove(L, -2);              /* remove 't' from the stack */
lua_pushinteger(L, 14);          /* 3rd argument */
lua_call(L, 3, 1);              /* call 'f' with 3 arguments and 1 result */
lua_setglobal(L, "a");           /* set global
'a' */
}
```

Note that the code above is `@emph{balanced}`:  
at its end, the stack is back to its original configuration.  
This is considered good programming practice.

}

```
@APIEntry{
void lua_callk (lua_State *L,
               int nargs,
               int nresults,
               lua_KContext ctx,
```

```
lua_KFunction k);|
@apii{nargs + 1,nresults,e}
```

This function behaves exactly like @Lid{lua\_call},  
but allows the called function to yield @see{continuations}.

```
}
```

```
@APIEntry{typedef int (*lua_CFunction) (lua_State *L);|
```

Type for @N{C functions}.

In order to communicate properly with Lua,  
a @N{C function} must use the following protocol,  
which defines the way parameters and results are passed:  
a @N{C function} receives its arguments from Lua in its stack  
in direct order (the first argument is pushed first).  
So, when the function starts,  
@T{lua\_gettop(L)} returns the number of arguments received by the function.  
The first argument (if any) is at index 1  
and its last argument  
is at index @T{lua\_gettop(L)}.  
To return values to Lua, a @N{C function} just pushes them onto the stack,  
in direct order (the first result is pushed first),  
and returns in C the number of results.  
Any other value in the stack below the results will be properly  
discarded by Lua.  
Like a Lua function, a @N{C function} called by Lua can also return  
many results.

As an example, the following function receives a variable number  
of numeric arguments and returns their average and their sum:

```
@verbatim{
static int foo (lua_State *L) {
  int n = lua_gettop(L);  /* number of arguments */
  lua_Number sum = 0.0;
  int i;
  for (i = 1; i <= n; i++) {
    if (!lua_isnumber(L, i)) {
      lua_pushliteral(L, "incorrect argument");
      lua_error(L);
    }
    sum += lua_tonumber(L, i);
  }
  lua_pushnumber(L, sum/n);  /* first result */
  lua_pushnumber(L, sum);   /* second result */
  return 2;                 /* number of results */
}
```



```
}
```

```
}
```

```
@APIEntry{int lua_checkstack (lua_State  
*L, int n);|  
@apii{0,0,-}}
```

Ensures that the stack has space for at least @id{n} extra elements, that is, that you can safely push up to @id{n} values into it. It returns false if it cannot fulfill the request, either because it would cause the stack to be greater than a fixed maximum size (typically at least several thousand elements) or because it cannot allocate memory for the extra space. This function never shrinks the stack; if the stack already has space for the extra elements, it is left unchanged.

```
}
```

```
@APIEntry{void lua_close (lua_State *L);|  
@apii{0,0,-}}
```

Close all active to-be-closed variables in the main thread, release all objects in the given Lua state (calling the corresponding garbage-collection metamethods, if any), and frees all dynamic memory used by this state.

On several platforms, you may not need to call this function, because all resources are naturally released when the host program ends. On the other hand, long-running programs that create multiple states, such as daemons or web servers, will probably need to close states as soon as they are not needed.

```
}
```

```
@APIEntry{void lua_closeslot (lua_State *L, int index);|  
@apii{0,0,e}}
```

Close the to-be-closed slot at the given index and set its value to @nil. The index must be the last index previously marked to be closed @see{lua\_toclose} that is still active (that is, not closed yet).

A `@idx{__close}` metamethod cannot yield when called through this function.

(This function was introduced in `@N{release 5.4.3}`.)

}

`@APIEntry{int lua_closethread (lua_State *L, lua_State *from);|  
@apii{0,?,~}`

Resets a thread, cleaning its call stack and closing all pending to-be-closed variables.

Returns a status code:

`@Lid{LUA_OK}` for no errors in the thread (either the original error that stopped the thread or errors in closing methods),  
or an error status otherwise.

In case of error,

leaves the error object on the top of the stack.

The parameter `@id{from}` represents the coroutine that is resetting `@id{L}`.

If

there is no such coroutine,  
this parameter can be `@id{NULL}`.

(This function was introduced in `@N{release 5.4.6}`.)

}

`@APIEntry{int lua_compare (lua_State *L, int index1, int index2, int op);|  
@apii{0,0,e}`

Compares two Lua values.

Returns 1 if the value at index `@id{index1}` satisfies `@id{op}` when compared with the value at index `@id{index2}`, following the semantics of the corresponding Lua operator (that is, it may call metamethods).

Otherwise `@N{returns 0}`.

Also `@N{returns 0}` if any of the indices is not valid.

The value of `@id{op}` must be one of the following constants:

`@description{`

`@item{@defid{LUA_OPEQ}| compares for equality (@T{==})}`

`@item{@defid{LUA_OPLT}| compares for less than (@T{<})}`

`@item{@defid{LUA_OPLE}| compares for less or equal (@T{<=})}`

}

```
}
```

```
@APIEntry{void lua_concat (lua_State *L, int n);|  
@apii{n,1,e}}
```

Concatenates the @id{n} values at the top of the stack,  
pops them, and leaves the result on the top.

If @N{@T{n} is 1}, the result is the single value on the  
stack

(that is, the function does nothing);

if @id{n} is 0, the result is the empty string.

Concatenation is performed following the usual semantics of Lua  
@see{concat}.

```
}
```

```
@APIEntry{void lua_copy (lua_State *L, int fromidx, int toidx);|  
@apii{0,0,-}}
```

Copies the element at index @id{fromidx}  
into the valid index @id{toidx},  
replacing the value at that position.  
Values at other positions are not affected.

```
}
```

```
@APIEntry{void lua_createtable (lua_State *L, int narr, int nrec);|  
@apii{0,1,m}}
```

Creates a new empty table and pushes it onto the stack.

Parameter @id{narr} is a hint for how many elements the table  
will have as a sequence;

parameter @id{nrec} is a hint for how many other elements  
the table will have.

Lua may use these hints to preallocate memory for the new table.

This preallocation may help performance when you know in advance  
how many elements the table will have.

Otherwise you can use the function @Lid{lua\_newtable}.

```
}
```

```
@APIEntry{int lua_dump (lua_State *L,
```

```
    lua_Writer writer,  
    void *data,  
    int strip);|
```

```
@apii{0,0,-}}
```

Dumps a function as a binary chunk.  
 Receives a Lua function on the top of the stack  
 and produces a binary chunk that,  
 if loaded again,  
 results in a function equivalent to the one dumped.  
 As it produces parts of the chunk,  
 @Lid{lua\_dump} calls function @id{writer} @seeC{lua\_Writer}  
 with the given @id{data}  
 to write them.

If @id{strip} is true,  
 the binary representation may not include all debug information  
 about the function,  
 to save space.

The value returned is the error code returned by the last  
 call to the writer;  
 @N{0 means} no errors.

This function does not pop the Lua function from the stack.

}

@APIEntry{int lua\_error (lua\_State \*L);|  
 @apii{1,0,v}}

Raises a Lua error,  
 using the value on the top of the stack as the error object.  
 This function does a long jump,  
 and therefore never returns  
 @seeC{luaL\_error}.

}

@APIEntry{int lua\_gc (lua\_State \*L, int what, ...);|  
 @apii{0,0,-}}

Controls  
 the garbage collector.

This function performs several tasks,  
 according to the value of the parameter @id{what}.  
 For options that need extra arguments,  
 they are listed after the option.  
 @description{

@item{@id{LUA\_GCCOLLECT}|

Performs a full garbage-collection cycle.

}

@item{@id{LUA\_GCSTOP}|

Stops the garbage collector.

}

@item{@id{LUA\_GCRESTART}|

Restarts the garbage collector.

}

@item{@id{LUA\_GCCOUNT}|

Returns the current amount of memory (in Kbytes) in use by Lua.

}

@item{@id{LUA\_GCCOUNTB}|

Returns the remainder of dividing the current amount of bytes of memory in use by Lua by 1024.

}

@item{@id{LUA\_GCSTEP} @T{(int stepsize)}|

Performs an incremental step of garbage collection, corresponding to the allocation of @id{stepsize} Kbytes.

}

@item{@id{LUA\_GCISRUNNING}|

Returns a boolean that tells whether the collector is running (i.e., not stopped).

}

@item{@id{LUA\_GCINC} (int pause, int stepmul, stepsize)|

Changes the collector to incremental mode with the

given parameters @see{incmode}.

Returns the previous mode (@id{LUA\_GCGEN} or @id{LUA\_GCINC}).

}

@item{@id{LUA\_GCGEN} (int minormul, int majormul)|

Changes the collector to generational mode with the given parameters @see{genmode}.

Returns the previous mode (@id{LUA\_GCGEN} or @id{LUA\_GCINC}).

}

}

For more details about these options, see @Lid{collectgarbage}.

This function should not be called by a finalizer.

}

```
@APIEntry{lua_Alloc lua_getallocf (lua_State *L, void **ud);|
@apii{0,0,-}
```

Returns the @x{memory-allocation function} of a given state.  
If @id{ud} is not @id{NULL}, Lua stores in @T{\*ud} the  
opaque pointer given when the memory-allocator function was set.

}

```
@APIEntry{int lua_getfield (lua_State *L, int index, const char *k);|
@apii{0,1,e}
```

Pushes onto the stack the value @T{t[k]},  
where @id{t} is the value at the given index.  
As in Lua, this function may trigger a metamethod  
for the @Q{index} event @see{metatable}.

Returns the type of the pushed value.

}

```
@APIEntry{void
*lua_getextraspace (lua_State *L);|
@apii{0,0,-}
```

Returns a pointer to a raw memory area associated with the  
given Lua state.  
The application can use this area for any purpose;  
Lua does not use it for anything.

Each new thread has this area initialized with a copy  
of the area of the @x{main thread}.

By default, this area has the size of a pointer to void,  
but you can recompile Lua with a different size for this area.  
(See @id{LUA\_EXTRASPACE} in @id{luaconf.h}.)

}

```
@APIEntry{int lua_getglobal (lua_State *L, const char *name);|
@apii{0,1,e}
```

Pushes onto the stack the value of the global @id{name}.  
Returns the type of that value.

}

```
@APIEntry{int lua_geti (lua_State *L, int index, lua_Integer i);|
@apii{0,1,e}
```

Pushes onto the stack the value `@T{t[i]}`,  
where `@id{t}` is the value at the given index.  
As in Lua, this function may trigger a metamethod  
for the `@Q{index}` event `@see{metatable}`.

Returns the type of the pushed value.

}

```
@APIEntry{int lua_getmetatable (lua_State *L, int index);|
@apii{0,0|1,-}
```

If  
the value at the given index has a metatable,  
the function pushes that metatable onto the stack and `@N{returns 1}`.  
Otherwise,  
the function `@N{returns 0}` and pushes nothing on the stack.

}

```
@APIEntry{int lua_gettable (lua_State *L, int index);|
@apii{1,1,e}
```

Pushes onto the stack the value `@T{t[k]}`,  
where `@id{t}` is the value at the given index  
and `@id{k}` is the value on the top of the stack.

This function pops the key from the stack,  
pushing the resulting value in its place.  
As in Lua, this function may trigger a metamethod  
for the `@Q{index}` event `@see{metatable}`.

Returns the type of the pushed value.

}

```
@APIEntry{int lua_gettop (lua_State *L);|
@apii{0,0,-}
```

Returns the index of the top element in the stack.  
Because indices start `@N{at 1}`,  
this result is equal to the number of elements in the stack;  
in particular, `@N{0}` means an empty stack.

```
}
```

```
@APIEntry{int lua_getiuservalue (lua_State *L, int index, int n);|  
@apii{0,1,-}}
```

Pushes onto the stack the @id{n}-th  
user value associated with the  
full userdata at the given index and  
returns the type of the pushed value.

If the userdata does not have that value,  
pushes @nil and returns @Lid{LUA\_TNONE}.

```
}
```

```
@APIEntry{void lua_insert (lua_State *L, int index);|  
@apii{1,1,-}}
```

Moves the top element into the given valid index,  
shifting up the elements above this index to open space.  
This function cannot be called with a pseudo-index,  
because a pseudo-index is not an actual stack position.

```
}
```

```
@APIEntry{typedef @ldots lua_Integer;|
```

The type of integers in Lua.

By default this type is @id{long long},  
(usually a 64-bit two-complement integer),  
but that can be changed to @id{long} or @id{int}  
(usually a 32-bit two-complement integer).  
(See @id{LUA\_INT\_TYPE} in @id{luaconf.h}.)

Lua also defines the constants

@defid{LUA\_MININTEGER} and @defid{LUA\_MAXINTEGER},  
with the minimum and the maximum values that fit in this type.

```
}
```

```
@APIEntry{int lua_isboolean (lua_State *L, int index);|  
@apii{0,0,-}}
```

Returns 1  
if the value at the given index is a boolean,  
and @N{0 otherwise}.



```
}
```

```
@APIEntry{int lua_iscfunction (lua_State *L, int index);|  
@apii{0,0,-}}
```

Returns 1 if the value at the given index is a @N{C function},  
and @N{0 otherwise}.

```
}
```

```
@APIEntry{int lua_isfunction (lua_State *L, int index);|  
@apii{0,0,-}}
```

Returns 1 if the value at the given index is a function  
(either C or Lua), and @N{0 otherwise}.

```
}
```

```
@APIEntry{int lua_isinteger (lua_State *L, int index);|  
@apii{0,0,-}}
```

Returns 1 if the value at the given index is an integer  
(that is, the value is a number and is represented as an integer),  
and @N{0 otherwise}.

```
}
```

```
@APIEntry{int lua_islightuserdata (lua_State *L, int index);|  
@apii{0,0,-}}
```

Returns 1 if the value at the given index is a light userdata,  
and @N{0 otherwise}.

```
}
```

```
@APIEntry{int lua_isnil (lua_State *L, int index);|  
@apii{0,0,-}}
```

Returns 1 if the value at the given index is @nil,  
and @N{0 otherwise}.

```
}
```

```
@APIEntry{int lua_isnone (lua_State *L, int index);|  
@apii{0,0,-}}
```

Returns

1 if the given index is not valid,  
and @N{0 otherwise}.

}

@APIEntry{int lua\_isnoneornil (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns 1 if the given index is not valid  
or if the value at this index is @nil,  
and @N{0 otherwise}.

}

@APIEntry{int lua\_isnumber (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns 1 if the value at the given index is a number  
or a string convertible to a number,  
and @N{0 otherwise}.

}

@APIEntry{int lua\_isstring (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns 1 if the value at the given index is a string  
or a number (which is always convertible to a string),  
and @N{0 otherwise}.

}

@APIEntry{int lua\_istable (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns 1 if the value at the given index is a table,  
and @N{0 otherwise}.

}

@APIEntry{int lua\_isthread (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns 1 if the value at the given index is a thread,  
and @N{0 otherwise}.

}

```
@APIEntry{int lua_isuserdata (lua_State *L, int index);|
@apii{0,0,-}}
```

Returns

1 if the value at the given index is a userdata  
(either full or light), and @N{0 otherwise}.

```
}
```

```
@APIEntry{int lua_isyieldable (lua_State *L);|
@apii{0,0,-}}
```

Returns 1 if the given coroutine can yield,  
and @N{0 otherwise}.

```
}
```

```
@APIEntry{typedef @ldots lua_KContext;|
```

The type for continuation-function contexts.

It must be a numeric type.

This type is defined as @id{intptr\_t}

when @id{intptr\_t} is available,

so that it can store pointers too.

Otherwise, it is defined as @id{ptrdiff\_t}.

```
}
```

```
@APIEntry{
typedef int (*lua_KFunction) (lua_State *L, int status, lua_KContext ctx);|
```

Type for continuation functions @see{continuations}.

```
}
```

```
@APIEntry{void lua_len (lua_State *L, int index);|
@apii{0,1,e}}
```

Returns the length of the value at the given index.

It is equivalent to the @Char{#} operator in Lua @see{len-op} and  
may trigger a metamethod for the @Q{length} event @see{metatable}.

The result is pushed on the stack.

```
}
```

```
@APIEntry{
int lua_load (lua_State *L,
             lua_Reader reader,
```

```

        void *data,
        const char *chunkname,
        const char *mode);|
@apii{0,1,-}

```

Loads a Lua chunk without running it.

If there are no errors,

@id{lua\_load} pushes the compiled chunk as a Lua function on top of the stack.

Otherwise, it pushes an error message.

The @id{lua\_load} function uses a user-supplied @id{reader} function to read the chunk @seeC{lua\_Reader}.

The @id{data} argument is an opaque value passed to the reader function.

The @id{chunkname} argument gives a name to the chunk, which is used for error messages and in debug information @see{debugI}.

@id{lua\_load} automatically detects whether the chunk is text or binary and loads it accordingly (see program @idx{luac}).

The string @id{mode} works as in function @Lid{load}, with the addition that a @id{NULL} value is equivalent to the string @St{bt}.

@id{lua\_load} uses the stack internally, so the reader function must always leave the stack unmodified when returning.

@id{lua\_load} can return @Lid{LUA\_OK}, @Lid{LUA\_ERRSYNTAX}, or @Lid{LUA\_ERRMEM}. The function may also return other values corresponding to errors raised by the read function @see{statuscodes}.

If the resulting function has upvalues, its first upvalue is set to the value of the @x{global environment} stored at index @id{LUA\_RIDX\_GLOBALS} in the registry @see{registry}. When loading main chunks, this upvalue will be the @id{\_ENV} variable @see{globalenv}. Other upvalues are initialized with @nil.

```

}

```

```

@APIEntry{lua_State *lua_newstate (lua_Alloc f, void *ud);|
@apii{0,0,-}

```

Creates a new independent state and returns its main thread.

Returns @id{NULL} if it cannot create the state

(due to lack of memory).

The argument `@id{f}` is the `@x{allocator function}`;

Lua will do all memory allocation for this state

through this function `@seeF{lua_Alloc}`.

The second argument, `@id{ud}`, is an opaque pointer that Lua passes to the allocator in every call.

}

`@APIEntry{void lua_newtable (lua_State *L);|`

`@apii{0,1,m}`

Creates

a new empty table and pushes it onto the stack.

It is equivalent to `@T{lua_createtable(L, 0, 0)}`.

}

`@APIEntry{lua_State *lua_newthread (lua_State *L);|`

`@apii{0,1,m}`

Creates a new thread, pushes it on the stack,

and returns a pointer to a `@Lid{lua_State}` that represents this new thread.

The new thread returned by this function shares with the original thread

its global environment,

but has an independent execution stack.

Threads are subject to garbage collection,

like any Lua object.

}

`@APIEntry{void *lua_newuserdatauv (lua_State *L, size_t size, int nuvalue);|`

`@apii{0,1,m}`

This function creates and pushes on the stack a new full userdata,

with `@id{nuvalue}` associated Lua values, called `@id{user values}`,

plus an associated block of raw memory with `@id{size}` bytes.

(The user values can be set and read with the functions

`@Lid{lua_setiuservalue}` and `@Lid{lua_getiuservalue}`.)

The function returns the address of the block of memory.

Lua ensures that this address is valid as long as

the

corresponding userdata is alive `@see{GC}`.

Moreover, if the userdata is marked for finalization `@see{finalizers}`,

its address is valid at least until the call to its finalizer.

```
}
```

```
@APIEntry{int lua_next (lua_State *L, int index);|
@apii{1,2|0,v}
```

Pops a key from the stack,  
and pushes a key@En{}value pair from the table at the given index,  
the @Q{next} pair after the given key.  
If there are no more elements in the table,  
then @Lid{lua\_next} @N{returns 0} and pushes nothing.

A typical table traversal looks like this:

```
@verbatim{
/* table is in the stack at index 't' */
lua_pushnil(L); /* first key */
while (lua_next(L, t) != 0) {
/* uses 'key' (at index -2) and 'value' (at index -1) */
printf("%s - %s\n",
    lua_typename(L, lua_type(L, -2)),
    lua_typename(L, lua_type(L, -1)));
/* removes 'value'; keeps 'key' for next iteration */
lua_pop(L, 1);
}
}
```

While traversing a table,  
avoid calling @Lid{lua\_tolstring} directly on a key,  
unless you know that the key is  
actually a string.  
Recall that @Lid{lua\_tolstring} may change  
the value at the given index;  
this confuses the next call to @Lid{lua\_next}.

This function may raise an error if the given key  
is neither @nil nor present in the table.  
See function @Lid{next} for the caveats of modifying  
the table during its traversal.

```
}
```

```
@APIEntry{typedef @ldots lua_Number;|
```

The type of floats in Lua.

By default this type is double,  
but that can be changed to a single float or a long double.  
(See @id{LUA\_FLOAT\_TYPE} in @id{luaconf.h}.)

}

```
@APIEntry{int lua_numbertointeger (lua_Number n, lua_Integer *p);|
```

Tries to convert a Lua float to a Lua integer;  
the float `@id{n}` must have an integral value.  
If that value is within the range of Lua integers,  
it is converted to an integer and assigned to `@T{*p}`.  
The macro results in a boolean indicating whether the  
conversion was successful.  
(Note that this range test can be tricky to do  
correctly without this macro, due to rounding.)

This macro may evaluate its  
arguments more than once.

}

```
@APIEntry{int lua_pcall (lua_State *L, int nargs, int nresults, int msggh);|  
@apii{nargs + 1,nresults|1,-}
```

Calls a function (or a callable object) in protected mode.

Both `@id{nargs}` and `@id{nresults}` have the same meaning as  
in `@Lid{lua_call}`.

If there are no errors during the call,  
`@Lid{lua_pcall}` behaves exactly like `@Lid{lua_call}`.  
However, if there is any error,  
`@Lid{lua_pcall}` catches it,  
pushes a single value on the stack (the error object),  
and returns an error code.

Like `@Lid{lua_call}`,  
`@Lid{lua_pcall}` always removes the function  
and its arguments from the stack.

If `@id{msggh}` is 0,  
then the error object returned on the stack  
is exactly the original error object.  
Otherwise, `@id{msggh}` is the stack index of a  
`@emph{message handler}`.  
(This index cannot be a pseudo-index.)

In case of runtime errors,  
this handler will be called with the error object  
and its return value will be the object  
returned on the stack by `@Lid{lua_pcall}`.

Typically, the message

handler is used to add more debug information to the error object, such as a stack traceback. Such information cannot be gathered after the return of `@Lid{lua_pcall}`, since by then the stack has unwound.

The `@Lid{lua_pcall}` function returns one of the following status codes: `@Lid{LUA_OK}`, `@Lid{LUA_ERRRUN}`, `@Lid{LUA_ERRMEM}`, or `@Lid{LUA_ERRERR}`.

}

```
@APIEntry{
int lua_pcallk (lua_State *L,
               int nargs,
               int nresults,
               int msgch,
               lua_KContext ctx,
               lua_KFunction k);|
@apii{nargs + 1,nresults|1,-}
```

This function behaves exactly like `@Lid{lua_pcall}`, except that it allows the called function to yield `@see{continuations}`.

}

```
@APIEntry{void lua_pop (lua_State *L, int n);|
@apii{n,0,e}
```

Pops `@id{n}` elements from the stack. It is implemented as a macro over `@Lid{lua_settop}`.

}

```
@APIEntry{void lua_pushboolean (lua_State *L, int b);|
@apii{0,1,-}
```

Pushes a boolean value with value `@id{b}` onto the stack.

}

```
@APIEntry{void
lua_pushcclosure (lua_State *L, lua_CFunction fn, int n);|
@apii{n,1,m}
```

Pushes a new `@N{C closure}` onto the stack. This function receives a pointer to a `@N{C function}` and pushes onto the stack a Lua value of type `@id{function}` that, when called, invokes the corresponding `@N{C function}`. The parameter `@id{n}` tells how many upvalues this function will have



@see{c-closure}.

Any function to be callable by Lua must follow the correct protocol to receive its parameters and return its results @seeC{lua\_CFunction}.

When a @N{C function} is created, it is possible to associate some values with it, the so called upvalues; these upvalues are then accessible to the function whenever it is called. This association is called a @x{@N{C closure}} @see{c-closure}. To create a @N{C closure}, first the initial values for its upvalues must be pushed onto the stack. (When there are multiple upvalues, the first value is pushed first.) Then @Lid{lua\_pushcclosure} is called to create and push the @N{C function} onto the stack, with the argument @id{n} telling how many values will be associated with the function. @Lid{lua\_pushcclosure} also pops these values from the stack.

The maximum value for @id{n} is 255.

When @id{n} is zero, this function creates a @def{light @N{C function}}, which is just a pointer to the @N{C function}. In that case, it never raises a memory error.

}

```
@APIEntry{void lua_pushcfunction (lua_State *L, lua_CFunction f);|
@apii{0,1,-}}
```

Pushes a @N{C function} onto the stack. This function is equivalent to @Lid{lua\_pushcclosure} with no upvalues.

}

```
@APIEntry{const char *lua_pushfstring (lua_State *L, const char *fmt, ...);|
@apii{0,1,v}}
```

Pushes onto the stack a formatted string and returns a pointer to this string @see{constchar}. It is similar to the @ANSI{sprintf}, but has two important differences. First, you do not have to allocate space for the result; the result is a Lua string and Lua takes care of memory allocation

(and deallocation, through garbage collection).

Second,

the conversion specifiers are quite restricted.

There are no flags, widths, or precisions.

The conversion specifiers can only be

@Char{%%} (inserts the character @Char{%}),

@Char{%s} (inserts a zero-terminated string, with no size restrictions),

@Char{%f} (inserts a @Lid{lua\_Number}),

@Char{%I} (inserts a @Lid{lua\_Integer}),

@Char{%p} (inserts a pointer),

@Char{%d} (inserts an @T{int}),

@Char{%c} (inserts an @T{int} as a one-byte character), and

@Char{%U} (inserts a @T{long int} as a @x{UTF-8} byte sequence).

This function may raise errors due to memory overflow or an invalid conversion specifier.

}

```
@APIEntry{void lua_pushglobaltable (lua_State *L);|
@apii{0,1,-}}
```

Pushes the @x{global environment} onto the stack.

}

```
@APIEntry{void lua_pushinteger (lua_State *L, lua_Integer n);|
@apii{0,1,-}}
```

Pushes an integer with value @id{n} onto the stack.

}

```
@APIEntry{void lua_pushlightuserdata (lua_State *L, void *p);|
@apii{0,1,-}}
```

Pushes a light userdata onto the stack.

Userdata

represent @N{C values} in Lua.

A @def{light userdata} represents a pointer, a @T{void\*}.

It is a value (like a number):

you do not create it, it has no individual metatable,

and it is not collected (as it was never created).

A light userdata is equal to @Q{any}

light userdata with the same @N{C address}.

}

```
@APIEntry{const char *lua_pushliteral (lua_State *L, const char *s);|
@apii{0,1,m}
```

This macro is equivalent to @Lid{lua\_pushstring},  
but should be used only when @id{s} is a literal string.  
(Lua may optimize this case.)

}

```
@APIEntry{const char *lua_pushlstring (lua_State *L, const char *s, size_t len);|
@apii{0,1,m}
```

Pushes the string pointed to by @id{s} with size @id{len}  
onto the stack.  
Lua will make or reuse an internal copy of the given string,  
so the memory at @id{s} can be freed or reused immediately after  
the function returns.  
The string can contain any binary data,  
including @x{embedded zeros}.

Returns a pointer to the internal copy of the string @see{constchar}.

}

```
@APIEntry{void
lua_pushnil (lua_State *L);|
@apii{0,1,-}
```

Pushes a nil value onto the stack.

}

```
@APIEntry{void lua_pushnumber (lua_State *L, lua_Number n);|
@apii{0,1,-}
```

Pushes a float with value @id{n} onto the stack.

}

```
@APIEntry{const char *lua_pushstring (lua_State *L, const char *s);|
@apii{0,1,m}
```

Pushes the zero-terminated string pointed to by @id{s}  
onto the stack.  
Lua will make or reuse an internal copy of the given string,  
so the memory at @id{s} can be freed or reused immediately after

the function returns.

Returns a pointer to the internal copy of the string @see{constchar}.

If @id{s} is @id{NULL}, pushes @nil and returns @id{NULL}.

}

```
@APIEntry{int lua_pushthread (lua_State *L);|
@apii{0,1,-}}
```

Pushes the thread represented by @id{L} onto the stack.  
Returns 1 if this thread is the @x{main thread} of its state.

}

```
@APIEntry{void lua_pushvalue (lua_State *L, int index);|
@apii{0,1,-}}
```

Pushes a copy of the element at the given index  
onto the stack.

}

```
@APIEntry{
const
char *lua_pushvfstring (lua_State *L,
                        const char *fmt,
                        va_list argp);|
@apii{0,1,v}}
```

Equivalent to @Lid{lua\_pushfstring}, except that it receives a @id{va\_list}  
instead of a variable number of arguments.

}

```
@APIEntry{int lua_rawequal (lua_State *L, int index1, int index2);|
@apii{0,0,-}}
```

Returns 1 if the two values in indices @id{index1} and  
@id{index2} are primitively equal  
(that is, equal without calling the @idx{\_\_eq} metamethod).  
Otherwise @N{returns 0}.  
Also @N{returns 0} if any of the indices are not valid.

}

```
@APIEntry{int lua_rawget (lua_State *L, int index);|
```

@apii{1,1,-}

Similar to @Lid{lua\_gettable}, but does a raw access  
(i.e., without metamethods).

The value at @id{index} must be a table.

}

@APIEntry{int lua\_rawgeti (lua\_State \*L, int index, lua\_Integer n);|  
@apii{0,1,-}

Pushes onto the stack the value @T{t[n]},  
where @id{t} is the table at the given index.

The access is raw,  
that is, it does not use  
the @idx{\_\_index} metavalue.

Returns the type of the pushed value.

}

@APIEntry{int lua\_rawgetp (lua\_State \*L, int index, const void \*p);|  
@apii{0,1,-}

Pushes onto the stack the value @T{t[k]},  
where @id{t} is the table at the given index and  
@id{k} is the pointer @id{p} represented as a light userdata.  
The access is raw;  
that is, it does not use the @idx{\_\_index} metavalue.

Returns the type of the pushed value.

}

@APIEntry{lua\_Unsigned lua\_rawlen (lua\_State \*L, int index);|  
@apii{0,0,-}

Returns the raw @Q{length} of the value at the given index:  
for strings, this is the string length;  
for tables, this is the result of the length operator (@Char{#})  
with no metamethods;  
for userdata, this is the size of the block of memory allocated  
for the userdata.  
For other values, this call @N{returns 0}.

}

@APIEntry{void lua\_rawset (lua\_State \*L, int index);|

@apii{2,0,m}

Similar to @Lid{lua\_settable}, but does a raw assignment (i.e., without metamethods).

The value at @id{index} must be a table.

}

@APIEntry{void lua\_rawseti (lua\_State \*L, int index, lua\_Integer i);|  
@apii{1,0,m}

Does the equivalent of @T{t[i] = v},  
where @id{t} is the table at the given index  
and @id{v} is the value on the top of the stack.

This function pops the value from the stack.  
The assignment is raw,  
that is, it does not use the @idx{\_\_newindex} metavalue.

}

@APIEntry{void lua\_rawsetp (lua\_State \*L, int index, const void \*p);|  
@apii{1,0,m}

Does the equivalent of @T{t[p] = v},  
where @id{t} is the table at the given index,  
@id{p} is encoded as a light userdata,  
and @id{v} is the value on the top of the stack.

This function pops the value from the stack.  
The assignment is raw,  
that is, it does not use the @idx{\_\_newindex} metavalue.

}

@APIEntry{  
typedef const char \* (\*lua\_Reader) (lua\_State \*L,  
void \*data,  
size\_t \*size);|

The reader function used by @Lid{lua\_load}.  
Every time @Lid{lua\_load} needs another piece of  
the chunk,  
it calls the reader,  
passing along its @id{data} parameter.  
The reader must return a pointer to a block of memory  
with a new piece of the chunk

and set @id{size} to the block size.

The block must exist until the reader function is called again.

To signal the end of the chunk,

the reader must return @id{NULL} or set @id{size} to zero.

The reader function may return pieces of any size greater than zero.

```
}
```

```
@APIEntry{void lua_register (lua_State *L, const char *name, lua_CFunction f);|
@apii{0,0,e}
```

Sets the @N{C function} @id{f} as the new value of global @id{name}.

It is defined as a macro:

```
@verbatim{
#define lua_register(L,n,f) \
    (lua_pushcfunction(L, f), lua_setglobal(L, n))
}
```

```
}
```

```
@APIEntry{void lua_remove (lua_State *L, int index);|
@apii{1,0,-}
```

Removes the element at the given valid index,

shifting down the elements above this index to fill the gap.

This function cannot be called with a pseudo-index,

because a pseudo-index is not an actual stack position.

```
}
```

```
@APIEntry{void
lua_replace (lua_State *L, int index);|
@apii{1,0,-}
```

Moves the top element into the given valid index

without shifting any element

(therefore replacing the value at that given index),

and then pops the top element.

```
}
```

```
@APIEntry{int lua_resetthread (lua_State *L);|
@apii{0,?, -}
```

This function is deprecated;

it is equivalent to @Lid{lua\_closethread} with

@id{from} being @id{NULL}.

}

```
@APIEntry{int lua_resume (lua_State *L, lua_State *from, int nargs,  
                        int *nresults);|  
@apii{?,?,-}
```

Starts and resumes a coroutine in the given thread @id{L}.

To start a coroutine,  
you push the main function plus any arguments  
onto the empty stack of the thread.  
then you call @Lid{lua\_resume},  
with @id{nargs} being the number of arguments.  
This call returns when the coroutine suspends or finishes its execution.  
When it returns,  
@id{\*nresults} is updated and  
the top of the stack contains  
the @id{\*nresults} values passed to @Lid{lua\_yield}  
or returned by the body function.  
@Lid{lua\_resume}  
returns  
@Lid{LUA\_YIELD} if the coroutine yields,  
@Lid{LUA\_OK} if the coroutine finishes its execution  
without errors,  
or an error code in case of errors @see{statuscodes}.  
In case of errors,  
the error object is on the top of the stack.

To resume a coroutine,  
you remove the @id{\*nresults} yielded values from its stack,  
push the values to be passed as results from @id{yield},  
and then call @Lid{lua\_resume}.

The parameter @id{from} represents the coroutine that is resuming @id{L}.  
If there is no such coroutine,  
this parameter can be @id{NULL}.

}

```
@APIEntry{void lua_rotate (lua_State *L, int idx, int n);|  
@apii{0,0,-}
```

Rotates the stack elements between the valid index @id{idx}  
and the top of the stack.  
The elements are rotated @id{n} positions in the direction of the top,  
for a positive @id{n},  
or @T{-n} positions in the direction of the bottom,  
for a negative @id{n}.



The absolute value of @id{n} must not be greater than the size of the slice being rotated.

This function

cannot be called with a pseudo-index,  
because a pseudo-index is not an actual stack position.

}

```
@APIEntry{void lua_setallocf (lua_State *L, lua_Alloc f, void *ud);|
@apii{0,0,-}
```

Changes the @x{allocator function} of a given state to @id{f}  
with user data @id{ud}.

}

```
@APIEntry{void lua_setfield (lua_State *L, int index, const char *k);|
@apii{1,0,e}
```

Does the equivalent to @T{t[k] = v},  
where @id{t} is the value at the given index  
and @id{v} is the value on the top of the stack.

This function pops the value from the stack.  
As in Lua, this function may trigger a metamethod  
for the @Q{newindex} event @see{metatable}.

}

```
@APIEntry{void lua_setglobal (lua_State *L, const char *name);|
@apii{1,0,e}
```

Pops a value from the stack and  
sets it as the new value of global @id{name}.

}

```
@APIEntry{void lua_seti (lua_State *L, int index, lua_Integer n);|
@apii{1,0,e}
```

Does the equivalent to @T{t[n] = v},  
where @id{t} is the value at the given index  
and @id{v} is the value on the top of  
the stack.

This function pops the value from the stack.  
As in Lua, this function may trigger a metamethod  
for the @Q{newindex} event @see{metatable}.

}

```
@APIEntry{int lua_setiuservalue (lua_State *L, int index, int n);|
@apii{1,0,-}}
```

Pops a value from the stack and sets it as the new @id{n}-th user value associated to the full userdata at the given index. Returns 0 if the userdata does not have that value.

}

```
@APIEntry{int lua_setmetatable (lua_State *L, int index);|
@apii{1,0,-}}
```

Pops a table or @nil from the stack and sets that value as the new metatable for the value at the given index. (@nil means no metatable.)

(For historical reasons, this function returns an @id{int}, which now is always 1.)

}

```
@APIEntry{void lua_settable (lua_State *L, int index);|
@apii{2,0,e}}
```

Does the equivalent to @T{t[k] = v}, where @id{t} is the value at the given index, @id{v} is the value on the top of the stack, and @id{k} is the value just below the top.

This function pops both the key and the value from the stack. As in Lua, this function may trigger a metamethod for the @Q{newindex} event @see{metatable}.

}

```
@APIEntry{void lua_settop (lua_State *L, int index);|
@apii{?,?,e}}
```

Accepts any index, @N{or 0}, and sets the stack top to this index. If the new top is greater than the old one, then the new elements are filled with @nil. If @id{index} @N{is 0}, then all stack elements are removed.

This function can run arbitrary code when removing an index marked as to-be-closed from the stack.

```
}
```

```
@APIEntry{void lua_setwarnf (lua_State *L, lua_WarnFunction f, void *ud);|
@apii{0,0,-}
```

Sets the @x{warning function} to be used by Lua to emit warnings @see{lua\_WarnFunction}.  
The @id{ud} parameter sets the value @id{ud} passed to the warning function.

```
}
```

```
@APIEntry{typedef struct lua_State lua_State;|
```

An opaque structure that points to a thread and indirectly (through the thread) to the whole state of a Lua interpreter.  
The Lua library is fully reentrant:  
it has no global variables.  
All  
information about a state is accessible through this structure.

A pointer to this structure must be passed as the first argument to every function in the library, except to @Lid{lua\_newstate}, which creates a Lua state from scratch.

```
}
```

```
@APIEntry{int lua_status (lua_State *L);|
@apii{0,0,-}
```

Returns the status of the thread @id{L}.

The status can be @Lid{LUA\_OK} for a normal thread,  
an error code if the thread finished the execution  
of a @Lid{lua\_resume} with an error,  
or @Lid{LUA\_YIELD} if the thread is suspended.

You can call functions only in threads with status @Lid{LUA\_OK}.  
You can resume threads with status @Lid{LUA\_OK}  
(to start a new coroutine) or @Lid{LUA\_YIELD}  
(to resume a coroutine).

```
}
```

```
@APIEntry{size_t lua_stringtonumber (lua_State *L, const char *s);|
@apii{0,1,-}}
```

Converts the zero-terminated string @id{s} to a number,  
pushes that number into the stack,  
and returns the total size of the string,  
that is, its length plus one.  
The conversion can result in an integer  
or a float,  
according to the lexical conventions of Lua @see{lexical}.  
The string may have leading and trailing whitespaces and a sign.  
If the string is not a valid numeral,  
returns 0 and pushes nothing.  
(Note that the result can be used as a boolean,  
true if the conversion succeeds.)

```
}
```

```
@APIEntry{int lua_toboolean (lua_State *L, int index);|
@apii{0,0,-}}
```

Converts the Lua value at the given index to a @N{C boolean}  
value (@N{0 or 1}).  
Like all tests in Lua,  
@Lid{lua\_toboolean} returns true for any Lua value  
different from @false and @nil;  
otherwise it returns false.  
(If you want to accept only actual boolean values,  
use @Lid{lua\_isboolean} to test the value's type.)

```
}
```

```
@APIEntry{lua_CFunction lua_tocfunction (lua_State *L, int index);|
@apii{0,0,-}}
```

Converts a value at the given index to a @N{C function}.  
That value must be a @N{C function};  
otherwise, returns @id{NULL}.

```
}
```

```
@APIEntry{void lua_toclose (lua_State *L, int index);|
@apii{0,0,v}}
```

Marks the given index in the stack as a  
to-be-closed  
slot @see{to-be-closed}.  
Like a to-be-closed variable in Lua,

the value at that slot in the stack will be closed  
when it goes out of scope.  
Here, in the context of a C function,  
to go out of scope means that the running function returns to Lua,  
or there is an error,  
or the slot is removed from the stack through  
@Lid{lua\_settop} or @Lid{lua\_pop},  
or there is a call to @Lid{lua\_closeslot}.  
A slot marked as to-be-closed should not be removed from the stack  
by any other function in the API except @Lid{lua\_settop} or @Lid{lua\_pop},  
unless previously deactivated by @Lid{lua\_closeslot}.

This function raises an error if the value at the given slot  
neither has a @idx{\_\_close} metamethod nor is a false value.

This function should not be called for an index  
that is equal to or below an active to-be-closed slot.

Note that, both in case of errors and of a regular return,  
by the time the @idx{\_\_close} metamethod runs,  
the @N{C stack} was already unwound,  
so that any automatic @N{C variable}  
declared in the calling function  
(e.g., a buffer) will be out of scope.

}

@APIEntry{lua\_Integer lua\_tointeger (lua\_State \*L, int index);|  
@apii{0,0,-}}

Equivalent to @Lid{lua\_tointegerx} with @id{isnum} equal to @id{NULL}.

}

@APIEntry{lua\_Integer lua\_tointegerx (lua\_State \*L, int index, int \*isnum);|  
@apii{0,0,-}}

Converts the Lua value at the given index  
to the signed integral type @Lid{lua\_Integer}.  
The Lua value must be an integer,  
or a number or string convertible to an integer @see{coercion};  
otherwise, @id{lua\_tointegerx} @N{returns 0}.

If @id{isnum} is not @id{NULL},  
its referent is assigned a boolean value that  
indicates whether the operation succeeded.

}

```
@APIEntry{const char *lua_tolstring (lua_State *L, int index, size_t *len);|
@apii{0,0,m}
```

Converts the Lua value at the given index to a @N{C string}.

If @id{len} is not @id{NULL},

it sets @T{\*len} with the string length.

The Lua value must be a string or a number;

otherwise, the function returns @id{NULL}.

If

the value is a number,

then @id{lua\_tolstring} also

@emph{changes the actual value in the stack to a string}.

(This change confuses @Lid{lua\_next}

when @id{lua\_tolstring} is applied to keys during a table traversal.)

@id{lua\_tolstring} returns a pointer

to a string inside the Lua state @see{constchar}.

This string always has a zero (@Char{\0})

after its last character (as @N{in C}),

but can contain other zeros in its body.

This function can raise memory errors only

when converting a number to a string

(as then it may create a new string).

}

```
@APIEntry{lua_Number lua_tonumber (lua_State *L, int index);|
```

```
@apii{0,0,-}
```

Equivalent to @Lid{lua\_tonumberx} with @id{isnum} equal to @id{NULL}.

}

```
@APIEntry{lua_Number lua_tonumberx (lua_State *L, int index, int *isnum);|
```

```
@apii{0,0,-}
```

Converts the Lua value at the given index

to the @N{C type} @Lid{lua\_Number} @seeC{lua\_Number}.

The Lua value must be a number or a string convertible to a number

@see{coercion};

otherwise, @Lid{lua\_tonumberx}

@N{returns 0}.

If @id{isnum} is not @id{NULL},

its referent is assigned a boolean value that

indicates whether the operation succeeded.

```
}
```

```
@APIEntry{const void *lua_topointer (lua_State *L, int index);|  
@apii{0,0,-}}
```

Converts the value at the given index to a generic

@N{C pointer} (@T{void\*}).

The value can be a userdata, a table, a thread, a string, or a function;  
otherwise, @id{lua\_topointer} returns @id{NULL}.

Different objects will give different pointers.

There is no way to convert the pointer back to its original value.

Typically this function is used only for hashing and debug information.

```
}
```

```
@APIEntry{const char *lua_tostring (lua_State *L, int index);|  
@apii{0,0,m}}
```

Equivalent to @Lid{lua\_tolstring} with @id{len} equal to @id{NULL}.

```
}
```

```
@APIEntry{lua_State *lua_tothread (lua_State *L, int index);|  
@apii{0,0,-}}
```

Converts the value at the given index to a Lua thread  
(represented as @T{lua\_State\*}).

This value must be a thread;

otherwise, the function returns @id{NULL}.

```
}
```

```
@APIEntry{void  
*lua_touserdata (lua_State *L, int index);|  
@apii{0,0,-}}
```

If the value at the given index is a full userdata,  
returns its memory-block address.

If the value is a light userdata,  
returns its value (a pointer).

Otherwise, returns @id{NULL}.

```
}
```

```
@APIEntry{int lua_type (lua_State *L, int index);|  
@apii{0,0,-}}
```

Returns the type of the value in the given valid index,  
 or @id{LUA\_TNONE} for a non-valid but acceptable index.  
 The types returned by @Lid{lua\_type} are coded by the following constants  
 defined in @id{lua.h}:

```
@defid{LUA_TNIL},
@defid{LUA_TNUMBER},
@defid{LUA_TBOOLEAN},
@defid{LUA_TSTRING},
@defid{LUA_TTABLE},
@defid{LUA_TFUNCTION},
@defid{LUA_TUSERDATA},
@defid{LUA_TTHREAD},
and
@defid{LUA_TLIGHTUSERDATA}.
```

```
}
```

```
@APIEntry{const char *lua_typename (lua_State *L, int tp);|
@apii{0,0,-}}
```

Returns the name of the type encoded by the value @id{tp},  
 which must be one the values returned by @Lid{lua\_type}.

```
}
```

```
@APIEntry{typedef @ldots lua_Unsigned;|
```

The unsigned version of @Lid{lua\_Integer}.

```
}
```

```
@APIEntry{int
lua_upvalueindex (int i);|
@apii{0,0,-}}
```

Returns the pseudo-index that represents the @id{i}-th upvalue of  
 the running function @see{c-closure}.  
 @id{i} must be in the range @M{[1,256]}.

```
}
```

```
@APIEntry{lua_Number lua_version (lua_State *L);|
@apii{0,0,-}}
```

Returns the version number of this core.

```
}
```



```
@APIEntry{
typedef void (*lua_WarnFunction) (void *ud, const char *msg, int tocont);|
```

The type of @x{warning function}s, called by Lua to emit warnings.

The first parameter is an opaque pointer  
set by @Lid{lua\_setwarnf}.

The second parameter is the warning message.

The third parameter is a boolean that  
indicates whether the message is  
to be continued by the message in the next call.

See @Lid{warn} for more details about warnings.

```
}
```

```
@APIEntry{
void lua_warning (lua_State *L, const char *msg, int tocont);|
@apii{0,0,-}
```

Emits a warning with the given message.

A message in a call with @id{tocont} true should be  
continued in another call to this function.

See

@Lid{warn} for more details about warnings.

```
}
```

```
@APIEntry{
typedef int (*lua_Writer) (lua_State *L,
                           const void* p,
                           size_t sz,
                           void* ud);|
```

The type of the writer function used by @Lid{lua\_dump}.

Every time @Lid{lua\_dump} produces another piece of chunk,  
it calls the writer,  
passing along the buffer to be written (@id{p}),  
its size (@id{sz}),  
and the @id{ud} parameter supplied to @Lid{lua\_dump}.

The writer returns an error code:

@N{0 means} no errors;

any other value means an error and stops @Lid{lua\_dump} from  
calling the writer again.

```
}
```

```
@APIEntry{void lua_xmove (lua_State *from, lua_State *to, int n);|
@apii{?,?,-}}
```

Exchange values between different threads of the same state.

This function pops @id{n} values from the stack @id{from}, and pushes them onto the stack @id{to}.

```
}
```

```
@APIEntry{int lua_yield (lua_State *L, int nresults);|
@apii{?,?,v}}
```

This function is equivalent to @Lid{lua\_yieldk}, but it has  
no continuation @see{continuations}.  
Therefore, when the thread resumes,  
it continues the function that called  
the function calling @id{lua\_yield}.  
To avoid surprises,  
this function should be called only in a tail call.

```
}
```

```
@APIEntry{
int lua_yieldk (lua_State *L,
                int nresults,
                lua_KContext ctx,
                lua_KFunction k);|
@apii{?,?,v}}
```

Yields a coroutine (thread).

When a @N{C function} calls @Lid{lua\_yieldk}, the running coroutine suspends its execution, and the call to @Lid{lua\_resume} that started this coroutine returns. The parameter @id{nresults} is the number of values from the stack that will be passed as results to @Lid{lua\_resume}.

When the coroutine is resumed again, Lua calls the given @x{continuation function} @id{k} to continue the execution of the @N{C function} that yielded @see{continuations}. This continuation function receives the same stack from the previous function, with the @id{n} results removed and replaced by the arguments

passed to @Lid{lua\_resume}.

Moreover,

the continuation function receives the value @id{ctx}  
that was passed to @Lid{lua\_yieldk}.

Usually, this function does not return;  
when the coroutine eventually resumes,  
it continues executing the continuation function.

However, there is one special case,  
which is when this function is called  
from inside a line or a count hook @see{debugI}.

In that case, @id{lua\_yieldk} should be called with no continuation  
(probably in the form of @Lid{lua\_yield}) and no results,  
and the hook should return immediately after the call.

Lua will yield and,  
when the coroutine resumes again,  
it will continue the normal execution  
of the (Lua) function that triggered the hook.

This function can raise an error if it is called from a thread  
with a pending C call with no continuation function  
(what is called a @emphx{C-call boundary}),  
or it is called from a thread that is not running inside a resume  
(typically the main thread).

}

}

@sect2{debugI| @title{The Debug  
Interface}}

Lua has no built-in debugging facilities.  
Instead, it offers a special interface  
by means of functions and @emph{hooks}.  
This interface allows the construction of different  
kinds of debuggers, profilers, and other tools  
that need @Q{inside information} from the interpreter.

```
@APIEntry{
typedef struct lua_Debug {
    int event;
    const char *name;      /* (n) */
    const char *namewhat;  /* (n) */
    const char *what;      /* (S) */
    const char *source;    /* (S) */
    size_t srclen;        /* (S) */
}
```

```

int currentline;      /* (l) */
int linedefined;     /* (S) */
int lastlinedefined; /* (S) */
unsigned char nups;   /* (u) number of upvalues */
unsigned char nparams; /* (u) number of parameters */
char isvararg;        /* (u) */
char istailcall;      /* (t) */
unsigned short ftransfer; /* (r) index of first value transferred */
unsigned short ntransfer; /* (r) number of transferred values
*/
char short_src[LUA_IDSIZE]; /* (S) */
/* private part */
@rep{other fields}
} lua_Debug;
|

```

A structure used to carry different pieces of information about a function or an activation record.

@Lid{lua\_getstack} fills only the private part of this structure, for later use.

To fill the other fields of @Lid{lua\_Debug} with useful information, you must call @Lid{lua\_getinfo} with an appropriate parameter.

(Specifically, to get a field, you must add the letter between parentheses in the field's comment to the parameter @id{what} of @Lid{lua\_getinfo}.)

The fields of @Lid{lua\_Debug} have the following meaning:

@description{

@item{@id{source}|

the source of the chunk that created the function.

If @T{source} starts with a @Char{@At},

it means that the function was defined in a file where

the file name follows the @Char{@At}.

If @T{source} starts with a @Char{=},

the remainder of its contents describes the source in a user-dependent manner.

Otherwise,

the function was defined in a string

where

@T{source} is that string.

}

@item{@id{srclen}|

The length of the string @id{source}.

}

@item{@id{short\_src}|

a @Q{printable} version of @T{source}, to be used in error messages.

}

@item{@id{linedefined}|

the line number where the definition of the function starts.

}

@item{@id{lastlinedefined}|

the line number where the definition of the function ends.

}

@item{@id{what}|

the string @T{"Lua"} if the function is a Lua function,

@T{"C"} if it is a @N{C function},

@T{"main"} if it is the main part of a chunk.

}

@item{@id{currentline}|

the current line where the given function is executing.

When no line information is available,

@T{currentline} is set to @num{-1}.

}

@item{@id{name}|

a reasonable name for the given function.

Because functions in Lua are first-class values,

they do not have a fixed name:

some functions can be the value of multiple global variables,

while others can be stored only in a table field.

The @T{lua\_getinfo} function checks how the function was called

to find a suitable name.

If it cannot find a name,

then @id{name} is set to @id{NULL}.

}

@item{@id{namewhat}|

explains the @T{name} field.

The value of @T{namewhat} can be

@T{"global"}, @T{"local"}, @T{"method"},

@T{"field"}, @T{"upvalue"}, or @T{""} (the empty string),

according to how the function was called.

(Lua uses the empty string when no other option seems to apply.)

}

@item{@id{istailcall}|

true if this function invocation was called by a tail call.

In this case, the caller of this level is not in the stack.

}

@item{@id{nups}|  
the number of upvalues of the function.  
}

@item{@id{nparams}|  
the number of parameters of the function  
(always @N{0 for} @N{C functions}).  
}

@item{@id{isvararg}|  
true if the function is a variadic function  
(always true for @N{C functions}).  
}

@item{@id{ftransfer}|  
the index in the stack of the first value being @Q{transferred},  
that is, parameters in a call or return values in a return.  
(The other values are in consecutive indices.)  
Using this  
index, you can access and modify these values  
through @Lid{lua\_getlocal} and @Lid{lua\_setlocal}.  
This field is only meaningful during a  
call hook, denoting the first parameter,  
or a return hook, denoting the first value being returned.  
(For call hooks, this value is always 1.)  
}

@item{@id{ntransfer}|  
The number of values being transferred (see previous item).  
(For calls of Lua functions,  
this value is always equal to @id{nparams}.)  
}

}

}

@APIEntry{lua\_Hook lua\_gethook (lua\_State \*L);|  
@apii{0,0,-}}

Returns the current hook function.

}

@APIEntry{int lua\_gethookcount (lua\_State \*L);|  
@apii{0,0,-}}

Returns the current hook count.

```
}
```

```
@APIEntry{int lua_gethookmask (lua_State *L);|
@apii{0,0,-}
```

Returns the current hook mask.

```
}
```

```
@APIEntry{int lua_getinfo (lua_State *L, const char *what, lua_Debug *ar);|
@apii{0|1,0|1|2,m}
```

Gets information about a specific function or function invocation.

To get information about a function invocation,  
the parameter `@id{ar}` must be a valid activation  
record that was  
filled by a previous call to `@Lid{lua_getstack}` or  
given as argument to a hook `@seeC{lua_Hook}`.

To get information about a function, you push it onto the stack  
and start the `@id{what}` string with the character `@Char{>}`.  
(In that case,  
`@id{lua_getinfo}` pops the function from the top of the stack.)  
For instance, to know in which line a function `@id{f}` was defined,  
you can write the following code:

```
@verbatim{
lua_Debug ar;
lua_getglobal(L, "f"); /* get global 'f' */
lua_getinfo(L, ">S", &ar);
printf("%d\n", ar.linedefined);
}
```

Each character in the string `@id{what}`  
selects some fields of the structure `@id{ar}` to be filled or  
a value to be pushed on the stack.  
(These characters are also documented in the declaration of  
the structure `@Lid{lua_Debug}`,  
between parentheses in the comments following each field.)  
`@description{`

```
@item{@Char{f}|
pushes onto the stack the function that is
running at the given level;
}
```

```
@item{@Char{1}| fills in the field @id{currentline};  
}
```

```
@item{@Char{n}|  
fills in the fields @id{name} and @id{namewhat};  
}
```

```
@item{@Char{r}| fills in the fields @id{ftransfer} and @id{ntransfer};  
}
```

```
@item{@Char{S}|  
fills in the fields @id{source}, @id{short_src},  
@id{linedefined}, @id{lastlinedefined}, and @id{what};  
}
```

```
@item{@Char{t}| fills in the field @id{istailcall};  
}
```

```
@item{@Char{u}| fills in the fields  
@id{nups}, @id{nparams}, and @id{isvararg};  
}
```

```
@item{@Char{L}|  
pushes onto the stack a table whose indices are  
the lines on the function with some associated code,  
that is, the lines where you can put a break point.  
(Lines with no code include empty lines and comments.)  
If this option is given together with option @Char{f},  
its table is pushed after the function.  
This is the only option that can raise a memory error.  
}
```

```
}
```

This function returns 0 to signal an invalid option in @id{what};  
even then the valid options are handled correctly.

```
}
```

```
@APIEntry{const char *lua_getlocal (lua_State *L, const lua_Debug *ar, int n);|  
@apii{0,0|1,-}}
```

Gets  
information about a local variable or a temporary value  
of a given activation record or a given function.

In the first case,  
the parameter @id{ar} must be a valid activation record that was



filled by a previous call to `@Lid{lua_getstack}` or given as argument to a hook `@seeC{lua_Hook}`. The index `@id{n}` selects which local variable to inspect; see `@Lid{debug.getlocal}` for details about variable indices and names.

`@Lid{lua_getlocal}` pushes the variable's value onto the stack and returns its name.

In the second case, `@id{ar}` must be `@id{NULL}` and the function to be inspected must be on the top of the stack.

In this case, only parameters of Lua functions are visible (as there is no information about what variables are active) and no values are pushed onto the stack.

Returns `@id{NULL}` (and pushes nothing) when the index is greater than the number of active local variables.

}

```
@APIEntry{int lua_getstack (lua_State *L, int level, lua_Debug *ar);|
@apii{0,0,-}
```

Gets information about the interpreter runtime stack.

This function fills parts of a `@Lid{lua_Debug}` structure with an identification of the `@emph{activation record}` of the function executing at a given level. `@N{Level 0}` is the current running function, whereas level `@M{n+1}` is the function that has called level `@M{n}` (except for tail calls, which do not count in the stack). When called with a level greater than the stack depth, `@Lid{lua_getstack}` returns 0; otherwise it returns 1.

}

```
@APIEntry{const char *lua_getupvalue (lua_State *L, int funcindex, int n);|
@apii{0,0|1,-}
```

Gets information about the `@id{n}`-th upvalue of the closure at index `@id{funcindex}`. It pushes the upvalue's value onto the stack and returns its name. Returns `@id{NULL}` (and pushes nothing) when the index `@id{n}` is greater than the number of upvalues.

See @Lid{debug.getupvalue} for more information about upvalues.

}

@APIEntry{typedef void (\*lua\_Hook) (lua\_State \*L, lua\_Debug \*ar);|

Type for debugging hook functions.

Whenever a hook

is called, its @id{ar} argument has its field

@id{event} set to the specific event that triggered the hook.

Lua identifies these events with the following constants:

@defid{LUA\_HOOKCALL}, @defid{LUA\_HOOKRET},

@defid{LUA\_HOOKTAILCALL}, @defid{LUA\_HOOKLINE},

and @defid{LUA\_HOOKCOUNT}.

Moreover, for line events, the field @id{currentline} is also set.

To get the value of any other field in @id{ar},

the hook must call @Lid{lua\_getinfo}.

For call events, @id{event} can be @id{LUA\_HOOKCALL},

the normal value, or @id{LUA\_HOOKTAILCALL}, for a tail call;

in this case, there will be no corresponding return event.

While Lua is running a hook, it disables other calls to hooks.

Therefore, if a hook calls back Lua to execute a function or a chunk,  
this execution occurs without any calls to hooks.

Hook functions cannot have continuations,

that is, they cannot call @Lid{lua\_yieldk},

@Lid{lua\_pcallk}, or @Lid{lua\_callk} with a non-null @id{k}.

Hook functions can yield under the following conditions:

Only

count and line events can yield;

to yield, a hook function must finish its execution

calling @Lid{lua\_yield} with @id{nresults} equal to zero

(that is, with no values).

}

@APIEntry{void lua\_sethook (lua\_State \*L, lua\_Hook f, int mask, int count);|

@apii{0,0,-}

Sets the debugging hook function.

Argument @id{f} is the hook function.

@id{mask} specifies on which events the hook will be called:

it is formed by a bitwise OR of the constants

@defid{LUA\_MASKCALL},

@defid{LUA\_MASKRET},

@defid{LUA\_MASKLINE},

and @defid{LUA\_MASKCOUNT}.

The @id{count} argument is only meaningful when the mask includes @id{LUA\_MASKCOUNT}.

For each event, the hook is called as explained below:

@description{

@item{The call hook| is called when the interpreter calls a function.

The hook is called just after Lua enters the new function.

}

@item{The return hook| is called when the interpreter returns from a function.

The hook is called just before Lua leaves the function.

}

@item{The line hook| is called

when the interpreter is about to

start the execution of a new line of code,

or when it jumps back in the code (even to the same line).

This event only happens while Lua is executing a Lua function.

}

@item{The count hook| is called after the interpreter executes every

@T{count} instructions.

This event only happens while Lua is executing a Lua function.

}

}

Hooks are disabled by setting @id{mask} to zero.

}

@APIEntry{const char \*lua\_setlocal (lua\_State \*L, const lua\_Debug \*ar, int n);|

@apii{0|1,0,-}

Sets the value of a local variable of a given activation record.

It assigns the value on the top of the stack

to the variable and returns its name.

It also pops the value from the stack.

Returns @id{NULL} (and pops nothing)

when the index is greater than

the number of active local variables.

Parameters @id{ar} and @id{n} are as in the function @Lid{lua\_getlocal}.

}

```
@APIEntry{const char *lua_setupvalue (lua_State *L, int funcindex, int n);|
@apii{0|1,0,-}
```

Sets the value of a closure's  
upvalue.

It assigns the value on the top of the stack  
to the upvalue and returns its name.

It also pops the value from the stack.

Returns @id{NULL} (and pops nothing)  
when the index @id{n} is greater than the number of upvalues.

Parameters @id{funcindex} and @id{n} are as in  
the function @Lid{lua\_getupvalue}.

}

```
@APIEntry{void *lua_upvalueid (lua_State *L, int funcindex, int n);|
@apii{0,0,-}
```

Returns a unique identifier for the upvalue numbered @id{n}  
from the closure at index @id{funcindex}.

These unique identifiers allow a program to check whether different  
closures share upvalues.

Lua closures that share an upvalue  
(that is, that access a same external local variable)  
will return identical ids for those upvalue indices.

Parameters @id{funcindex} and @id{n} are as in  
the function @Lid{lua\_getupvalue},  
but @id{n} cannot be greater than the number of upvalues.

}

```
@APIEntry{
void lua_upvaluejoin (lua_State *L, int funcindex1, int n1,
                    int
                    funcindex2, int n2);|
@apii{0,0,-}
```

Make the @id{n1}-th upvalue of the Lua closure at index @id{funcindex1}  
refer to the @id{n2}-th upvalue of the Lua closure at index @id{funcindex2}.

}

}

}

@C{-----}

@sect1{auxlib|@title{The Auxiliary Library}}

@simplesect{

@index{luauxlib.h}

The @def{auxiliary library} provides several convenient functions to interface C with Lua.

While the basic API provides the primitive functions for all interactions between C and Lua, the auxiliary library provides higher-level functions for some common tasks.

All functions and types from the auxiliary library are defined in header file @id{luauxlib.h} and have a prefix @id{luaL\_}.

All functions in the auxiliary library are built on top of the basic API, and so they provide nothing that cannot be done with that API. Nevertheless, the use of the auxiliary library ensures more consistency to your code.

Several functions in the auxiliary library use internally some extra stack slots. When a function in the auxiliary library uses less than five slots, it does not check the stack size; it simply assumes that there are enough slots.

Several functions in the auxiliary library are used to check @N{C function} arguments. Because the error message is formatted for arguments (e.g., @St{bad argument #1}), you should not use these functions for other stack values.

Functions called @id{luaL\_check\*} always raise an error if the check is not satisfied.

}

@sect2{@title{Functions and Types}}

Here we list all functions and types from the auxiliary library in alphabetical order.

@APIEntry{void luaL\_addchar (luaL\_Buffer \*B, char c);|  
@apii{?,?,m}}

Adds the byte @id{c} to the buffer @id{B}  
@seeC{luaL\_Buffer}.

}

@APIEntry{  
const void luaL\_addgsub (luaL\_Buffer \*B, const char \*s,  
const char \*p, const char \*r);|  
@apii{?,?,m}}

Adds a copy of the string @id{s} to the buffer @id{B} @seeC{luaL\_Buffer},  
replacing any  
occurrence of the string @id{p}  
with the string @id{r}.

}

@APIEntry{void luaL\_addlstring (luaL\_Buffer \*B, const char \*s, size\_t l);|  
@apii{?,?,m}}

Adds the string pointed to by @id{s} with length @id{l} to  
the buffer @id{B}  
@seeC{luaL\_Buffer}.

The string can contain @x{embedded zeros}.

}

@APIEntry{void luaL\_addsize (luaL\_Buffer \*B, size\_t n);|  
@apii{?,?,-}}

Adds to the buffer @id{B}  
a string of length @id{n} previously copied to the  
buffer area @seeC{luaL\_prepbuffer}.

}

@APIEntry{void luaL\_addstring (luaL\_Buffer \*B, const char \*s);|

@apii{?,?,m}

Adds the zero-terminated string pointed to by @id{s}  
to the buffer @id{B}  
@seeC{luaL\_Buffer}.

}

@APIEntry{void luaL\_addvalue (luaL\_Buffer \*B);|  
@apii{?,?,m}

Adds the value on the top of the stack  
to the buffer @id{B}  
@seeC{luaL\_Buffer}.  
Pops the value.

This is the only function on string buffers that can (and must)  
be called with an extra element on the stack,  
which is the value to be added to the buffer.

}

@APIEntry{  
void luaL\_argcheck  
(lua\_State \*L,  
int cond,  
int arg,  
const char \*extramsg);|  
@apii{0,0,v}

Checks whether @id{cond} is true.  
If it is not, raises an error with a standard message @seeF{luaL\_argerror}.

}

@APIEntry{int luaL\_argerror (lua\_State \*L, int arg, const char \*extramsg);|  
@apii{0,0,v}

Raises an error reporting a problem with argument @id{arg}  
of the @N{C function} that called it,  
using a standard message  
that includes @id{extramsg} as a comment:  
@verbatim{  
bad argument #@rep{arg} to '@rep{funcname}' (@rep{extramsg})  
}  
This function never returns.

}

```
@APIEntry{
void luaL_argexpected (lua_State *L,
                        int cond,
                        int arg,
                        const char *tname);|
@apii{0,0,v}
```

Checks whether @id{cond} is true.

If it is not, raises an error about the type of the argument @id{arg} with a standard message @seeF{luaL\_typeerror}.

```
}
```

```
@APIEntry{typedef struct luaL_Buffer luaL_Buffer;|
```

Type for

a @def{string buffer}.

A string buffer allows @N{C code} to build Lua strings piecemeal.

Its pattern of use is as follows:

```
@itemize{
```

```
@item{First declare a variable @id{b} of type @Lid{luaL_Buffer}.}
```

```
@item{Then initialize it with a call @T{luaL_buffinit(L, &b)}.
```

```
@item{
```

Then add string pieces to the buffer calling any of the @id{luaL\_add\*} functions.

```
}
```

```
@item{
```

Finish by calling @T{luaL\_pushresult(&b)}.

This call leaves the final string on the top of the stack.

```
}
```

```
}
```

If you know beforehand the maximum size of the resulting string, you can use the buffer like this:

```
@itemize{
```

```
@item{First declare a variable @id{b} of type @Lid{luaL_Buffer}.}
```

```
@item{Then initialize it and preallocate a space of
size @id{sz} with a call @T{luaL_buffinitsize(L, &b, sz)}.
```



```
@item{Then produce the string into that space.}
```

```
@item{  
Finish by calling @T{luaL_pushresultsize(&b, sz)},  
where @id{sz} is the total size of the resulting string  
copied into that space (which may be less than or  
equal to the preallocated  
size).  
}  
  
}
```

During its normal operation,  
a string buffer uses a variable number of stack slots.  
So, while using a buffer, you cannot assume that you know where  
the top of the stack is.  
You can use the stack between successive calls to buffer operations  
as long as that use is balanced;  
that is,  
when you call a buffer operation,  
the stack is at the same level  
it was immediately after the previous buffer operation.  
(The only exception to this rule is @Lid{luaL\_addvalue}.)  
After calling @Lid{luaL\_pushresult},  
the stack is back to its level when the buffer was initialized,  
plus the final string on its top.

```
}
```

```
@APIEntry{char *luaL_buffaddr (luaL_Buffer *B);|  
@apii{0,0,-}}
```

Returns the address of the current content of buffer @id{B}  
@seeC{luaL\_Buffer}.  
Note that any addition to the buffer may invalidate this address.

```
}
```

```
@APIEntry{void luaL_buffinit (lua_State *L, luaL_Buffer *B);|  
@apii{0,?,-}}
```

Initializes a buffer @id{B}  
@seeC{luaL\_Buffer}.  
This function does not allocate any space;  
the  
buffer must be declared as a variable.

```
}
```

```
@APIEntry{size_t luaL_bufflen (luaL_Buffer *B);|
@apii{0,0,-}
```

Returns the length of the current content of buffer @id{B}  
@seeC{luaL\_Buffer}.

```
}
```

```
@APIEntry{char *luaL_buffinitsize (lua_State *L, luaL_Buffer *B, size_t sz);|
@apii{?,?,m}
```

Equivalent to the sequence  
@Lid{luaL\_buffinit}, @Lid{luaL\_prepbuffsize}.

```
}
```

```
@APIEntry{void luaL_buffsub (luaL_Buffer *B, int n);|
@apii{?,?,-}
```

Removes @id{n} bytes from the buffer @id{B}  
@seeC{luaL\_Buffer}.  
The buffer must have at least that many bytes.

```
}
```

```
@APIEntry{int luaL_callmeta (lua_State *L, int obj, const char *e);|
@apii{0,0|1,e}
```

Calls a metamethod.

If the object at index @id{obj} has a metatable and this  
metatable has a field @id{e},  
this function calls this field passing the object as its only argument.  
In this case this function returns true and pushes onto the  
stack the value returned by the call.  
If there is no metatable or no metamethod,  
this function returns false without pushing any value  
on the stack.

```
}
```

```
@APIEntry{void luaL_checkany (lua_State *L, int arg);|
@apii{0,0,v}
```

Checks whether the function has an argument  
of any type (including @nil) at position @id{arg}.

```
}
```

```
@APIEntry{lua_Integer luaL_checkinteger (lua_State *L, int arg);|
@apii{0,0,v}
```

Checks whether the function argument @id{arg} is an integer  
(or can be converted to an integer)  
and returns this integer.

```
}
```

```
@APIEntry{const char *luaL_checklstring (lua_State *L, int arg, size_t *l);|
@apii{0,0,v}
```

Checks whether the function argument @id{arg} is a string  
and returns this string;  
if @id{l} is not @id{NULL} fills its referent  
with the string's length.

This function uses @Lid{lua\_tolstring} to get its result,  
so all conversions and caveats of that function apply here.

```
}
```

```
@APIEntry{lua_Number luaL_checknumber (lua_State *L, int arg);|
@apii{0,0,v}
```

Checks whether the function argument @id{arg} is a number  
and returns this number converted to a @id{lua\_Number}.

```
}
```

```
@APIEntry{
int luaL_checkoption (lua_State
*L,
    int arg,
    const char *def,
    const char *const lst[]);|
@apii{0,0,v}
```

Checks whether the function argument @id{arg} is a string and  
searches for this string in the array @id{lst}  
(which must be NULL-terminated).  
Returns the index in the array where the string was found.  
Raises an error if the argument is not a string or  
if the string cannot be found.

If @id{def} is not @id{NULL},

the function uses `@id{def}` as a default value when there is no argument `@id{arg}` or when this argument is `@nil`.

This is a useful function for mapping strings to `@N{C enums}`.  
(The usual convention in Lua libraries is to use strings instead of numbers to select options.)

```
}
```

```
@APIEntry{void luaL_checkstack (lua_State *L, int sz, const char *msg);|
@apii{0,0,v}
```

Grows the stack size to `@T{top + sz}` elements, raising an error if the stack cannot grow to that size.  
`@id{msg}` is an additional text to go into the error message (or `@id{NULL}` for no additional text).

```
}
```

```
@APIEntry{const char *luaL_checkstring (lua_State *L, int arg);|
@apii{0,0,v}
```

Checks whether the function argument `@id{arg}` is a string and returns this string.

This function uses `@Lid{lua_tolstring}` to get its result, so all conversions and caveats of that function apply here.

```
}
```

```
@APIEntry{void luaL_checktype (lua_State *L, int arg, int t);|
@apii{0,0,v}
```

Checks whether the function argument `@id{arg}` has type `@id{t}`. See `@Lid{lua_type}` for the encoding of types for `@id{t}`.

```
}
```

```
@APIEntry{void *luaL_checkudata (lua_State *L, int arg, const char *tname);|
@apii{0,0,v}
```

Checks whether the function argument `@id{arg}` is a userdata of the type `@id{tname}` `@seeC{luaL_newmetatable}` and returns the userdata's memory-block address `@seeC{lua_touserdata}`.

```
}
```

```
@APIEntry{void luaL_checkversion (lua_State *L);|
@apii{0,0,v}
```

Checks whether the code making the call and the Lua library being called are using the same version of Lua and the same numeric types.

```
}
```

```
@APIEntry{int
luaL_dofile (lua_State *L, const char *filename);|
@apii{0,?,m}
```

Loads and runs the given file.

It is defined as the following macro:

```
@verbatim{
(luaL_loadfile(L, filename) || lua_pcall(L, 0, LUA_MULTRET, 0))
}
```

It @N{returns 0} (@Lid{LUA\_OK}) if there are no errors,  
or 1 in case of errors.

```
}
```

```
@APIEntry{int luaL_dostring (lua_State *L, const char *str);|
@apii{0,?,-}
```

Loads and runs the given string.

It is defined as the following macro:

```
@verbatim{
(luaL_loadstring(L, str) || lua_pcall(L, 0, LUA_MULTRET, 0))
}
```

It @N{returns 0} (@Lid{LUA\_OK}) if there are no errors,  
or 1 in case of errors.

```
}
```

```
@APIEntry{int luaL_error (lua_State *L, const char *fmt, ...);|
@apii{0,0,v}
```

Raises an error.

The error message format is given by @id{fmt}

plus any extra arguments,

following the same rules of @Lid{lua\_pushfstring}.

It also adds at the beginning of the message the file name and  
the line number where the error occurred,  
if this information is available.

This function never returns,

but it is an

idiom to use it in @N{C functions}  
as @T{return luaL\_error(@rep{args})}.

}

@APIEntry{int luaL\_execresult (lua\_State \*L, int stat);|  
@apii{0,3,m}}

This function produces the return values for  
process-related functions in the standard library  
(@Lid{os.execute} and @Lid{io.close}).

}

@APIEntry{  
int luaL\_fileresult (lua\_State \*L, int stat, const char \*fname);|  
@apii{0,1|3,m}}

This function produces the return values for  
file-related functions in the standard library  
(@Lid{io.open}, @Lid{os.rename}, @Lid{file:seek}, etc.).

}

@APIEntry{int luaL\_getmetafield (lua\_State \*L, int obj, const char \*e);|  
@apii{0,0|1,m}}

Pushes onto the stack the field @id{e} from the metatable  
of the object at index @id{obj} and returns the type of the pushed value.  
If the object does not have a metatable,  
or if the metatable does not have this field,  
pushes nothing and returns @id{LUA\_TNIL}.

}

@APIEntry{int luaL\_getmetatable (lua\_State \*L, const char \*tname);|  
@apii{0,1,m}}

Pushes onto the stack the metatable  
associated with the name @id{tname}  
in the registry @seeC{luaL\_newmetatable},  
or @nil if there is no metatable associated with that name.  
Returns the type of the pushed value.

}

@APIEntry{int luaL\_getsubtable (lua\_State \*L, int idx, const char \*fname);|  
@apii{0,1,e}}

Ensures that the value `@T{t[fname]}`,  
 where `@id{t}` is the value at index `@id{idx}`,  
 is a table,  
 and pushes that table onto the stack.  
 Returns true if it finds a previous table there  
 and false if it creates a new table.

}

@APIEntry{  
 const char \*luaL\_gsub (lua\_State \*L,  
     const char \*s,  
     const char \*p,  
     const char \*r);|  
 @apii{0,1,m}

Creates a copy of string `@id{s}`,  
 replacing any occurrence of the string `@id{p}`  
 with the string `@id{r}`.  
 Pushes the resulting string on the stack and returns it.

}

@APIEntry{lua\_Integer luaL\_len (lua\_State \*L, int index);|  
 @apii{0,0,e}

Returns the `@Q{length}` of the value at the given index  
 as a number;  
 it is equivalent to the  
`@Char{#}` operator in Lua `@see{len-op}`.  
 Raises an error if the result of the operation is not an integer.  
 (This case can only happen through metamethods.)

}

@APIEntry{  
 int luaL\_loadbuffer (lua\_State \*L,  
     const char \*buff,  
     size\_t sz,  
     const char \*name);|  
 @apii{0,1,-}

Equivalent to `@Lid{luaL_loadbufferx}` with `@id{mode}` equal to `@id{NULL}`.

}

```
@APIEntry{
int luaL_loadbufferx (lua_State *L,
                    const char *buff,
                    size_t sz,
                    const char *name,
                    const char *mode);|
@apii{0,1,-}
```

Loads a buffer as a Lua chunk.

This function uses @Lid{lua\_load} to load the chunk in the buffer pointed to by @id{buff} with size @id{sz}.

This function returns the same results as @Lid{lua\_load}.

@id{name} is the chunk name,

used for debug information and error messages.

The string @id{mode} works as in the function @Lid{lua\_load}.

```
}
```

```
@APIEntry{int luaL_loadfile (lua_State
*L, const char *filename);|
@apii{0,1,m}
```

Equivalent to @Lid{luaL\_loadfilex} with @id{mode} equal to @id{NULL}.

```
}
```

```
@APIEntry{int luaL_loadfilex (lua_State *L, const char *filename,
                             const char *mode);|
@apii{0,1,m}
```

Loads a file as a Lua chunk.

This function uses @Lid{lua\_load} to load the chunk in the file named @id{filename}.

If @id{filename} is @id{NULL},

then it loads from the standard input.

The first line in the file is ignored if it starts with a @T{#}.

The string @id{mode} works as in the function @Lid{lua\_load}.

This function returns the same results as @Lid{lua\_load}

or @Lid{LUA\_ERRFILE} for file-related errors.

As @Lid{lua\_load}, this function only loads the chunk;

it does not run it.

```
}
```



```
@APIEntry{int luaL_loadstring (lua_State *L, const char *s);|
@apii{0,1,-}}
```

Loads a string as a Lua chunk.

This function uses @Lid{lua\_load} to load the chunk in the zero-terminated string @id{s}.

This function returns the same results as @Lid{lua\_load}.

Also as @Lid{lua\_load}, this function only loads the chunk; it does not run it.

```
}
```

```
@APIEntry{void luaL_newlib (lua_State *L, const luaL_Reg l[]);|
@apii{0,1,m}}
```

Creates a new table and registers there the functions in the list @id{l}.

It is implemented as the following macro:

```
@verbatim{
(luaL_newlibtable(L,l), luaL_setfuncs(L,l,0))
}
```

The array @id{l} must be the actual array, not a pointer to it.

```
}
```

```
@APIEntry{void luaL_newlibtable (lua_State *L, const luaL_Reg l[]);|
@apii{0,1,m}}
```

Creates a new table with a size optimized to store all entries in the array @id{l} (but does not actually store them).

It is intended to be used in conjunction with @Lid{luaL\_setfuncs} @seeF{luaL\_newlib}.

It is implemented as a macro.

The array @id{l} must be the actual array, not a pointer to it.

```
}
```

```
@APIEntry{int luaL_newmetatable (lua_State *L, const char *tname);|
```

@apii{0,1,m}

If the registry already has the key @id{tname},  
returns 0.  
Otherwise,  
creates a new table to be used as a  
metatable for userdata,  
adds to this new table the pair @T{\_\_name = tname},  
adds to the registry the pair @T{[tname] = new table},  
and returns 1.

In both cases,  
the function pushes onto the stack the final value associated  
with @id{tname} in the registry.

}

@APIEntry{lua\_State \*luaL\_newstate (void);|  
@apii{0,0,-}}

Creates a new Lua state.  
It calls @Lid{lua\_newstate} with an  
allocator based on the @N{ISO C} allocation functions  
and then sets a warning function and a panic function @see{C-error}  
that print messages to the standard error output.

Returns the new state,  
or @id{NULL} if there is a @x{memory allocation error}.

}

@APIEntry{void luaL\_openlibs (lua\_State \*L);|  
@apii{0,0,e}}

Opens all standard Lua libraries into the given state.

}

@APIEntry{  
T luaL\_opt (L, func, arg, dflt);|  
@apii{0,0,-}}

This macro is defined as follows:

@verbatim{  
(lua\_istoneornil(L,(arg)) ? (dflt) : func(L,(arg)))  
}

In words, if the argument @id{arg} is nil or absent,  
the macro results in the default

@id{dflt}.

Otherwise, it results in the result of calling @id{func} with the state @id{L} and the argument index @id{arg} as arguments.

Note that it evaluates the expression @id{dflt} only if needed.

}

```
@APIEntry{
lua_Integer luaL_optinteger (lua_State *L,
                           int arg,
                           lua_Integer d);|
@apii{0,0,v}
```

If the function argument @id{arg} is an integer (or it is convertible to an integer), returns this integer.

If this argument is absent or is @nil, returns @id{d}.

Otherwise, raises an error.

}

```
@APIEntry{
const char *luaL_optlstring (lua_State *L,
                           int arg,
                           const char *d,
                           size_t *l);|
@apii{0,0,v}
```

If the function argument @id{arg} is a string, returns this string.

If this argument is absent or is @nil, returns @id{d}.

Otherwise, raises an error.

If @id{l} is not @id{NULL}, fills its referent with the result's length. If the result is @id{NULL} (only possible when returning @id{d} and @T{d == NULL}), its length is considered zero.

This function uses @Lid{lua\_tolstring} to get its result, so all conversions and caveats of that function apply here.

}

```
@APIEntry{lua_Number luaL_optnumber (lua_State *L, int arg, lua_Number d);|
@apii{0,0,v}
```

If the function argument @id{arg} is a number,  
returns this number as a @id{lua\_Number}.

If this argument is absent or is @nil,  
returns @id{d}.

Otherwise, raises an error.

```
}
```

```
@APIEntry{
const char *luaL_optstring (lua_State *L,
                           int arg,
                           const char *d);|
@apii{0,0,v}
```

If the function argument @id{arg} is a string,  
returns this string.

If this argument is absent or is @nil,  
returns @id{d}.

Otherwise, raises an error.

```
}
```

```
@APIEntry{char *luaL_prepbuffer (luaL_Buffer *B);|
@apii{?,?,m}
```

Equivalent to @Lid{luaL\_prepbuffsize}  
with the predefined size @defid{LUAL\_BUFFERSIZE}.

```
}
```

```
@APIEntry{char *luaL_prepbuffsize (luaL_Buffer *B, size_t sz);|
@apii{?,?,m}
```

Returns

an address to a space of size @id{sz}

where you can copy a string to be added to buffer @id{B}

@seeC{luaL\_Buffer}.

After copying the string into this space you must call

@Lid{luaL\_addsize} with the size of the string to actually add  
it to the buffer.

```
}
```

```
@APIEntry{void luaL_pushfail (lua_State *L);|
@apii{0,1,-}
```

Pushes the @fail value onto the stack @see{libraries}.

}

```
@APIEntry{void luaL_pushresult (luaL_Buffer *B);|
@apii{?,1,m}
```

Finishes the use of buffer @id{B} leaving the final string on the top of the stack.

}

```
@APIEntry{void luaL_pushresultsz (luaL_Buffer *B, size_t sz);|
@apii{?,1,m}
```

Equivalent to the sequence @Lid{luaL\_addsize}, @Lid{luaL\_pushresult}.

}

```
@APIEntry{int luaL_ref (lua_State *L, int t);|
@apii{1,0,m}
```

Creates and returns a @def{reference},  
in the table at index @id{t},  
for the object on the top of the stack (and pops the object).

A reference is a unique integer key.

As long as you do not manually add integer keys into the table @id{t},

@Lid{luaL\_ref}

ensures the uniqueness of the key it returns.

You can retrieve an object referred by the reference @id{r}

by calling @T{lua\_rawgeti(L, t, r)}.

The function @Lid{luaL\_unref} frees a reference.

If the object on the top of the stack is @nil,

@Lid{luaL\_ref} returns the constant @defid{LUA\_REFNIL}.

The constant @defid{LUA\_NOREF} is guaranteed to be different  
from any reference returned by @Lid{luaL\_ref}.

}

```
@APIEntry{
typedef struct luaL_Reg {
  const char *name;
  lua_CFunction func;
} luaL_Reg;
|
```

Type for arrays of functions to be registered by

@Lid{luaL\_setfuncs}.

@id{name} is the function name and @id{func} is a pointer to the function.

Any array of @Lid{luaL\_Reg} must end with a sentinel entry in which both @id{name} and @id{func} are @id{NULL}.

}

@APIEntry{

void luaL\_requiref (lua\_State \*L, const char \*modname,  
lua\_CFunction openf, int glb);|

@apii{0,1,e}

If @T{package.loaded[modname]} is not true,  
calls the function @id{openf} with the string @id{modname}  
as an argument  
and sets the call result to @T{package.loaded[modname]},  
as if that function has been called through @Lid{require}.

If @id{glb} is true,  
also stores the module into the global @id{modname}.

Leaves a copy of the module on the stack.

}

@APIEntry{void luaL\_setfuncs (lua\_State \*L, const luaL\_Reg \*l, int nup);|  
@apii{nup,0,m}

Registers all functions in the array @id{l}  
@seeC{luaL\_Reg} into the table on the top of the stack  
(below optional upvalues, see next).

When @id{nup} is not zero,  
all functions are created with @id{nup} upvalues,  
initialized with copies of the @id{nup} values  
previously pushed on the stack  
on top of the library table.  
These values are popped from the stack after the registration.

A function with a @id{NULL} value represents a placeholder,  
which is filled with @false.

}

@APIEntry{void luaL\_setmetatable (lua\_State \*L, const char \*tname);|

@apii{0,0,-}

Sets the metatable of the object on the top of the stack  
as the metatable associated  
with name @id{tname}  
in the registry @seeC{luaL\_newmetatable}.

}

```
@APIEntry{
typedef struct luaL_Stream {
    FILE *f;
    lua_CFunction closef;
} luaL_Stream;
|
```

The standard representation for @x{file handles}  
used by the standard I/O library.

A file handle is implemented as a full userdata,  
with a metatable called @id{LUA\_FILEHANDLE}  
(where @id{LUA\_FILEHANDLE} is a macro with the actual metatable's name).  
The metatable is created by the I/O library  
@seeF{luaL\_newmetatable}.

This userdata must start with the structure @id{luaL\_Stream};  
it can contain other data after this initial structure.  
The field @id{f} points to the corresponding C stream  
(or it can be @id{NULL} to indicate an incompletely created handle).  
The field @id{closef} points to a Lua function  
that will be called to close the stream  
when the handle is closed or collected;  
this function receives the file handle as its sole argument and  
must return either a true value, in case of success,  
or a false value plus an error message,  
in case of error.  
Once Lua calls this field,  
it changes the field value to @id{NULL}  
to signal that the handle is closed.

}

```
@APIEntry{void *luaL_testudata (lua_State *L, int arg, const char *tname);|
@apii{0,0,m}
```

This function works like @Lid{luaL\_checkudata},  
except that, when the test fails,  
it returns @id{NULL} instead of raising an error.

```
}
```

```
@APIEntry{const char *luaL_tolstring (lua_State *L, int idx, size_t *len);|
@apii{0,1,e}
```

Converts any Lua value at the given index to a @N{C string}  
in a reasonable format.

The resulting string is pushed onto the stack and also  
returned by the function @see{constchar}.

If @id{len} is not @id{NULL},  
the function also sets @T{\*len} with the string length.

If the value has a metatable with a @idx{\_\_tostring} field,  
then @id{luaL\_tolstring} calls the corresponding metamethod  
with the value as argument,  
and uses the result of the call as its result.

```
}
```

```
@APIEntry{
void luaL_traceback (lua_State *L, lua_State *L1, const char *msg,

    int level);|
@apii{0,1,m}
```

Creates and pushes a traceback of the stack @id{L1}.

If @id{msg} is not @id{NULL}, it is appended  
at the beginning of the traceback.

The @id{level} parameter tells at which level  
to start the traceback.

```
}
```

```
@APIEntry{int luaL_typeerror (lua_State *L, int arg, const char *tname);|
@apii{0,0,v}
```

Raises a type error for the argument @id{arg}  
of the @N{C function} that called it,  
using a standard message;  
@id{tname} is a @Q{name} for the expected type.  
This function never returns.

```
}
```

```
@APIEntry{const char *luaL_typename (lua_State *L, int index);|
@apii{0,0,-}
```



Returns the name of the type of the value at the given index.

}

@APIEntry{void luaL\_unref (lua\_State \*L, int t, int ref);|  
@apii{0,0,-}}

Releases the reference @id{ref} from the table at index @id{t}  
@seeC{luaL\_unref}.

The entry is removed from the table,  
so that the referred object can be collected.

The reference @id{ref} is also freed to be used again.

If @id{ref} is @Lid{LUA\_NOREF} or @Lid{LUA\_REFNIL},  
@Lid{luaL\_unref}  
does nothing.

}

@APIEntry{void luaL\_where (lua\_State \*L, int lvl);|  
@apii{0,1,m}}

Pushes onto the stack a string identifying the current position  
of the control at level @id{lvl} in the call stack.

Typically this string has the following format:

@verbatim{  
@rep{chunkname}:@rep{currentline}:  
}

@N{Level 0} is the running function,  
@N{level 1} is the function that called the running function,  
etc.

This function is used to build a prefix for error messages.

}

}

}

@C{-----}  
@sect1{libraries| @title{The Standard Libraries}}

@simplesect{

The standard Lua libraries provide useful functions  
that are implemented @N{in C} through the @N{C API}.

Some of these functions provide essential services to the language (e.g., `@Lid{type}` and `@Lid{getmetatable}`); others provide access to outside services (e.g., I/O); and others could be implemented in Lua itself, but that for different reasons deserve an implementation in C (e.g., `@Lid{table.sort}`).

All libraries are implemented through the official `@N{C API}` and are provided as separate `@N{C modules}`. Unless otherwise noted, these library functions do not adjust its number of arguments to its expected parameters. For instance, a function documented as `@T{foo(arg)}` should not be called without an argument.

The notation `@fail` means a false value representing some kind of failure. (Currently, `@fail` is equal to `@nil`, but that may change in future versions. The recommendation is to always test the success of these functions with `@T{(not status)}`, instead of `@T{(status == nil)}`.)

Currently, Lua has the following standard libraries:

`@itemize{`

`@item{@link{predefined|basic library};}`

`@item{@link{corolib|coroutine library};}`

`@item{@link{packlib|package library};}`

`@item{@link{strlib|string manipulation};}`

`@item{@link{utf8|basic UTF-8 support};}`

`@item{@link{tablib|table manipulation};}`

`@item{@link{mathlib|mathematical functions}`  
`(sin, log, etc.);}`

`@item{@link{iolib|input and output};}`

`@item{@link{oslib|operating system facilities};}`

`@item{@link{debuglib|debug facilities}.}`

}

Except for the basic and the package libraries,  
each library provides all its functions as fields of a global table  
or as methods of its objects.

To have access to these libraries,  
the @N{C host} program should call the @Lid{luaL\_openlibs} function,  
which opens all standard libraries.

Alternatively,  
the host program can open them individually by using  
@Lid{luaL\_requiref} to call  
@defid{luaopen\_base} (for the basic library),  
@defid{luaopen\_package} (for the package library),  
@defid{luaopen\_coroutine} (for the coroutine library),  
@defid{luaopen\_string} (for the string library),  
@defid{luaopen\_utf8} (for the UTF-8 library),  
@defid{luaopen\_table} (for the table library),  
@defid{luaopen\_math} (for the mathematical library),  
@defid{luaopen\_io} (for the I/O library),  
@defid{luaopen\_os} (for the operating system library),  
and @defid{luaopen\_debug}  
(for the debug library).

These functions are declared in @defid{lualib.h}.

}

@sect2{predefined| @title{Basic Functions}}

The basic library provides core functions to Lua.  
If you do not include this library in your application,  
you should check carefully whether you need to provide  
implementations for some of its facilities.

@LibEntry{assert (v [, message])|

Raises an error if  
the value of its argument @id{v} is false (i.e., @nil or @false);  
otherwise, returns all its arguments.

In case of error,  
@id{message} is the error object;  
when absent, it defaults to @St{assertion failed!}

}

@LibEntry{collectgarbage ([opt [, arg]])|

This function is a generic interface to the garbage collector.  
It performs different functions according to its first argument, @id{opt}:  
@description{

@item{@St{collect}}|

Performs a full garbage-collection cycle.

This is the default option.

}

@item{@St{stop}}|

Stops automatic execution of the garbage collector.

The collector will run only when explicitly  
invoked,

until a call to restart it.

}

@item{@St{restart}}|

Restarts automatic execution of the garbage collector.

}

@item{@St{count}}|

Returns the total memory in use by Lua in Kbytes.

The value has a fractional part,

so that it multiplied by 1024

gives the exact number of bytes in use by Lua.

}

@item{@St{step}}|

Performs a garbage-collection step.

The step @Q{size} is controlled by @id{arg}.

With a zero value,

the collector will perform one basic (indivisible) step.

For non-zero values,

the collector will perform as if that amount of memory  
(in Kbytes) had been allocated by Lua.

Returns @true if the step finished a collection cycle.

}

@item{@St{isrunning}}|

Returns a boolean that tells whether the collector is running  
(i.e., not stopped).

}

@item{@St{incremental}}|

Change the collector mode to incremental.

This option can be followed by three numbers:

the garbage-collector pause,

the step multiplier,

and the step size @see{incmode}.

A zero means to not change that value.

}

@item{@St{generational}|  
Change  
the collector mode to generational.  
This option can be followed by two numbers:  
the garbage-collector minor multiplier  
and the major multiplier @see{genmode}.

A zero means to not change that value.

}

}

See @See{GC} for more details about garbage collection  
and some of these options.

This function should not be called by a finalizer.

}

@LibEntry{dofile ([filename])|  
Opens the named file and executes its content as a Lua chunk.  
When called without arguments,  
@id{dofile} executes the content of the standard input (@id{stdin}).  
Returns all values returned by the chunk.  
In case of errors, @id{dofile} propagates the error  
to its caller.  
(That is, @id{dofile} does not run in protected mode.)

}

@LibEntry{error (message [, level])|  
Raises an error @see{error} with @id{message} as the error object.  
This function never returns.

Usually, @id{error} adds some information about the error position  
at the beginning of the message, if the message is a string.

The @id{level}

argument specifies how to get the error position.

With @N{level 1} (the default), the error position is where the  
@id{error} function was called.

@N{Level 2} points the error to where the function  
that called @id{error} was called; and so on.

Passing a @N{level 0} avoids the addition of error position information  
to the message.

}

@LibEntry{\_G|

A global variable (not a function) that holds the @x{global environment} @see{globalenv}. Lua itself does not use this variable; changing its value does not affect any environment, nor vice versa.

}

@LibEntry{getmetatable (object)|

If @id{object} does not have a metatable, returns @nil. Otherwise, if the object's metatable has a @idx{\_\_metatable} field, returns the associated value. Otherwise, returns the metatable of the given object.

}

@LibEntry{ipairs (t)|

Returns three values (an iterator function, the table @id{t}, and 0) so that the construction

```
@verbatim{
for i,v in ipairs(t) do @rep{body} end
}
```

will iterate over the key@En{ }value pairs (@T{1,t[1]}), (@T{2,t[2]}), @ldots, up to the first absent index.

}

@LibEntry{load (chunk [, chunkname [, mode [, env]])|

Loads a chunk.

If @id{chunk} is a string, the chunk is this string.  
If @id{chunk} is a function,  
@id{load} calls it repeatedly to get the chunk pieces.  
Each call to @id{chunk} must return a string that concatenates with previous results.  
A return of an empty string, @nil, or no value signals the end of the chunk.

If there are no syntactic errors,  
@id{load} returns the compiled chunk as a function;  
otherwise, it returns @fail plus the error message.

When you load a main chunk,  
the resulting function will always have exactly one upvalue,  
the `@id{_ENV}` variable `@see{globalenv}`.  
However,  
when you load a binary chunk created from a function `@seeF{string.dump}`,  
the resulting function can have an arbitrary number of upvalues,  
and there is no guarantee that its first upvalue will be  
the `@id{_ENV}` variable.  
(A non-main function may not even have an `@id{_ENV}`  
upvalue.)

Regardless, if the resulting function has any upvalues,  
its first upvalue is set to the value of `@id{env}`,  
if that parameter is given,  
or to the value of the `@x{global environment}`.  
Other upvalues are initialized with `@nil`.  
All upvalues are fresh, that is,  
they are not shared with any other function.

`@id{chunkname}` is used as the name of the chunk for error messages  
and debug information `@see{debugI}`.  
When absent,  
it defaults to `@id{chunk}`, if `@id{chunk}` is a string,  
or to `@St{=(load)}` otherwise.

The string `@id{mode}` controls whether the chunk can be text or binary  
(that is, a precompiled chunk).  
It may be the string `@St{b}` (only `@x{binary chunk}`s),  
`@St{t}` (only text chunks),  
or `@St{bt}` (both binary and text).  
The default is `@St{bt}`.

It is safe to load malformed binary chunks;  
`@id{load}` signals an appropriate error.  
However,  
Lua does not check the consistency of the code inside binary chunks;  
running maliciously crafted bytecode can crash the interpreter.

}

`@LibEntry{loadfile`  
`[[filename [, mode [, env]]]]`

Similar to `@Lid{load}`,  
but gets the chunk from file `@id{filename}`  
or from the standard input,  
if no file name is given.

}

@LibEntry{next (table [, index])|

Allows a program to traverse all fields of a table.

Its first argument is a table and its second argument is an index in this table.

A call to @id{next} returns the next index of the table and its associated value.

When called with @nil as its second argument,

@id{next} returns an initial index and its associated value.

When called with the last index,

or with @nil in an empty table,

@id{next} returns @nil.

If the second argument is absent, then it is interpreted as @nil.

In particular,

you can use @T{next(t)} to check whether a table is empty.

The order in which the indices are enumerated is not specified,

@emph{even for numeric indices}.

(To traverse a table in numerical order,

use a numerical @Rw{for}.)

You should not assign any value to a non-existent field in a table during its traversal.

You

may however modify existing fields.

In particular, you may set existing fields to nil.

}

@LibEntry{pairs (t)|

If @id{t} has a metamethod @idx{\_\_pairs},

calls it with @id{t} as argument and returns the first three results from the call.

Otherwise,

returns three values: the @Lid{next} function, the table @id{t}, and @nil, so that the construction

@verbatim{

for k,v in pairs(t) do @rep{body} end

}

will iterate over all key@En{ }value pairs of table @id{t}.

See function @Lid{next} for the caveats of modifying



the table during its traversal.

```
}
```

```
@LibEntry{pcall (f [, arg1, @Cdots])|
```

Calls the function `@id{f}` with the given arguments in `@emphx{protected mode}`. This means that any error `@N{inside @T{f}}` is not propagated; instead, `@id{pcall}` catches the error and returns a status code.

Its first result is the status code (a boolean), which is `@true` if the call succeeds without errors. In such case, `@id{pcall}` also returns all results from the call, after this first result.

In case of any error, `@id{pcall}` returns `@false` plus the error object. Note that errors caught by `@id{pcall}` do not call a message handler.

```
}
```

```
@LibEntry{print (@Cdots)|
```

Receives any number of arguments and prints their values to `@id{stdout}`, converting each argument to a string following the same rules of `@Lid{tostring}`.

The function `@id{print}` is not intended for formatted output, but only as a quick way to show a value, for instance for debugging. For complete control over the output, use `@Lid{string.format}` and `@Lid{io.write}`.

```
}
```

```
@LibEntry{rawequal (v1, v2)|
```

Checks whether `@id{v1}` is equal to `@id{v2}`, without invoking the `@idx{__eq}` metamethod. Returns a boolean.

```
}
```

```
@LibEntry{rawget (table, index)|
```

Gets the real value of `@T{table[index]}`, without using the `@idx{__index}` metavalue. `@id{table}` must be a table; `@id{index}` may be any value.

}

@LibEntry{rawlen (v)|

Returns the length of the object @id{v},  
which must be a table or a string,  
without invoking the @idx{\_\_len} metamethod.

Returns

an integer.

}

@LibEntry{rawset (table, index, value)|

Sets the real value of @T{table[index]} to @id{value},  
without using the @idx{\_\_newindex} metavalue.

@id{table} must be a table,

@id{index} any value different from @nil and @x{NaN},  
and @id{value} any Lua value.

This function returns @id{table}.

}

@LibEntry{select (index, @Cdots)|

If @id{index} is a number,

returns all arguments after argument number @id{index};

a negative number indexes from the end (@num{-1} is the last argument).

Otherwise, @id{index} must be the string @T{"#"},

and @id{select} returns the total number of extra arguments it received.

}

@LibEntry{setmetatable (table, metatable)|

Sets the metatable for the given table.

If @id{metatable} is @nil,

removes the metatable of the given table.

If the original metatable has a @idx{\_\_metatable} field,  
raises an error.

This function returns @id{table}.

To change the metatable of other types from Lua code,  
you must use the @link{debuglib|debug library}.

}

@LibEntry{tonumber

(e [, base])|

When called with no @id{base},  
@id{tonumber} tries to convert its argument to a number.  
If the argument is already a number or  
a string convertible to a number,  
then @id{tonumber} returns this number;  
otherwise, it returns @fail.

The conversion of strings can result in integers or floats,  
according to the lexical conventions of Lua @see{lexical}.  
The string may have leading and trailing spaces and a sign.

When called with @id{base},  
then @id{e} must be a string to be interpreted as  
an integer numeral in that base.  
The base may be any integer between 2 and 36, inclusive.  
In bases @N{above 10}, the letter @Char{A} (in either upper or lower case)  
@N{represents 10}, @Char{B} @N{represents 11}, and so forth,  
with @Char{Z} representing 35.  
If the string @id{e} is not a valid numeral in the given base,  
the function returns @fail.

}

@LibEntry{tostring (v)|

Receives a value of any type and  
converts it to a string in a human-readable format.

If the metatable  
of @id{v} has a @idx{\_\_tostring} field,  
then @id{tostring} calls the corresponding value  
with @id{v} as argument,  
and uses the result of the call as its result.  
Otherwise, if the metatable of @id{v} has a @idx{\_\_name} field  
with a string value,  
@id{tostring} may use that string in its final result.

For complete control of how numbers are converted,  
use @Lid{string.format}.

}

@LibEntry{type (v)|

Returns the type of its only argument, coded as a string.  
The possible results of this function are

@St{nil} (a string, not the value @nil),  
@St{number},  
@St{string},  
@St{boolean},  
@St{table},  
@St{function},  
@St{thread},  
and @St{userdata}.

}

@LibEntry{\_VERSION|

A global variable (not a function) that  
holds a string containing the running Lua version.  
The current value of this variable is @St{Lua 5.4}.

}

@LibEntry{warn (msg1, @Cdots)|

Emits a warning with a message composed by the concatenation  
of all its arguments (which should be strings).

By convention,  
a one-piece message starting  
with @Char{@At}  
is intended to be a @emph{control message},  
which is a message to the warning system itself.  
In particular, the standard warning function in Lua  
recognizes the control messages @St{@At{}off},  
to stop the emission of warnings,  
and @St{@At{}on}, to (re)start the emission;  
it ignores unknown control messages.

}

@LibEntry{xpcall (f, msgh [, arg1, @Cdots])|

This function is similar to @Lid{pcall},  
except that it sets a new @x{message handler} @id{msgh}.

}

}

@sect2{corolib| @title{Coroutine Manipulation}}

This library comprises the operations to manipulate coroutines, which come inside the table `@defid{coroutine}`. See `@See{coroutine}` for a general description of coroutines.

`@LibEntry{coroutine.close (co)|`

Closes coroutine `@id{co}`, that is, closes all its pending to-be-closed variables and puts the coroutine in a dead state. The given coroutine must be dead or suspended. In case of error (either the original error that stopped the coroutine or errors in closing methods), returns `@false` plus the error object; otherwise returns `@true`.

`}`

`@LibEntry{coroutine.create (f)|`

Creates a new coroutine, with body `@id{f}`. `@id{f}` must be a function. Returns this new coroutine, an object with type `@T{"thread"}`.

`}`

`@LibEntry{coroutine.isyieldable ([co])|`

Returns `@true` when the coroutine `@id{co}` can yield. The default for `@id{co}` is the running coroutine.

A coroutine is yieldable if it is not the main thread and it is not inside a non-yieldable `@N{C function}`.

`}`

`@LibEntry{coroutine.resume (co [, val1, @Cdots])|`

Starts or continues the execution of coroutine `@id{co}`. The first time you resume a coroutine, it starts running its body. The values `@id{val1}`, `@ldots` are passed as the arguments to the body function. If the coroutine has yielded,

@id{resume} restarts it;  
the values @id{val1}, @ldots are passed  
as the results from the yield.

If the coroutine runs without any errors,  
@id{resume} returns @true plus any values passed to @id{yield}  
(when the coroutine  
yields) or any values returned by the body function  
(when the coroutine terminates).  
If there is any error,  
@id{resume} returns @false plus the error message.

}

@LibEntry{coroutine.running ()|

Returns the running coroutine plus a boolean,  
@true when the running coroutine is the main one.

}

@LibEntry{coroutine.status (co)|

Returns the status of the coroutine @id{co}, as a string:  
@T{"running"},  
if the coroutine is running  
(that is, it is the one that called @id{status});  
@T{"suspended"}, if the coroutine is suspended in a call to @id{yield},  
or if it has not started running yet;  
@T{"normal"} if the coroutine is active but not running  
(that is, it has resumed another coroutine);  
and @T{"dead"} if the coroutine has finished its body function,  
or if it has stopped with an error.

}

@LibEntry{coroutine.wrap (f)|

Creates a new coroutine, with body @id{f};  
@id{f} must be a function.  
Returns a function that resumes the coroutine each time it is called.  
Any arguments passed to this  
function behave as the  
extra arguments to @id{resume}.  
The function returns the same values returned by @id{resume},  
except the first boolean.  
In case of error,  
the function closes the coroutine and propagates the error.

```
}
```

```
@LibEntry{coroutine.yield (@Cdots)|
```

Suspends the execution of the calling coroutine.

Any arguments to @id{yield} are passed as extra results to @id{resume}.

```
}
```

```
}
```

```
@sect2{packlib| @title{Modules}}
```

The package library provides basic facilities for loading modules in Lua.

It exports one function directly in the global environment:

@Lid{require}.

Everything else is exported in the table @defid{package}.

```
@LibEntry{require (modname)|
```

Loads the given module.

The function starts by looking into the @Lid{package.loaded} table to determine whether @id{modname} is already loaded.

If it is, then @id{require} returns the value stored at @T{package.loaded[modname]}.

(The absence of a second result in this case signals that this call did not have to load the module.)

Otherwise,

it tries to find a @emph{loader} for the module.

To find a loader,

@id{require} is guided by the table @Lid{package.searchers}.

Each item in this table is a search function, that searches for the module in a particular way.

By changing this table,

we can change how @id{require} looks for a module.

The following explanation is based on the default configuration for @Lid{package.searchers}.

First @id{require} queries @T{package.preload[modname]}.

If it has a value,

this value (which must be a function) is the loader.

Otherwise @id{require} searches for a Lua loader using the path stored in @Lid{package.path}.

If that also fails, it searches for a @N{C loader} using the

path stored in `@Lid{package.cpath}`.

If that also fails,

it tries an `@emph{all-in-one}` loader `@seeF{package.searchers}`.

Once a loader is found,

`@id{require}` calls the loader with two arguments:

`@id{modname}` and an extra value,

a `@emph{loader data}`,

also returned by the searcher.

The loader data can be any value useful

to the module;

for the default searchers,

it indicates where the loader was found.

(For instance, if the loader came from a file,

this extra value is the file path.)

If the loader returns any non-nil value,

`@id{require}` assigns the returned value to `@T{package.loaded[modname]}`.

If the loader does not return a non-nil value and

has not assigned any value to `@T{package.loaded[modname]}`,

then `@id{require}` assigns `@true` to this entry.

In any case, `@id{require}` returns the

final value of `@T{package.loaded[modname]}`.

Besides that value, `@id{require}` also returns as a second result

the loader data returned by the searcher,

which indicates how `@id{require}` found the module.

If there is any error loading or running the module,

or if it cannot find any loader for the module,

then `@id{require}` raises an error.

}

`@LibEntry{package.config|`

A string describing some compile-time configurations for packages.

This string is a sequence of lines:

`@itemize{`

`@item{The first line is the @x{directory  
separator} string.`

Default is `@Char{\}` for `@x{Windows}` and `@Char{/}` for all other systems.}

`@item{The second line is the character that separates templates in a path.`

Default is `@Char{;}.}`

`@item{The third line is the string that marks the  
substitution points in a template.`

Default is `@Char{?}.}`



@item{The fourth line is a string that, in a path in @x{Windows}, is replaced by the executable's directory.  
Default is @Char{!}.}

@item{The fifth line is a mark to ignore all text after it when building the @id{luaopen\_} function name.  
Default is @Char{-}.}

}

}

@LibEntry{package.cpath|

A string with the path used by @Lid{require} to search for a @N{C loader}.

Lua initializes the @N{C path} @Lid{package.cpath} in the same way it initializes the Lua path @Lid{package.path}, using the environment variable @defid{LUA\_CPATH\_5\_4}, or the environment variable @defid{LUA\_CPATH}, or a default path defined in @id{luaconf.h}.

}

@LibEntry{package.loaded|

A table used by @Lid{require} to control which modules are already loaded.  
When you require a module @id{modname} and @T{package.loaded[modname]} is not false, @Lid{require} simply returns the value stored there.

This variable is only a reference to the real table; assignments to this variable do not change the table used by @Lid{require}.  
The real table is stored in the C registry @see{registry}, indexed by the key @defid{LUA\_LOADED\_TABLE}, a string.

}

@LibEntry{package.loadlib (libname, funcname)|

Dynamically links the host program with the @N{C library} @id{libname}.

If @id{funcname} is @St{\*},

then it only links with the library,  
making the symbols exported by the library  
available to other dynamically linked libraries.  
Otherwise,  
it looks for a function @id{funcname} inside the library  
and returns this function as a @N{C function}.  
So, @id{funcname} must follow the @Lid{lua\_CFunction} prototype  
@seeC{lua\_CFunction}.

This is a low-level function.  
It completely bypasses the package and module system.  
Unlike @Lid{require},  
it  
does not perform any path searching and  
does not automatically adds extensions.  
@id{libname} must be the complete file name of the @N{C library},  
including if necessary a path and an extension.  
@id{funcname} must be the exact name exported by the @N{C library}  
(which may depend on the @N{C compiler} and linker used).

This functionality is not supported by @N{ISO C}.  
As such, it is only available on some platforms  
(Windows, Linux, Mac OS X, Solaris, BSD,  
plus other Unix systems that support the @id{dlfcn} standard).

This function is inherently insecure,  
as it allows Lua to call any function in any readable dynamic  
library in the system.  
(Lua calls any function assuming the function  
has a proper prototype and respects a proper protocol  
@see{lua\_CFunction}.  
Therefore,  
calling an arbitrary function in an arbitrary dynamic library  
more often than not results in an access violation.)

}

@LibEntry{package.path|

A string with the path used by @Lid{require}  
to search for a Lua  
loader.

At start-up, Lua initializes this variable with  
the value of the environment variable @defid{LUA\_PATH\_5\_4} or  
the environment variable @defid{LUA\_PATH} or  
with a default path defined in @id{luaconf.h},  
if those environment variables are not defined.

A `@St{;;}` in the value of the environment variable is replaced by the default path.

}

`@LibEntry{package.preload|`

A table to store loaders for specific modules  
`@seeF{require}`.

This variable is only a reference to the real table; assignments to this variable do not change the table used by `@Lid{require}`.  
The real table is stored in the C registry `@see{registry}`, indexed by the key `@defid{LUA_PRELOAD_TABLE}`, a string.

}

`@LibEntry{package.searchers|`

A table used by `@Lid{require}` to control how to find modules.

Each entry in this table is a `@def{searcher function}`.  
When looking for a module,  
`@Lid{require}` calls each of these searchers in ascending order, with the module name (the argument given to `@Lid{require}`) as its sole argument.

If  
the searcher finds the module,  
it returns another function, the module `@def{loader}`,  
plus an extra value, a `@emph{loader data}`,  
that will be passed to that loader and  
returned as a second result by `@Lid{require}`.  
If it cannot find the module,  
it returns a string explaining why  
(or `@nil` if it has nothing to say).

Lua initializes this table with four searcher functions.

The first searcher simply looks for a loader in the  
`@Lid{package.preload}` table.

The second searcher looks for a loader as a Lua library,  
using the path stored at `@Lid{package.path}`.  
The search is done as described in function `@Lid{package.searchpath}`.

The third searcher looks for a loader as a `@N{C library}`,  
using the path given by the variable `@Lid{package.cpath}`.

Again,  
the search is done as described in function `@Lid{package.searchpath}`.  
For instance,  
if the `@N{C path}` is the string  
`@verbatim{`  
`"/?.so;/.dll;/usr/local/?/init.so"`  
`}`  
the searcher for module `@id{foo}`  
will try to open the files `@T{./foo.so}`,  
`@T{./foo.dll}`,  
and `@T{/usr/local/foo/init.so}`, in that order.  
Once it finds a `@N{C library}`,  
this searcher first uses a dynamic link facility to link the  
application with the library.  
Then it tries to find a `@N{C function}` inside the library to  
be used as the loader.  
The name of this `@N{C function}` is the string `@St{luaopen_}`  
concatenated with a copy of the module name where each dot  
is replaced by an underscore.  
Moreover, if the module name has a hyphen,  
its suffix after (and including) the first hyphen is removed.  
For instance, if the module name is `@id{a.b.c-v2.1}`,  
the function name will be `@id{luaopen_a_b_c}`.

The fourth searcher tries an `@def{all-in-one loader}`.  
It searches the `@N{C path}` for a library for  
the root name of the given module.  
For instance, when requiring `@id{a.b.c}`,  
it will search for a `@N{C library}` for `@id{a}`.  
If found, it looks into it for an open function for  
the submodule;  
in our example, that would be `@id{luaopen_a_b_c}`.  
With this facility, a package can pack  
several `@N{C submodules}`  
into one single library,  
with each submodule keeping its original open function.

All searchers except the first one (preload) return as the extra value  
the file path where the module was found,  
as returned by `@Lid{package.searchpath}`.  
The first searcher always returns the string `@St{:preload:}`.

Searchers should raise no errors and have no side effects in Lua.  
(They may have side effects in C,  
for instance by linking the application with a library.)

}

@LibEntry{package.searchpath (name, path [, sep [, rep]])|

Searches for the given @id{name} in the given @id{path}.

A path is a string containing a sequence of

@emph{templates} separated by semicolons.

For each template,

the function replaces each interrogation mark (if any)

in the template with a copy of @id{name}

wherein all occurrences of @id{sep}

(a dot, by default)

were replaced by @id{rep}

(the system's directory separator, by default),

and then tries to open the resulting file name.

For instance, if

the path is the string

@verbatim{

"/?.lua;/?..lc;/usr/local/?.init.lua"

}

the search for the name @id{foo.a}

will try to open the files

@T{./foo/a.lua}, @T{./foo/a.lc}, and

@T{/usr/local/foo/a/init.lua}, in that order.

Returns the resulting name of the first file that it can

open in read mode (after closing the file),

or @fail plus an error message if none succeeds.

(This error message lists all file names it tried to open.)

}

}

@sect2{strlib| @title{String Manipulation}}

@simplesect{

This library provides generic functions for string manipulation,

such as finding and extracting substrings, and pattern matching.

When indexing a string in Lua, the first character is at @N{position 1}

(not @N{at 0}, as in C).

Indices are allowed to be negative and are interpreted as indexing backwards,

from the end of the string.

Thus, the last character is at position @num{-1}, and so on.

The string library provides all its functions inside the table

@defid{string}.

It also sets a `@x{metatable for strings}` where the `@idx{__index}` field points to the `@id{string}` table. Therefore, you can use the string functions in object-oriented style. For instance, `@T{string.byte(s,i)}` can be written as `@T{s:byte(i)}`.

The string library assumes one-byte character encodings.

`@LibEntry{string.byte (s [, i [, j]])}`  
Returns the internal numeric codes of the characters `@T{s[i]}`, `@T{s[i+1]}`, `@ldots`, `@T{s[j]}`.  
The default value for `@id{i}` `@N{is 1}`;  
the default value for `@id{j}` `@N{is @id{i}}`.  
These indices are corrected following the same rules of function `@Lid{string.sub}`.

Numeric codes are not necessarily portable across platforms.

}

`@LibEntry{string.char (@Cdots)}`  
Receives zero or more integers.  
Returns a string with length equal to the number of arguments, in which each character has the internal numeric code equal to its corresponding argument.

Numeric codes are not necessarily portable across platforms.

}

`@LibEntry{string.dump (function [, strip])}`

Returns a string containing a binary representation  
(a `@emph{binary chunk}`)  
of the given function,  
so that a later `@Lid{load}` on this string returns  
a copy of the function (but with new upvalues).  
If `@id{strip}` is a true value,  
the binary representation may not include all debug information  
about the function,  
to save space.

Functions with upvalues have only their number of upvalues saved.  
When (re)loaded,  
those upvalues receive fresh instances.

(See the `@Lib{load}` function for details about how these upvalues are initialized. You can use the debug library to serialize and reload the upvalues of a function in a way adequate to your needs.)

}

`@LibEntry{string.find (s, pattern [, init [, plain]])|`

Looks for the first match of

`@id{pattern}` `@see{pm}` in the string `@id{s}`.

If it finds a match, then `@id{find}` returns the indices `@N{of @T{s}}` where this occurrence starts and ends;

otherwise, it returns `@fail`.

A third, optional numeric argument `@id{init}` specifies where to start the search;

its default value `@N{is 1}` and can be negative.

A `@true` as a fourth, optional argument `@id{plain}` turns off the pattern matching facilities, so the function does a plain `@Q{find substring}` operation, with no characters in `@id{pattern}` being considered magic.

If the pattern has captures, then in a successful match the captured values are also returned, after the two indices.

}

`@LibEntry{string.format (formatstring, @Cdots)|`

Returns a formatted version of its variable number of arguments following the description given in its first argument, which must be a string.

The format string follows the same rules as the `@ANSI{sprintf}`.

The only differences are that the conversion specifiers and modifiers `@id{F}`, `@id{n}`, `@T{*}`, `@id{h}`, `@id{L}`, and `@id{l}` are not supported and that there is an extra specifier, `@id{q}`.

Both width and precision, when present, are limited to two digits.

The specifier `@id{q}` formats booleans, nil, numbers, and strings in a way that the result is a valid constant in Lua source code.

Booleans and nil

are written in the obvious way

(`@id{true}`, `@id{false}`, `@id{nil}`).

Floats are written in hexadecimal,  
to preserve full precision.  
A string is written between double quotes,  
using escape sequences when necessary to ensure that  
it can safely be read back by the Lua interpreter.  
For instance, the call

```
@verbatim{
string.format("%q", 'a string with "quotes" and \n new line')
}

```

may produce the string:

```
@verbatim{
"a string with \"quotes\" and \
new line"
}

```

This specifier does not support modifiers (flags, width, precision).

The conversion specifiers  
`@id{A}`, `@id{a}`, `@id{E}`, `@id{e}`, `@id{f}`,  
`@id{G}`, and `@id{g}` all expect a number as argument.  
The specifiers `@id{c}`, `@id{d}`,  
`@id{i}`, `@id{o}`, `@id{u}`, `@id{X}`, and `@id{x}`  
expect an integer.  
When Lua is compiled with a C89 compiler,  
the specifiers `@id{A}` and `@id{a}` (hexadecimal floats)  
do not support modifiers.

The specifier `@id{s}` expects a string;  
if its argument is not a string,  
it is converted to one following the same rules of `@Lid{tostring}`.  
If  
the specifier has any modifier,  
the corresponding string argument should not contain `@x{embedded zeros}`.

The specifier `@id{p}` formats the pointer  
returned by `@Lid{lua_topointer}`.  
That gives a unique string identifier for tables, userdata,  
threads, strings, and functions.  
For other values (numbers, nil, booleans),  
this specifier results in a string representing  
the pointer `@id{NULL}`.

}

```
@LibEntry{string.gmatch (s, pattern [, init])|
Returns an iterator function that,
each time it is called,
returns the next captures from @id{pattern} @see{pm}
over the string @id{s}.

```



If `@id{pattern}` specifies no captures, then the whole match is produced in each call. A third, optional numeric argument `@id{init}` specifies where to start the search; its default value `@N{is 1}` and can be negative.

As an example, the following loop will iterate over all the words from string `@id{s}`, printing one per line:

```
@verbatim{
s = "hello world from Lua"
for w in string.gmatch(s, "%a+") do
  print(w)
end
}
```

The next example collects all pairs `@T{key=value}` from the given string into a table:

```
@verbatim{
t = {}
s = "from=world, to=Lua"
for k, v in string.gmatch(s, "(%w+)=(%w+)") do
  t[k] = v
end
}
```

For this function, a caret `@Char{^}` at the start of a pattern does not work as an anchor, as this would prevent the iteration.

```
}
```

```
@LibEntry{string.gsub (s, pattern, repl [, n])|
```

Returns a copy of `@id{s}`

in which all (or the first `@id{n}`, if given)

occurrences of the `@id{pattern}` `@see{pm}` have been replaced by a replacement string specified by `@id{repl}`,

which can be a string, a table, or a function.

`@id{gsub}` also returns, as its second value, the total number of matches that occurred.

The name `@id{gsub}` comes from `@emph{Global SUBstitution}`.

If `@id{repl}` is a string, then its value is used for replacement.

The `@N{character @T{%}}` works as an escape character:

any sequence in `@id{repl}` of the form `@T{%@rep{d}}`,

with `@rep{d}` between 1 and 9,

stands for the value of the `@rep{d}`-th captured substring;

the

sequence `@T{%0}` stands for the whole match;  
the sequence `@T{%%}` stands for a `@N{single @T{%}}`.

If `@id{repl}` is a table, then the table is queried for every match,  
using the first capture as the key.

If `@id{repl}` is a function, then this function is called every time a  
match occurs, with all captured substrings passed as arguments,  
in order.

In any case,  
if the pattern specifies no captures,  
then it behaves as if the whole pattern was inside a capture.

If the value returned by the table query or by the function call  
is a string or a number,  
then it is used as the replacement string;  
otherwise, if it is `@Rw{false}` or `@nil`,  
then there is no replacement  
(that is, the original match is kept in the string).

Here are some examples:

```
@verbatim{
```

```
x = string.gsub("hello world", "(%w+)", "%1 %1")
```

```
--> x="hello hello world world"
```

```
x = string.gsub("hello world", "%w+", "%0 %0", 1)
```

```
--> x="hello hello world"
```

```
x = string.gsub("hello world from Lua", "(%w+)%s*(%w+)", "%2 %1")
```

```
--> x="world hello Lua
```

```
from"
```

```
x = string.gsub("home = $HOME, user = $USER", "%$(%w+)", os.getenv)
```

```
--> x="home = /home/roberto, user = roberto"
```

```
x = string.gsub("4+5 = $return 4+5$", "%$(.)%", function (s)
```

```
    return load(s)()
```

```
end)
```

```
--> x="4+5 = 9"
```

```
local t = {name="lua", version="5.4"}
```

```
x = string.gsub("$name-$version.tar.gz", "%$(%w+)", t)
```

```
--> x="lua-5.4.tar.gz"
```

```
}
```

```
}
```

@LibEntry{string.len (s)|

Receives a string and returns its length.  
The empty string @T{""} has length 0.  
Embedded zeros are counted,  
so @T{"a\000bc\000"} has length 5.

}

@LibEntry{string.lower (s)|

Receives a string and returns a copy of this string with all  
uppercase letters changed to lowercase.  
All other characters are left unchanged.  
The definition of what an uppercase letter is depends on the current locale.

}

@LibEntry{string.match (s, pattern [, init])|

Looks for the first @emph{match} of  
the @id{pattern} @see{pm} in the string @id{s}.  
If it finds one, then @id{match} returns  
the captures from the pattern;  
otherwise it  
returns @fail.  
If @id{pattern} specifies no captures,  
then the whole match is returned.  
A third, optional numeric argument @id{init} specifies  
where to start the search;  
its default value @N{is 1} and can be negative.

}

@LibEntry{string.pack (fmt, v1, v2, @Cdots)|

Returns a binary string containing the values @id{v1}, @id{v2}, etc.  
serialized in binary form (packed)  
according to the format string @id{fmt} @see{pack}.

}

@LibEntry{string.packsize (fmt)|

Returns the length of a string resulting from @Lid{string.pack}  
with the given format.  
The format string cannot have the variable-length options  
@Char{s} or @Char{z} @see{pack}.

}

@LibEntry{string.rep (s, n [, sep])|

Returns a string that is the concatenation of @id{n} copies of the string @id{s} separated by the string @id{sep}.

The default value for @id{sep} is the empty string (that is, no separator).

Returns the empty string if @id{n} is not positive.

(Note that it is very easy to exhaust the memory of your machine with a single call to this function.)

}

@LibEntry{string.reverse (s)|

Returns a string that is the string @id{s} reversed.

}

@LibEntry{string.sub (s, i [, j])|

Returns the substring of @id{s} that starts at @id{i} and continues until @id{j};

@id{i} and @id{j} can be negative.

If @id{j} is absent, then it is assumed to be equal to @num{-1} (which is the same as the string length).

In particular,

the call @T{string.sub(s,1,j)} returns a prefix of @id{s} with length @id{j},

and @T{string.sub(s, -i)} (for a positive @id{i}) returns a suffix of @id{s} with length @id{i}.

If, after the translation of negative indices,

@id{i} is less than 1,

it is corrected to 1.

If @id{j} is greater than the string length,

it is corrected to that length.

If, after these corrections,

@id{i} is greater than @id{j},

the function returns the empty string.

}

@LibEntry{string.unpack (fmt, s [, pos])|

Returns the values packed in string @id{s} @seeF{string.pack}  
according to the format string @id{fmt} @see{pack}.

An

optional @id{pos} marks where  
to start reading in @id{s} (default is 1).

After the read values,  
this function also returns the index of the first unread byte in @id{s}.

}

@LibEntry{string.upper (s)|

Receives a string and returns a copy of this string with all  
lowercase letters changed to uppercase.  
All other characters are left unchanged.  
The definition of what a lowercase letter is depends on the current locale.

}

}

@sect3{pm| @title{Patterns}}

@simplesect{

Patterns in Lua are described by regular strings,  
which are interpreted as patterns by the pattern-matching functions  
@Lid{string.find},  
@Lid{string.gmatch},  
@Lid{string.gsub},  
and @Lid{string.match}.  
This section describes the syntax and the meaning  
(that is, what they match) of these strings.

}

@sect4{@title{Character Class:}}

A @def{character class} is used to represent a set of characters.  
The following combinations are allowed in describing a character class:  
@description{

@item{@rep{x}|  
(where @rep{x} is not one  
of the @emphx{magic characters}  
@T{^\$()%%.[]\*+-.?})

represents the character `@emph{x}` itself.

}

`@item{@T{.}|` (a dot) represents all characters.

`@item{@T{%a}|` represents all letters.

`@item{@T{%c}|` represents all control characters.

`@item{@T{%d}|` represents all digits.

`@item{@T{%g}|` represents all printable characters except space.

`@item{@T{%l}|` represents all lowercase letters.

`@item{@T{%p}|` represents all punctuation characters.

`@item{@T{%s}|` represents all space characters.

`@item{@T{%u}|` represents all uppercase letters.

`@item{@T{%w}|` represents all alphanumeric characters.

`@item{@T{%x}|` represents all hexadecimal digits.

`@item{@T{%@rep{x}}|` (where `@rep{x}` is any non-alphanumeric character)  
represents the character `@rep{x}`.

This is the standard way to escape the magic characters.

Any non-alphanumeric character

(including all punctuation characters, even the non-magical)

can be preceded by a `@Char{%}` to represent itself in a pattern.

}

`@item{@T{[@rep{set}]}`

represents

the class which is the union of all

characters in `@rep{set}`.

A range of characters can be specified by

separating the end characters of the range,

in ascending order, with a `@Char{-}`.

All classes `@T{%}@emph{x}` described above can also be used as  
components in `@rep{set}`.

All other characters in `@rep{set}` represent themselves.

For example, `@T{[%w_]}` (or `@T{[_%w]}`)

represents all alphanumeric characters plus the underscore,

`@T{[0-7]}` represents the octal digits,

and `@T{[0-7%l%-]}` represents the octal digits plus

the lowercase letters plus the `@Char{-}` character.

You can put a closing square bracket in a set  
by positioning it as the first character in the set.  
You can put a hyphen in a set  
by positioning it as the first or the last character in the set.  
(You can also use an escape for both cases.)

The interaction between ranges and classes is not defined.  
Therefore, patterns like `@T{[%a-z]}` or `@T{[a-%]}`  
have no meaning.  
}

`@item{@T{[^@rep{set}]}`  
represents the complement of `@rep{set}`,  
where  
`@rep{set}` is interpreted as above.  
}

}

For all classes represented by single letters (`@T{%a}`, `@T{%c}`, etc.),  
the corresponding uppercase letter represents the complement of the class.  
For instance, `@T{%S}` represents all non-space characters.

The definitions of letter, space, and other character groups  
depend on the current locale.  
In particular, the class `@T{[a-z]}` may not be equivalent to `@T{%l}`.  
}

`@sect4{@title{Pattern Item:}`  
A `@def{pattern item}` can be  
`@itemize{`

`@item{`  
a single character class,  
which matches any single character in the class;  
}

`@item{`  
a single character class followed by `@Char{*}`,  
which matches sequences of zero or more characters in the class.  
These repetition items will always match the longest possible sequence;  
}

`@item{`  
a single character class followed by `@Char{+}`,  
which matches sequences of one or more characters in the class.  
These repetition items will always match the longest possible sequence;

}

@item{

a single character class followed

by @Char{-},

which also matches sequences of zero or more characters in the class.

Unlike @Char{\*},

these repetition items will always match the shortest possible sequence;

}

@item{

a single character class followed by @Char{?},

which matches zero or one occurrence of a character in the class.

It always matches one occurrence if possible;

}

@item{

@T{%@rep{n}}, for @rep{n} between 1 and 9;

such item matches a substring equal to the @rep{n}-th captured string

(see below);

}

@item{

@T{%b@rep{xy}}, where @rep{x} and @rep{y} are two distinct characters;

such item matches strings that start @N{with @rep{x}}, end @N{with @rep{y}},

and where the @rep{x} and @rep{y} are @emph{balanced}.

This means that, if one reads the string from left to right,

counting @M{+1} for an @rep{x} and @M{-1} for a @rep{y},

the ending @rep{y} is the first @rep{y} where the count reaches 0.

For instance, the item @T{%b()} matches expressions with

balanced parentheses.

}

@item{

@T{%f[@rep{set}]}, a @def{frontier

pattern};

such item matches an empty string at any position such that

the next character belongs to @rep{set}

and the previous character does not belong to @rep{set}.

The set @rep{set} is interpreted as previously described.

The beginning and the end of the subject are handled as if

they were the character @Char{\0}.

}

}

}



@sect4{@title{Pattern:}}

A @def{pattern} is a sequence of pattern items.

A caret @Char{^} at the beginning of a pattern anchors the match at the beginning of the subject string.

A @Char{\$} at the end of a pattern anchors the match at the end of the subject string.

At other positions,

@Char{^} and @Char{\$} have no special meaning and represent themselves.

}

@sect4{@title{Captures:}}

A pattern can contain sub-patterns enclosed in parentheses; they describe @def{captures}.

When a match succeeds, the substrings of the subject string that match captures are stored (@emph{captured}) for future use.

Captures are numbered according to their left parentheses.

For instance,

in the pattern @T{"(a\*(.)%w(%s\*))"},  
the part of the string matching @T{"a\*(.)%w(%s\*)"} is  
stored as the first capture, and therefore has @N{number 1};  
the character matching @St{.} is captured with @N{number 2},  
and the part matching @St{%s\*} has @N{number 3}.

As a special case, the capture @T{} captures the current string position (a number).

For instance, if we apply the pattern @T{"()aa()"} on the string @T{"flaaap"}, there will be two captures: @N{3 and 5}.

}

@sect4{@title{Multiple matches:}}

The function @Lid{string.gsub} and the iterator @Lid{string.gmatch} match multiple occurrences of the given pattern in the subject.

For these functions,

a new match is considered valid only  
if it ends at least one byte after the end of the previous match.

In other words, the pattern machine never accepts the empty string as a match immediately after another match.

As an example,

consider the results of the following code:

@verbatim{

> string.gsub("abc", "()a\*()", print);

--> 1 2

--> 3

3

--> 4 4

}

The second and third results come from Lua matching an empty string after `@Char{b}` and another one after `@Char{c}`.  
 Lua does not match an empty string after `@Char{a}`, because it would end at the same position of the previous match.

}

}

`@sect3{pack| @title{Format Strings for Pack and Unpack}}`

The first argument to `@Lid{string.pack}`,  
`@Lid{string.packsize}`, and `@Lid{string.unpack}`  
 is a format string,  
 which describes the layout of the structure being created or read.

A format string is a sequence of conversion options.

The conversion options are as follows:

```
@description{
@item{@T{<}|sets little endian}
@item{@T{>}|sets big endian}
@item{@T{=}|sets native endian}
@item{@T{![@rep{n}]}|sets maximum alignment to @id{n}
(default is native alignment)}
@item{@T{b}|a signed byte (@id{char})}
@item{@T{B}|an unsigned byte (@id{char})}
@item{@T{h}|a signed @id{short} (native size)}
@item{@T{H}|an unsigned @id{short} (native size)}
@item{@T{l}|a signed @id{long} (native size)}
@item{@T{L}|an
  unsigned @id{long} (native size)}
@item{@T{j}|a @id{lua_Integer}}
@item{@T{J}|a @id{lua_Unsigned}}
@item{@T{T}|a @id{size_t} (native size)}
@item{@T{i[@rep{n}]}|a signed @id{int} with @id{n} bytes
(default is native size)}
@item{@T{I[@rep{n}]}|an unsigned @id{int} with @id{n} bytes
(default is native size)}
@item{@T{f}|a @id{float} (native size)}
@item{@T{d}|a @id{double} (native size)}
@item{@T{n}|a @id{lua_Number}}
@item{@T{c[@rep{n}]}|a fixed-sized string with @id{n} bytes}
@item{@T{z}|a zero-terminated string}
@item{@T{s[@emph{n}]}|a string preceded by its length
coded as an unsigned integer with @id{n} bytes
(default is a @id{size_t})}
@item{@T{x}|one byte of padding}
@item{@T{X[@rep{op}]}|an empty item that aligns
```

according to option `@id{op}`  
 (which is otherwise ignored)}  
`@item{@Char{ }(space) ignored}`  
`}`  
 (A `@St{[@rep{n}]}` means an optional integral numeral.)  
 Except for padding, spaces, and configurations  
 (options `@St{xX <=>!}`),  
 each option corresponds to an argument in `@Lid{string.pack}`  
 or  
 a result in `@Lid{string.unpack}`.

For options `@St{!@rep{n}}`, `@St{s@rep{n}}`, `@St{i@rep{n}}`, and `@St{I@rep{n}}`,  
`@id{n}` can be any integer between 1 and 16.  
 All integral options check overflows;  
`@Lid{string.pack}` checks whether the given value fits in the given size;  
`@Lid{string.unpack}` checks whether the read value fits in a Lua integer.  
 For the unsigned options,  
 Lua integers are treated as unsigned values too.

Any format string starts as if prefixed by `@St{!1=}`,  
 that is,  
 with maximum alignment of 1 (no alignment)  
 and native endianness.

Native endianness assumes that the whole system is  
 either big or little endian.  
 The packing functions will not emulate correctly the behavior  
 of mixed-endian formats.

Alignment works as follows:  
 For each option,  
 the format gets extra padding until the data starts  
 at an offset that is a multiple of the minimum between the  
 option size and the maximum alignment;  
 this minimum must be a power of 2.  
 Options `@St{c}` and `@St{z}` are not aligned;  
 option  
`@St{s}` follows the alignment of its starting integer.

All padding is filled with zeros by `@Lid{string.pack}`  
 and ignored by `@Lid{string.unpack}`.

`}`

`}`

`@sect2{utf8| @title{UTF-8 Support}`

This library provides basic support for `@x{UTF-8}` encoding.  
It provides all its functions inside the table `@defid{utf8}`.  
This library does not provide any support for `@x{Unicode}` other than the handling of the encoding.  
Any operation that needs the meaning of a character, such as character classification, is outside its scope.

Unless stated otherwise,  
all functions that expect a byte position as a parameter assume that the given position is either the start of a byte sequence or one plus the length of the subject string.  
As in the string library,  
negative indices count from the end of the string.

Functions that create byte sequences  
accept all values up to `@T{0x7FFFFFFF}`,  
as defined in the original UTF-8 specification;  
that implies byte sequences of up to six bytes.

Functions that interpret  
byte sequences only accept  
valid sequences (well formed and not overlong).  
By default, they only accept byte sequences  
that result in valid Unicode code points,  
rejecting values greater than `@T{10FFFF}` and surrogates.  
A boolean argument `@id{lax}`, when available,  
lifts these checks,  
so that all values up to `@T{0x7FFFFFFF}` are accepted.  
(Not well formed and overlong sequences are still rejected.)

`@LibEntry{utf8.char (@Cdots)|`

Receives zero or more integers,  
converts each one to its corresponding UTF-8 byte sequence  
and returns a string with the concatenation of all these sequences.

`}`

`@LibEntry{utf8.charpattern|`

The pattern (a string, not a function) `@St{[\0-\x7F\xC2-\xFD][\x80-\xBF]*}`  
`@see{pm}`,  
which matches exactly one UTF-8 byte sequence,  
assuming that the subject is a valid UTF-8 string.

`}`

@LibEntry{utf8.codes (s [, lax])|

Returns values so that the construction

@verbatim{

for p, c in utf8.codes(s) do @rep{body} end

}

will iterate over all UTF-8 characters in string @id{s},

with

@id{p} being the position (in bytes) and @id{c} the code point of each character.

It raises an error if it meets any invalid byte sequence.

}

@LibEntry{utf8.codepoint (s [, i [, j [, lax]])]|

Returns the code points (as integers) from all characters in @id{s}

that start between byte position @id{i} and @id{j} (both included).

The default for @id{i} is 1 and for @id{j} is @id{i}.

It raises an error if it meets any invalid byte sequence.

}

@LibEntry{utf8.len (s [, i [, j [, lax]])]|

Returns the number of UTF-8 characters in string @id{s}

that start between positions @id{i} and @id{j} (both inclusive).

The default for @id{i} is @num{1} and for @id{j} is @num{-1}.

If it finds any invalid byte sequence,

returns @fail plus the position of the first invalid byte.

}

@LibEntry{utf8.offset (s, n [, i)]|

Returns the position (in bytes) where the encoding of the

@id{n}-th character of @id{s}

(counting from position @id{i}) starts.

A negative @id{n} gets characters before position @id{i}.

The

default for @id{i} is 1 when @id{n} is non-negative

and @T{#s + 1} otherwise,

so that @T{utf8.offset(s, -n)} gets the offset of the

@id{n}-th character from the end of the string.

If the specified character is neither in the subject

nor right after its end,

the function returns @fail.

As a special case,  
when @id{n} is 0 the function returns the start of the encoding  
of the character that contains the @id{i}-th byte of @id{s}.

This function assumes that @id{s} is a valid UTF-8 string.

}

}

@sect2{tablib| @title{Table Manipulation}

This library provides generic functions for table manipulation.  
It provides all its functions inside the table @defid{table}.

Remember that, whenever an operation needs the length of a table,  
all caveats about the length operator apply @see{len-op}.  
All functions ignore non-numeric keys  
in the tables given as arguments.

@LibEntry{table.concat (list [, sep [, i [, j]])]}

Given a list where all elements are strings or numbers,  
returns the string

@T{list[i]..sep..list[i+1] @Cdots sep..list[j]}.

The default value for @id{sep} is the empty string,

the default for @id{i} is 1,

and the default for @id{j} is @T{#list}.

If @id{i} is greater than @id{j}, returns the empty string.

}

@LibEntry{table.insert (list, [pos,] value)}

Inserts element @id{value} at position @id{pos} in @id{list},  
shifting up the elements

@T{list[pos], list[pos+1], @Cdots, list[#list]}.

The default value for @id{pos} is @T{#list+1},

so that a call @T{table.insert(t,x)} inserts @id{x} at the end  
of the list @id{t}.

}

@LibEntry{table.move (a1, f, e, t [,a2])}

Moves elements from the table @id{a1} to the table @id{a2},

performing the equivalent to the following

multiple assignment:

`@T{a2[t],@Cdots = a1[f],@Cdots,a1[e]}`.

The default for `@id{a2}` is `@id{a1}`.

The destination range can overlap with the source range.

The number of elements to be moved must fit in a Lua integer.

Returns the destination table `@id{a2}`.

}

`@LibEntry{table.pack (@Cdots)|`

Returns

a new table with all arguments stored into keys 1, 2, etc.

and with a field `@St{n}` with the total number of arguments.

Note that the resulting table may not be a sequence,

if some arguments are `@nil`.

}

`@LibEntry{table.remove (list [, pos])|`

Removes from `@id{list}` the element at position `@id{pos}`,  
returning the value of the removed element.

When `@id{pos}` is an integer between 1 and `@T{#list}`,

it shifts down the elements

`@T{list[pos+1], list[pos+2], @Cdots, list[#list]}`

and erases element `@T{list[#list]}`;

The index `@id{pos}` can also be 0 when `@T{#list}` is 0,

or `@T{#list + 1}`.

The default value for `@id{pos}` is `@T{#list}`,

so that a call `@T{table.remove(l)}` removes the last element  
of the list `@id{l}`.

}

`@LibEntry{table.sort (list [, comp])|`

Sorts the list elements in a given order, *@emph{in-place}*,  
from `@T{list[1]}` to `@T{list[#list]}`.

If `@id{comp}` is given,

then it must be a function that receives two list elements

and returns true when the first element must come

before the second in

the final order,

so that, after the sort,

`@T{i <= j}` implies `@T{not comp(list[j],list[i])}`.  
If `@id{comp}` is not given,  
then the standard Lua operator `@T{<}` is used instead.

The `@id{comp}` function must define a consistent order;  
more formally, the function must define a strict weak order.  
(A weak order is similar to a total order,  
but it can equate different elements for comparison purposes.)

The sort algorithm is not stable:  
Different elements considered equal by the given order  
may have their relative positions changed by the sort.

}

`@LibEntry{table.unpack (list [, i [, j]])|`

Returns the elements from the given list.  
This function is equivalent to  
`@verbatim{`  
`return list[i], list[i+1], @Cdots, list[j]`  
`}`  
By default, `@id{i}` `@N{is 1}` and `@id{j}` is `@T{#list}`.

}

}

`@sect2{mathlib| @title{Mathematical Functions}`

This library provides basic mathematical functions.  
It provides all its functions and constants inside the table `@defid{math}`.  
Functions with the annotation `@St{integer/float}`  
give  
integer results for integer arguments  
and float results for non-integer arguments.  
The rounding functions  
`@Lid{math.ceil}`, `@Lid{math.floor}`, and `@Lid{math.modf}`  
return an integer when the result fits in the range of an integer,  
or a float otherwise.

`@LibEntry{math.abs (x)|`

Returns the maximum value between `@id{x}` and `@id{-x}`. (integer/float)

}

`@LibEntry{math.acos (x)|`



Returns the arc cosine of  $\text{@id}\{x\}$  (in radians).

}

`@LibEntry{math.asin (x)}`

Returns the arc sine of  $\text{@id}\{x\}$  (in radians).

}

`@LibEntry{math.atan (y [, x])}`

`@index{atan}` `@index{atan2}`

Returns the arc tangent of  $\text{@T}\{y/x\}$  (in radians), using the signs of both arguments to find the quadrant of the result.

It also handles correctly the case of  $\text{@id}\{x\}$  being zero.

The default value for  $\text{@id}\{x\}$  is 1, so that the call `@T{math.atan(y)}` returns the arc tangent of  $\text{@id}\{y\}$ .

}

`@LibEntry{math.ceil (x)}`

Returns the smallest integral value greater than or equal to  $\text{@id}\{x\}$ .

}

`@LibEntry{math.cos (x)}`

Returns the cosine of  $\text{@id}\{x\}$  (assumed to be in radians).

}

`@LibEntry{math.deg (x)}`

Converts the angle  $\text{@id}\{x\}$  from radians to degrees.

}

`@LibEntry{math.exp (x)}`

Returns the value  $\text{@M}\{e^{\text{@sp}\{x\}}\}$  (where  $\text{@id}\{e\}$  is the base of natural logarithms).

}

@LibEntry{math.floor (x)|

Returns the largest integral value less than or equal to @id{x}.

}

@LibEntry{math.fmod (x, y)|

Returns the remainder of the division of @id{x} by @id{y}  
that rounds the quotient towards zero. (integer/float)

}

@LibEntry{math.huge|

The float value @idx{HUGE\_VAL},  
a value greater than any other numeric value.

}

@LibEntry{math.log (x [, base])|

Returns the logarithm of @id{x} in the given base.  
The default for @id{base} is @M{e}  
(so that the function returns the natural logarithm of @id{x}).

}

@LibEntry{math.max (x, @Cdots)|

Returns the argument with the maximum value,  
according to the Lua operator @T{<}.

}

@LibEntry{math.maxinteger|

An integer with the maximum value for an integer.

}

@LibEntry{math.min (x, @Cdots)|

Returns  
the argument with the minimum value,  
according to the Lua operator @T{<}.

}

@LibEntry{math.mininteger|

An integer with the minimum value for an integer.

}

@LibEntry{math.modf (x)|

Returns the integral part of @id{x} and the fractional part of @id{x}.

Its second result is always a float.

}

@LibEntry{math.pi|

The value of @M{@pi}.

}

@LibEntry{math.rad (x)|

Converts the angle @id{x} from degrees to radians.

}

@LibEntry{math.random ([m [, n]])|

When called without arguments,  
returns a pseudo-random float with uniform distribution  
in the range @C{() @M{[0,1)}. @C{[]}

When called with two integers @id{m} and @id{n},  
@id{math.random} returns a pseudo-random integer  
with uniform distribution in the range @M{[m, n]}.

The call @T{math.random(n)}, for a positive @id{n},  
is equivalent to @T{math.random(1,n)}.

The call @T{math.random(0)} produces an integer with  
all bits (pseudo)random.

This function uses the @idx{xoshiro256\*\*} algorithm to produce  
pseudo-random 64-bit integers,  
which

are the results of calls with @N{argument 0}.

Other results (ranges and floats)

are unbiased extracted from these integers.

Lua initializes its pseudo-random generator with the equivalent of

a call to `@Lid{math.randomseed}` with no arguments,  
so that `@id{math.random}` should generate  
different sequences of results each time the program runs.

}

`@LibEntry{math.randomseed ([x [, y]])|`

When called with at least one argument,  
the integer parameters `@id{x}` and `@id{y}` are  
joined into a 128-bit `@emphx{seed}` that  
is used to reinitialize the pseudo-random generator;  
equal seeds produce equal sequences of numbers.  
The default for `@id{y}` is zero.

When called with no arguments,  
Lua generates a seed with  
a weak attempt for randomness.

This function returns the two seed components  
that were effectively used,  
so that setting them again repeats the sequence.

To ensure a required level of randomness to the initial state  
(or contrarily, to have a deterministic sequence,  
for instance when debugging  
a program),  
you should call `@Lid{math.randomseed}` with explicit arguments.

}

`@LibEntry{math.sin (x)|`

Returns the sine of `@id{x}` (assumed to be in radians).

}

`@LibEntry{math.sqrt (x)|`

Returns the square root of `@id{x}`.  
(You can also use the expression `@T{x^0.5}` to compute this value.)

}

`@LibEntry{math.tan (x)|`

Returns the tangent of `@id{x}` (assumed to be in radians).

}

@LibEntry{math.tointeger (x)|

If the value @id{x} is convertible to an integer,  
returns that integer.

Otherwise, returns @fail.

}

@LibEntry{math.type (x)|

Returns @St{integer} if @id{x} is an integer,

@St{float} if it is a float,

or @fail if @id{x} is not a number.

}

@LibEntry{math.ult (m, n)|

Returns a boolean,

@true if and only if integer @id{m} is below integer @id{n} when  
they are compared as @x{unsigned integers}.

}

}

@sect2{iolib| @title{Input and Output Facilities}}

The I/O library provides two different styles for file manipulation.

The first one uses implicit file handles;

that is, there

are operations to set a default input file and a

default output file,

and all input/output operations are done over these default files.

The second style uses explicit file handles.

When using implicit file handles,

all operations are supplied by table @defid{io}.

When using explicit file handles,

the operation @Lid{io.open} returns a file handle

and then all operations are supplied as methods of the file handle.

The metatable for file handles provides metamethods

for @idx{\_\_gc} and @idx{\_\_close} that try

to close the file when called.

The table @id{io} also provides  
three predefined file handles with their usual meanings from C:  
@defid{io.stdin}, @defid{io.stdout}, and @defid{io.stderr}.  
The I/O library never closes these files.

Unless otherwise stated,  
all I/O functions return @fail on failure,  
plus an error message as a second result and  
a system-dependent error code as a third result,  
and some non-false value on success.  
On non-POSIX systems,  
the computation of the error message  
and error code  
in case of errors  
may be not @x{thread safe},  
because they rely on the global C variable @id{errno}.

@LibEntry{io.close ([file])|

Equivalent to @T{file:close()}.  
Without a @id{file}, closes the default output file.

}

@LibEntry{io.flush ()|

Equivalent to @T{io.output():flush()}.

}

@LibEntry{io.input ([file])|

When called with a file name, it opens the named file (in text mode),  
and sets its handle as the default input file.  
When called with a file handle,  
it simply sets this file handle as the default input file.  
When called without arguments,  
it returns the current default input file.

In case of errors this function raises the error,  
instead of returning an error code.

}

@LibEntry{io.lines ([filename, @Cdots])|

Opens the given file name in read mode  
and returns an iterator function that

works like `@T{file:lines(@Cdots)}` over the opened file.

When the iterator function fails to read any value,

it automatically closes the file.

Besides the iterator function,

`@id{io.lines}`

returns three other values:

two `@nil` values as placeholders,

plus the created file handle.

Therefore, when used in a generic `@Rw{for}` loop,

the file is closed also if the loop is interrupted by an

error or a `@Rw{break}`.

The call `@T{io.lines()}` (with no file name) is equivalent

to `@T{io.input():lines("")}`;

that is, it iterates over the lines of the default input file.

In this case, the iterator does not close the file when the loop ends.

In case of errors opening the file,

this function raises the error,

instead of returning an error code.

}

`@LibEntry{io.open (filename [, mode])|`

This function opens a file,

in the mode specified in the string `@id{mode}`.

In case of success,

it returns a new file handle.

The `@id{mode}` string can be any of the following:

`@description{`

`@item{@St{r}| read mode (the default);}`

`@item{@St{w}| write mode;}`

`@item{@St{a}| append mode;}`

`@item{@St{r+}| update mode, all previous data is preserved;}`

`@item{@St{w+}| update mode, all previous data is  
erased;}`

`@item{@St{a+}| append update mode, previous data is preserved,  
writing is only allowed at the end of file.}`

}

The `@id{mode}` string can also have a `@Char{b}` at the end,

which is needed in some systems to open the file in binary mode.

}

`@LibEntry{io.output ([file])|`

Similar to @Lid{io.input}, but operates over the default output file.

```
}
```

```
@LibEntry{io.popen (prog [, mode])|
```

This function is system dependent and is not available on all platforms.

Starts the program @id{prog} in a separated process and returns a file handle that you can use to read data from this program (if @id{mode} is @T{"r"}, the default) or to write data to this program (if @id{mode} is @T{"w"}).

```
}
```

```
@LibEntry{io.read (@Cdots)|
```

Equivalent to @T{io.input():read(@Cdots)}.

```
}
```

```
@LibEntry{io.tmpfile ()|
```

In case of success,  
returns a handle for a temporary file.  
This file is opened in update mode  
and it is automatically removed when the program ends.

```
}
```

```
@LibEntry{io.type (obj)|
```

Checks whether @id{obj}  
is a valid file handle.  
Returns the string @T{"file"} if @id{obj} is an open file handle,  
@T{"closed file"} if @id{obj} is a closed file handle,  
or @fail if @id{obj} is not a file handle.

```
}
```

```
@LibEntry{io.write (@Cdots)|
```

Equivalent to @T{io.output():write(@Cdots)}.

```
}
```



```
@LibEntry{file:close ()|
```

Closes @id{file}.

Note that files are automatically closed when their handles are garbage collected, but that takes an unpredictable amount of time to happen.

When closing a file handle created with @Lid{io.popen}, @Lid{file:close} returns the same values returned by @Lid{os.execute}.

```
}
```

```
@LibEntry{file:flush ()|
```

Saves any written data to @id{file}.

```
}
```

```
@LibEntry{file:lines (@Cdots)|
```

Returns an iterator function that, each time it is called, reads the file according to the given formats.

When no format is given, uses @St{1} as a default.

As an example, the construction

```
@verbatim{  
for c in file:lines(1) do @rep{body} end  
}
```

will iterate over all characters of the file, starting at the current position.

Unlike @Lid{io.lines}, this function does not close the file when the loop ends.

```
}
```

```
@LibEntry{file:read (@Cdots)|
```

Reads the file @id{file}, according to the given formats, which specify what to read.

For each format, the function returns a string or a number with the characters read, or @fail if it cannot read data with the specified format.

(In this latter case, the function does not read subsequent formats.)

When called without arguments,  
it uses a default format that reads the next line  
(see below).

The available formats are  
`@description{`

`@item{@St{n}|`  
reads a numeral and returns it as a float or an integer,  
following the lexical conventions of Lua.  
(The numeral may have leading whitespaces and a sign.)  
This format always reads the longest input sequence that  
is a valid prefix for a numeral;  
if that prefix does not form a valid numeral  
(e.g., an empty string, `@St{0x}`, or `@St{3.4e-}`)  
or it is too long (more than 200 characters),  
it is discarded and the format returns `@fail`.  
`}`

`@item{@St{a}|`  
reads  
the whole file, starting at the current position.  
On end of file, it returns the empty string;  
this format never fails.  
`}`

`@item{@St{1}|`  
reads the next line skipping the end of line,  
returning `@fail` on end of file.  
This is the default format.  
`}`

`@item{@St{L}|`  
reads the next line keeping the end-of-line character (if present),  
returning `@fail` on end of file.  
`}`

`@item{@emph{number}|`  
reads a string with up to this number of bytes,  
returning `@fail` on end of file.  
If `@id{number}` is zero,  
it reads nothing and returns an empty string,  
or `@fail` on end of file.  
`}`

`}`

The formats `@St{1}` and `@St{L}` should be used only for text files.

}

@LibEntry{file:seek ([whence [, offset]])|

Sets and gets the file position,  
measured from the beginning of the file,  
to the position given by @id{offset} plus a base  
specified by the string @id{whence}, as follows:

@description{  
@item{@St{set}| base is position 0 (beginning of the file);}  
@item{@St{cur}| base is current position;}  
@item{@St{end}|  
base is end of file;}  
}

In case of success, @id{seek} returns the final file position,  
measured in bytes from the beginning of the file.

If @id{seek} fails, it returns @fail,  
plus a string describing the error.

The default value for @id{whence} is @T{"cur"},  
and for @id{offset} is 0.

Therefore, the call @T{file:seek()} returns the current  
file position, without changing it;  
the call @T{file:seek("set")} sets the position to the  
beginning of the file (and returns 0);  
and the call @T{file:seek("end")} sets the position to the  
end of the file, and returns its size.

}

@LibEntry{file:setvbuf (mode [, size])|

Sets the buffering mode for a file.

There are three available modes:

@description{  
@item{@St{no}| no buffering.}  
@item{@St{full}| full buffering.}  
@item{@St{line}| line buffering.}  
}

For the last two cases,

@id{size} is a hint for the size of the buffer, in bytes.

The default is an appropriate size.

The specific behavior of each mode is non portable;  
check the underlying

@ANSI{setvbuf} in your platform for  
more details.

```
}
```

```
@LibEntry{file:write (@Cdots)|
```

Writes the value of each of its arguments to @id{file}.

The arguments must be strings or numbers.

In case of success, this function returns @id{file}.

```
}
```

```
}
```

```
@sect2{oslib| @title{Operating System Facilities}
```

This library is implemented through table @defid{os}.

```
@LibEntry{os.clock ()|
```

Returns an approximation of the amount in seconds of CPU time used by the program,

as returned by the underlying @ANSI{clock}.

```
}
```

```
@LibEntry{os.date ([format [, time]])|
```

Returns a string or a table containing date and time, formatted according to the given string @id{format}.

If the @id{time} argument is present,  
this is the time to be formatted  
(see the @Lid{os.time} function for a description of this value).  
Otherwise, @id{date} formats the current time.

If @id{format} starts with @Char{!},  
then the date is formatted in Coordinated Universal Time.  
After this optional character,  
if @id{format} is the string @St{\*t},  
then

@id{date} returns a table with the following fields:  
@id{year}, @id{month} (1@En{ }12), @id{day} (1@En{ }31),  
@id{hour} (0@En{ }23), @id{min} (0@En{ }59),  
@id{sec} (0@En{ }61, due to leap seconds),  
@id{yday} (weekday, 1@En{ }7, Sunday @N{is 1}),  
@id{yday} (day of the year, 1@En{ }366),

and @id{isdst} (daylight saving flag, a boolean).

This last field may be absent  
if the information is not available.

If @id{format} is not @St{\*t},  
then @id{date} returns the date as a string,  
formatted according to the same rules as the @ANSI{strftime}.

If @id{format} is absent, it defaults to @St{%c},  
which gives a human-readable date and time representation  
using the current locale.

On non-POSIX systems,  
this function may be not @x{thread safe}  
because of its reliance on @Cid{gmtime} and @Cid{localtime}.

}

@LibEntry{os.difftime (t2, t1)|

Returns the difference, in seconds,  
from time @id{t1} to time @id{t2}  
(where the times are values returned by @Lid{os.time}).  
In @x{POSIX}, @x{Windows}, and  
some other systems,  
this value is exactly @id{t2}@M{-}@id{t1}.

}

@LibEntry{os.execute ([command])|

This function is equivalent to the @ANSI{system}.  
It passes @id{command} to be executed by an operating system shell.  
Its first result is @true  
if the command terminated successfully,  
or @fail otherwise.  
After this first result  
the function returns a string plus a number,  
as follows:  
@description{

@item{@St{exit}|  
the command terminated normally;  
the following number is the exit status of the command.  
}

@item{@St{signal}|  
the command was terminated by a signal;

the following number is the signal that terminated the command.

}

}

When called without a @id{command},

@id{os.execute} returns a boolean that is true if a shell is available.

}

@LibEntry{os.exit ([code [, close]])|

Calls the @ANSI{exit} to terminate the host program.

If @id{code} is @true,

the returned status is @idx{EXIT\_SUCCESS};

if @id{code} is @false,

the returned status is @idx{EXIT\_FAILURE};

if @id{code} is a number,

the

returned status is this number.

The default value for @id{code} is @true.

If the optional second argument @id{close} is true,

the function closes the Lua state before exiting @seeF{lua\_close}.

}

@LibEntry{os.getenv (varname)|

Returns the value of the process environment variable @id{varname}

or @fail if the variable is not defined.

}

@LibEntry{os.remove (filename)|

Deletes the file (or empty directory, on @x{POSIX} systems)

with the given name.

If this function fails, it returns @fail

plus a string describing the error and the error code.

Otherwise, it returns true.

}

@LibEntry{os.rename (oldname, newname)|

Renames the file or directory named @id{oldname} to @id{newname}.

If this function fails, it returns @fail,

plus a string describing the error and the error code.

Otherwise, it returns true.

}

@LibEntry{os.setlocale (locale [, category])|

Sets the current locale of the program.

@id{locale} is a system-dependent string specifying a locale;

@id{category} is an optional

string describing which category to change:

@T{"all"}, @T{"collate"}, @T{"ctype"},

@T{"monetary"}, @T{"numeric"}, or @T{"time"};

the default category is @T{"all"}.

The function returns the name of the new locale,

or @fail if the request cannot be honored.

If @id{locale} is the empty string,

the current locale is set to an implementation-defined native locale.

If @id{locale} is the string @St{C},

the current locale is set to the standard C locale.

When called with @nil as the first argument,

this function only returns the name of the current locale

for the given category.

This function may be not @x{thread safe}

because of its reliance on @CId{setlocale}.

}

@LibEntry{os.time ([table])|

Returns the current time when called without arguments,

or a time representing the local date and time specified by the given table.

This table must have fields @id{year}, @id{month}, and @id{day},

and may have fields

@id{hour} (default is 12),

@id{min} (default is 0),

@id{sec} (default is 0),

and

@id{isdst} (default is @nil).

Other fields are ignored.

For a description of these fields, see the @Lid{os.date} function.

When the function is called,

the values in these fields do not need to be inside their valid ranges.

For instance, if @id{sec} is -10,

it means 10 seconds before the time specified by the other fields;  
if @id{hour} is 1000,  
it means 1000 hours after the time specified by the other fields.

The returned value is a number, whose meaning depends on your system.  
In @x{POSIX}, @x{Windows}, and some other systems,  
this number counts the number  
of seconds since some given start time (the @Q{epoch}).  
In other systems, the meaning is not specified,  
and the number returned by @id{time} can be used only as an argument to  
@Lid{os.date} and @Lid{os.difftime}.

When called with a table,  
@id{os.time} also normalizes all the fields  
documented in the @Lid{os.date} function,  
so that they represent the same time as before the call  
but with values inside their valid ranges.

}

@LibEntry{os.tmpname  
()|

Returns a string with a file name that can  
be used for a temporary file.  
The file must be explicitly opened before its use  
and explicitly removed when no longer needed.

In @x{POSIX} systems,  
this function also creates a file with that name,  
to avoid security risks.  
(Someone else might create the file with wrong permissions  
in the time between getting the name and creating the file.)  
You still have to open the file to use it  
and to remove it (even if you do not use it).

When possible,  
you may prefer to use @Lid{io.tmpfile},  
which automatically removes the file when the program ends.

}

}

@sect2{debuglib| @title{The Debug Library}}

This library provides  
the functionality of the @link{debugI|debug interface} to Lua programs.



You should exert care when using this library.  
Several of its functions  
violate basic assumptions about Lua code  
(e.g., that variables local to a function  
cannot be accessed from outside;  
that userdata metatables cannot be changed by Lua  
code;  
that Lua programs do not crash)  
and therefore can compromise otherwise secure code.  
Moreover, some functions in this library may be slow.

All functions in this library are provided  
inside the `@defid{debug}` table.  
All functions that operate over a thread  
have an optional first argument which is the  
thread to operate over.  
The default is always the current thread.

`@LibEntry{debug.debug ()|`

Enters an interactive mode with the user,  
running each string that the user enters.  
Using simple commands and other debug facilities,  
the user can inspect global and local variables,  
change their values, evaluate expressions, and so on.  
A line containing only the word `@id{cont}` finishes this function,  
so that the caller continues its execution.

Note that commands for `@id{debug.debug}` are not lexically nested  
within any function and so have no direct access to local variables.

`}`

`@LibEntry{debug.gethook ([thread])|`

Returns the current hook settings of the thread, as three values:  
the current  
hook function, the current hook mask,  
and the current hook count,  
as set by the `@Lid{debug.sethook}` function.

Returns `@fail` if there is no active hook.

`}`

`@LibEntry{debug.getinfo ([thread,] f [, what])|`

Returns a table with information about a function.

You can give the function directly

or you can give a number as the value of `@id{f}`,

which means the function running at level `@id{f}` of the call stack of the given thread:

`@N{level 0}` is the current function (`@id{getinfo}` itself);

`@N{level 1}` is the function that called `@id{getinfo}`

(except for tail calls, which do not count in the stack);

and so on.

If `@id{f}` is a number greater than the number of active functions, then `@id{getinfo}` returns `@fail`.

The returned table can contain all the fields returned by `@Lid{lua_getinfo}`, with the string `@id{what}` describing which fields to fill in.

The default for `@id{what}` is to get all information available, except the table of valid lines.

The option `@Char{f}`

adds a field named `@id{func}` with the function itself.

The option `@Char{L}` adds a field named `@id{activelines}` with the table of valid lines, provided the function is a Lua function.

If the function has no debug information, the table is empty.

For instance, the expression `@T{debug.getinfo(1,"n").name}` returns a name for the current function, if a reasonable name can be found, and the expression `@T{debug.getinfo(print)}` returns a table with all available information about the `@Lid{print}` function.

}

`@LibEntry{debug.getlocal ([thread,] f, local)}`

This function returns the name and the value of the local variable with index `@id{local}` of the function at level `@id{f}` of the stack. This function accesses not only explicit local variables, but also parameters and temporary values.

The first parameter or local variable has `@N{index 1}`, and so on, following the order that they are declared in the code, counting only the variables that are active in the current scope of the function.

Compile-time constants may not appear in this listing,

if they were optimized away by the compiler.

Negative indices refer to vararg arguments;  
@num{-1} is the first vararg argument.  
The function returns @fail  
if there is no variable with the given index,  
and raises an error when called with a level out of range.  
(You can call @Lid{debug.getinfo} to check whether the level is valid.)

Variable names starting with @Char{() (open parenthesis) @C{}}  
represent variables with no known names  
(internal variables such as loop control variables,  
and variables from chunks saved without debug information).

The parameter @id{f} may also be a function.  
In that case, @id{getlocal} returns only the name of function parameters.

}

@LibEntry{debug.getmetatable (value)|

Returns the metatable of the given @id{value}  
or @nil if it does not have a metatable.

}

@LibEntry{debug.getregistry ()|

Returns the registry table @see{registry}.

}

@LibEntry{debug.getupvalue (f, up)|

This function returns the name and the value of the upvalue  
with

index @id{up} of the function @id{f}.

The function returns @fail  
if there is no upvalue with the given index.

(For Lua functions,  
upvalues are the external local variables that the function uses,  
and that are consequently included in its closure.)

For @N{C functions}, this function uses the empty string @T{""}  
as a name for all upvalues.

Variable name @Char{?} (interrogation mark)  
represents variables with no known names  
(variables from chunks saved without debug information).

```
}
```

```
@LibEntry{debug.getuservalue (u, n)|
```

Returns the @id{n}-th user value associated to the userdata @id{u} plus a boolean, @false if the userdata does not have that value.

```
}
```

```
@LibEntry{debug.sethook ([thread,] hook, mask [, count])|
```

Sets the given function as the debug hook.

The string @id{mask} and the number @id{count} describe when the hook will be called.

The string mask may have any combination of the following characters, with the given meaning:

```
@description{
```

```
@item{@Char{c}| the hook is called every  
time Lua calls a function;}
```

```
@item{@Char{r}| the hook is called every time Lua returns from a function;}
```

```
@item{@Char{l}| the hook is called every time Lua enters a new line of code.}
```

```
}
```

Moreover,

with a @id{count} different from zero,

the hook is called also after every @id{count} instructions.

When called without arguments,

@Lib{debug.sethook} turns off the hook.

When the hook is called, its first parameter is a string describing the event that has triggered its call:

@T{"call"}, @T{"tail call"}, @T{"return"},

@T{"line"}, and @T{"count"}.

For line events,

the hook also gets the new line number as its second parameter.

Inside a hook,

you can call @id{getinfo} with @N{level 2} to get more information about the running function.

(@N{Level 0} is the @id{getinfo} function,

and @N{level 1} is the hook function.)

```
}
```

```
@LibEntry{debug.setlocal ([thread,] level, local, value)|
```

This function assigns the value @id{value} to the local variable

with index `@id{local}` of the function at level `@id{level}` of the stack.  
The function returns `@fail` if there is no local variable with the given index,  
and raises an error when called with a `@id{level}` out of range.  
(You can call `@id{getinfo}` to check whether the level is valid.)  
Otherwise, it returns the name of the local variable.

See `@Lid{debug.getlocal}` for more information about variable indices and names.

}

`@LibEntry{debug.setmetatable (value, table)|`

Sets the metatable for the given `@id{value}` to the given `@id{table}` (which can be `@nil`).  
Returns `@id{value}`.

}

`@LibEntry{debug.setupvalue (f, up, value)|`

This function assigns the value `@id{value}` to the upvalue with index `@id{up}` of the function `@id{f}`.  
The function returns `@fail` if there is no upvalue with the given index.  
Otherwise, it returns the name of the upvalue.

See `@Lid{debug.getupvalue}` for more information about upvalues.

}

`@LibEntry{debug.setuservalue (udata, value, n)|`

Sets the given `@id{value}` as the `@id{n}`-th user value associated to the given `@id{udata}`.  
`@id{udata}`  
must be a full userdata.

Returns `@id{udata}`,  
or `@fail` if the userdata does not have that value.

}

`@LibEntry{debug.traceback ([thread,] [message [, level]])|`

If `@id{message}` is present but is neither a string nor `@nil`,

this function returns @id{message} without further processing.

Otherwise,

it returns a string with a traceback of the call stack.

The optional @id{message} string is appended at the beginning of the traceback.

An optional @id{level} number tells at which level to start the traceback

(default is 1, the function calling @id{traceback}).

}

@LibEntry{debug.upvalueid (f, n)|

Returns a unique identifier (as a light userdata)

for the upvalue numbered @id{n}

from the given function.

These unique identifiers allow a program to check whether different closures share upvalues.

Lua closures that share an upvalue

(that is, that access a same external local variable)

will return identical ids for those upvalue indices.

}

@LibEntry{debug.upvaluejoin (f1, n1, f2, n2)|

Make

the @id{n1}-th upvalue of the Lua closure @id{f1}

refer to the @id{n2}-th upvalue of the Lua closure @id{f2}.

}

}

}

@C{-----}

@sect1{lua-sa| @title{Lua Standalone}}

Although Lua has been designed as an extension language,

to be embedded in a host @N{C program},

it is also frequently used as a standalone language.

An interpreter for Lua as a standalone language,

called simply @id{lua},

is provided with the standard distribution.

The @x{standalone interpreter} includes

all standard libraries.

Its usage is:

```
@verbatim{
lua [options] [script [args]]
}
```

The options are:

```
@description{
@item{@T{-e @rep{stat}}| execute string @rep{stat};}
@item{@T{-i}| enter interactive mode after running @rep{script};}
@item{@T{-l @rep{mod}}| @Q{require} @rep{mod} and assign the
result to global @rep{mod};}
@item{@T{-l @rep{g=mod}}| @Q{require} @rep{mod} and assign the
result to global @rep{g};}
@item{@T{-v}| print version information;}
@item{@T{-E}|
ignore environment variables;}
@item{@T{-W}| turn warnings on;}
@item{@T{--}| stop handling options;}
@item{@T{-}| execute @id{stdin} as a file and stop handling options.}
}
```

(The form `@T{-l @rep{g=mod}}` was introduced in `@N{release 5.4.4}`.)

After handling its options, `@id{lua}` runs the given `@emph{script}`.

When called without arguments,

`@id{lua}` behaves as `@T{lua -v -i}`

when the standard input (`@id{stdin}`) is a terminal,

and as `@T{lua -}` otherwise.

When called without the option `@T{-E}`,

the interpreter checks for an environment variable `@defid{LUA_INIT_5_4}`  
(or `@defid{LUA_INIT}` if the versioned name is not defined)

before running any argument.

If the variable content has the format `@T{@At@rep{filename}}`,

then `@id{lua}` executes the file.

Otherwise, `@id{lua}` executes the string itself.

When called with the option `@T{-E}`,

Lua does not consult any environment variables.

In particular,

the values of `@Lid{package.path}` and `@Lid{package.cpath}`  
are set with the default

paths defined in `@id{luaconf.h}`.

To signal to the libraries that this option is on,

the stand-alone interpreter sets the field

`@idx{"LUA_NOENV"}` in the registry to a true value.

Other libraries may consult this field for the same purpose.

The options `@T{-e}`, `@T{-l}`, and `@T{-W}` are handled in

the order they appear.

For instance, an invocation like

```
@verbatim{
$ lua -e 'a=1' -llib1 script.lua
}
```

will first set `@id{a}` to 1, then require the library `@id{lib1}`,

and finally run the file `@id{script.lua}` with no arguments.

(Here `@T{$}` is the shell prompt. Your prompt may be different.)

Before running any code,

`@id{lua}` collects all command-line arguments

in a global table called `@id{arg}`.

The script name goes to index 0,

the first argument after the script name goes to index 1,

and so on.

Any arguments before the script name

(that is, the interpreter name plus its options)

go to negative indices.

For instance, in the call

```
@verbatim{
$ lua -la b.lua t1 t2
}
```

the table is like this:

```
@verbatim{
arg
= { [-2] = "lua", [-1] = "-la",
    [0] = "b.lua",
    [1] = "t1", [2] = "t2" }
}
```

If there is no script in the call,

the interpreter name goes to index 0,

followed by the other arguments.

For instance, the call

```
@verbatim{
$ lua -e "print(arg[1])"
}
```

will print `@St{-e}`.

If there is a script,

the script is called with arguments

`@T{arg[1]}`, `@Cdots`, `@T{arg[#arg]}`.

Like all chunks in Lua,

the script is compiled as a variadic function.

In interactive mode,

Lua repeatedly prompts and waits for a line.

After reading a line,

Lua first try to interpret the line as an expression.

If it succeeds, it prints its value.



Otherwise, it interprets the line as a statement.

If you write an incomplete statement,  
the interpreter waits for its completion  
by issuing a different prompt.

If the global variable `@defid{_PROMPT}` contains a string,  
then its value is used as the prompt.

Similarly, if the global variable `@defid{_PROMPT2}` contains a string,  
its value is used as the secondary prompt  
(issued  
during incomplete statements).

In case of unprotected errors in the script,  
the interpreter reports the error to the standard error stream.

If the error object is not a string but  
has a metamethod `@idx{__tostring}`,  
the interpreter calls this metamethod to produce the final message.  
Otherwise, the interpreter converts the error object to a string  
and adds a stack traceback to it.

When warnings are on,  
they are simply printed in the standard error output.

When finishing normally,  
the interpreter closes its main Lua state  
`@seeF{lua_close}`.

The script can avoid this step by  
calling `@Lid{os.exit}` to terminate.

To allow the use of Lua as a  
script interpreter in Unix systems,  
Lua skips the first line of a file chunk if it starts with `@T{#}`.  
Therefore, Lua scripts can be made into executable programs  
by using `@T{chmod +x}` and `@N{the @T{#!}}` form,  
as in

```
@verbatim{
#!/usr/local/bin/lua
}
```

Of course,  
the location of the Lua interpreter may be different in your machine.  
If `@id{lua}` is in your

`@id{PATH}`,  
then

```
@verbatim{
#!/usr/bin/env lua
}
```

is a more portable solution.

```
}
```

@sect1{incompat| @title{Incompatibilities with the Previous Version}

@simplesect{

Here we list the incompatibilities that you may find when moving a program from @N{Lua 5.3} to @N{Lua 5.4}.

You can avoid some incompatibilities by compiling Lua with appropriate options (see file @id{luaconf.h}).

However,

all these compatibility options will be removed in the future.

More often than not,

compatibility issues arise when these compatibility options are removed.

So, whenever you have the chance,

you should try to test your code with a version of Lua compiled with all compatibility options turned off.

That will ease transitions to newer versions of Lua.

Lua versions can always change the C API in ways that

do not imply source-code changes in a program,

such as the numeric values for constants

or the implementation of functions as macros.

Therefore,

you should never assume that binaries are compatible between different

Lua versions.

Always recompile clients of the Lua API when using a new version.

Similarly, Lua versions can always change the internal representation

of precompiled chunks;

precompiled chunks are not compatible between different Lua versions.

The standard paths in the official distribution may

change between versions.

}

@sect2{@title{Incompatibilities in the Language}

@itemize{

@item{

The coercion of strings to numbers in

arithmetic and bitwise operations

has been removed from the core language.

The string library does a similar job for arithmetic (but not for bitwise) operations using the string metamethods. However, unlike in previous versions, the new implementation preserves the implicit type of the numeral in the string. For instance, the result of `@T{"1" + "2"}` now is an integer, not a float.

```
}

```

```
@item{

```

Literal decimal integer constants that overflow are read as floats, instead of wrapping around. You can use hexadecimal notation for such constants if you want the old behavior (reading them as integers with wrap around).

```
}

```

```
@item{

```

The use of the `@idx{__lt}` metamethod to emulate `@idx{__le}` has been removed. When needed, this metamethod must be explicitly defined.

```
}

```

```
@item{

```

The semantics of the numerical `@Rw{for}` loop over integers changed in some details. In particular, the control variable never wraps around.

```
}

```

```
@item{

```

A label for a `@Rw{goto}` cannot be declared where a label with the same name is visible, even if this other label is declared in an enclosing block.

```
}

```

```
@item{

```

When finalizing an object, Lua does not ignore `@idx{__gc}` metamethods that are not functions. Any value will be called, if present. (Non-callable values will generate a warning, like any other error when calling a finalizer.)

```
}
}
}

```

@sect2{@title{Incompatibilities in the Libraries}}

@itemize{

@item{

The function @Lid{print} does not call @Lid{tostring} to format its arguments;

instead, it has this functionality hardwired.

You should use @idx{\_\_tostring} to modify how values are printed.

}

@item{

The pseudo-random number generator used by the function @Lid{math.random} now starts with a somewhat random seed.

Moreover, it uses a different algorithm.

}

@item{

By default, the decoding functions in the @Lid{utf8} library do not accept surrogates as valid code points.

An extra parameter in these functions makes them more permissive.

}

@item{

The options @St{setpause} and @St{setstepmul}

of the function @Lid{collectgarbage} are deprecated.

You should use the new option @St{incremental} to set them.

}

@item{

The function @Lid{io.lines} now returns four values, instead of just one.

That can be a problem when it is used as the sole argument to another function that has optional parameters, such as in @T{load(io.lines(filename, "L"))}.

To fix that issue,

you can wrap the call into parentheses,

to adjust its number of results to one.

}

}

}

@sect2{@title{Incompatibilities in the API}}

@itemize{

@item{  
Full userdata now has an arbitrary number of associated  
user values.  
Therefore, the functions @id{lua\_newuserdata},  
@id{lua\_setuservalue}, and @id{lua\_getuservalue} were  
replaced by @Lid{lua\_newuserdatauv},  
@Lid{lua\_setiuservalue}, and @Lid{lua\_getiuservalue},  
which have an extra argument.

For compatibility, the old names still work as macros assuming  
one single user value.

Note, however, that userdata with zero user values  
are more efficient memory-wise.

}

@item{  
The function @Lid{lua\_resume} has an extra parameter.  
This out parameter returns the number of values on  
the top of the stack that were yielded or returned by the coroutine.  
(In previous versions,  
those values were the entire stack.)  
}

@item{  
The function @Lid{lua\_version} returns the version number,  
instead of an address of the version number.  
The Lua core should work correctly with libraries using their  
own static copies of the same core,  
so there is no need to check whether they are using the same  
address space.  
}

@item{  
The constant @id{LUA\_ERRGCM} was removed.  
Errors in  
finalizers are never propagated;  
instead, they generate a warning.  
}

@item{  
The options @idx{LUA\_GCSETPAUSE} and @idx{LUA\_GCSETSTEPMUL}  
of the function @Lid{lua\_gc} are deprecated.  
You should use the new option @id{LUA\_GCINC} to set them.  
}

}

}

}

@C{[=====]}

@sect1{BNF| @title{The Complete Syntax of Lua}

Here is the complete syntax of Lua in extended BNF.

As usual in extended BNF,

@bnfNter{A} means 0 or more @bnfNter{A}s,

and @bnfNter{[A]} means an optional @bnfNter{A}.

(For operator precedences, see @See{prec};

for a description of the terminals

@bnfNter{Name}, @bnfNter{Numeral},

and @bnfNter{LiteralString}, see @See{lexical}.)

@index{grammar}

@Produc{

@producname{chunk}@producbody{block}

@producname{block}@producbody{@bnfrep{stat} @bnfopt{retstat}}

@producname{stat}@producbody{

@bnfter{;}

@OrNL varlist @bnfter{=} explist

@OrNL functioncall

@OrNL label

@OrNL @Rw{break}

@OrNL @Rw{goto} Name

@OrNL @Rw{do} block

@Rw{end}

@OrNL @Rw{while} exp @Rw{do} block @Rw{end}

@OrNL @Rw{repeat} block @Rw{until} exp

@OrNL @Rw{if} exp @Rw{then} block

@bnfrep{@Rw{elseif} exp @Rw{then} block}

@bnfopt{@Rw{else} block} @Rw{end}

@OrNL @Rw{for} @bnfNter{Name} @bnfter{=} exp @bnfter{,} exp @bnfopt{@bnfter{,} exp}

@Rw{do} block @Rw{end}

@OrNL @Rw{for} namelist @Rw{in} explist @Rw{do} block @Rw{end}

@OrNL @Rw{function} funcname funcbody

@OrNL @Rw{local} @Rw{function} @bnfNter{Name} funcbody

@OrNL @Rw{local} attnamelist @bnfopt{@bnfter{=} explist}

}

@producname{attnamelist}@producbody{

```

@bnfNter{Name} attrib @bnfrep{@bnfter{,} @bnfNter{Name} attrib}}

@producname{attrib}@producbody{@bnfopt{@bnfter{<} @bnfNter{Name} @bnfter{>}}}

@producname{retstat}@producbody{@Rw{return}
    @bnfopt{explist} @bnfopt{@bnfter{;}}}}

@producname{label}@producbody{@bnfter{::} Name @bnfter{::}}

@producname{funcname}@producbody{@bnfNter{Name} @bnfrep{@bnfter{.} @bnfNter{Name}}

    @bnfopt{@bnfter{:} @bnfNter{Name}}}}

@producname{varlist}@producbody{var @bnfrep{@bnfter{,} var}}

@producname{var}@producbody{
    @bnfNter{Name}
    @Or prefixexp @bnfter{[] exp @bnfter{[]}}
    @Or prefixexp @bnfter{.} @bnfNter{Name}
}

@producname{namelist}@producbody{@bnfNter{Name} @bnfrep{@bnfter{,} @bnfNter{Name}}}}

@producname{explist}@producbody{exp @bnfrep{@bnfter{,} exp}}

@producname{exp}@producbody{
    @Rw{nil}
    @Or @Rw{false}
    @Or @Rw{true}
    @Or @bnfNter{Numeral}
    @Or @bnfNter{LiteralString}
    @Or @bnfter{...}
    @Or functiondef
    @OrNL prefixexp
    @Or tableconstructor
    @Or exp binop exp
    @Or unop exp
}

@producname{prefixexp}@producbody{var @Or functioncall @Or @bnfter{() exp @bnfter{)}}}

@producname{functioncall}@producbody{
    prefixexp args
    @Or prefixexp @bnfter{:} @bnfNter{Name} args
}

@producname{args}@producbody{

```

```

@bnfter{() @bnfopt{explist} @bnfter{}}
@Or tableconstructor
@Or @bnfNter{LiteralString}
}

@producname{functiondef}@producbody{@Rw{function} funcbody}

@producname{funcbody}@producbody{@bnfter{()
@bnfopt{parlist} @bnfter{)}} block @Rw{end}}

@producname{parlist}@producbody{namelist @bnfopt{@bnfter{,} @bnfter{...}}
@Or @bnfter{...}}

@producname{tableconstructor}@producbody{@bnfter{@Open} @bnfopt{fieldlist} @bnfter{@Close}}

@producname{fieldlist}@producbody{field @bnfrep{fieldsep field} @bnfopt{fieldsep}}

@producname{field}@producbody{@bnfter{[] exp @bnfter{[]} @bnfter{=} exp @Or @bnfNter{Name}
@bnfter{=} exp @Or exp}

@producname{fieldsep}@producbody{@bnfter{,} @Or @bnfter{;}}

@producname{binop}@producbody{
@bnfter{+} @Or @bnfter{-} @Or @bnfter{*} @Or @bnfter{/} @Or @bnfter{//}
@Or @bnfter{^} @Or @bnfter{%}
@OrNL
@bnfter{&} @Or @bnfter{~} @Or @bnfter{[]} @Or @bnfter{>>} @Or @bnfter{<<}
@Or @bnfter{..}
@OrNL
@bnfter{<} @Or @bnfter{<=} @Or @bnfter{>} @Or @bnfter{>=}
@Or @bnfter{==} @Or @bnfter{~=}
@OrNL
@Rw{and} @Or @Rw{or}}

@producname{unop}@producbody{@bnfter{-} @Or @Rw{not} @Or @bnfter{#} @Or
@bnfter{~}}

}

}

@C{=====}

}
@C{-----}

```

Found



in path(s):

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Julian Seward, jseward@bzip.org  
bzip2/libbzip2 version 1.0.6 of 6 September 2010

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```
/* Definitions for BSD assembler syntax for Intel 386
   (actually AT&T syntax for insns and operands,
   adapted to BSD conventions for symbol names and debugging.)
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```

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```
/* Use the Sequent Symmetry assembler syntax. */
```

```
/* Define the syntax of pseudo-ops, labels and comments. */
```

```
/* Prefix for internally generated assembler
   labels. If we aren't using
   underscores, we are using prefix `.'s to identify labels that should
   be ignored, as in `i386/gas.h' --karl@cs.umb.edu */
```

```
#define LPREFIX "L"
```

```
/* Assembler pseudos to introduce constants of various size. */
```

```
#define ASM_BYTE "\t.byte\t"
#define ASM_SHORT "\t.word\t"
#define ASM_LONG "\t.long\t"
#define ASM_QUAD "\t.quad\t" /* Should not be used for 32bit compilation. */
```

```
/* This was suggested, but it shouldn't be right for debugger output. -- RMS
   #define ASM_OUTPUT_SOURCE_FILENAME(FILE, NAME) */
```

```
/* Define the syntax of labels and symbol definitions/declarations. */
```

```
/* This is how to output an assembler line
   that says to advance the location counter by SIZE bytes. */
```

```

#define ASM_OUTPUT_SKIP(FILE,SIZE) \
    fprintf (FILE, "\t.space " HOST_WIDE_INT_PRINT_UNSIGNED"\n", (SIZE))

/* Define the syntax of labels and symbol definitions/declarations. */

/* This says how to output an assembler line
   to define a global common symbol. */

#define
    ASM_OUTPUT_COMMON(FILE, NAME, SIZE, ROUNDED) \
    ( fputs (".comm ", (FILE)), \
      assemble_name ((FILE), (NAME)), \
      fprintf ((FILE), ",%u\n", (int)(ROUNDED)))

/* This says how to output an assembler line
   to define a local common symbol. */

#define ASM_OUTPUT_LOCAL(FILE, NAME, SIZE, ROUNDED) \
    ( fputs (".lcomm ", (FILE)), \
      assemble_name ((FILE), (NAME)), \
      fprintf ((FILE), ",%u\n", (int)(ROUNDED)))

#ifdef HAVE_GAS_LCOMM_WITH_ALIGNMENT
#define ASM_OUTPUT_ALIGNED_LOCAL(FILE, NAME, SIZE, ALIGNMENT) \
    ( fputs (".lcomm ", (FILE)), \
      assemble_name ((FILE), (NAME)), \
      fprintf ((FILE), ",%u,%u\n", (int)(SIZE), (int)(ALIGNMENT) / BITS_PER_UNIT))
#endif

/* This is how to output an assembler line
   that says to advance the location counter
   to a multiple of 2**LOG bytes. */

#define ASM_OUTPUT_ALIGN(FILE,LOG) \
    if ((LOG)!=0) fprintf ((FILE), "\t.align %d\n", (LOG))

/* This is how to store into the string BUF
   the symbol_ref name of an internal numbered
   label where
   PREFIX is the class of label and NUM is the number within the class.
   This is suitable for output with `assemble_name'. */

#define ASM_GENERATE_INTERNAL_LABEL(BUF,PREFIX,NUMBER) \
    sprintf ((BUF), "%s%d", (PREFIX), (long)(NUMBER))

/* The prefix to add to user-visible assembler symbols. */

#define USER_LABEL_PREFIX "_"

```

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```
#ifndef __VTV_H__
#define __VTV_H__
```

```
/* We could have used an enumeration here but it just makes it more
   difficult for the compiler to generate a call to this. These are
   used as arguments to the function __VLTChangePermission, declared
   below. */
```

```
#define __VLTP_READ_ONLY 0
#define __VLTP_READ_WRITE 1
```

```
#ifdef __cplusplus
extern "C" void __VLTChangePermission (int);
#else
extern void __VLTChangePermission (int);
#endif
```

```
#ifdef BIG_PAGE_SIZE
/* TODO - Replace '4096' below with correct big page size. */
#define VTV_PAGE_SIZE 4096
```

```

#else
#if defined(__sun__) && defined(__svr4__) && defined(__sparc__)
#define VTV_PAGE_SIZE 8192
#elif defined(__loongarch_lp64)
/* The page size is configurable by the kernel to
be 4, 16 or 64 KiB.
For now, only the default page size of 16KiB is supported. */
#define VTV_PAGE_SIZE 16384
#else
#define VTV_PAGE_SIZE 4096
#endif
#endif

```

```

#endif /* __VTV_H__ */
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```

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```
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under certain conditions; type `show c' for details.
```

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

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

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## 1.73 bzip2 1.0.8-r6

### 1.73.1 Available under license :

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Julian Seward, [jseward@acm.org](mailto:jseward@acm.org)  
bzip2/libbzip2 version 1.0.8 of 13 July 2019

## 1.74 pyproject-hooks 1.2.0

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## 1.75 libnetfilter-cthelper 1.0.1-r2

### 1.75.1 Available under license :

Format: <http://dep.debian.net/deps/dep5>  
Upstream-Name: libnetfilter-cthelper  
Source: [http://www.netfilter.org/projects/libnetfilter\\_cthelper/index.html](http://www.netfilter.org/projects/libnetfilter_cthelper/index.html)

Files: \*  
Copyright: 2012 Pablo Neira Ayuso <pablo@netfilter.org>  
License: GPL-2.0+

Files: debian/\*  
Copyright: 2013 Alexander Wirt <formorer@debian.org>  
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## 1.76 python-pip 25.1.1

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=====

Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <http://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <http://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations (now Zope Corporation, see <http://www.zope.com>). In 2001, the Python Software Foundation (PSF, see <http://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation is a sponsoring member of the PSF.

All Python releases are Open Source (see <http://www.opensource.org> for the Open Source Definition). Historically, most, but not all, Python

releases have also been GPL-compatible; the table below summarizes the various releases.

| Release        | Derived from | Year      | Owner      | GPL-compatible? (1) |
|----------------|--------------|-----------|------------|---------------------|
| 0.9.0 thru 1.2 |              | 1991-1995 | CWI        | yes                 |
| 1.3 thru 1.5.2 | 1.2          | 1995-1999 | CNRI       | yes                 |
| 1.6            | 1.5.2        | 2000      | CNRI       | no                  |
| 2.0            | 1.6          | 2000      | BeOpen.com | no                  |
| 1.6.1          | 1.6          | 2001      | CNRI       | yes (2)             |
| 2.1            | 2.0+1.6.1    | 2001      | PSF        | no                  |
| 2.0.1          | 2.0+1.6.1    | 2001      | PSF        | yes                 |
| 2.1.1          | 2.1+2.0.1    | 2001      | PSF        | yes                 |
| 2.2            | 2.1.1        | 2001      | PSF        | yes                 |
| 2.1.2          | 2.1.1        | 2002      | PSF        | yes                 |
| 2.1.3          |              |           |            |                     |
| 2.1.2          | 2002         | PSF       | yes        |                     |
| 2.2.1          | 2.2          | 2002      | PSF        | yes                 |
| 2.2.2          | 2.2.1        | 2002      | PSF        | yes                 |
| 2.2.3          | 2.2.2        | 2003      | PSF        | yes                 |
| 2.3            | 2.2.2        | 2002-2003 | PSF        | yes                 |
| 2.3.1          | 2.3          | 2002-2003 | PSF        | yes                 |
| 2.3.2          | 2.3.1        | 2002-2003 | PSF        | yes                 |
| 2.3.3          | 2.3.2        | 2002-2003 | PSF        | yes                 |
| 2.3.4          | 2.3.3        | 2004      | PSF        | yes                 |
| 2.3.5          | 2.3.4        | 2005      | PSF        | yes                 |
| 2.4            | 2.3          | 2004      | PSF        | yes                 |
| 2.4.1          | 2.4          | 2005      | PSF        | yes                 |
| 2.4.2          | 2.4.1        | 2005      | PSF        | yes                 |
| 2.4.3          | 2.4.2        | 2006      | PSF        | yes                 |
| 2.4.4          | 2.4.3        | 2006      | PSF        | yes                 |
| 2.5            | 2.4          | 2006      | PSF        | yes                 |
| 2.5.1          | 2.5          | 2007      | PSF        | yes                 |
| 2.5.2          | 2.5.1        | 2008      | PSF        | yes                 |
| 2.5.3          | 2.5.2        | 2008      | PSF        | yes                 |
| 2.6            | 2.5          | 2008      | PSF        | yes                 |
| 2.6.1          | 2.6          | 2008      | PSF        | yes                 |
| 2.6.2          | 2.6.1        | 2009      | PSF        | yes                 |
| 2.6.3          | 2.6.2        | 2009      | PSF        | yes                 |
| 2.6.4          | 2.6.3        | 2009      | PSF        | yes                 |
| 2.6.5          | 2.6.4        | 2010      | PSF        | yes                 |
| 3.0            | 2.6          | 2008      | PSF        | yes                 |
| 3.0.1          | 3.0          | 2009      | PSF        | yes                 |
| 3.1            | 3.0.1        | 2009      | PSF        | yes                 |
| 3.1.1          | 3.1          | 2009      | PSF        | yes                 |
| 3.1.2          | 3.1          | 2010      | PSF        | yes                 |
| 3.2            | 3.1          | 2010      | PSF        | yes                 |



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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <https://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <https://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property.

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|----------------|--------------|-----------|------------|---------------------|
| 0.9.0 thru 1.2 |              | 1991-1995 | CWI        | yes                 |
| 1.3 thru 1.5.2 | 1.2          | 1995-1999 | CNRI       | yes                 |
| 1.6            | 1.5.2        | 2000      | CNRI       | no                  |
| 2.0            | 1.6          | 2000      | BeOpen.com | no                  |
| 1.6.1          | 1.6          | 2001      | CNRI       | yes (2)             |
| 2.1            | 2.0+1.6.1    | 2001      | PSF        | no                  |
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## 1.77 zsh 5.9-r5

### 1.77.1 Available under license :

```
#autoload
```

```
# Options:
```

```
#
```

```
# -0    include jid 0 as a match for the host system
```

```

# -o param jail parameter to complete instead of jid -
#           e.g. name, path, ip4.addr, host.hostname

local addhost host param desc=1
local -a jails args expl
zparseopts -D -K -E 0=addhost o:=param
param=${param[2]:-name}

jails=( ${$(f)"$_call_program jails jls $param name)"/ /:} )
case $param in
jid) host=0 ;;
name)
    host=0
    desc=0
;;
path)
    host=/
    args=( -M 'r:/=* r:|=*' )
;;
ip4.addr) args=( -M 'r:|=* r:|=*' ) ;;
esac
[[ -n $addhost && -n $host ]] && jails+=( "$host:$HOST" )

if (( desc )); then
    _describe -t jails jail jails "$@" "$args[@]"
else
    _wanted jails expl jail compadd "$@" "$args[@]" - ${jails%:*}
fi
#autoload

local points=(
'c[trace system calls]'
'i[trace I/O]'
'n[trace namei translations]'
's[trace signal processing]'
'u[trace user data]'
'+[trace the default points]'
)

case $OSTYPE in
dragonfly*|freebsd*|netbsd*)
    points+=(
        'w[context switches]'
    )
    ;|
freebsd*|openbsd*)
    points+=(
        't[trace various structures]'
    )

```

```

)
;|
freebsd*)
points+=(
    'f[trace page faults]'
    'p[trace capability check failures]'
    'y[trace sysctl(3) requests]'
)
;;
netbsd*)
points+=(
    'A[trace all tracepoints]'
    'a[trace exec arguments]'
    'e[trace emulation changes]'
    'f[trace open file descriptors after exec]'
    'S[trace MIB access (sysctl)]'
    'v[trace exec environment]'
    '-[do not trace following trace points]'
)
;;
openbsd*)
points+=(
    'p[trace violation of pledge(2) restrictions]'
    'x[trace argument vector in execve(2)]'
    'X[trace environment in execve(2)]'
)
;;
esac

_values -s " 'ktrace point' $points
#autoload
#
# device types on FreeBSD/DragonFly
# (for commands using devstat_buildmatch(), such as iostat and vmstat)
#
local -a d i types

d=( da sa printer proc worm cd scanner optical changer
    comm array enclosure floppy)
i=( IDE SCSI other )
types=(
    "($d)da[direct access devices]"
    "($d)sa[sequential access devices]"
    "($d)printer[printers]"
    "($d)proc[processor devices]"
    "($d)worm[write once read multiple devices]"
    "($d)cd[CD devices]"
    "($d)scanner[scanner devices]"

```



```

"($d)optical[optical memory devices]"
"($d)changer[medium changer devices]"
"($d)comm[communication devices]"
"($d)array[storage array devices]"
"($d)enclosure[enclosure services devices]"
"($d)floppy[floppy devices]"
"($i)IDE[Integrated Drive Electronics devices]"
"($i)SCSI[Small Computer System Interface devices]"
"($i)other[any other device interface]"
'pass[passthrough devices]'
)

_values -s , 'device type' $types
#autoload

local expl

_description architectures expl 'architecture'
compadd "$@" "$expl[@]" amd64 arm arm64 i386 mips powerpc riscv sparc64
#autoload

local expl

_description routing-domains expl 'routing domain'
compadd "$@" "$expl[@]" - ${$(M)}${(f)}${(_call_program routing-domains netstat -R)}:#Rdomain *}#Rdomain
}
#autoload

# Provides completion for file flags (formerly part of _chflags)

local curcontext=$curcontext su=$(( ! EUID || $_comp_priv_prefix ))
local -a context line state state_descr copts=( "${@}" ) flags flag_descs
local -A val_args

flag_descs+=(
  nodump nodump
  uappnd 'user append-only'
  uchg 'user immutable'
)

if (( su )); then
  flag_descs+=(
    arch archived
    sappnd 'system append-only'
    schg 'system immutable'
  )
fi

```

```

if [[ $OSTYPE = (darwin|dragonfly|freebsd|netbsd)* ]]; then
    flag_descs+=(opaque opaque)

if [[ $OSTYPE = darwin* ]]; then
    flag_descs+=(hidden hidden)
fi

if [[ $OSTYPE = (dragonfly|freebsd)* ]]; then
    flag_descs+=(uunlnk 'user undeletable')

    (( su )) &&
    flag_descs+=(sunlnk 'system undeletable')
fi

if [[ $OSTYPE = dragonfly* ]]; then
    flag_descs+=(
        cache cache
        nouhistory 'user nohistory'
    )

    (( su )) && flag_descs+=(
        noscache noscache
        noshistory 'system nohistory'
    )
fi

[[ $OSTYPE =
freebsd* ]] && flag_descs+=(
    uarch archive
    uhidden hidden
    uoffline offline
    urdonly 'DOS, Windows and CIFS readonly'
    ureparse 'Windows reparse point'
    usparse 'sparse file'
    usystem 'DOS, Windows and CIFS system'
)
fi

for 1 2 in $flag_descs; do
    if [[ $1 = no* ]]; then
        flags+=("${1#no}$1[set the $2 flag]"
            "$1){1#no}[unset the $2 flag]")
    else
        flags+=("(no$1)$1[set the $2 flag]"
            "$1)no$1[unset the $2 flag]")
    fi
done

```

```

_values -O copts -s , 'file flags' $flags
#autoload
# disk device names on BSDs
local -a disks

case $OSTYPE in
freebsd*)
    disks=( ${$(M){(f)"$(geom disk list)"}\:#Geom name\:.*}#\*: } )
;;
dragonfly*)
    disks=( $(sysctl -n kern.disks) )
;;
openbsd*)
    disks=( ${$(s,..)"$(sysctl -n hw.disknames)"}%\:.*} )
;;
netbsd*)
    disks=( $(sysctl -n hw.disknames) )
;;
esac

if (( $#disks )); then
    local expl
    _wanted disk-devices expl 'disk device' compadd "$@" $disks
    return
fi

return 1

```

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--

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## ZSH CONTRIBUTORS

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Zsh was originally written by Paul Falstad. Zsh is now maintained by the members of the zsh-workers mailing list <zsh-workers@zsh.org>. The development is currently coordinated by Peter Stephenson <pws@zsh.org>.

This file credits only the major contributors to the current release. See the ChangeLog files for a complete list of people who have submitted patches. Note that email addresses below and in the ChangeLog file are included for disambiguation purposes only, and are not guaranteed to be currently accurate. If you feel that you or someone else have been unfairly omitted from this list please mail the list <zsh-workers@zsh.org>.

## Version 4.3

-----

Contributors to the main shell include Clint Adams, Rocky Bernstein, Andrey Borzenkov, Dan Bullok, Marc Chantreux, Thorsten Dahlheimer, Wayne Davison, Lionel Flandrin, Michael Hwang, Oliver Kiddle, Greg Klanderma, Matthias Kopferman, Mikael Magnusson, Dan Nelson, Phil Pennock, Toby Peterson, R. Ramkumar, Franois Revol, Bart Schaefer, Tom Smetana, Joerg Sonnenberger, Peter Stephenson, Jon Strait, Takimoto Jun, River Tarnell, Frank Terbeck, Philippe Troin, Geoff Wing, Matt Wozniski.

The VCS\_Info function system was written by Frank Terbeck with contributions from Julien Langer.

Contributors to documentation and to completion and other shell functions include those above plus Nuno Alexandre, Ralph Amissah, Micah Anderson, arno, Frank Benkstein, Jay Berkenbilt, Frank Blendinger, Zack Cerza, Brendan Cully, Baptiste Daroussin, Danek Duvall, Ryan F, Sean Finney, Daniel Friesel, Alexey I. Froloff, Tobias Gruetzmacher, Pierre Habouzit, Richard Hartmann, Benjamin R. Haskell, Ag. D. Hatzimanikas, Pete Hollobon, Erik Johansson, Kohsuke Kawaguchi, Dough Kearns, Hannu Koivisto, Henryk Konsek, Chris Lamb, Vincent Lefevre, Roger Leigh, Eric Mangold, Max Mikhanosha, Arkadiusz Miskiewicz, Matthieu Moy, Scott Murray, Alexander Myodov, tpm Nmec, Kalle Olavi Niemitalo, Kazuhiro NISHIYAMA,

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Version 4.2

-----

The contributor list is similar to that for 4.1.1.

Version 4.1.1

-----

Clint Adams <clint@zsh.org>: termcap/terminfo, completion, configuration, various modules, networking, prompts

Andrey Borzenkov <bor@zsh.org>: configuration, completion functions, cygwin support

Chmouel Boudjnah <chmouel@mandrakesoft.com>: Linux completion support

Wayne Davison <wayned@users.sourceforge.net>: shell history mechanism, arithmetic

Zvi Har'El <rl@math.technion.ac.il>: completion functions

Doug Kearns <djkea2@mugca.its.monash.edu.au>:  
completion functions

Oliver Kiddle <opk@zsh.org>: builtins, completion, parameters, prompts, standards support, tests

Andrew Main <zefram@zsh.org>: zle keymaps, games

Akinori Musha: BSD completion support

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Bart Schaefer <schaefer@zsh.org>: configuration, parameters, prompts, signals, syntax, tests, functions, sanity checking

Adam Spiers <adam@spiers.net>: completion and other functions

Peter Stephenson <pws@zsh.org>: configuration, zle, networking, syntax, completion

Tanaka Akira <akr@zsh.org>: completion functions

Philippe Troin <phil@fifi.org>: signals, process groups.

Geoff Wing <gcw@zsh.org>: archiving and distribution network, line editor display, configuration

Sven Wischnowsky <wischnow@zsh.org>: internal completion mechanism and low-level functions, line editor internals, syntax, wordcode mechanism,

Version 4.0.1

-----

Clint Adams <schizo@debian.org>: Completion functions, general configuration and module issues.

Andrej Borsenkow <bor@zsh.org>: Cygwin support, configuration, completion functions.

Chmouel Boudjnah <chmouel@mandrakesoft.com>: configuration support.

Wayne Davison <wayned@users.sourceforge.net>: History code.

Alexandre Duret-Lutz: completion functions and substitution code.

Oliver Kiddle <opk@zsh.org>: Modules and completion functions, AIX support.

Andrew Main <zefram@zsh.org>: Parameters and arithmetic, configuration.

Felix Rosencrantz <f\_rosencrantz@yahoo.com>: Test code and shell functions.

Bart Schaefer <schaefer@zsh.org>: bits of everything in all parts of code; general sanity control.

Adam Spiers <adam@spiers.net>: Completion and other functions, completion caching.

Peter Stephenson <pws@zsh.org>: configuration and installation, parameters, completion functions and configuration.

Tanaka Akira <akr@zsh.org>: Completion and test functions.

Geoff Wing <gcw@zsh.org>: FTP and mailing list archive

Sven Wischnowsky <wischnow@zsh.org>:

Most of the completion code, zpty,  
signal queueing, parameters, builtins, builtouts, built-here-and-theres;  
mend garden shed, rewire electricity, reinstall shutters, fix TV aerial in  
howling gale...

Other patches from E. Jay Birkenbilt, Jan Fedak, Ulrik Haugen, Paul  
Johnson, Fr. Br. George (George V Kouryachy).

Versions 3.1.7 to 3.1.9

-----

\* Clint Adams <schizo@debian.org>: configuration, various fixes esp. in  
completion

\* Andrej Borsenkow <Andrej.Borsenkow@mow.siemens.ru>: design, testing and  
patches for completion system, documentation, various other fixes

\* Chmouel Boudjnah <chmouel@mandrakesoft.com>: design, testing and patches  
for completion system, documentation, various other fixes

\* Wayne Davison <wayne@clari.net>: History code

\* Alexandre Duret-Lutz <duret\_g@epita.fr>: design, testing and patches for  
completion system, documentation, various other fixes

\* Oliver Kiddle <opk@zsh.org>: AIX dynamic library support, various  
completion functions,  
web page maintenance, documentation fixes

\* Andrew Main <zefram@zsh.org>: configuration and module/DLL code, IPv6  
support, various other bits

\* Felix Rosencrantz <f\_rosencrantz@yahoo.com>: design, testing and patches  
for completion system, documentation, various other fixes

\* Bart Schaefer <schaefer@zsh.org>: documentation and many other bits,

archive maintenance

- \* Adam Spiers <adam@spiers.net>: various completion functions, source code archive maintenance, documentation fixes, prompt themes
- \* Peter Stephenson <pws@zsh.org>: pattern matching code rewrite and enhancements, typeset and local variables, zftp maintenance, general configuration, floating point support
- \* Tanaka Akira <akr@zsh.org>: CVS archive, numerous completion functions for common commands, regex shell function state machine
- \* Geoff Wing <gcw@zsh.org>: mailing list and FTP archive, various other bits
- \* Sven Wischnowsky <wischnow@zsh.org>: almost all completion code including all comp\* libraries, all core functions in completion function system; styles; job control code; rewrite of internal shell code structures and parsing and execution code to use word code; parameter code; repair roof, fix guttering, put up shelves in study, recarpet hall, ...

Other patches were submitted by Will Day, Irving Wolfe, John Williams, Vin Shelton, Akim Demaille, Helmut Jarausch, Gene Cohler, Johan Sundstrm.

Version 3.1.6

-----

- \* Sven Wischnowsky <wischnow@informatik.hu-berlin.de>: completion code, major rewrite and enhancements, including matching control, completion widgets and function system, complist module; zle code additions; job control code changes; parameters code changes; parameter module; additional autoloading code; general code changes for extra efficiency; subscribing and ordering of globbing lists.
- \* Peter Stephenson <pws@zsh.org>: zftp and mapfile modules and zf\* functions; local parameters and typeset changes; changes in autoconf system; case-independent and approximate pattern matching; various options; a few completion modules; some zle changes; FAQ.
- \* Bart Schaefer <schaefer@zsh.org>: associative array implementation; other parameter changes; keeping track of missing patches; function autoloading changes.
- \* Wayne Davison <wayne@clari.net>: History code novelties and improvements with new options.



\* Geoff Wing <gcw@zsh.org>: Zle display code fixes, mailing list and patch archive.

\* Zoltn Hidvigi <hzoli@cs.elte.hu>: AIX dynamic loading code.

\* Matt Armstrong: cygwin configuration changes.

Other improvements, bug fixes and design suggestions from all the above plus Andrej Borsenkow, Oliver Kiddle, Tanaka Akira, Naoki Wakamatsu, Tatuso Furukawa, Ville Herva, Will Day, Lehti Rahmi, Larry P. Schrof, Helmut Jarausch, Phil Pennock, Wilfredo Sanchez, Bruce Stephens, Gene Cohler, Ollivier Robert, Felix Rosencrantz.

Previous versions of zsh 3 were maintained by Zoltn Hidvigi and Andrew Main (Zefram).

Version 3.0

-----

\*

Richard Coleman <coleman@math.gatech.edu> maintained the code till the release of zsh-2.6-beta16. Converted zsh to use autoconf thus greatly improving the portability. Rewrote signal handling code. Reorganized internal hash tables and rewrote the related builtins (enable, disable, hash, unhash). Made some cleanups in exec.c.

\* Zoltn Hidvigi <hzoli@cs.elte.hu> maintained zsh from version 2.6-beta16. Rewrote most of the lexer and substitution and the related completion code. Improved sh/ksh/POSIX compatibility. Fixed lots of bugs in completion, parameter and history code. Made zsh fully 8-bit clean. Made some reorganizations in exec.c. Fixed signal handling bugs. Fixed lots of bugs in various places.

\* Peter W. Stephenson <pws@zsh.org> the maintainer of the zsh FAQ. Reorganizations in exec.c. Rewrote and reorganized the history code. Rewrote the zshcompctl manual page. Fixed several bugs related to programmable completion. Fixed several signal handling bugs. Rewrote test and read builtins. Lots of other bugfixes.

\* Andrew Main (Zefram) <zefram@zsh.org> reorganized builtin.c. Rewrote large parts of the zle vi mode. Redirection fixes. Reorganized parts of the completion code, added some enhancements and fixed lots of bugs. Made zle fully 8-bit clean. Fixed several zle bugs. Reorganized zsh option handling. Lots of other bugfixes.

\* Sven Wischnowsky <wischnow@informatik.hu-berlin.de> wrote most of the programmable completion code in zsh-2.5.0. Several bugfixes in exec.c

and jobs.c. Lots of completion bugfixes and enhancements.

\* Geoff Wing <gcw@zsh.org> rewrote most of zle\_refresh.c. Some other bugfixes.

\* Clive Messer <clive@epos.demon.co.uk> brought the texinfo documentation up-to-date.

\* Mark Borges <mdb@cdc.noaa.gov> contributed several documentation fixes including further texinfo documentation updates and maintained the zsh web pages during their tenure at www.mal.com.

\* Wayne

Davison <wayne@clari.net> improved the zle search functions and made them 8-bit clean. Some other little bugfixes.

\* Bart Schaefer <schaefer@zsh.org> submitted several bugfixes, reported lots of bugs and gave many very useful suggestions.

Version 2.5

-----

Bas de Bakker maintained zsh till the release of zsh-2.5.0. People who have contributed to zsh-2.5.0 are (in lexical order):

Chris.Moore@src.bae.co.uk (Chris Moore)  
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 seniorr@teleport.com (Russell Senior)  
 sinclair@dcs.gla.ac.uk (Duncan Sinclair)  
 sterling@oldcolo.com (Bruce Sterling Woodcock)  
 suzuki@otsl.oki.co.jp (Hisao Suzuki)  
 tsm@cs.brown.edu (Timothy Miller)  
 vogelke@c17mis.wpafb.af.mil (Karl E. Vogel)  
 wacker@physik.uni-dortmund.de (Klaus Wacker)  
 wacren@cis10.ens-cachan.fr (Laurent Wacrenier)  
 #autoload

local expl

\_description architectures expl 'architecture'

compadd "\$@" "\$expl[@]" alpha amd64 arm64 armv7 hppa i386 landisk loongson luna88k macppc octeon sparc64  
 #autoload

local expl

\_description architectures expl 'architecture'

compadd "\$@" "\$expl[@]" amd64 evbarm evbmips evbppc hpcarm i386 sparc64 xen \  
 acorn32 algor alpha amiga amigappc arc atari bebox cats cesfic cobalt dreamcast \  
 #autoload

```

emips epoc32 evbsh3 ews4800mips hp300 hppa hpcmips hpcsh ia64 ibmnws iyonix \
landisk luna68k mac68k macppc mipsco mmeye mvme68k mvmeppc netwinder news68k \
newsmips next68k ofppc pmax prep rs6000 sandpoint sbmips sgimips shark sparc \
sun2 sun3 vax x68k zaurus
#autoload

local expl

_description routing-tables expl 'routing table'
compadd "$@" "$expl[@]" - ${(s: )}${(M)}${(f)"$_call_program routing-tables netstat -R")}:# Routing tables#:
*}#*: } }
#autoload

local expl login_classes

login_classes=(${(M)}${(f)"$(</etc/login.conf)"}:#^[^#[:blank:]]*}%%[:]*})
if [[ $OSTYPE = openbsd* ]]; then
    login_classes+=(/etc/login.conf.d/*(N:t))
fi

_description login-classes expl 'login class'
compadd "$@" "$expl[@]" - $login_classes

```

## 1.78 gnutls 3.8.8-r0

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## 1.80 urllib3 1.26.20

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# 1.81 speedtest-cli 2.1.3-r7

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## 1.82 py3-packaging 25.0-r0

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## 1.83 python-certifi 2025.01.31

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# 1.86 e2fsprogs 1.47.2-r2

## 1.86.1 Available under license :

Index: tdbsa/tdb.c

=====

--- tdbsa.orig/tdb.c

+++ tdbsa/tdb.c

@@ -4,11 +4,11 @@ Rev: 23371

Last Changed Date: 2007-06-06 20:14:06 -0400 (Wed, 06 Jun 2007)

\*/

/\*

- Unix SMB/CIFS implementation.
- + trivial database library - standalone version

- trivial database library - private includes

-

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Gadi Oxman, August 1995

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

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Theodore Ts'o  
23-June-2007

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Version 2, June 1991

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That's all there is to it!

#

# This is a Makefile stub which handles the creation of BSD shared  
# libraries.

#

# In order to use this stub, the following makefile variables must be defined.

#

# BSDLIB\_VERSION = 1.0

# BSDLIB\_IMAGE = libce

# BSDLIB\_MYDIR = et

# BSDLIB\_INSTALL\_DIR = \$(SHLIBDIR)

#

all:: image

real-subdirs:: Makefile

```
@echo " MKDIR pic"
```

```
@mkdir -p pic
```

```
BSD_LIB = $(BSDLIB_IMAGE).so.$(BSDLIB_VERSION)
```

```
BSDLIB_PIC_FLAG = -fpic
```

```
image: $(BSD_LIB)
```

```
$(BSD_LIB): $(OBJS)
```

```
(cd pic; ld -Bshareable -o $(BSD_LIB) $(LDFLAGS_SHLIB) $(OBJS))
```

```
$(MV) pic/$(BSD_LIB) .
```

```
$(RM) -f ../$(BSD_LIB)
```

```
(cd ..; $(LN) $(LINK_BUILD_FLAGS) \
```

```
`echo $(my_dir) | sed -e 's;lib/;;'/'$(BSD_LIB) $(BSD_LIB))
```

```
install-shlibs install:: $(BSD_LIB)
```

```
@echo " INSTALL_PROGRAM $(BSDLIB_INSTALL_DIR)/$(BSD_LIB)"
```

```
@$(INSTALL_PROGRAM) $(BSD_LIB) \
```

```
$(DESTDIR)$ (BSDLIB_INSTALL_DIR)/$(BSD_LIB)
```

```
@-$(LDCONFIG)
```

```
install-strip: install
```

```
install-shlibs-strip:: install-shlibs
```

```
uninstall-shlibs uninstall::
```

```
$(RM) -f $(DESTDIR)$ (BSDLIB_INSTALL_DIR)/$(BSD_LIB)
```

```
clean::
```

```
$(RM)
```

```
-rf pic
```

```
$(RM) -f $(BSD_LIB)
```

```
$(RM) -f ../$(BSD_LIB)
```

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Upstream-Name: e2fsprogs

Upstream-Contact: Theodore Ts'o <tytso@mit.edu>

Source: <http://sourceforge.net/projects/e2fsprogs>

Comment:

This is the Debian GNU/Linux prepackaged version of the EXT2 file system utilities (e2fsck, mke2fs, etc.). The EXT2 utilities were written by Theodore Ts'o <tytso@mit.edu> and Remy Card <card@masi.ibp.fr>.

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Comment: Taken from lib/com\_err/error.c from Kerberos4kth distribution.

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\*/

#ifndef UV\_BSD\_H

#define UV\_BSD\_H

#define UV\_PLATFORM\_FS\_EVENT\_FIELDS \

uv\_\_io\_t event\_watcher; \

#define UV\_IO\_PRIVATE\_PLATFORM\_FIELDS \

int rcount; \

int wcount; \

#define UV\_HAVE\_KQUEUE 1

#endif /\* UV\_BSD\_H \*/

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## 1.90 kerberos 1.21.3-r0

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cmd/krb5/iprop/iprop_hdr.h
cmd/krb5/kadmin/server/ipropd_svc.c
cmd/krb5/kproplog/kproplog.c
cmd/krb5/slave/kpropd_rpc.c
lib/gss_mechs/mech_krb5/et/kdb5_err.c
lib/gss_mechs/mech_spnego/mech/gssapiP_spnego.h
lib/gss_mechs/mech_spnego/mech/spnego_mech.c
lib/krb5/kadm5/kadm_host_srv_names.c
lib/krb5/kdb/kdb_convert.c
lib/krb5/kdb/kdb_hdr.h
lib/krb5/kdb/kdb_log.c
lib/krb5/kdb/kdb_log.h
lib/libgss/g_accept_sec_context.c
lib/libgss/g_acquire_cred.c
lib/libgss/g_canon_name.c
lib/libgss/g_compare_name.c
lib/libgss/g_context_time.c
lib/libgss/g_delete_sec_context.c
lib/libgss/g_dsp_name.c
lib/libgss/g_dsp_status.c
lib/libgss/g_dup_name.c
lib/libgss/g_exp_sec_context.c
lib/libgss/g_export_name.c
lib/libgss/g_glue.c
lib/libgss/g_imp_name.c
lib/libgss/g_imp_sec_context.c
lib/libgss/g_init_sec_context.c
lib/libgss/g_initialize.c
lib/libgss/g_inquire_context.c
lib/libgss/g_inquire_cred.c
lib/libgss/g_inquire_names.c
lib/libgss/g_process_context.c
lib/libgss/g_rel_buffer.c
lib/libgss/g_rel_cred.c
lib/libgss/g_rel_name.c
lib/libgss/g_rel_oid_set.c
lib/libgss/g_seal.c
lib/libgss/g_sign.c
lib/libgss/g_store_cred.c
```

lib/libgss/g\_unseal.c  
lib/libgss/g\_userok.c  
lib/libgss/g\_utils.c  
lib/libgss/g\_verify.c  
lib/libgss/gssd\_pname\_to\_uid.c  
uts/common/gssapi/include/gssapi\_err\_generic.h  
uts/common/gssapi/include/mechglueP.h

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- lib/gssapi/mechglue/g\_accept\_sec\_context.c
- lib/gssapi/mechglue/g\_acquire\_cred.c
- lib/gssapi/mechglue/g\_canon\_name.c
- lib/gssapi/mechglue/g\_compare\_name.c
- lib/gssapi/mechglue/g\_context\_time.c
- lib/gssapi/mechglue/g\_delete\_sec\_context.c
- lib/gssapi/mechglue/g\_dsp\_name.c
- lib/gssapi/mechglue/g\_dsp\_status.c
- lib/gssapi/mechglue/g\_dup\_name.c
- lib/gssapi/mechglue/g\_exp\_sec\_context.c
- lib/gssapi/mechglue/g\_export\_name.c
- lib/gssapi/mechglue/g\_glue.c
- lib/gssapi/mechglue/g\_imp\_name.c
- lib/gssapi/mechglue/g\_imp\_sec\_context.c
- lib/gssapi/mechglue/g\_init\_sec\_context.c
- lib/gssapi/mechglue/g\_initialize.c
- lib/gssapi/mechglue/g\_inquire\_context.c
- lib/gssapi/mechglue/g\_inquire\_cred.c
- lib/gssapi/mechglue/g\_inquire\_names.c
- lib/gssapi/mechglue/g\_process\_context.c
- lib/gssapi/mechglue/g\_rel\_buffer.c
- lib/gssapi/mechglue/g\_rel\_cred.c
- lib/gssapi/mechglue/g\_rel\_name.c
- lib/gssapi/mechglue/g\_rel\_oid\_set.c
- lib/gssapi/mechglue/g\_seal.c
- lib/gssapi/mechglue/g\_sign.c
- lib/gssapi/mechglue/g\_store\_cred.c

lib/gssapi/mechglue/g\_unseal.c  
lib/gssapi/mechglue/g\_userok.c  
lib/gssapi/mechglue/g\_utils.c  
lib/gssapi/mechglue/g\_verify.c  
lib/gssapi/mechglue/gssd\_pname\_to\_uid.c  
lib/gssapi/mechglue/mglueP.h  
lib/gssapi/mechglue/oid\_ops.c  
lib/gssapi/spnego/gssapiP\_spnego.h  
lib/gssapi/spnego/spnego\_mech.c

and the initial implementation of incremental propagation, including the following new or changed files:

include/iprof\_hdr.h  
kadmin/server/iprof\_svc.c  
lib/kdb/iprof.x  
lib/kdb/kdb\_convert.c  
lib/kdb/kdb\_log.c  
lib/kdb/kdb\_log.h  
lib/krb5/error\_tables/kdb5\_err.et  
kprop/kpropd\_rpc.c  
kprop/kproplog.c

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\*

\* `stdio.c`

\* by Mark Gates <[mgates@nlanr.net](mailto:mgates@nlanr.net)>

\* and Ajay Tirumalla <[tirumala@ncsa.uiuc.edu](mailto:tirumala@ncsa.uiuc.edu)>

\* -----

\* input and output numbers, converting with kilo, mega, giga

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|  | NR | START | END   | SECTORS | SIZE | NAME | UUID        |
|--|----|-------|-------|---------|------|------|-------------|
|  | 1  | 32    | 7679  | 7648    | 3.7M |      | 8f8378c0-01 |
|  | 2  | 7680  | 16383 | 8704    | 4.3M |      | 8f8378c0-02 |

5 7936 12799 4864 2.4M

6 12544 16127 3584 1.8M

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```
#ifndef UTIL_LINUX_PT_BSD_H
#define UTIL_LINUX_PT_BSD_H
```

```
#define BSD_MAXPARTITIONS 16
#define BSD_FS_UNUSED 0
```

```
#ifndef BSD_DISKMAGIC
# define BSD_DISKMAGIC ((uint32_t) 0x82564557)
#endif
```

```
#define BSD_LINUX_BOOTDIR "/usr/ucb/mdec"
```

```
#if defined (__alpha__) || defined (__powerpc__) || \
    defined (__ia64__) || defined (__hppa__)
# define BSD_LABELSECTOR 0
# define BSD_LABELOFFSET 64
#else
# define BSD_LABELSECTOR 1
# define BSD_LABELOFFSET 0
#endif
```

```
#define BSD_BBSIZE      8192 /* size of boot area, with label */
#define BSD_SBSIZE      8192 /* max size of fs superbblock */
```

```

struct bsd_disklabel {
    uint32_t d_magic; /* the magic number */
    int16_t d_type; /* drive type */
    int16_t d_subtype; /* controller/d_type specific */
    char d_typename[16]; /* type name, e.g. "eagle" */
    char d_packname[16]; /* pack identifier */

    /* disk geometry: */
    uint32_t d_sectsize; /*
# of bytes per sector */
    uint32_t d_nsectors; /* # of data sectors per track */
    uint32_t d_ntracks; /* # of tracks per cylinder */
    uint32_t d_ncylinders; /* # of data cylinders per unit */
    uint32_t d_secperscyl; /* # of data sectors per cylinder */
    uint32_t d_secperunit; /* # of data sectors per unit */

    /*
* Spares (bad sector replacements) below
* are not counted in d_nsectors or d_secperscyl.
* Spare sectors are assumed to be physical sectors
* which occupy space at the end of each track and/or cylinder.
*/
    uint16_t d_sparepertrack; /* # of spare sectors per track */
    uint16_t d_spareperscyl; /* # of spare sectors per cylinder */

    /*
* Alternate cylinders include maintenance, replacement,
* configuration description areas, etc.
*/
    uint32_t d_acylinders; /* # of alt. cylinders per unit */

    /* hardware characteristics: */
    /*
* d_interleave, d_trackskew and d_cylskew describe perturbations
* in the media format used to compensate for a slow
controller.
* Interleave is physical sector interleave, set up by the formatter
* or controller when formatting. When interleaving is in use,
* logically adjacent sectors are not physically contiguous,
* but instead are separated by some number of sectors.
* It is specified as the ratio of physical sectors traversed
* per logical sector. Thus an interleave of 1:1 implies contiguous
* layout, while 2:1 implies that logical sector 0 is separated
* by one sector from logical sector 1.
* d_trackskew is the offset of sector 0 on track N
* relative to sector 0 on track N-1 on the same cylinder.
* Finally, d_cylskew is the offset of sector 0 on cylinder N

```

```

* relative to sector 0 on cylinder N-1.
*/
uint16_t d_rpm; /* rotational speed */
uint16_t d_interleave; /* hardware sector interleave */
uint16_t d_trackskew; /* sector 0 skew, per track */
uint16_t d_cylskew; /* sector 0 skew, per cylinder */
uint32_t d_headswitch; /* head switch time, usec */
uint32_t d_trkseek; /*
track-to-track seek, usec */
uint32_t d_flags; /* generic flags */
uint32_t d_drivedata[5]; /* drive-type specific information */
uint32_t d_spare[5]; /* reserved for future use */
uint32_t d_magic2; /* the magic number (again) */
uint16_t d_checksum; /* xor of data incl. partitions */

/* filesystem and partition information: */
uint16_t d_npartitions; /* number of partitions in following */
uint32_t d_bbsize; /* size of boot area at sn0, bytes */
uint32_t d_sbsize; /* max size of fs superblock, bytes */

struct bsd_partition { /* the partition table */
    uint32_t p_size; /* number of sectors in partition */
    uint32_t p_offset; /* starting sector */
    uint32_t p_fsize; /* filesystem basic fragment size */
    uint8_t p_fstype; /* filesystem type, see below */
    uint8_t p_frag; /* filesystem fragments per block */
    uint16_t p_cpgr; /* filesystem cylinders per group */
} __attribute__((packed))
d_partitions[BSD_MAXPARTITIONS]; /* actually may be more */
} __attribute__((packed));

/* d_type values: */
#define BSD_DTYPE_SMD 1 /* SMD, XSMD; VAX hp/up */
#define BSD_DTYPE_MSCP 2 /* MSCP */
#define BSD_DTYPE_DEC 3 /* other DEC (rk, rl) */
#define BSD_DTYPE_SCSI 4 /* SCSI */
#define BSD_DTYPE_ESDI 5 /* ESDI interface */
#define BSD_DTYPE_ST506 6 /* ST506 etc. */
#define BSD_DTYPE_HPIB 7 /* CS/80 on HP-IB */
#define BSD_DTYPE_HPFL 8 /* HP Fiber-link */
#define BSD_DTYPE_FLOPPY 10 /* floppy */

/* d_subtype values: */
#define BSD_DSTYPE_INDOSPART 0x8 /* is inside dos partition */
#define BSD_DSTYPE_DOSPART(s) ((s) & 3) /* dos partition number */
#define BSD_DSTYPE_GEOMETRY 0x10 /* drive params in label */

```



```

/*
 * Filesystem type and version.
 * Used to interpret other filesystem-specific
 * per-partition information.
 */

#define BSD_FS_UNUSED 0 /* unused */
#define BSD_FS_SWAP 1 /* swap */
#define BSD_FS_V6 2 /* Sixth Edition */
#define BSD_FS_V7
    3 /* Seventh Edition */
#define BSD_FS_SYSV 4 /* System V */
#define BSD_FS_V71K 5 /* V7 with 1K blocks (4.1, 2.9) */
#define BSD_FS_V8 6 /* Eighth Edition, 4K blocks */
#define BSD_FS_BSDFFS 7 /* 4.2BSD fast file system */
#define BSD_FS_BSDLFS 9 /* 4.4BSD log-structured file system */
#define BSD_FS_OTHER 10 /* in use, but unknown/unsupported */
#define BSD_FS_HPFS 11 /* OS/2 high-performance file system */
#define BSD_FS_ISO9660 12 /* ISO-9660 filesystem (cdrom) */
#define BSD_FS_ISOFS BSD_FS_ISO9660
#define BSD_FS_BOOT 13 /* partition contains bootstrap */
#define BSD_FS_ADOS 14 /* AmigaDOS fast file system */
#define BSD_FS_HFS 15 /* Macintosh HFS */
#define BSD_FS_ADVFS 16 /* Digital Unix AdvFS */

/* this is annoying, but it's also the way it is :( */
#ifdef __alpha__
#define BSD_FS_EXT2 8 /* ext2 file system */
#else
#define BSD_FS_MSDOS 8 /* MS-DOS file system */
#endif

/*
 * flags shared by various drives:
 */
#define BSD_D_REMOVABLE 0x01 /*
    removable media */
#define BSD_D_ECC 0x02 /* supports ECC */
#define BSD_D_BADSECT 0x04 /* supports bad sector forw. */
#define BSD_D_RAMDISK 0x08 /* disk emulator */
#define BSD_D_CHAIN 0x10 /* can do back-back transfers */
#define BSD_D_DOSPART 0x20 /* within MSDOS partition */

#endif /* UTIL_LINUX_PT_BSD_H */

```

## 1.98 libtasn 4.20.0-r0

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Version 3, 29 June 2007

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Before (and including) argparse 1.1, the argparse package was licensed under  
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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <https://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <https://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

All

Python releases are Open Source (see <https://opensource.org> for the Open Source Definition). Historically, most, but not all, Python releases have also been GPL-compatible; the table below summarizes the various releases.

| Release        | Derived from | Year      | Owner      | GPL-compatible? (1) |
|----------------|--------------|-----------|------------|---------------------|
| 0.9.0 thru 1.2 |              | 1991-1995 | CWI        | yes                 |
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| 1.6            | 1.5.2        | 2000      | CNRI       | no                  |
| 2.0            | 1.6          | 2000      | BeOpen.com | no                  |
| 1.6.1          | 1.6          | 2001      | CNRI       | yes (2)             |
| 2.1            | 2.0+1.6.1    | 2001      | PSF        | no                  |
| 2.0.1          | 2.0+1.6.1    | 2001      | PSF        | yes                 |
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| 2.1.3          | 2.1.2        | 2002      | PSF        | yes                 |
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| 2.3.4          | 2.3.3        | 2004      | PSF        | yes                 |
| 2.3.5          | 2.3.4        | 2005      | PSF        | yes                 |
| 2.4            | 2.3          | 2004      | PSF        | yes                 |
| 2.4.1          | 2.4          | 2005      | PSF        | yes                 |
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|-------|-------|------|-----|-----|
| 2.6   | 2.5   | 2008 | PSF | yes |
| 2.6.1 | 2.6   | 2008 | PSF | yes |
| 2.6.2 | 2.6.1 | 2009 | PSF | yes |
| 2.6.3 | 2.6.2 | 2009 | PSF | yes |
| 2.6.4 | 2.6.3 | 2009 | PSF | yes |
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#### A. HISTORY OF THE SOFTWARE

Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <http://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <http://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations (now Zope Corporation, see <http://www.zope.com>). In 2001, the Python Software Foundation (PSF, see <http://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation is a sponsoring member of the PSF.

All Python releases are Open Source (see <http://www.opensource.org> for the Open Source Definition). Historically, most, but not all, Python releases have also been GPL-compatible; the table below summarizes the various releases.

| Release        | Derived from | Year      | Owner      | GPL-compatible? (1) |
|----------------|--------------|-----------|------------|---------------------|
| 0.9.0 thru 1.2 |              | 1991-1995 | CWI        | yes                 |
| 1.3 thru 1.5.2 | 1.2          | 1995-1999 | CNRI       | yes                 |
| 1.6            | 1.5.2        | 2000      | CNRI       | no                  |
| 2.0            | 1.6          | 2000      | BeOpen.com | no                  |
| 1.6.1          | 1.6          | 2001      | CNRI       | yes (2)             |
| 2.1            | 2.0+1.6.1    | 2001      | PSF        | no                  |
| 2.0.1          | 2.0+1.6.1    | 2001      | PSF        | yes                 |
| 2.1.1          | 2.1+2.0.1    | 2001      | PSF        | yes                 |
| 2.2            | 2.1.1        | 2001      | PSF        | yes                 |
| 2.1.2          | 2.1.1        | 2002      | PSF        | yes                 |
| 2.1.3          |              |           |            |                     |
| 2.1.2          | 2002         | PSF       | yes        |                     |
| 2.2.1          | 2.2          | 2002      | PSF        | yes                 |
| 2.2.2          | 2.2.1        | 2002      | PSF        | yes                 |
| 2.2.3          | 2.2.2        | 2003      | PSF        | yes                 |
| 2.3            | 2.2.2        | 2002-2003 | PSF        | yes                 |
| 2.3.1          | 2.3          | 2002-2003 | PSF        | yes                 |
| 2.3.2          | 2.3.1        | 2002-2003 | PSF        | yes                 |
| 2.3.3          | 2.3.2        | 2002-2003 | PSF        | yes                 |
| 2.3.4          | 2.3.3        | 2004      | PSF        | yes                 |
| 2.3.5          | 2.3.4        | 2005      | PSF        | yes                 |
| 2.4            | 2.3          | 2004      | PSF        | yes                 |
| 2.4.1          | 2.4          | 2005      | PSF        | yes                 |
| 2.4.2          | 2.4.1        | 2005      | PSF        | yes                 |
| 2.4.3          | 2.4.2        | 2006      | PSF        | yes                 |

|       |       |      |     |     |
|-------|-------|------|-----|-----|
| 2.4.4 | 2.4.3 | 2006 | PSF | yes |
| 2.5   | 2.4   | 2006 | PSF | yes |
| 2.5.1 | 2.5   | 2007 | PSF | yes |
| 2.5.2 | 2.5.1 | 2008 | PSF | yes |
| 2.5.3 | 2.5.2 | 2008 | PSF | yes |
| 2.6   | 2.5   | 2008 | PSF | yes |
| 2.6.1 | 2.6   | 2008 | PSF | yes |
| 2.6.2 | 2.6.1 | 2009 | PSF | yes |
| 2.6.3 | 2.6.2 | 2009 | PSF | yes |
| 2.6.4 | 2.6.3 | 2009 | PSF | yes |
| 2.6.5 | 2.6.4 | 2010 | PSF | yes |
| 3.0   | 2.6   | 2008 | PSF | yes |
| 3.0.1 | 3.0   | 2009 | PSF | yes |
| 3.1   | 3.0.1 | 2009 | PSF | yes |
| 3.1.1 | 3.1   | 2009 | PSF | yes |
| 3.1.2 | 3.1   | 2010 | PSF | yes |
| 3.2   | 3.1   | 2010 | PSF | yes |

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```
python -m validate_pyproject.pre_compile --output-dir=setuptools/config/_validate_pyproject --enable-plugins
setuptools.distutils --very-verbose -t setuptools=setuptools/config/setuptools.schema.json -t
distutils=setuptools/config/distutils.schema.json
```

Please avoid changing it manually.

You can report issues or suggest changes directly to `validate-pyproject` (or to the relevant plugin repository)

- <https://github.com/abravalheri/validate-pyproject/issues>

\*\*\*

The following files include code from opensource projects (either as direct copies or modified versions):

- `fastjsonschema\_exceptions.py`:
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- `extra\_validations.py` and `format.py`, `error\_reporting.py`:
  - project: `validate-pyproject` - licensed under MPL-2.0 (<https://github.com/abravalheri/validate-pyproject>)

Additionally

the following files are automatically generated by tools provided by the same projects:

- `\_\_init\_\_.py`
- `fastjsonschema\_validations.py`



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\*\*\*

`fastjsonschema`

=====

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`validate-pyproject`

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In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <https://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

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## 1.114 truststore 0.10.0

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```
#ifndef _BASENAME_LGPL_H
#define _BASENAME_LGPL_H
```

```
/* This file uses _GL_ATTRIBUTE_PURE. */
#if !_GL_CONFIG_H_INCLUDED
#error "Please include config.h first."
#endif
```

```
#include <stddef.h>
```

```
#ifndef
DOUBLE_SLASH_IS_DISTINCT_ROOT
# define DOUBLE_SLASH_IS_DISTINCT_ROOT 0
#endif
```

```
#ifdef __cplusplus
extern "C" {
#endif
```

/\* Return the address of the last file name component of FILENAME.  
If FILENAME has some trailing slash(es), they are considered to be part of the last component.  
If FILENAME has no relative file name components because it is a file system root, return the empty string.  
Examples:

| FILENAME     | RESULT  |
|--------------|---------|
| "foo.c"      | "foo.c" |
| "foo/bar.c"  | "bar.c" |
| "/foo/bar.c" | "bar.c" |

```

"foo/bar/"  "bar/"
"foo/bar//" "bar//"
"/"         ""
"//"        ""
""          ""

```

The return value is a tail of the given FILENAME; do NOT free() it! \*/

/\* This function was traditionally called 'basename', but we avoid this function name because

\* Various platforms have different functions in their libc.

In particular, the glibc basename(),

defined in <string.h>, does

not consider trailing slashes to be part of the component:

```

FILENAME  RESULT
"foo/bar/" ""
"foo/bar//" ""

```

\* The 'basename' command eliminates trailing slashes and for a root produces a non-empty result:

```

FILENAME  RESULT
"foo/bar/" "bar"
"foo/bar//" "bar"
"/"        "/"
"//"       "/"

```

\*/

extern char \*last\_component (char const \*filename) \_GL\_ATTRIBUTE\_PURE;

/\* Return the length of the basename FILENAME.

Typically FILENAME is the value returned by base\_name or last\_component.

Act like strlen (FILENAME), except omit all trailing slashes. \*/

extern size\_t base\_len (char const \*filename) \_GL\_ATTRIBUTE\_PURE;

#ifdef \_\_cplusplus

} /\* extern "C" \*/

#endif

#endif /\* \_BASENAME\_LGPL\_H \*/

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## 1.117 liburcu 0.15.2-r0

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# Userspace-RCU LGPL 2.1+ re-licensing

Mathieu Desnoyers



May 13th, 2009

IBM Corporation allowed LGPLv2.1+ licensing of their contribution to the userspace RCU library in a patch submitted on May 8, 2009 from Paul E. McKenney and reviewed by Steven L. Bennett:

<https://lists.lttng.org/pipermail/lttng-dev/2009-May/012835.html>

I (Mathieu Desnoyers) re-implemented ACCESS\_ONCE(), likely(), unlikely() and barrier() from scratch without reference to the original code.

commit id : 2dc5fa0f7cfbfb0a64a7a67b39626650e863f16a

Bert Wesarg <bert.wesarg@googlemail.com> approved LGPL re-licensing of his patch in an email dated May 13, 2009 :

<http://lkml.org/lkml/2009/5/13/16>

xchg() primitives has been rewritten from a MIT-licensed cmpxchg for Intel and powerpc. They are MIT-licensed and therefore usable in LGPL code. This cmpxchg code was obtained from the atomic\_ops project:

[http://www.hpl.hp.com/research/linux/atomic\\_ops/](http://www.hpl.hp.com/research/linux/atomic_ops/)

I (Mathieu Desnoyers) wrote the remainder of the code.

The license for the library files in this project was therefore changed to LGPLv2.1 on May 13, 2009, as detailed in LICENSE.  
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```
****
#define _LGPL_SOURCE
#include <urcu.h>
****
```

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

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

5. A program that contains no derivative of any portion of the

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

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library.

The threshold for this to be true is not precisely defined by law.

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

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

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

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

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

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## 1.122 zstd 1.5.7-r0

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# 1.123 vim 9.1.1566-r0

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\*uganda.txt\* For Vim version 9.1. Last change: 2025 Jul 08

VIM REFERENCE MANUAL by Bram Moolenaar

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\*iccf\* \*ICCF\*

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=====

Kibaale

Children's Centre \*kcc\* \*Kibaale\* \*charity\*

Kibaale Children's Centre (KCC) is located in Kibaale, a small town in the south of Uganda, near Tanzania, in East Africa. The area is known as Rakai District. The population is mostly farmers. Although people are poor, there usually is enough food. But this district is suffering from AIDS more than any other part of the world. Some say that it started there. Estimations are that in the past 10 to 30% of the Ugandans are infected with HIV. Because parents die, there are many orphans. In this district about 60,000 children have lost one or both parents, out of a population of 350,000. Although AIDS is now mostly under control, the problems are still continuing.

The children need a lot of help. The KCC is working hard to provide the needy with food, medical care and education. Food and medical care to keep them healthy now, and education so that they can take care of themselves in the future. KCC works on a Christian base, but help is given to children of any religion.

The key to solving the problems in this area is education. This has been neglected in the past years with president Idi Amin and the following civil wars. Now that the government is stable again, the children and parents have to learn how to take care of themselves and how to avoid infections. There is also help for people who are ill and hungry, but the primary goal is to prevent people from getting ill and to teach them how to grow healthy food.

Most of the orphans are living in an extended family. An uncle or older sister is taking care of them. Because these families are big and the income (if any) is low, a child is lucky if it gets healthy food. Clothes, medical care and schooling is beyond its reach. To help these needy children, a sponsorship program was put into place. A child can be financially adopted. For a few dollars a month KCC sees to it that the child gets indispensable items, is healthy, goes to school and KCC takes care of anything else that needs to be done for the child and the family that supports it.

Besides helping the child directly, the environment where the child grows up

needs to be improved. KCC helps schools to improve their teaching methods. There is a demonstration school at the centre and teacher trainings are given. Health workers are being trained, hygiene education is carried out and households are stimulated to build a proper latrine. I helped setting up a production site for cement slabs. These are used to build a good latrine. They are sold below cost price.

There is a clinic at the project, which provides children and their family medical help. Since 2020 a maternity ward was added and 24/7 service is available. When needed, transport to a hospital is offered. Immunization programs are carried out and help is provided when an epidemic is breaking out (measles and cholera have been a problem).

\*donate\*

Summer

1994 to summer 1995 I spent a whole year at the centre, working as a volunteer. I have helped to expand the centre and worked in the area of water and sanitation. I learned that the help that the KCC provides really helps. When I came back to Holland, I wanted to continue supporting KCC. To do this I'm raising funds and organizing the sponsorship program. Please consider one of these possibilities:

1. Sponsor a child in primary school: 17 euro a month (or more).
2. Sponsor a child in secondary school: 25 euro a month (or more).
3. Sponsor the clinic: Any amount a month or quarter
4. A one-time donation

Compared with other organizations that do child sponsorship the amounts are very low. This is because the money goes directly to the centre. Less than 5% is used for administration. This is possible because this is a small organization that works with volunteers. If you would like to sponsor a child, you should have the intention to do this for at least one year.

How do you know that the money will be spent right? First of all you have my personal guarantee as the author of Vim. I trust the people that are working at the centre, I know them personally. Furthermore, the centre has been co-sponsored and inspected by World Vision, Save the Children Fund and is now under the supervision of Pacific Academy Outreach Society. The centre is visited about once a year to check the progress (at our own cost). I have visited the centre myself many times, starting in 1993. The visit reports are on the ICCF web site.

If you have any further questions, send e-mail: <Bram@vim.org>.

The address of the centre is:

Kibaale Children's Centre  
p.o. box 1658  
Masaka, Uganda, East Africa

Sending money:    \*iccf-donations\*

Check the ICCF web site for the latest information! See [iccf] for the URL.

USA: The methods mentioned below can be used.

If you must send a check send it to our Canadian partner:

<https://www.kuwasha.net/>

Canada: Contact

Kuwasha in Surrey, Canada. They take care of the Canadian sponsors for the children in Kibaale. Kuwasha forwards 100% of the money to the project in Uganda. You can send them a one time donation directly.

Look on their site for information about sponsorship:

<https://www.kuwasha.net/>

If you make a donation to Kuwasha you will receive a tax receipt which can be submitted with your tax return.

Holland: Transfer to the account of "Stichting ICCF Holland" in Amersfoort. This will allow for tax deduction if you live in Holland. ING bank, IBAN: NL95 INGB 0004 5487 74

Germany: It is possible to make donations that allow for a tax return.

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[Bram@iccf-holland.org](mailto:Bram@iccf-holland.org)

Others: Transfer to this account if possible:

ING bank: IBAN: NL95 INGB 0004 5487 74

Swift code: INGBNL2A

under the name "stichting ICCF Holland", Amersfoort

Checks are not accepted.

vim:tw=78:ts=8:noet:ft=help:norl:

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LICENZA VIM

Nota: Agli effetti legali ha valore non la seguente traduzione italiana, ma l'originale inglese su cui basata. alla versione inglese che si fa riferimento qui sotto quando si parla di "questa licenza" (NdT).

- I) Non ci sono restrizioni alla distribuzione di copie non modificate di Vim, alla condizione che esse includano il testo di questa licenza. Si possono anche distribuire parti non modificate di Vim, sempre senza restrizioni, alla condizione che esse includano il testo di questa licenza. anche consentito includere programmi eseguibili da voi preparati a partire dai file sorgenti Vim non modificati, pi i vostri esempi di utilizzo e i vostri script Vim.
- II) consentito distribuire una versione modificata (o estesa) di Vim, contenente programmi eseguibile e/o codice sorgente, quando siano rispettare le seguenti quattro condizioni:
- 1) Il testo di questa licenza deve essere incluso senza modifiche.
  - 2) La versione modificata di Vim

dev'essere distribuita in una della

seguenti cinque maniere:

- a) Se voi personalmente modificate a Vim, dovete descrivere chiaramente nella distribuzione come possibile mettersi in contatto con voi. Quando il manutentore vi chiede (in qualsiasi forma) una copia della versione modificata di Vim da voi distribuita, dovete rendere disponibili le vostre modifiche, compreso il codice sorgente, al manutentore, senza alcuna spesa. Il manutentore si riserva il diritto di includere le vostre modifiche nella versione ufficiale di Vim. Quel che il manutentore potrà fare con le vostre modifiche e sotto quale licenza esse verranno distribuite può essere oggetto di negoziazione. Se non c'è stata alcuna negoziazione, questa licenza, o una versione successiva della stessa, anche applicabile alle vostre modifiche.

I manutentori correnti sono elencati qui:

<https://github.com/orgs/vim/people>.

Se dovessero cambiare, ne sarà dato annuncio nei luoghi appropriati (verosimilmente [vim.sf.net](http://vim.sf.net), [www.vim.org](http://www.vim.org) e/o [comp.editors](mailto:comp.editors)). Quando sia completamente impossibile contattare il manutentore, l'obbligo di spedirgli le vostre modifiche viene meno. Una volta che il manutentore abbia confermato di aver ricevuto le vostre modifiche, non sarà necessario spedirle ulteriormente.

- b) Se avete ricevuto un Vim modificato che era stato distribuito come descritto al punto a) potete ulteriormente distribuirlo senza modificarlo, come menzionato al punto I). Se fate ulteriori modifiche, il testo al punto a) si applica a queste modifiche.
- c) Includete tutte le modifiche, compreso il codice sorgente, con ogni copia del Vim modificato da voi distribuito. Questo può essere fatto sotto forma dell'output di un comando "diff", che contenga anche

il contesto [ossia anche le linee non modificate di sorgente

che vengono prima o dopo le modifiche - NdT]. Potete scegliere quale licenza volete utilizzare per il nuovo codice sorgente che voi aggiungere. Le modifiche e la relativa licenza non devono impedire a terze parti di apportare le loro proprie modifiche a Vim.

- d) Quando avete un Vim modificato che comprende modifiche quali quelle menzionate al punto c), potete distribuirlo senza il codice sorgente che descrive le modifiche, se le seguenti tre condizioni sono soddisfatte:

- La licenza applicabile alle modifiche vi consente di distribuire le modifiche al manutentore Vim senza alcun costo o restrizione, e permette al manutentore Vim di includere le modifiche nella versione ufficiale di Vim senza alcun costo o restrizione.
- Le modifiche da voi fatte sono conservate per almeno tre anni,

dopo che avrete distribuito per l'ultima volta il Vim modificato corrispondente alle modifiche stesse. Quando il manutentore o qualcuno a cui voi avete distribuito il Vim modificato vi chiede

(in qualsiasi forma) le modifiche, entro il periodo qui indicato, dovete fargliele avere.

- Dovete descrivere chiaramente nella distribuzione come possibile mettersi in contatto con voi. Questa informazione di contatto deve rimanere valida per almeno tre anni dopo l'ultima data di distribuzione della corrispondente modifica di Vim, oppure il più a lungo possibile.

e) Quando al GNU General Public License (GPL) si applica alle modifiche, potete distribuire il Vim modificato sotto la versione 2 della licenza GNU GPL versione 2 o una qualsiasi versione successiva della stessa licenza.

3) Un messaggio deve essere aggiunto, almeno all'output del comando ":",version" e nella schermata introduttiva, in modo che l'utilizzatore del Vim modificato sia in grado di comprendere cosa è stato modificato. Quando si distribuisca come menzionato al punto 2)e) l'aggiunta del messaggio richiesta solo se ci non conduca a conflitti con la licenza usata per le modifiche.

4) L'informazione di contatto, richiesta ai punti 2)a) e 2)d) non deve essere rimossa o modificata, tranne che per il fatto che la persona stessa può apportare delle correzioni.

III) Se distribuite una versione modificata di Vim, siete incoraggiati a utilizzare la licenza Vim per le vostre modifiche, e a mettere le modifiche a disposizione del manutentore, compreso il codice sorgente. Il modo preferito in cui fare questo è tramite e-mail o caricando i file su un server ed inviandone l'indirizzo (URL) tramite e-mail. Se il numero di modifiche è piccolo (per esempio, una modifica a un Makefile) inviare tramite

email l'output del comando diff con contesto

può essere sufficiente. L'indirizzo e-mail da utilizzare

<maintainer@vim.org>

IV) Non è consentito rimuovere questa licenza dalla distribuzione dei codici sorgente Vim, anche in parte, o da una versione di Vim modificata. Potete usare questa licenza per precedenti versioni di Vim, invece della licenza con cui esse sono state distribuite, a vostra scelta.

#### LICENZA DO VIM

I) Não há restrições para distribuir cópias não modificadas do Vim, exceto que elas devem incluir este texto de licença. Você também pode distribuir partes não modificadas do Vim, igualmente irrestritas, exceto que elas devem incluir este texto de licença. Você também tem permissão para incluir executáveis que você fez a partir das fontes não modificadas do Vim, além de seus próprios exemplos de uso e scripts do Vim.

II) permitido distribuir uma versão modificada (ou estendida) do Vim, incluindo executáveis e/ou código-fonte, quando as quatro condições a seguir forem atendidas:



- 1) Este texto de licena deve ser includo sem modificaes.
- 2) O Vim modificado deve ser distribudo de uma das cinco formas a seguir:
  - a) Se voc fizer alteraes no Vim, dever descrever claramente na distribuio como entrar em contato com voc. Quando o mantenedor solicitar a voc (de qualquer forma) uma cpia do Vim modificado que voc distribuiu, voc dever disponibilizar suas alteraes, incluindo o cdigo-fonte, ao mantenedor sem taxa. O mantenedor reserva o direito de incluir suas alteraes na verso oficial do Vim. O que o mantenedor far com suas alteraes e sob qual licena elas sero distribudas negociavel. Se no houve negcio ento esta licena, ou uma verso posterior, tambm se aplica s suas alteraes. Os mantenedores atuais esto listados aqui: <https://github.com/orgs/vim/people>. Se isso mudar, ser anunciado em lugares apropriados (provavelmente [vim.sf.net](http://vim.sf.net), [www.vim.org](http://www.vim.org) e/ou [comp.editors](mailto:comp.editors)). Quando for completamente impossvel contatar o mantenedor, a obrigao de enviar a ele suas alteraes cessa. Uma vez que o mantenedor tenha confirmado que ele recebeu suas alteraes, elas no precisaro ser enviadas novamente.
  - b) Se voc recebeu um Vim modificado que foi distribudo como mencionado em a), voc tem permissso para distribu-lo sem modificaes, como mencionado em 1). Se voc fizer alteraes adicionais, o texto em a) se aplica a essas alteraes.
  - c) Fornea todas as alteraes, incluindo o cdigo-fonte, com cada cpia do Vim modificado que voc distribuir. Isso pode ser feito na forma de um diff de contexto. Voc pode escolher qual licena usar para o novo cdigo que voc adicionar. As alteraes e sua licena no devem restringir outros de fazer suas prprias alteraes na verso oficial do Vim.
  - d) Quando voc tem um Vim modificado que inclui alteraes conforme mencionado em c), voc pode distribu-lo sem o cdigo-fonte para as alteraes se as trs condies a seguir forem atendidas:
    - A licena que se aplica s alteraes permite que voc distribua as alteraes para o mantenedor do Vim sem taxa ou restrio, e permite que o mantenedor do Vim inclua as alteraes na verso oficial do Vim sem taxa ou restrio.
    - Voc mantm as alteraes por pelo menos trs anos aps a ltima distribuio do Vim modificado correspondente. Quando o mantenedor ou algum para quem voc distribuiu o Vim modificado solicitar a voc (de qualquer forma) as alteraes dentro deste perodo, voc deve disponibiliz-las a ele.
    - Voc descreve claramente na distribuio como entrar em contato com voc. Estas informaes de contato devem permanecer vlidas por pelo menos trs anos aps a ltima distribuio do Vim modificado correspondente, ou pelo maior tempo possvel.
  - e) Quando a Licena Pblica Geral GNU (GPL) se aplica s alteraes,

você pode distribuir o Vim modificado sob a GNU GPL versão 2 ou qualquer versão posterior.

- 3) Uma mensagem deve ser adicionada, no mínimo na saída do comando `":version"` e na tela de introdução, de modo que o usuário do Vim modificado seja capaz de ver que ele foi modificado.

Ao distribuir

conforme mencionado em 2)e), é necessário adicionar a mensagem na medida em que isso não entre em conflito com a licença usada para as alterações.

- 4) As informações de contato conforme exigido em 2)a) e 2)d) não devem ser removidas ou alteradas, exceto que a própria pessoa pode fazer correções.

III) Se você distribuir uma versão modificada do Vim, encorajamos que use a licença do Vim para suas alterações e disponibilizá-las ao mantenedor, incluindo o código-fonte. A maneira preferida de fazer isso por e-mail ou enviando os arquivos para um servidor e enviando a URL por e-mail. Se o número de alterações for pequeno (por exemplo, um Makefile modificado), enviar um diff de contexto por e-mail será suficiente.

O endereço de e-mail a ser usado <maintainer@vim.org>

IV) Não é permitido remover esta licença da distribuição das fontes do Vim, partes dela ou de uma versão modificada. Você pode usar esta licença para versões anteriores do Vim em vez da licença com a qual elas vieram, a seu critério.

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Version 2.1, February 1999

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[This is the first released version of the Lesser GPL. It also counts as the successor of the GNU Library Public License, version 2, hence the version number 2.1.]

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the terms of the  
Sections above.

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bzip2/libbzip2 version 1.0.4 of 20 December 2006

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## 1.127 xz 5.8.1-r0

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package main

```
import (  
    "bufio"  
    "bytes"  
    "flag"  
    "fmt"  
    "io"  
    "log"  
    "os"  
    "path/filepath"  
    "strings"  
)
```

```
const crUsageString = `xb copyright [options] <path>....
```

The xb copyright command adds a copyright remark to all go files below path.

```
-h prints this message and exits  
,
```

```
func crUsage(w io.Writer) {  
    fmt.Fprint(w, crUsageString)  
}
```

```
const copyrightText = `  
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,
```

```

func goComment(text string) string {
    buf := new(bytes.Buffer)
    scanner := bufio.NewScanner(strings.NewReader(text))
    var err error
    for scanner.Scan() {
        s := strings.TrimSpace(scanner.Text())
        if len(s) == 0 {
            continue
        }
        if _, err = fmt.Fprintln(buf, "///", s); err != nil {
            panic(err)
        }
    }
    if err
    = scanner.Err(); err != nil {
        panic(err)
    }
    if _, err = fmt.Fprintln(buf); err != nil {
        panic(err)
    }
    return buf.String()
}

```

```

var goCopyright = goComment(copyrightText)

```

```

func addCopyright(path string) (err error) {
    log.Printf("adding copyright to %s", path)
    src, err := os.Open(path)
    if err != nil {
        return err
    }
    defer func() {
        cerr := src.Close()
        if cerr != nil && err == nil {
            err = cerr
        }
    }()
    newPath := path + ".new"
    dst, err := os.Create(newPath)
    if err != nil {
        return err
    }
    defer func() {
        cerr := dst.Close()
        if cerr != nil && err == nil {
            err = cerr
        }
    }
}

```



```

}()
out := bufio.NewWriter(dst)
fmt.Fprint(out, goCopyright)
scanner := bufio.NewScanner(src)
line := 0
del := false
for scanner.Scan() {
    line++
    txt := scanner.Text()
    if line == 1 && strings.Contains(txt, "Copyright") {
        del = true
        continue
    }
    if del {
        s := strings.TrimSpace(txt)
        if len(s) == 0 {
            del = false
        }
        continue
    }
    fmt.Fprintln(out, txt)
}
if err = scanner.Err();
err != nil {
    return err
}
if err = out.Flush(); err != nil {
    return
}
err = os.Rename(newPath, path)
return
}

func walkCopyrights(path string, info os.FileInfo, err error) error {
    if err != nil {
        return err
    }
    if info.IsDir() {
        return nil
    }
    if !strings.HasSuffix(info.Name(), ".go") {
        return nil
    }
    return addCopyright(path)
}

func copyright() {
    cmdName := os.Args[0]

```

```

log.SetPrefix(fmt.Sprintf("%s: ", cmdName))
log.SetFlags(0)

flag.CommandLine = flag.NewFlagSet(cmdName, flag.ExitOnError)
flag.Usage = func() { crUsage(os.Stderr); os.Exit(1) }

help := flag.Bool("h", false, "")

flag.Parse()

if *help {
    crUsage(os.Stdout)
    os.Exit(0)
}

for _, path := range flag.Args() {
    fi, err := os.Stat(path)
    if err != nil {
        log.Print(err)
        continue
    }
    if !fi.IsDir() {
        log.Printf("%s is not a directory", path)
        continue
    }
    if err = filepath.Walk(path, walkCopyrights); err != nil {
        log.Fatalf("%s error %s", path, err)
    }
}
}
package main

```

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## 1.128 py3-parsing 3.2.3-r0

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## 1.129 lua5.4 5.4.7-r0

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@Ci{\$Id: manual.of \$}

@C{[(-----)}

@manual{

@sect1{@title{Introduction}}

Lua is a powerful, efficient, lightweight, embeddable scripting language. It supports procedural programming, object-oriented programming, functional programming, data-driven programming, and data description.

Lua combines simple procedural syntax with powerful data description constructs based on associative arrays and extensible semantics.

Lua is dynamically typed, runs by interpreting bytecode with a register-based virtual machine, and has automatic memory management with a generational garbage collection, making it ideal for configuration, scripting, and rapid prototyping.

Lua is implemented as a library, written in `@emphx{clean C}`,  
the common subset of `@N{standard C}` and C++.

The Lua distribution includes a host program called `@id{lua}`,  
which uses the Lua library to offer  
a complete,  
standalone Lua interpreter,  
for interactive or batch use.

Lua is intended to be used both as a powerful, lightweight,  
embeddable scripting language for any program that needs one,  
and as a powerful but lightweight and efficient stand-alone language.

As an extension language, Lua has no notion of a `@Q{main}` program:  
it works `@emph{embedded}` in a host client,  
called the `@emph{embedding program}` or simply the `@emphx{host}`.  
(Frequently, this host is the stand-alone `@id{lua}` program.)

The host program can invoke functions to execute a piece of Lua code,  
can write and read Lua variables,  
and can register `@N{C functions}` to be called by Lua code.

Through the use of `@N{C functions}`, Lua can be augmented to cope with  
a wide range of different domains,  
thus creating customized programming languages sharing a syntactical framework.

Lua is free software,  
and is provided as usual with no guarantees,  
as stated in its license.

The implementation described in this manual is available  
at  
Lua's official web site, `@id{www.lua.org}`.

Like any other reference manual,  
this document is dry in places.

For a discussion of the decisions behind the design of Lua,  
see the technical papers available at Lua's web site.

For a detailed introduction to programming in Lua,  
see Roberto's book, `@emphx{Programming in Lua}`.

}

`@C{-----}`  
`@sect1{basic| @title{Basic Concepts}`

`@simplesect{`

This section describes the basic concepts of the language.

}

Lua is a dynamically typed language.

This means that

variables do not have types; only values do.

There are no type definitions in the language.

All values carry their own type.

All values in Lua are first-class values.

This means that all values can be stored in variables,  
passed as arguments to other functions, and returned as results.

There are eight @x{basic types} in Lua:

@def{nil}, @def{boolean}, @def{number},

@def{string},

@def{function}, @def{userdata},

@def{thread}, and @def{table}.

The type @emph{nil} has one single value, @nil,  
whose main property is to be different from any other value;  
it often represents the absence of a useful value.

The type @emph{boolean} has two values, @false and @true.

Both @nil and @false make a condition false;  
they are collectively called @def{false values}.

Any other value makes a condition true.

Despite its name,

@false is frequently used as an alternative to @nil,  
with the key difference that @false behaves  
like a regular value in a table,  
while a @nil in a table represents an absent key.

The type @emph{number} represents both  
integer numbers and real (floating-point) numbers,  
using two @x{subtypes}: @def{integer} and @def{float}.

Standard Lua uses 64-bit integers and double-precision (64-bit) floats,  
but you can also compile Lua so that it  
uses 32-bit integers and/or single-precision (32-bit) floats.

The option with 32 bits for both integers and floats  
is particularly

attractive

for small machines and embedded systems.

(See macro @id{LUA\_32BITS} in file @id{luaconf.h}.)

Unless stated otherwise,

any overflow when manipulating integer values @def{wrap around},  
according to the usual rules of two-complement arithmetic.

(In other words,

the actual result is the unique representable integer

that is equal modulo  $2^M$  to the mathematical result,  
where  $M$  is the number of bits of the integer type.)

Lua has explicit rules about when each subtype is used,  
but it also converts between them automatically as needed (see coercion).  
Therefore,  
the programmer may choose to mostly ignore the difference  
between integers and floats  
or to assume complete control over the representation of each number.

The type `string` represents immutable sequences of bytes.

Eight-bit clean

Lua is 8-bit clean:

strings can contain any 8-bit value,  
including embedded zeros (`\0`).

Lua is also encoding-agnostic;  
it makes no assumptions about the contents  
of a string.

The length of any string in Lua must fit in a Lua integer.

Lua can call (and manipulate) functions written in Lua and  
functions written in C (see function call).

Both are represented by the type `function`.

The type `userdata` is provided to allow arbitrary C data to  
be stored in Lua variables.

A userdata value represents a block of raw memory.

There are two kinds of userdata:

`full userdata`,

which is an object with a block of memory managed by Lua,

and `light userdata`,

which is simply a C pointer value.

Userdata has no predefined operations in Lua,  
except assignment and identity test.

By using `metatables`,  
the programmer can define operations for full userdata values  
(see metatable).

Userdata values cannot be created or modified in Lua,  
only through the C API.

This guarantees the integrity of data owned by  
the host program and C libraries.

The type `thread` represents independent threads of execution  
and it is used to

implement coroutines (see coroutine).

Lua threads are not related to operating-system threads.

Lua supports coroutines on all systems,  
even those that do not support threads natively.

The type `@emph{table}` implements `@x{associative arrays}`, that is, `@x{arrays}` that can have as indices not only numbers, but any Lua value except `@nil` and `@x{NaN}`. (`@emphx{Not a Number}` is a special floating-point value used by the `@x{IEEE 754}` standard to represent undefined numerical results, such as `@T{0/0}`.) Tables can be `@emph{heterogeneous}`; that is, they can contain values of all types (except `@nil`). Any key associated to the value `@nil` is not considered part of the table. Conversely, any key that is not part of a table has an associated value `@nil`.

Tables are the sole data-structuring mechanism in Lua; they can be used to represent ordinary arrays, lists, symbol tables, sets, records, graphs, trees, etc. To represent `@x{records}`, Lua uses the field name as an index. The language supports this representation by providing `@id{a.name}` as syntactic sugar for `@T{a["name"]}`. There are several convenient ways to create tables in Lua `@see{tableconstructor}`.

Like indices, the values of table fields can be of any type. In particular, because functions are first-class values, table fields can contain functions. Thus tables can also carry `@emph{methods}` `@see{func-def}`.

The indexing of tables follows the definition of raw equality in the language. The expressions `@T{a[i]}` and `@T{a[j]}` denote the same table element if and only if `@id{i}` and `@id{j}` are raw equal (that is, equal without metamethods). In particular, floats with integral values are equal to their respective integers (e.g., `@T{1.0 == 1}`). To avoid ambiguities, any float used as a key that is equal to an integer is converted to that integer. For instance, if you write `@T{a[2.0] = true}`, the actual key inserted into the table will be the integer `@T{2}`.

Tables, functions, threads, and (full) userdata values are `@emph{objects}`: variables



do not actually @emph{contain} these values,  
only @emph{references} to them.  
Assignment, parameter passing, and function returns  
always manipulate references to such values;  
these operations do not imply any kind of copy.

The library function @Lid{type} returns a string describing the type  
of a given value @seeF{type}.

}

@sect2{globalenv| @title{Environments and the Global Environment}}

As we will discuss further in @refsec{variables} and @refsec{assignment},  
any reference to a free name  
(that is, a name not bound to any declaration) @id{var}  
is syntactically translated to @T{\_ENV.var}.  
Moreover, every chunk is compiled in the scope of  
an external local variable named @id{\_ENV} @see{chunks},  
so @id{\_ENV} itself is never a free name in a chunk.

Despite the existence of this external @id{\_ENV} variable and  
the translation of free names,  
@id{\_ENV} is a completely regular name.  
In particular,  
you can define new variables and parameters with that name.  
Each reference to a free  
name uses the @id{\_ENV} that is  
visible at that point in the program,  
following the usual visibility rules of Lua @see{visibility}.

Any table used as the value of @id{\_ENV} is called an @def{environment}.

Lua keeps a distinguished environment called the @def{global environment}.  
This value is kept at a special index in the C registry @see{registry}.  
In Lua, the global variable @Lid{\_G} is initialized with this same value.  
(@Lid{\_G} is never used internally,  
so changing its value will affect only your own code.)

When Lua loads a chunk,  
the default value for its @id{\_ENV} variable  
is the global environment @seeF{load}.  
Therefore, by default,  
free names in Lua code refer to entries in the global environment  
and, therefore, they are also called @def{global variables}.  
Moreover, all standard libraries are loaded in the global environment  
and some functions there operate on that environment.  
You can use @Lid{load} (or @Lid{loadfile})

to load a chunk with a different environment.  
(In C,  
you have to load the chunk and then change the value  
of its first upvalue; see @See{lua\_setupvalue}.)

```
}
```

@sect2{error| @title{Error Handling}}

Several operations in Lua can @emph{raise} an error.  
An error interrupts the normal flow of the program,  
which can continue by @emph{catching} the error.

Lua code can explicitly raise an error by calling the  
@Lid{error} function.  
(This function never returns.)

To catch errors in Lua,  
you can do a @def{protected call},  
using @Lid{pcall} (or @Lid{xpcall}).  
The function @Lid{pcall} calls a given function in @def{protected mode}.  
Any error while running the function stops its execution,  
and control returns immediately to @id{pcall},  
which returns a status code.

Because Lua is an embedded extension language,  
Lua code starts running by a call  
from @N{C code} in the host program.  
(When you use Lua standalone,  
the @id{lua} application is the host program.)  
Usually, this call is protected;  
so, when an otherwise unprotected error occurs during  
the compilation  
or execution of a Lua chunk,  
control returns to the host,  
which can take appropriate measures,  
such as printing an error message.

Whenever there is an error,  
an @def{error object}  
is propagated with information about the error.  
Lua itself only generates errors whose error object is a string,  
but programs can generate errors with  
any value as the error object.  
It is up to the Lua program or its host to handle such error objects.  
For historical reasons,  
an error object is often called an @def{error message},  
even though it does not have to be a string.

When you use `@Lid{xpcall}` (or `@Lid{lua_pcall}`, in C) you can give a `@def{message handler}` to be called in case of errors. This function is called with the original error object and returns a new error object. It is called before the error unwinds the stack, so that it can gather more information about the error, for instance by inspecting the stack and creating a stack traceback. This message handler is still protected by the protected call; so, an error inside the message handler will call the message handler again. If this loop goes on for too long, Lua breaks it and returns an appropriate message. The message handler is called only for regular runtime errors. It is not called for memory-allocation errors nor for errors while running finalizers or other message handlers.

Lua also offers a system of `@emph{warnings}` `@seeF{warn}`. Unlike errors, warnings do not interfere in any way with program execution. They typically only generate a message to the user, although this behavior can be adapted from C `@seeC{lua_setwarnf}`.

}

`@sect2{metatable| @title{Metatables and Metamethods}}`

Every value in Lua can have a `@emph{metatable}`. This `@def{metatable}` is an ordinary Lua table that defines the behavior of the original value under certain events. You can change several aspects of the behavior of a value by setting specific fields in its metatable. For instance, when a non-numeric value is the operand of an addition, Lua checks for a function in the field `@idx{__add}` of the value's metatable. If it finds one, Lua calls this function to perform the addition.

The key for each event in a metatable is a string with the event name prefixed by two underscores; the corresponding value is called a `@def{metavalue}`. For most events, the metavalue must be a function, which is then called a `@def{metamethod}`. In the previous example, the key is the string `@St{__add}`

and the metamethod is the function that performs the addition.  
Unless stated otherwise,  
a metamethod can in fact be any `@x{callable value}`,  
which is either a function or a value with a `@idx{__call}` metamethod.

You can query the metatable of any value  
using the `@Lid{getmetatable}` function.  
Lua queries metamethods in metatables using a raw access `@seeF{rawget}`.

You can replace the metatable of tables  
using the `@Lid{setmetatable}` function.  
You cannot change the metatable of other types from Lua code,  
except by using the `@link{debuglib|debug library}`.

Tables  
and full userdata have individual metatables,  
although multiple tables and userdata can share their metatables.  
Values of all other types share one single metatable per type;  
that is, there is one single metatable for all numbers,  
one for all strings, etc.  
By default, a value has no metatable,  
but the string library sets a metatable for the string type `@see{strlib}`.

A detailed list of operations controlled by metatables is given next.  
Each event is identified by its corresponding key.  
By convention, all metatable keys used by Lua are composed by  
two underscores followed by lowercase Latin letters.

`@description{`

`@item{@idx{__add}|`  
the addition (`@T{+}`) operation.  
If any operand for an addition is not a number,  
Lua will try to call a metamethod.  
It starts by checking the first operand (even if it is a number);  
if that operand does not define a metamethod for `@idx{__add}`,  
then Lua will check the second operand.  
If Lua can find a metamethod,  
it calls the metamethod with the two  
operands as arguments,  
and the result of the call  
(adjusted to one value)  
is the result of the operation.  
Otherwise, if no metamethod is found,  
Lua raises an error.  
`}`

`@item{@idx{__sub}|`

the subtraction ( $@T\{-}$ ) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_mul}|  
the multiplication ( $@T\{*\}$ ) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_div}|  
the division ( $@T\{/}$ ) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_mod}|  
the modulo ( $@T\{\%\}$ ) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_pow}|  
the exponentiation ( $@T\{^\wedge\}$ ) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_unm}|  
the negation (unary  $@T\{-}$ ) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_idiv}|  
the floor division ( $@T\{//\}$ ) operation.  
Behavior similar to the addition operation.  
}

@item{@idx{\_\_band}|  
the bitwise AND ( $@T\{\&\}$ ) operation.  
Behavior similar to the addition operation,  
except that Lua will  
try a metamethod  
if any operand is neither an integer  
nor a float coercible to an integer @see{coercion}.  
}

@item{@idx{\_\_bor}|  
the bitwise OR ( $@T\{|\}$ ) operation.  
Behavior similar to the bitwise AND operation.  
}

@item{@idx{\_\_bxor}|  
the bitwise exclusive OR (binary @T{~}) operation.  
Behavior similar to the bitwise AND operation.  
}

@item{@idx{\_\_bnot}|  
the bitwise NOT (unary @T{~}) operation.  
Behavior similar to the bitwise AND operation.  
}

@item{@idx{\_\_shl}|  
the bitwise left shift (@T{<<}) operation.  
Behavior similar to the bitwise AND operation.  
}

@item{@idx{\_\_shr}|  
the bitwise right shift (@T{>>}) operation.  
Behavior similar to the bitwise AND operation.  
}

@item{@idx{\_\_concat}|  
the concatenation (@T{..}) operation.  
Behavior similar to the addition operation,  
except that Lua will try a metamethod  
if any operand is neither a string nor a number  
(which is always coercible to a string).  
}

@item{@idx{\_\_len}|  
the length (@T{#}) operation.  
If the object is not a string,  
Lua will try its  
metamethod.  
If there is a metamethod,  
Lua calls it with the object as argument,  
and the result of the call  
(always adjusted to one value)  
is the result of the operation.  
If there is no metamethod but the object is a table,  
then Lua uses the table length operation @see{len-op}.  
Otherwise, Lua raises an error.  
}

@item{@idx{\_\_eq}|  
the equal (@T{==}) operation.  
Behavior similar to the addition operation,  
except that Lua will try a metamethod only when the values  
being compared are either both tables or both full userdata

and they are not primitively equal.  
The result of the call is always converted to a boolean.  
}

@item{@idx{\_\_lt}|  
the less than (@T{<}) operation.  
Behavior similar to the addition operation,  
except that Lua will try a metamethod only when the values  
being compared are neither both numbers nor both strings.  
Moreover, the result of the call is always converted to a boolean.  
}

@item{@idx{\_\_le}|  
the less equal (@T{<=}) operation.  
Behavior similar to the less than operation.  
}

@item{@idx{\_\_index}|  
The  
indexing access operation @T{table[key]}.  
This event happens when @id{table} is not a table or  
when @id{key} is not present in @id{table}.  
The metavalue is looked up in the metatable of @id{table}.

The metavalue for this event can be either a function, a table,  
or any value with an @idx{\_\_index} metavalue.  
If it is a function,  
it is called with @id{table} and @id{key} as arguments,  
and the result of the call  
(adjusted to one value)  
is the result of the operation.  
Otherwise,  
the final result is the result of indexing this metavalue with @id{key}.  
This indexing is regular, not raw,  
and therefore can trigger another @idx{\_\_index} metavalue.  
}

@item{@idx{\_\_newindex}|  
The indexing assignment @T{table[key] = value}.  
Like the index event,  
this event happens when @id{table} is not a table or  
when @id{key} is not present in @id{table}.  
The metavalue is looked up in the metatable of @id{table}.

Like with indexing,  
the metavalue for this event can be either a function,  
a table,  
or any value with an @idx{\_\_newindex} metavalue.

If it is a function,  
it is called with `@id{table}`, `@id{key}`, and `@id{value}` as arguments.  
Otherwise,  
Lua repeats the indexing assignment over this metavalue  
with the same key and value.  
This assignment is regular, not raw,  
and therefore can trigger another `@idx{__newindex}` metavalue.

Whenever a `@idx{__newindex}` metavalue is invoked,  
Lua does not perform the primitive assignment.  
If needed,  
the metamethod itself can call `@Lid{rawset}`  
to do the assignment.  
}

`@item{@idx{__call}|`  
The call operation `@T{func(args)}`.  
This event happens when Lua tries to call a non-function value  
(that is, `@id{func}` is not a function).  
The metamethod is looked up in `@id{func}`.  
If present,  
the metamethod is called with `@id{func}` as its first argument,  
followed by the arguments of the original call (`@id{args}`).  
All results of the call  
are the results of the operation.  
This is the only metamethod that allows multiple results.  
}  
  
}

In addition to  
the previous list,  
the interpreter also respects the following keys in metatables:  
`@idx{__gc}` `@see{finalizers}`,  
`@idx{__close}` `@see{to-be-closed}`,  
`@idx{__mode}` `@see{weak-table}`,  
and `@idx{__name}`.  
(The entry `@idx{__name}`,  
when it contains a string,  
may be used by `@Lid{tostring}` and in error messages.)

For the unary operators (negation, length, and bitwise NOT),  
the metamethod is computed and called with a dummy second operand,  
equal to the first one.  
This extra operand is only to simplify Lua's internals  
(by making these operators behave like a binary operation)  
and may be removed in future versions.  
For most uses this extra operand is irrelevant.



Because metatables are regular tables,  
they can contain arbitrary fields,  
not only the event names defined above.  
Some functions in the standard library  
(e.g., `@Lid{tostring}`)  
use other fields in metatables for their own purposes.

It is a good practice to add all needed metamethods to a table  
before setting it as a metatable of some object.

In

particular, the `@idx{__gc}` metamethod works only when this order  
is followed `@see{finalizers}`.

It is also a good practice to set the metatable of an object  
right after its creation.

}

`@sect2{GC| @title{Garbage Collection}`

`@simplesect{`

Lua performs automatic memory management.

This means that

you do not have to worry about allocating memory for new objects  
or freeing it when the objects are no longer needed.

Lua manages memory automatically by running  
a `@def{garbage collector}` to collect all `@emph{dead}` objects.

All memory used by Lua is subject to automatic management:  
strings, tables, userdata, functions, threads, internal structures, etc.

An object is considered `@def{dead}`  
as soon as the collector can be sure the object  
will not be accessed again in the normal execution of the program.  
(`@Q{Normal execution}` here excludes finalizers,  
which can resurrect dead objects `@see{finalizers}`,  
and excludes also operations using the debug library.)

Note that the time when the collector can  
be sure that an object

is dead may not coincide with the programmer's expectations.

The only guarantees are that Lua will not collect an object  
that may still be accessed in the normal execution of the program,  
and it will eventually collect an object  
that is inaccessible from Lua.

(Here,

`@emph{inaccessible from Lua}` means that neither a variable nor  
another live object refer to the object.)

Because Lua has no knowledge about `@N{C code}`,

it never collects objects accessible through the registry `@see{registry}`, which includes the global environment `@see{globalenv}`.

The garbage collector (GC) in Lua can work in two modes: incremental and generational.

The default GC mode with the default parameters are adequate for most uses.

However, programs that waste a large proportion of their time allocating and freeing memory can benefit from other settings.

Keep in mind that the GC behavior is non-portable both across platforms and across different Lua releases; therefore, optimal settings are also non-portable.

You can change the GC mode and parameters by calling

`@Lid{lua_gc}` `@N{in C}`

or `@Lid{collectgarbage}` in Lua.

You can also use these functions to control the collector directly (e.g., to stop and restart it).

}

`@sect3{incmode| @title{Incremental Garbage Collection}`

In incremental mode, each GC cycle performs a mark-and-sweep collection in small steps interleaved with the program's execution.

In this mode,

the collector uses three numbers to control its garbage-collection cycles:

the `@def{garbage-collector pause}`,

the `@def{garbage-collector step multiplier}`,

and the `@def{garbage-collector step size}`.

The garbage-collector pause

controls how long the collector waits before starting a new cycle.

The collector starts a new cycle when the use of memory hits `@M{n%}` of the use after the previous collection.

Larger values make the collector less aggressive.

Values equal to or less than 100 mean the collector will not wait to start a new cycle.

A value of 200 means that

the collector waits for the total memory in use to double before starting a new cycle.

The default value is 200; the maximum value is 1000.

The garbage-collector step multiplier

controls the speed of the collector relative to memory allocation, that is, how many elements it marks or sweeps for each kilobyte of memory allocated. Larger values make the collector more aggressive but also increase the size of each incremental step. You should not use values less than 100, because they make the collector too slow and can result in the collector never finishing a cycle. The default value is 100; the maximum value is 1000.

The garbage-collector step size controls the size of each incremental step, specifically how many bytes the interpreter allocates before performing a step.

This parameter is logarithmic:

A value of  $2^n$  means the interpreter will allocate  $2^n$  bytes between steps and perform equivalent work during the step.

A large value (e.g., 60) makes the collector a stop-the-world (non-incremental) collector.

The default value is 13, which means steps of approximately 8 Kbytes.

}

@sect3{genmode| @title{Generational Garbage Collection}

In generational mode, the collector does frequent @emph{minor} collections, which traverses only objects recently created. If after a minor collection the use of memory is still above a limit, the collector does a stop-the-world @emph{major} collection, which traverses all objects.

The generational mode uses two parameters: the @def{minor multiplier} and the @def{the major multiplier}.

The minor multiplier controls the frequency of minor collections. For a minor multiplier  $2^x$ , a new minor collection will be done when memory grows  $2^x\%$  larger than the memory in use after the previous major collection.

For instance, for a multiplier of 20, the collector will do a minor collection when the use of memory gets 20% larger than the use after the previous major collection. The default value is 20; the maximum value is 200.

The major multiplier controls the frequency of major collections. For a major multiplier `@M{x}`, a new major collection will be done when memory grows `@M{x%}` larger than the memory in use after the previous major collection. For instance, for a multiplier of 100, the collector will do a major collection when the use of memory gets larger than twice the use after the previous collection. The default value is 100; the maximum value is 1000.

}

@sect3{finalizers| @title{Garbage-Collection Metamethods}

You can set garbage-collector metamethods for tables and, using the `@N{C API}`, for full userdata `@see{metatable}`. These metamethods, called `@def{finalizers}`, are called when the garbage collector detects that the corresponding table or userdata is dead. Finalizers allow you to coordinate Lua's garbage collection with external resource management such as closing files, network or database connections, or freeing your own memory.

For an object (table or userdata) to be finalized when collected, you must `@emph{mark}` it for finalization. `@index{mark (for finalization)}` You mark an object for finalization when you set its metatable and the metatable has a `@idx{__gc}` metamethod. Note that if you set a metatable without a `@idx{__gc}` field and later create that field in the metatable, the object will not be marked for finalization.

When a marked object becomes dead, it is not collected immediately by the garbage collector. Instead, Lua puts it in a list. After the collection, Lua goes through that list. For each object in the list, it checks the object's `@idx{__gc}` metamethod: If it is present, Lua calls it with the object as its single argument.

At the end of each garbage-collection cycle, the finalizers are called in

the reverse order that the objects were marked for finalization,  
among those collected in that cycle;  
that is, the first finalizer to be called is the one associated  
with the object marked last in the program.  
The execution of each finalizer may occur at any  
point during  
the execution of the regular code.

Because the object being collected must still be used by the finalizer,  
that object (and other objects accessible only through it)  
must be *@emph{resurrected}* by Lua.*@index{resurrection}*  
Usually, this resurrection is transient,  
and the object memory is freed in the next garbage-collection cycle.  
However, if the finalizer stores the object in some global place  
(e.g., a global variable),  
then the resurrection is permanent.  
Moreover, if the finalizer marks a finalizing object for finalization again,  
its finalizer will be called again in the next cycle where the  
object is dead.  
In any case,  
the object memory is freed only in a GC cycle where  
the object is dead and not marked for finalization.

When you close a state *@seeF{lua\_close}*,  
Lua calls the finalizers of all objects marked for finalization,  
following the reverse order that they were marked.  
If any finalizer marks objects for collection during that phase,  
these marks have no effect.

Finalizers  
cannot yield nor run the garbage collector.  
Because they can run in unpredictable times,  
it is good practice to restrict each finalizer  
to the minimum necessary to properly release  
its associated resource.

Any error while running a finalizer generates a warning;  
the error is not propagated.

}

*@sect3{weak-table| @title{Weak Tables}*

A *@def{weak table}* is a table whose elements are  
*@def{weak references}*.  
A weak reference is ignored by the garbage collector.  
In other words,  
if the only references to an object are weak references,

then the garbage collector will collect that object.

A weak table can have weak keys, weak values, or both.

A table with weak values allows the collection of its values, but prevents the collection of its keys.

A table with both weak keys and weak values allows the collection of both keys and values.

In any case, if either the key or the value is collected, the whole pair is removed from the table.

The weakness of a table is controlled by the

`@idx{__mode}`

field of its metatable.

This metavalue, if present, must be one of the following strings:

`@St{k}`, for a table with weak keys;

`@St{v}`, for a table with weak values;

or `@St{kv}`, for a table with both weak keys and values.

A table with weak keys and strong values

is also called an `@def{ephemeron table}`.

In an ephemeron table,

a value is considered reachable only if its key is reachable.

In particular,

if the only reference to a key comes through its value,

the pair is removed.

Any change in the weakness of a table may take effect only at the next collect cycle.

In particular, if you change the weakness to a stronger mode,

Lua may still collect some items from that table

before the change takes effect.

Only objects that have an explicit construction are removed from weak tables.

Values, such as numbers and `@x{light @N{C functions}}`,

are not subject to garbage collection,

and therefore are not removed from weak tables

(unless their associated values are collected).

Although strings

are subject to garbage collection,

they do not have an explicit construction and

their equality is by value;

they behave more like values than like objects.

Therefore, they are not removed from weak tables.

Resurrected objects

(that is, objects being finalized

and objects accessible only through objects being finalized)

have a special behavior in weak tables.

They are removed from weak values before running their finalizers, but are removed from weak keys only in the next collection after running their finalizers, when such objects are actually freed. This behavior allows the finalizer to access properties associated with the object through weak tables.

If a weak table is among the resurrected objects in a collection cycle, it may not be properly cleared until the next cycle.

}

}

@sect2{coroutine| @title{Coroutines}

Lua supports coroutines, also called @emphx{collaborative multithreading}. A coroutine in Lua represents an independent thread of execution. Unlike threads in multithread systems, however, a coroutine only suspends its execution by explicitly calling a yield function.

You create a coroutine by calling @Lid{coroutine.create}. Its sole argument is a function that is the main function of the coroutine. The @id{create} function only creates a new coroutine and returns a handle to it (an object of type @emph{thread}); it does not start the coroutine.

You execute a coroutine by calling @Lid{coroutine.resume}. When you first call @Lid{coroutine.resume}, passing as its first argument a thread returned by @Lid{coroutine.create}, the coroutine starts its execution by calling its main function. Extra arguments passed to @Lid{coroutine.resume} are passed as arguments to that function. After the coroutine starts running, it runs until it terminates or @emph{yields}.

A coroutine can terminate its execution in two ways: normally, when its main function returns (explicitly or implicitly, after the last instruction); and abnormally, if there is an unprotected error.

In case of normal termination, @Lid{coroutine.resume} returns @true,

plus any values returned by the coroutine main function.  
In case of errors, `@Lid{coroutine.resume}` returns `@false`  
plus the error object.  
In this case, the coroutine does not unwind its stack,  
so that it is possible to inspect it after the error  
with the debug API.

A coroutine yields by calling `@Lid{coroutine.yield}`.  
When a coroutine yields,  
the corresponding `@Lid{coroutine.resume}` returns immediately,  
even if the yield happens inside nested function calls  
(that is, not in the main function,  
but in a function directly or indirectly called by the main function).  
In the case of a yield, `@Lid{coroutine.resume}` also returns `@true`,  
plus any values passed to `@Lid{coroutine.yield}`.  
The next time you resume the same coroutine,  
it continues its execution from the point where it yielded,  
with the call to `@Lid{coroutine.yield}` returning any extra  
arguments passed to `@Lid{coroutine.resume}`.

Like `@Lid{coroutine.create}`,  
the  
`@Lid{coroutine.wrap}` function also creates a coroutine,  
but instead of returning the coroutine itself,  
it returns a function that, when called, resumes the coroutine.  
Any arguments passed to this function  
go as extra arguments to `@Lid{coroutine.resume}`.  
`@Lid{coroutine.wrap}` returns all the values returned by `@Lid{coroutine.resume}`,  
except the first one (the boolean error code).  
Unlike `@Lid{coroutine.resume}`,  
the function created by `@Lid{coroutine.wrap}`  
propagates any error to the caller.  
In this case,  
the function also closes the coroutine `@seeF{coroutine.close}`.

As an example of how coroutines work,  
consider the following code:

```
@verbatim{
function foo (a)
  print("foo", a)
  return coroutine.yield(2*a)
end

co = coroutine.create(function (a,b)
  print("co-body", a, b)
  local r = foo(a+1)
  print("co-body", r)
  local r, s = coroutine.yield(a+b, a-b)
```



```

    print("co-body", r, s)
    return b, "end"
end)

print("main", coroutine.resume(co, 1, 10))
print("main", coroutine.resume(co,
    "r"))
print("main", coroutine.resume(co, "x", "y"))
print("main", coroutine.resume(co, "x", "y"))
}

```

When you run it, it produces the following output:

```

@verbatim{
co-body 1    10
foo    2
main  true  4
co-body r
main  true  11  -9
co-body x    y
main  true  10  end
main  false  cannot resume dead coroutine
}

```

You can also create and manipulate coroutines through the C API:

see functions `@Lid{lua_newthread}`, `@Lid{lua_resume}`,  
and `@Lid{lua_yield}`.

```

}

```

```

}

```

```

@C{-----}
@sect1{language| @title{The Language}

```

```

@simplesect{

```

This section describes the lexis, the syntax, and the semantics of Lua.

In other words,

this section describes

which tokens are valid,

how they can be combined,

and what their combinations mean.

Language constructs will be explained using the usual extended BNF notation,  
in which

`@N{@bnfrep{@rep{a}}` means 0} or more `@rep{a}`'s, and

`@N{@bnfopt{@rep{a}}` means} an

optional @rep{a}.

Non-terminals are shown like @bnfNter{non-terminal},

keywords are shown like @rw{kword},

and other terminal symbols are shown like @bnfter{=}.

The complete syntax of Lua can be found in @refsec{BNF}

at the end of this manual.

}

@sect2{lexical| @title{Lexical Conventions}}

Lua is a @x{free-form} language.

It ignores spaces and comments between lexical elements (@x{tokens}),

except as delimiters between two tokens.

In source code,

Lua recognizes as spaces the standard ASCII whitespace

characters space, form feed, newline,

carriage return, horizontal tab, and vertical tab.

@def{Names}

(also called @def{identifiers})

in Lua can be any string of Latin letters,

Arabic-Indic digits, and underscores,

not beginning with a digit and

not being a reserved word.

Identifiers are used to name variables, table fields, and labels.

The following @def{keywords} are reserved

and cannot be used as names:

@index{reserved words}

@verbatim{

and    break    do    else    elseif

      end

false   for    function goto   if    in

local   nil    not    or    repeat   return

then    true    until   while

}

Lua is a case-sensitive language:

@id{and} is a reserved word, but @id{And} and @id{AND}

are two different, valid names.

As a convention,

programs should avoid creating

names that start with an underscore followed by

one or more uppercase letters (such as @Lid{\_VERSION}).

The following strings denote other @x{tokens}:

@verbatim{

```

+ - * / % ^ #
& ~ | << >> //
== ~= <= >= < > =
( ) { } [ ] ::
; : , . .. ...
}

```

A `@def{short literal string}`

can be delimited by matching single or double quotes,  
and can contain the following C-like escape sequences:

```

@Char{a} (bell),
@Char{b} (backspace),
@Char{f} (form feed),
@Char{n} (newline),
@Char{r} (carriage return),
@Char{t} (horizontal tab),
@Char{v} (vertical tab),
@Char{\\} (backslash),
@Char{"}
    (quotation mark [double quote]),
and @Char{'} (apostrophe [single quote]).

```

A backslash followed by a line break  
results in a newline in the string.

The escape sequence `@Char{z}` skips the following span  
of whitespace characters,  
including line breaks;

it is particularly useful to break and indent a long literal string  
into multiple lines without adding the newlines and spaces  
into the string contents.

A short literal string cannot contain unescaped line breaks  
nor escapes not forming a valid escape sequence.

We can specify any byte in a short literal string,  
including `@x{embedded zeros}`,  
by its numeric value.

This can be done

with the escape sequence `@T{x@rep{XX}}`,  
where `@rep{XX}` is a sequence of exactly two hexadecimal digits,  
or with the escape sequence `@T{@rep{ddd}}`,  
where `@rep{ddd}` is a sequence of up to three decimal digits.

(Note that if a decimal escape sequence is to be followed by a digit,  
it must be expressed using exactly three digits.)

The `@x{UTF-8}` encoding  
of a `@x{Unicode}` character  
can be inserted in a literal string with  
the escape sequence `@T{u{@rep{XXX}}}`  
(with mandatory enclosing braces),

where @rep{XXX} is a sequence of one or more hexadecimal digits representing the character code point.

This code point can be any value less than @M{2@sp{31}}.

(Lua uses the original UTF-8 specification here, which is not restricted to valid Unicode code points.)

Literal strings can also be defined using a long format enclosed by @def{long brackets}.

We define an @def{opening long bracket of level @rep{n}} as an opening square bracket followed by @rep{n} equal signs followed by another opening square bracket.

So, an opening long bracket of @N{level 0} is written as @T{[[, @C{]]}

an opening long bracket of @N{level 1} is written as @T{[=[, @C{]]}

and so on.

A @emph{closing long bracket} is defined similarly;

for instance,

a closing long bracket of @N{level 4} is written as @C{[[ @T{]===}]}

A @def{long literal} starts with an opening long bracket of any level and

ends at the first closing long bracket of the same level.

It can contain any text except a closing bracket of the same level.

Literals in this bracketed form can run for several lines,

do not interpret any escape sequences,

and ignore long brackets of any other level.

Any kind of end-of-line sequence

(carriage return, newline, carriage return followed by newline,

or newline followed by carriage return)

is converted to a simple newline.

When the opening long bracket is immediately followed by a newline, the newline is not included in the string.

As an example, in a system using ASCII

(in which @Char{a} is coded @N{as 97},

newline is coded @N{as 10}, and @Char{1} is coded @N{as 49}),

the five literal strings below denote the same string:

```
@verbatim{
a = 'alo\n123'
a = "alo\n123\"
a = "\97lo\10\04923"
a = [[alo
123"]]
a = [=[
alo
123"]=]
}
```

Any byte in a literal string not

explicitly affected by the previous rules represents itself.

However, Lua opens files for  
parsing in text mode,  
and the system's file functions may have problems with  
some control characters.  
So, it is safer to represent  
binary data as a quoted literal with  
explicit escape sequences for the non-text characters.

A `@def{numeric constant}` (or `@def{numeral}`)  
can be written with an optional fractional part  
and an optional decimal exponent,  
marked by a letter `@Char{e}` or `@Char{E}`.  
Lua also accepts `@x{hexadecimal constants}`,  
which start with `@T{0x}` or `@T{0X}`.  
Hexadecimal constants also accept an optional fractional part  
plus an optional binary exponent,  
marked by a letter `@Char{p}` or `@Char{P}` and written in decimal.  
(For instance, `@T{0x1.fp10}` denotes 1984,  
which is `@M{0x1f / 16}` multiplied by `@M{2@sp{10}}`.)

A numeric constant with a radix point or an exponent  
denotes a float;  
otherwise,  
if its value fits in an integer or it is a hexadecimal constant,  
it denotes an integer;  
otherwise (that is, a decimal integer numeral that overflows),  
it denotes a float.  
Hexadecimal numerals  
with neither a radix point nor an exponent  
always denote an integer value;  
if the value overflows, it `@emph{wraps around}`  
to fit into a valid integer.

Examples of valid integer constants are

```
@verbatim{
3 345 0xff 0xBEBADA
}
```

Examples of valid float constants are

```
@verbatim{
3.0 3.1416 314.16e-2 0.31416E1 34e1
0x0.1E 0xA23p-4 0X1.921FB54442D18P+1
}
```

A `@def{comment}` starts with a double hyphen (`@T{--}`)  
anywhere outside a string.  
If the text immediately after `@T{--}` is not an opening long bracket,  
the comment is a `@def{short comment}`,  
which runs until the end of the line.

Otherwise, it is a `@def{long comment}`,  
which runs until the corresponding closing long bracket.

}

`@sect2{variables| @title{Variables}}`

Variables are places that store values.  
There are three kinds of variables in Lua:  
global variables, local variables, and table fields.

A single name can denote a global variable or a local variable  
(or a function's formal parameter,  
which is a particular kind of  
local variable):

`@Produc{`  
`@producname{var}@producbody{@bnfNter{Name}}`  
`}`  
`@bnfNter{Name}` denotes identifiers `@see{lexical}`.

Any variable name is assumed to be global unless explicitly declared  
as a local `@see{localvar}`.

`@x{Local variables}` are `@emph{lexically scoped}`:  
local variables can be freely accessed by functions  
defined inside their scope `@see{visibility}`.

Before the first assignment to a variable, its value is `@nil`.

Square brackets are used to index a table:

`@Produc{`  
`@producname{var}@producbody{prefixexp @bnfter{[] exp @bnfter{[]}}`  
`}`

The meaning of accesses to table fields can be changed via metatables  
`@see{metatable}`.

The syntax `@id{var.Name}` is just syntactic sugar for

`@T{var["Name"]}`:  
`@Produc{`  
`@producname{var}@producbody{prefixexp @bnfter{.} @bnfNter{Name}}`  
`}`

An access to a global variable `@id{x}`  
is equivalent to `@id{_ENV.x}`.

Due to the way that chunks are compiled,  
the variable `@id{_ENV}` itself is never global `@see{globalenv}`.

}

```
@sect2{stats| @title{Statements}}
```

```
@simplesect{
```

Lua

supports an almost conventional set of @x{statements},  
similar to those in other conventional languages.

This set includes

blocks, assignments, control structures, function calls,  
and variable declarations.

```
}
```

```
@sect3{@title{Blocks}}
```

A @x{block} is a list of statements,  
which are executed sequentially:

```
@Produc{  
@producname{block}@producbody{@bnfrep{stat}}  
}
```

Lua has @def{empty statements}  
that allow you to separate statements with semicolons,  
start a block with a semicolon  
or write two semicolons in sequence:

```
@Produc{  
@producname{stat}@producbody{@bnfter{;}}  
}
```

Both function calls and assignments  
can start with an open parenthesis.  
This possibility leads to an ambiguity in Lua's grammar.  
Consider the following fragment:

```
@verbatim{  
a = b + c  
(print or io.write)('done')  
}
```

The grammar could see this fragment in two ways:

```
@verbatim{  
a = b + c(print or io.write)('done')
```

```
a = b + c; (print or io.write)('done')  
}
```

The current parser always sees such constructions  
in the first way,  
interpreting  
the open parenthesis  
as the start of the arguments to a call.

To avoid this ambiguity,

it is a good practice to always precede with a semicolon  
statements that start with a parenthesis:

```
@verbatim{
;(print or io.write)('done')
}
```

A block can be explicitly delimited to produce a single statement:

```
@Produc{
@producname{stat}@producbody{@Rw{do} block @Rw{end}}
}
```

Explicit blocks are useful  
to control the scope of variable declarations.  
Explicit blocks are also sometimes used to  
add a `@Rw{return}` statement in the middle  
of another block `@see{control}`.

```
}
```

```
@sect3{chunks| @title{Chunks}}
```

The unit of compilation of Lua is called a `@def{chunk}`.  
Syntactically,  
a chunk is simply a block:

```
@Produc{
@producname{chunk}@producbody{block}
}
```

Lua handles a chunk as the body of an anonymous function  
with a variable number of arguments  
`@see{func-def}`.

As such, chunks can define local variables,  
receive arguments, and return values.

Moreover, such anonymous function is compiled as in the  
scope of

an external local variable called `@id{_ENV}` `@see{globalenv}`.

The resulting function always has `@id{_ENV}` as its only external variable,  
even if it does not use that variable.

A chunk can be stored in a file or in a string inside the host program.

To execute a chunk,

Lua first *@emph{loads}* it,

precompiling the chunk's code into instructions for a virtual machine,  
and then Lua executes the compiled code  
with an interpreter for the virtual machine.

Chunks can also be precompiled into binary form;

see the program `@idx{luac}` and the function `@Lid{string.dump}` for details.

Programs in source and compiled forms are interchangeable;



Lua automatically detects the file type and acts accordingly @seeF{load}.

}

@sect3{assignment| @title{Assignment}}

Lua allows @x{multiple assignments}.

Therefore, the syntax for assignment defines a list of variables on the left side and a list of expressions on the right side.

The elements in both lists are separated by commas:

```
@Produc{
@producname{stat}@producbody{varlist
@bnfter{=} explist}
@producname{varlist}@producbody{var @bnfrep{@bnfter{,} var}}
@producname{explist}@producbody{exp @bnfrep{@bnfter{,} exp}}
}
```

Expressions are discussed in @See{expressions}.

Before the assignment,  
the list of values is @emph{adjusted} to the length of  
the list of variables @see{multires}.

If a variable is both assigned and read  
inside a multiple assignment,  
Lua ensures that all reads get the value of the variable  
before the assignment.

Thus the code

```
@verbatim{
i = 3
i, a[i] = i+1, 20
}
sets @T{a[3]} to 20, without affecting @T{a[4]}
because the @id{i} in @T{a[i]} is evaluated (to 3)
before it is @N{assigned 4}.
```

Similarly, the line

```
@verbatim{
x, y = y, x
}
exchanges the values of @id{x} and @id{y},
and
@verbatim{
x, y, z = y, z, x
}
cyclically permutes the values of @id{x}, @id{y}, and @id{z}.
```

Note that this guarantee covers only accesses  
syntactically inside the assignment statement.

If a function or a metamethod called during the assignment changes the value of a variable, Lua gives no guarantees about the order of that access.

An assignment to a global name `@T{x = val}` is equivalent to the assignment `@T{_ENV.x = val} @see{globalenv}`.

The meaning of assignments to table fields and global variables (which are actually table fields, too) can be changed via metatables `@see{metatable}`.

}

`@sect3{control| @title{Control Structures}`

The control structures

`@Rw{if}`, `@Rw{while}`, and `@Rw{repeat}` have the usual meaning and familiar syntax:

`@index{while-do statement}`

`@index{repeat-until statement}`

`@index{if-then-else statement}`

`@Produc{`

`@producname{stat}@produciblebody{@Rw{while} exp @Rw{do} block @Rw{end}}`

`@producname{stat}@produciblebody{@Rw{repeat} block @Rw{until} exp}`

`@producname{stat}@produciblebody{@Rw{if} exp @Rw{then} block`

`@bnfrep{@Rw{elseif} exp @Rw{then} block}`

`@bnfoft{@Rw{else} block} @Rw{end}}`

}

Lua also has a `@Rw{for}` statement, in two flavors `@see{for}`.

The `@x{condition expression}` of a control structure can return any value.

Both

`@false` and `@nil` test false.

All values different from `@nil` and `@false` test true.

In particular, the number 0 and the empty string also test true.

In the `@Rw{repeat}@En@Rw{until}` loop, the inner block does not end at the `@Rw{until}` keyword, but only after the condition.

So, the condition can refer to local variables declared inside the loop block.

The `@Rw{goto}` statement transfers the program control to a label.

For syntactical reasons,

labels in Lua are considered statements too:

`@index{goto statement}`

```

@index{label}
@Produc{
@producname{stat}@producbody{@Rw{goto} Name}
@producname{stat}@producbody{label}
@producname{label}@producbody{@bnfter{::} Name @bnfter{::}}
}

```

A label is visible in the entire block where it is defined, except inside nested functions.

A goto can jump to any visible label as long as it does not enter into the scope of a local variable.

A label should not be declared where a label with the same name is visible, even if this other label has been declared in an enclosing block.

The @Rw{break} statement terminates the execution of a @Rw{while}, @Rw{repeat}, or @Rw{for} loop, skipping to the next statement after the loop:

```

@index{break statement}
@Produc{
@producname{stat}@producbody{@Rw{break}}
}

```

A @Rw{break} ends the innermost enclosing loop.

The @Rw{return} statement is used to return values from a function or a chunk (which is handled as an anonymous function).

```
@index{return statement}
```

Functions can return more than one value, so the syntax for the @Rw{return} statement is

```

@Produc{
@producname{stat}@producbody{@Rw{return} @bnfopt{explist} @bnfopt{@bnfter{;}}}
}

```

The @Rw{return} statement can only be written as the last statement of a block.

If it is necessary to @Rw{return} in the middle of a block, then an explicit inner block can be used, as in the idiom @T{do return end},

because now @Rw{return} is the last statement in its (inner) block.

```
}
```

```
@sect3{for| @title{For Statement}
```

```
@index{for statement}
```

The @Rw{for} statement has two forms:

one

numerical and one generic.

```
@sect4{@title{The numerical @Rw{for} loop}
```

The numerical `@Rw{for}` loop repeats a block of code while a control variable goes through an arithmetic progression.

It has the following syntax:

```
@Produc{  
@producname{stat}@producbody{@Rw{for} @bnfNter{Name} @bnfter{=}  
exp @bnfter{,} exp @bnfter{@bnfter{,} exp} @Rw{do} block @Rw{end}}  
}
```

The given identifier (`@bnfNter{Name}`) defines the control variable, which is a new variable local to the loop body (`@emph{block}`).

The loop starts by evaluating once the three control expressions.

Their values are called respectively

the `@emph{initial value}`, the `@emph{limit}`, and the `@emph{step}`.

If the step is absent, it defaults `@N{to 1}`.

If both the initial value and the step are integers,

the loop is done with integers;

note that the limit may not be an integer.

Otherwise, the three values are converted to

floats and the loop is done with floats.

Beware of floating-point accuracy in this case.

After that initialization,

the

loop body is repeated with the value of the control variable

going through an arithmetic progression,

starting at the initial value,

with a common difference given by the step.

A negative step makes a decreasing sequence;

a step equal to zero raises an error.

The loop continues while the value is less than

or equal to the limit

(greater than or equal to for a negative step).

If the initial value is already greater than the limit

(or less than, if the step is negative),

the body is not executed.

For integer loops,

the control variable never wraps around;

instead, the loop ends in case of an overflow.

You should not change the value of the control variable

during the loop.

If you need its value after the loop,  
assign it to another variable before exiting the loop.

```
}
```

```
@sect4{@title{The generic @Rw{for} loop}
```

The generic @Rw{for} statement works over functions,  
called @def{iterators}.

On each iteration, the iterator function is called to produce a new value,  
stopping when this new  
value is @nil.

The generic @Rw{for} loop has the following syntax:

```
@Produc{  
@producname{stat}@produciblebody{@Rw{for} namelist @Rw{in} explist  
    @Rw{do} block @Rw{end}}  
@producname{namelist}@produciblebody{@bnfNter{Name} @bnfrep{@bnfter{,} @bnfNter{Name}}}  
}
```

A @Rw{for} statement like

```
@verbatim{  
for @rep{var_1}, @Cdots, @rep{var_n} in @rep{explist} do @rep{body} end  
}
```

works as follows.

The names @rep{var\_i} declare loop variables local to the loop body.  
The first of these variables is the @emph{control variable}.

The loop starts by evaluating @rep{explist}  
to produce four values:  
an @emph{iterator function},  
a @emph{state},  
an initial value for the control variable,  
and a @emph{closing value}.

Then, at each iteration,  
Lua calls the iterator function with two arguments:  
the state and the control variable.  
The results from this call are then assigned to the loop variables,  
following the rules of multiple assignments @see{assignment}.  
If the control variable becomes @nil,  
the  
loop terminates.  
Otherwise, the body is executed and the loop goes  
to the next iteration.

The closing value behaves like a  
to-be-closed variable @see{to-be-closed},

which can be used to release resources when the loop ends.  
Otherwise, it does not interfere with the loop.

You should not change the value of the control variable during the loop.

```
}
```

```
}
```

@sect3{funcstat| @title{Function Calls as Statements}}

To allow possible side-effects,  
function calls can be executed as statements:

```
@Produc{
@producname{stat}@producbody{functioncall}
}
```

In this case, all returned values are thrown away.  
Function calls are explained in @See{functioncall}.

```
}
```

@sect3{localvar| @title{Local Declarations}}

@x{Local variables} can be declared anywhere inside a block.  
The declaration can include an initialization:

```
@Produc{
@producname{stat}@producbody{@Rw{local} attnamelist @bnfopt{@bnfter{=} explist}}
@producname{attnamelist}@producbody{
@bnfNter{Name} attrib @bnfrep{@bnfter{,} @bnfNter{Name} attrib}}
}
```

If  
present, an initial assignment has the same semantics  
of a multiple assignment @see{assignment}.  
Otherwise, all variables are initialized with @nil.

Each variable name may be postfixed by an attribute  
(a name between angle brackets):

```
@Produc{
@producname{attrib}@producbody{@bnfopt{@bnfter{<} @bnfNter{Name} @bnfter{>}}}
}
```

There are two possible attributes:  
@id{const}, which declares a @x{constant variable},  
that is, a variable that cannot be assigned to  
after its initialization;  
and @id{close}, which declares a to-be-closed variable @see{to-be-closed}.  
A list of variables can contain at most one to-be-closed variable.

A chunk is also a block @see{chunks},  
and so local variables can be declared in a chunk outside any explicit block.

The visibility rules for local variables are explained in `@See{visibility}`.

}

`@sect3{to-be-closed| @title{To-be-closed Variables}`

A to-be-closed variable behaves like a constant local variable, except that its value is `@emph{closed}` whenever the variable goes

out of scope, including normal block termination, exiting its block by `@Rw{break}/@Rw{goto}/@Rw{return}`, or exiting by an error.

Here, to `@emph{close}` a value means to call its `@idx{__close}` metamethod.

When calling the metamethod, the value itself is passed as the first argument and the error object that caused the exit (if any) is passed as a second argument; if there was no error, the second argument is `@nil`.

The value assigned to a to-be-closed variable must have a `@idx{__close}` metamethod or be a false value.  
(`@nil` and `@false` are ignored as to-be-closed values.)

If several to-be-closed variables go out of scope at the same event, they are closed in the reverse order that they were declared.

If there is any error while running a closing method, that error is handled like an error in the regular code where the variable was defined.  
After an error, the other pending closing methods will still be called.

If a coroutine yields and is never resumed again, some variables may never go out of scope, and therefore they will never be closed.  
(These variables are the ones created inside the coroutine and in scope at the point where the coroutine yielded.)  
Similarly, if a coroutine ends with an error, it does not unwind its stack, so it does not close any variable.  
In both cases, you can either use finalizers or call `@Lid{coroutine.close}` to close the variables.

However, if the coroutine was created through `@Lid{coroutine.wrap}`, then its corresponding function will close the coroutine in case of errors.

```
}
```

```
}
```

```
@sect2{expressions| @title{Expressions}}
```

```
@simplesect{
```

The basic expressions in Lua are the following:

```
@Produc{
@producname{exp}@producbody{prefixexp}
@producname{exp}@producbody{@Rw{nil} @Or @Rw{false} @Or @Rw{true}}
@producname{exp}@producbody{@bnfNter{Numeral}}
@producname{exp}@producbody{@bnfNter{LiteralString}}
@producname{exp}@producbody{functiondef}
@producname{exp}@producbody{tableconstructor}
@producname{exp}@producbody{@bnfter{...}}
@producname{exp}@producbody{exp
binop exp}
@producname{exp}@producbody{unop exp}
@producname{prefixexp}@producbody{var @Or functioncall @Or
@bnfter{() exp @bnfter{}}}
}
```

Numerals and literal strings are explained in `@See{lexical}`;  
variables are explained in `@See{variables}`;  
function definitions are explained in `@See{func-def}`;  
function calls are explained in `@See{functioncall}`;  
table constructors are explained in `@See{tableconstructor}`.  
Vararg expressions,  
denoted by three dots (`@Char{...}`), can only be used when  
directly inside a variadic function;  
they are explained in `@See{func-def}`.

Binary operators comprise arithmetic operators `@see{arith}`,  
bitwise operators `@see{bitwise}`,  
relational operators `@see{rel-ops}`, logical operators `@see{logic}`,  
and the concatenation operator `@see{concat}`.  
Unary operators comprise the unary minus `@see{arith}`,  
the unary bitwise NOT `@see{bitwise}`,  
the unary logical `@Rw{not} @see{logic}`,  
and the unary `@def{length operator} @see{len-op}`.



}

```
@sect3{arith|
  @title{Arithmetic Operators}
  Lua supports the following @x{arithmetic operators}:
  @description{
    @item{@T{+}|addition}
    @item{@T{-}|subtraction}
    @item{@T{*}|multiplication}
    @item{@T{/}|float division}
    @item{@T{//}|floor division}
    @item{@T{%}|modulo}
    @item{@T{^}|exponentiation}
    @item{@T{-}|unary minus}
  }
```

With the exception of exponentiation and float division, the arithmetic operators work as follows:

If both operands are integers, the operation is performed over integers and the result is an integer.

Otherwise, if both operands are numbers, then they are converted to floats, the operation is performed following the machine's rules for floating-point arithmetic (usually the @x{IEEE 754} standard), and the result is a float.

(The string library coerces strings to numbers in arithmetic operations; see @See{coercion} for details.)

Exponentiation and float division (@T{/}) always convert their operands to floats and the result is always a float.

Exponentiation uses the @ANSI{pow}, so that it works for non-integer exponents too.

Floor division (@T{//}) is a division that rounds the quotient towards minus infinity, resulting in the floor of the division of its operands.

Modulo is defined as the remainder of a division that rounds the quotient towards minus infinity (floor division).

In case of overflows in integer arithmetic, all operations @emphx{wrap around}.

}

@sect3{bitwise| @title{Bitwise Operators}

Lua supports the following @x{bitwise operators}:

@description{

@item{@T{&}|bitwise AND}

@item{@T{@VerBar}|bitwise OR}

@item{@T{~}|bitwise exclusive OR}

@item{@T{>>}|right shift}

@item{@T{<<}|left shift}

@item{@T{~}|unary bitwise NOT}

}

All bitwise operations convert its operands to integers

@see{coercion},

operate on all bits of those integers,

and result in an integer.

Both right and left shifts fill the vacant bits with zeros.

Negative displacements shift to the other direction;

displacements with absolute values equal to or higher than the

number of bits in an integer

result in zero (as all bits are shifted out).

}

@sect3{coercion| @title{Coercions and Conversions}

Lua provides some automatic conversions between some types and representations at run time.

Bitwise operators always convert float operands to integers.

Exponentiation and float division

always convert integer operands to floats.

All other arithmetic operations applied to mixed numbers

(integers and floats) convert the integer operand to a float.

The C API also converts both integers to floats and

floats to integers, as needed.

Moreover, string concatenation accepts numbers as arguments, besides strings.

In a conversion from integer to float,

if the integer value has an exact representation as a float, that is the result.

Otherwise,

the conversion gets the nearest higher or

the nearest lower representable value.

This kind of conversion never fails.

The conversion from float to integer checks whether the float has an exact representation as an integer (that is, the float has an integral value and it is in the range of integer representation). If it does, that representation is the result. Otherwise, the conversion fails.

Several places in Lua coerce strings to numbers when necessary. In particular, the string library sets metamethods that try to coerce strings to numbers in all arithmetic operations. If the conversion fails, the library calls the metamethod of the other operand (if present) or it raises an error. Note that bitwise operators do not do this coercion.

It is always a good practice not to rely on the implicit coercions from strings to numbers, as they are not always applied; in particular, `@T{"1"==1}` is false and `@T{"1"<1}` raises an error `@see{rel-ops}`. These coercions exist mainly for compatibility and may be removed in future versions of the language.

A string is converted to an integer or a float following its syntax and the rules of the Lua lexer. The string may have also leading and trailing whitespaces and a sign. All conversions from strings to numbers accept both a dot and the current locale mark as the radix character. (The Lua lexer, however, accepts only a dot.) If the string is not a valid numeral, the conversion fails. If necessary, the result of this first step is then converted to a specific number subtype following the previous rules for conversions between floats and integers.

The conversion from numbers to strings uses a non-specified human-readable format. To convert numbers to strings in any specific way, use the function `@Lid{string.format}`.

}

`@sect3{rel-ops| @title{Relational Operators}`  
Lua supports the following `@x{relational operators}`:

```

@description{
@item{@T{==}|equality}
@item{@T{~=}|inequality}
@item{@T{<}|less than}
@item{@T{>}|greater than}
@item{@T{<=}|less or equal}
@item{@T{>=}|greater or equal}
}

```

These operators always result in `@false` or `@true`.

Equality (`@T{==}`) first compares the type of its operands.

If the types are different, then the result is `@false`.

Otherwise,

the values of the operands are compared.

Strings are equal if they have the same byte content.

Numbers are equal if they denote the same mathematical value.

Tables, userdata, and threads

are compared by reference:

two objects are considered equal only if they are the same object.

Every time you create a new object

(a table, a userdata, or a thread),

this new object is different from any previously existing object.

A function is always equal to itself.

Functions with any detectable difference

(different behavior, different definition) are always different.

Functions created at different times but with no detectable differences

may be classified as equal or not

(depending on internal caching details).

You can change the way that Lua compares tables and userdata

by using the `@idx{__eq}` metamethod `@see{metatable}`.

Equality comparisons do not convert strings to numbers

or vice versa.

Thus, `@T{"0"]==0}` evaluates to `@false`,

and `@T{t[0]}` and `@T{t["0"]}` denote different

entries in a table.

The

operator `@T{~=}` is exactly the negation of equality (`@T{==}`).

The order operators work as follows.

If both arguments are numbers,

then they are compared according to their mathematical values,

regardless of their subtypes.

Otherwise, if both arguments are strings,

then their values are compared according to the current locale.

Otherwise, Lua tries to call the `@idx{__lt}` or the `@idx{__le}` metamethod `@see{metatable}`.

A comparison `@T{a > b}` is translated to `@T{b < a}` and `@T{a >= b}` is translated to `@T{b <= a}`.

Following the `@x{IEEE 754}` standard, the special value `@x{NaN}` is considered neither less than, nor equal to, nor greater than any value, including itself.

}

`@sect3{logic| @title{Logical Operators}`

The `@x{logical operators}` in Lua are

`@Rw{and}`, `@Rw{or}`, and `@Rw{not}`.

Like the control structures `@see{control}`, all logical operators consider both `@false` and `@nil` as false and anything else as true.

The negation operator `@Rw{not}` always returns `@false` or `@true`.

The conjunction

operator `@Rw{and}` returns its first argument

if this value is `@false` or `@nil`;

otherwise, `@Rw{and}` returns its second argument.

The disjunction operator `@Rw{or}` returns its first argument

if this value is different from `@nil` and `@false`;

otherwise, `@Rw{or}` returns its second argument.

Both `@Rw{and}` and `@Rw{or}` use `@x{short-circuit evaluation}`;

that is,

the second operand is evaluated only if necessary.

Here are some examples:

`@verbatim{`

`10 or 20       --> 10`

`10 or error()  --> 10`

`nil or "a"     --> "a"`

`nil and 10     --> nil`

`false and error() --> false`

`false and nil   --> false`

`false or nil    --> nil`

`10 and 20       --> 20`

`}`

}

`@sect3{concat| @title{Concatenation}`

The string `@x{concatenation}` operator in Lua is denoted by two dots (`@Char{..}`).

If both operands are strings or numbers, then the numbers are converted to strings

in a non-specified format @see{coercion}.

Otherwise, the @idx{\_\_concat} metamethod is called @see{metatable}.

}

@sect3{len-op|  
@title{The Length Operator}}

The length operator is denoted by the unary prefix operator @T{#}.

The length of a string is its number of bytes.  
(That is the usual meaning of string length when each  
character is one byte.)

The length operator applied on a table  
returns a @x{border} in that table.  
A @def{border} in a table @id{t} is any non-negative integer  
that satisfies the following condition:

@verbatim{  
(border == 0 or t[border] ~= nil) and  
(t[border + 1] == nil or border == math.maxinteger)  
}

In words,  
a border is any positive integer index present in the table  
that is followed by an absent index,  
plus two limit cases:  
zero, when index 1 is absent;  
and the maximum value for an integer, when that index is present.  
Note that keys that are not positive integers  
do not interfere with borders.

A table with exactly one border is called a @def{sequence}.

For instance, the table @T{{10, 20, 30, 40, 50}} is a sequence,  
as it has only one border (5).

The table @T{{10, 20, 30, nil, 50}} has  
two borders (3 and 5),  
and therefore it is not a sequence.  
(The @nil at index 4 is called a @emphx{hole}.)

The table @T{{nil, 20, 30, nil, nil, 60, nil}}  
has three borders (0, 3, and 6),  
so it is not a sequence, too.

The table @T{{}} is a sequence with border 0.

When @id{t} is a sequence,  
@T{#t} returns its only border,  
which corresponds to the intuitive notion of the length of the sequence.  
When @id{t} is not a sequence,  
@T{#t} can return any of its borders.

(The exact one depends on details of the internal representation of the table, which in turn can depend on how the table was populated and the memory addresses of its non-numeric keys.)

The computation of the length of a table has a guaranteed worst time of  $\mathcal{O}(\log n)$ , where  $M\{n\}$  is the largest integer key in the table.

A program can modify the behavior of the length operator for any value but strings through the `@idx{__len}` metamethod `@see{metatable}`.

}

`@sect3{prec| @title{Precedence}`  
`@x{Operator precedence}` in Lua follows the table below, from lower to higher priority:

```
@verbatim{
or
and
< > <= >= ~= ==
|
~
&
<< >>
..
+ -
* / // %
unary operators (not # - ~)
^
}
```

As usual, you can use parentheses to change the precedences of an expression. The concatenation (`@Char{..}`) and exponentiation (`@Char{^}`) operators are right associative. All other binary operators are left associative.

}

`@sect3{tableconstructor| @title{Table Constructors}`  
Table `@x{constructors}` are expressions that create tables. Every time a constructor is evaluated, a new table is created. A constructor can be used to create an empty table or to create a table and initialize some of its fields. The general syntax for constructors is

```
@Produc{
@producname{tableconstructor}@producbody{@bnfter{@Open} @bnfopt{fieldlist} @bnfter{@Close}}
```

```

@producname{fieldlist}@producbody{field @bnfrep{fieldsep field} @bnfopt{fieldsep}}
@producname{field}@producbody{@bnfter{[] exp @bnfter{[]} @bnfter{=} exp @Or

    @bnfNter{Name} @bnfter{=} exp @Or exp}
@producname{fieldsep}@producbody{@bnfter{,} @Or @bnfter{;}}
}

```

Each field of the form `@T{[exp1] = exp2}` adds to the new table an entry with key `@id{exp1}` and value `@id{exp2}`.

A field of the form `@T{name = exp}` is equivalent to `@T{["name"] = exp}`.

Fields of the form `@id{exp}` are equivalent to `@T{[i] = exp}`, where `@id{i}` are consecutive integers starting with 1; fields in the other formats do not affect this counting.

For example,

```

@verbatim{
a = { [f(1)] = g; "x", "y"; x = 1, f(x), [30] = 23; 45 }
}

```

is equivalent to

```

@verbatim{
do
  local t = {}
  t[f(1)] = g
  t[1] = "x"      -- 1st exp
  t[2] = "y"      -- 2nd exp
  t.x = 1         -- t["x"] = 1
  t[3] = f(x)     -- 3rd exp
  t[30] = 23
  t[4] = 45       -- 4th exp
  a = t
end
}

```

The order of the assignments in a constructor is undefined.  
(This order would be relevant only when there are repeated keys.)

If the last field in the list has the form `@id{exp}` and the expression is a multires expression, then all values returned by this expression enter the list consecutively `@see{multires}`.

The field list can have an optional trailing separator, as a convenience for machine-generated code.

```

}

```



@sect3{functioncall| @title{Function Calls}

A @x{function call} in Lua has the following syntax:

```
@Produc{
@producname{functioncall}@producbody{prefixexp args}
}
```

In a function call,

first @bnfNter{prefixexp} and @bnfNter{args} are evaluated.

If the value of @bnfNter{prefixexp} has type @emph{function},  
then this function is called

with the given arguments.

Otherwise, if present,

the @bnfNter{prefixexp} @idx{\_\_call} metamethod is called:

its first argument is the value of @bnfNter{prefixexp},

followed by the original call arguments

@see{metatable}.

The form

```
@Produc{
@producname{functioncall}@producbody{prefixexp @bnfter{:} @bnfNter{Name} args}
}
```

can be used to emulate methods.

A call @T{v:name(@rep{args})}

is syntactic sugar for @T{v.name(v,@rep{args})},

except that @id{v}

is evaluated only once.

Arguments have the following syntax:

```
@Produc{
@producname{args}@producbody{@bnfter{(} @bnfopt{explist} @bnfter{)}}
@producname{args}@producbody{tableconstructor}
@producname{args}@producbody{@bnfNter{LiteralString}}
}
```

All argument expressions are evaluated before the call.

A call of the form @T{f{@rep{fields}}} is

syntactic sugar for @T{f({@rep{fields}})};

that is, the argument list is a single new table.

A call of the form @T{f'@rep{string}'}

(or @T{f"@rep{string}" or @T{f[[@rep{string}]])

is syntactic sugar for @T{f('@rep{string}')};

that is, the argument list is a single literal string.

A call of the form @T{return @rep{functioncall}} not in the  
scope of a to-be-closed variable is called a @def{tail call}.

Lua implements @def{proper tail calls}

(or @def{proper tail recursion}):

In a tail call,

the called function reuses the stack entry of the calling function.

Therefore, there is no limit on the number of nested tail calls that

a program can execute.

However,

a tail call erases any debug information about the calling function.

Note that a tail call only happens with a particular syntax, where the `@Rw{return}` has one single function call as argument, and it is outside the scope of any to-be-closed variable.

This syntax makes the calling function return exactly the returns of the called function, without any intervening action.

So, none of the following examples are tail calls:

```
@verbatim{
return (f(x))    -- results adjusted to 1
return 2 * f(x)  -- result multiplied by 2
return x, f(x)   -- additional results
f(x); return     -- results discarded
return x or f(x) -- results adjusted to 1
}

}
```

```
@sect3{func-def| @title{Function Definitions}}
```

The syntax for function definition is

```
@Produc{
@producname{functiondef}@producbody{@Rw{function} funcbody}
@producname{funcbody}@producbody{@bnfter{() @bnfopt{parlist} @bnfter{}} block @Rw{end}}
}
```

The following syntactic sugar simplifies function definitions:

```
@Produc{
@producname{stat}@producbody{@Rw{function}
funcname funcbody}
@producname{stat}@producbody{@Rw{local} @Rw{function} @bnfNter{Name} funcbody}
@producname{funcname}@producbody{@bnfNter{Name} @bnfrep{@bnfter{.} @bnfNter{Name}}
@bnfopt{@bnfter{:} @bnfNter{Name}}}
}
```

The statement

```
@verbatim{
function f () @rep{body} end
}
```

translates to

```
@verbatim{
f = function () @rep{body} end
}
```

The statement

```
@verbatim{
function t.a.b.c.f () @rep{body} end
```

```
}
```

translates to

```
@verbatim{
```

```
t.a.b.c.f = function () @rep{body} end
```

```
}
```

The statement

```
@verbatim{
```

```
local function f () @rep{body} end
```

```
}
```

translates to

```
@verbatim{
```

```
local f; f = function () @rep{body} end
```

```
}
```

not to

```
@verbatim{
```

```
local f = function () @rep{body} end
```

```
}
```

(This only makes a difference when the body of the function contains references to @id{f}.)

A function definition is an executable expression, whose value has type @emph{function}.

When Lua precompiles a chunk,

all its function bodies are precompiled too,

but they are not created yet.

Then, whenever Lua executes the

function definition,

the function is @emph{instantiated} (or @emph{closed}).

This function instance, or @emph{closure},

is the final value of the expression.

Parameters act as local variables that are initialized with the argument values:

```
@Produc{
```

```
@producname{parlist}@produciblebody{namelist @bnfopt{@bnfter{,} @bnfter{...}} @Or
```

```
@bnfter{...}}
```

```
}
```

When a Lua function is called,

it adjusts its list of @x{arguments} to

the length of its list of parameters @see{multires},

unless the function is a @def{variadic function},

which is indicated by three dots (@Char{...})

at the end of its parameter list.

A variadic function does not adjust its argument list;

instead, it collects all extra arguments and supplies them

to the function through a @def{vararg expression},

which is also written as three dots.

The value of this expression is a list of all actual extra arguments,

similar to a function with multiple results @see{multires}.

As an example, consider the following definitions:

```
@verbatim{
function
  f(a, b) end
function g(a, b, ...) end
function r() return 1,2,3 end
}
```

Then, we have the following mapping from arguments to parameters and to the vararg expression:

```
@verbatim{
CALL      PARAMETERS
```

```

f(3)      a=3, b=nil
f(3, 4)    a=3, b=4
f(3, 4, 5) a=3, b=4
f(r(), 10) a=1, b=10
f(r())     a=1, b=2
```

```

g(3)      a=3, b=nil, ... --> (nothing)
g(3, 4)    a=3, b=4,  ... --> (nothing)
g(3, 4, 5, 8) a=3, b=4,  ... --> 5 8
g(5, r())   a=5, b=1,  ... --> 2 3
}
```

Results are returned using the @Rw{return} statement @see{control}.

If control reaches the end of a function  
without encountering a @Rw{return} statement,  
then the function returns with no results.

@index{multiple return}

There is a system-dependent limit on the number of values  
that a function may return.

This limit is guaranteed to be greater than 1000.

The @emphx{colon} syntax  
is used to emulate @def{methods},  
adding an implicit extra parameter @idx{self} to  
the function.

Thus, the statement

```
@verbatim{
function t.a.b.c:f (@rep{params}) @rep{body} end
}
```

is syntactic sugar for

```
@verbatim{
t.a.b.c.f = function (self, @rep{params}) @rep{body} end
```

}

}

@sect3{multires| @title{Lists of expressions, multiple results,  
and adjustment}

Both function calls and vararg expressions can result in multiple values.  
These expressions are called @def{multires expressions}.

When a multires expression is used as the last element  
of a list of expressions,  
all results from the expression are added to the  
list of values produced by the list of expressions.  
Note that a single expression  
in a place that expects a list of expressions  
is the last expression in that (singleton) list.

These are the places where Lua expects a list of expressions:

@description{

@item{A @rw{return} statement,  
for instance @T{return e1, e2, e3} @see{control}.}

@item{A table constructor,  
for instance @T{{e1, e2, e3}} @see{tableconstructor}.}

@item{The arguments of a function call,  
for  
instance @T{foo(e1, e2, e3)} @see{functioncall}.}

@item{A multiple assignment,  
for instance @T{a , b, c = e1, e2, e3} @see{assignment}.}

@item{A local declaration,  
for instance @T{local a , b, c = e1, e2, e3} @see{localvar}.}

@item{The initial values in a generic @rw{for} loop,  
for instance @T{for k in e1, e2, e3 do ... end} @see{for}.}

}

In the last four cases,  
the list of values from the list of expressions  
must be @emph{adjusted} to a specific length:  
the number of parameters in a call to a non-variadic function  
@see{func-def},  
the number of variables in a multiple assignment or  
a local declaration,

and exactly four values for a generic `@rw{for}` loop.

The `@def{adjustment}` follows these rules:

If there are more values than needed,  
the extra values are thrown away;  
if there are fewer values than needed,  
the list is extended with `@nil`'s.

When the list of expressions ends with a multi-res expression,  
all results from that expression enter the list of values  
before the adjustment.

When

a multi-res expression is used  
in a list of expressions without being the last element,  
or in a place where the syntax expects a single expression,  
Lua adjusts the result list of that expression to one element.  
As a particular case,  
the syntax expects a single expression inside a parenthesized expression;  
therefore, adding parentheses around a multi-res expression  
forces it to produce exactly one result.

We seldom need to use a vararg expression in a place  
where the syntax expects a single expression.  
(Usually it is simpler to add a regular parameter before  
the variadic part and use that parameter.)

When there is such a need,  
we recommend assigning the vararg expression  
to a single variable and using that variable  
in its place.

Here are some examples of uses of multi-res expressions.

In all cases, when the construction needs

`@Q{the n-th result}` and there is no such result,  
it uses a `@nil`.

`@verbatim{`

`print(x, f())` -- prints x and all results from f().

`print(x, (f()))` -- prints

x and the first result from f().

`print(f(), x)` -- prints the first result from f() and x.

`print(1 + f())` -- prints 1 added to the first result from f().

`local x = ...` -- x gets the first vararg argument.

`x,y = ...` -- x gets the first vararg argument,  
-- y gets the second vararg argument.

`x,y,z = w, f()` -- x gets w, y gets the first result from f(),  
-- z gets the second result from f().

`x,y,z = f()` -- x gets the first result from f(),  
-- y gets the second result from f(),  
-- z gets the third result from f().

`x,y,z = f(), g()` -- x gets the first result from f(),

```

        -- y gets the first result from g(),
        -- z gets the second result from g().
x,y,z = (f())    -- x gets the first result from f(), y and z get nil.
return f()      -- returns all results from f().
return x, ...   -- returns x and all received vararg arguments.
return x,y,f()
    -- returns x, y, and all results from f().
{f()}          -- creates a list with all results from f().
{...}          -- creates a list with all vararg arguments.
{f(), 5}       -- creates a list with the first result from f() and 5.
}

}

}

```

@sect2{visibility| @title{Visibility Rules}

@index{visibility}

Lua is a lexically scoped language.

The scope of a local variable begins at the first statement after its declaration and lasts until the last non-void statement of the innermost block that includes the declaration.

(@emph{Void statements} are labels and empty statements.)

Consider the following example:

```

@verbatim{
x = 10          -- global variable
do             -- new block
  local x = x   -- new 'x', with value 10
  print(x)     --> 10
  x = x+1
do             -- another block
  local x = x+1 -- another 'x'
  print(x)     --> 12
end
print(x)      --> 11
end
print(x)      --> 10 (the global one)
}

```

Notice

that, in a declaration like @T{local x = x}, the new @id{x} being declared is not in scope yet, and so the second @id{x} refers to the outside variable.

Because of the @x{lexical scoping} rules, local variables can be freely accessed by functions defined inside their scope.

A local variable used by an inner function is called an `@def{upvalue}` (or `@emphx{external local variable}`, or simply `@emphx{external variable}`) inside the inner function.

Notice that each execution of a `@Rw{local}` statement defines new local variables.

Consider the following example:

```
@verbatim{
a = {}
local x = 20
for i = 1, 10 do
  local y = 0
  a[i] = function () y = y + 1; return x + y end
end
}
```

The loop creates ten closures

(that is, ten instances of the anonymous function).

Each of these closures uses a different `@id{y}` variable, while all of them share the same `@id{x}`.

```
}
```

```
}
```

```
@C{-----}
@sect1{API| @title{The Application Program Interface}}
```

```
@simplesect{
```

```
@index{C
API}
```

This section describes the `@N{C API}` for Lua, that is, the set of `@N{C functions}` available to the host program to communicate with Lua.

All API functions and related types and constants are declared in the header file `@defid{lua.h}`.

Even when we use the term `@Q{function}`, any facility in the API may be provided as a macro instead. Except where stated otherwise, all such macros use each of their arguments exactly once (except for the first argument, which is always a Lua state), and so do not generate any hidden side-effects.

As in most `@N{C libraries}`, the Lua API functions do not check their arguments for validity or consistency.



However, you can change this behavior by compiling Lua with the macro `@defid{LUA_USE_APICHECK}` defined.

The Lua library is fully reentrant:  
it has no global variables.  
It keeps all information it needs in a dynamic structure,  
called the `@def{Lua state}`.

Each Lua state has one or more threads,  
which correspond to independent,  
cooperative lines of execution.  
The type `@Lid{lua_State}` (despite its name) refers to a thread.  
(Indirectly, through the thread, it also refers to the  
Lua state associated to the thread.)

A pointer to a thread must be passed as the first argument to  
every function in the library, except to `@Lid{lua_newstate}`,  
which creates a Lua state from scratch and returns a pointer  
to the `@emph{main thread}` in the new state.

}

`@sect2{@title{The Stack}`

`@simplesect{`

Lua uses a `@emph{virtual stack}` to pass values to and from C.  
Each element in this stack represents a Lua value  
(`@nil`, number, string, etc.).  
Functions in the API can access this stack through the  
Lua state parameter that they receive.

Whenever Lua calls C, the called function gets a new stack,  
which is independent of previous stacks and of stacks of  
`@N{C functions}` that are still active.  
This stack initially contains any arguments to the `@N{C function}`  
and it is where the `@N{C function}` can store temporary  
Lua values and must push  
its results  
to be returned to the caller `@seeC{lua_CFunction}`.

For convenience,  
most query operations in the API do not follow a strict stack discipline.  
Instead, they can refer to any element in the stack  
by using an `@emph{index}:@index{index (API stack)}`  
A positive index represents an absolute stack position,  
starting `@N{at 1}` as the bottom of the stack;

a negative index represents an offset relative to the top of the stack.  
More specifically, if the stack has `@rep{n}` elements,  
then `@N{index 1}` represents the first element  
(that is, the element that was pushed onto the stack first)  
and  
`@N{index @rep{n}}` represents the last element;  
`@N{index @num{-1}}` also represents the last element  
(that is, the element at `@N{the top}`)  
and index `@M{-n}` represents the first element.

}

@sect3{stacksize| @title{Stack Size}

When you interact with the Lua API,  
you are responsible for ensuring consistency.  
In particular,  
`@emph{you are responsible for controlling stack overflow}`.  
When you call any  
API function,  
you must ensure the stack has enough room to accommodate the results.

There is one exception to the above rule:  
When you call a Lua function  
without a fixed number of results `@seeF{lua_call}`,  
Lua ensures that the stack has enough space for all results.  
However, it does not ensure any extra space.  
So, before pushing anything on the stack after such a call  
you should use `@Lid{lua_checkstack}`.

Whenever Lua calls C,  
it ensures that the stack has space for  
at least `@defid{LUA_MINSTACK}` extra elements;  
that is, you can safely push up to `@id{LUA_MINSTACK}` values into it.  
`@id{LUA_MINSTACK}` is defined as 20,  
so that usually you do not have to worry about stack space  
unless your code has loops pushing elements onto the stack.  
Whenever necessary,  
you can use the function `@Lid{lua_checkstack}`  
to ensure that the stack has enough space for pushing new elements.

}

@sect3{@title{Valid and Acceptable Indices}

Any function in the API that receives stack indices  
works only with `@emphx{valid`

indices} or @emphx{acceptable indices}.

A @def{valid index} is an index that refers to a position that stores a modifiable Lua value. It comprises stack indices @N{between 1} and the stack top (@T{1 @leq abs(index) @leq top}) @index{stack index} plus @def{pseudo-indices}, which represent some positions that are accessible to @N{C code} but that are not in the stack. Pseudo-indices are used to access the registry @see{registry} and the upvalues of a @N{C function} @see{c-closure}.

Functions that do not need a specific mutable position, but only a value (e.g., query functions), can be called with acceptable indices. An @def{acceptable index} can be any valid index, but it also can be any positive index after the stack top within the space allocated for the stack, that is, indices up to the stack size. (Note that 0 is never an acceptable index.) Indices to upvalues @see{c-closure} greater than the real number of upvalues in the current @N{C function} are also acceptable (but invalid). Except when noted otherwise, functions in the API work with acceptable indices.

Acceptable indices serve to avoid extra tests against the stack top when querying the stack. For instance, a @N{C function} can query its third argument without the need to check whether there is a third argument, that is, without the need to check whether 3 is a valid index.

For functions that can be called with acceptable indices, any non-valid index is treated as if it contains a value of a virtual type @defid{LUA\_TNONE}, which behaves like a nil value.

}

@sect3{constchar|@title{Pointers to strings}}

Several functions in the API return pointers (@T{const char\*}) to Lua strings in the stack. (See @Lid{lua\_pushfstring}, @Lid{lua\_pushlstring}, @Lid{lua\_pushstring}, and @Lid{lua\_tolstring}. See also @Lid{luaL\_checklstring}, @Lid{luaL\_checkstring}, and @Lid{luaL\_tolstring} in the auxiliary library.)

In general,  
 Lua's garbage collection can free or move internal memory  
 and then invalidate pointers to  
 internal strings.  
 To allow a safe use of these pointers,  
 the API guarantees that any pointer to a string in a stack index  
 is valid while the string value at that index is not removed from the stack.  
 (It can be moved to another index, though.)  
 When the index is a pseudo-index (referring to an upvalue),  
 the pointer is valid while the corresponding call is active and  
 the corresponding upvalue is not modified.

Some functions in the debug interface  
 also return pointers to strings,  
 namely `@Lid{lua_getlocal}`, `@Lid{lua_getupvalue}`,  
`@Lid{lua_setlocal}`, and `@Lid{lua_setupvalue}`.  
 For these functions, the pointer is guaranteed to  
 be valid while the caller function is active and  
 the given closure (if one was given) is in the stack.

Except for these guarantees,  
 the garbage collector is free to invalidate  
 any pointer to internal strings.

}

}

`@sect2{c-closure| @title{C Closures}`

When a `@N{C function}` is created,  
 it is possible to associate some values with it,  
 thus creating a `@def{@N{C closure}}`  
`@seeC{lua_pushcclosure};`  
 these  
 values are called `@def{upvalues}` and are  
 accessible to the function whenever it is called.

Whenever a `@N{C function}` is called,  
 its upvalues are located at specific pseudo-indices.  
 These pseudo-indices are produced by the macro  
`@Lid{lua_upvalueindex}`.  
 The first upvalue associated with a function is at index  
`@T{lua_upvalueindex(1)}`, and so on.  
 Any access to `@T{lua_upvalueindex(@rep{n})}`,  
 where `@rep{n}` is greater than the number of upvalues of the  
 current function

(but not greater than 256,  
which is one plus the maximum number of upvalues in a closure),  
produces an acceptable but invalid index.

A `@N{C closure}` can also change the values  
of its corresponding upvalues.

}

`@sect2{registry| @title{Registry}}`

Lua provides a `@def{registry}`,  
a predefined table that can be used by any `@N{C code}` to  
store whatever Lua values it needs to store.

The registry table is always accessible at pseudo-index  
`@defid{LUA_REGISTRYINDEX}`.

Any `@N{C library}` can store data into  
this table,

but it must take care to choose keys  
that are different from those used  
by other libraries, to avoid collisions.

Typically, you should use as key a string containing your library name,  
or a light userdata with the address of a `@N{C object}` in your code,  
or any Lua object created by your code.

As with variable names,  
string keys starting with an underscore followed by  
uppercase letters are reserved for Lua.

The integer keys in the registry are used  
by the reference mechanism `@seeC{luaL_ref}`  
and by some predefined values.

Therefore, integer keys in the registry  
must not be used for other purposes.

When you create a new Lua state,  
its registry comes with some predefined values.

These predefined values are indexed with integer keys  
defined as constants in `@id{lua.h}`.

The following constants are defined:

`@description{`

`@item{@defid{LUA_RIDX_MAINTHREAD}|` At this index the registry has  
the main thread of the state.

(The main thread is the one created together with the state.)

`}`

`@item{@defid{LUA_RIDX_GLOBALS}|`

At this index the registry has  
the `@x{global environment}`.

```
}  
}  
  
}
```

@sect2{C-error|@title{Error Handling in C}}

@simplesect{

Internally, Lua uses the C @id{longjmp} facility to handle errors.

(Lua will use exceptions if you compile it as C++;

search for @id{LUA\_THROW} in the source code for details.)

When Lua faces any error,

such as a @x{memory allocation error} or a type error,

it @emph{raises} an error;

that is, it does a long jump.

A @emphx{protected environment} uses @id{setjmp}

to set a recovery point;

any error jumps to the most recent active recovery point.

Inside a @N{C function} you can raise an error explicitly  
by calling @Lid{lua\_error}.

Most functions in the API can raise an error,

for instance due to a @x{memory allocation error}.

The documentation for each function indicates whether  
it can raise errors.

If an error happens outside any protected environment,  
Lua calls a @def{panic function} (see @Lid{lua\_atpanic})  
and then calls @T{abort},  
thus

exiting the host application.

Your panic function can avoid this exit by  
never returning

(e.g., doing a long jump to your own recovery point outside Lua).

The panic function,  
as its name implies,  
is a mechanism of last resort.

Programs should avoid it.

As a general rule,

when a @N{C function} is called by Lua with a Lua state,  
it can do whatever it wants on that Lua state,  
as it should be already protected.

However,

when C code operates on other Lua states

(e.g., a Lua-state argument to the function,

a Lua state stored in the registry, or  
the result of `@Lid{lua_newthread}`),  
it should use them only in API calls that cannot raise errors.

The panic function runs as if it were a `@x{message handler} @see{error}`;  
in particular, the error object is on the top of the stack.  
However, there is no guarantee about stack space.  
To push anything on the stack,  
the panic function must first check the available space `@see{stacksize}`.

}

`@sect3{statuscodes|@title{Status Codes}`

Several functions  
that report errors in the API use the following  
status codes to indicate different kinds of errors or other conditions:  
`@description{`

`@item{@defid{LUA_OK} (0)| no errors.}`

`@item{@defid{LUA_ERRRUN}| a runtime error.}`

`@item{@defid{LUA_ERRMEM}|  
@x{memory allocation error}.  
For such errors, Lua does not call the @x{message handler}.  
}`

`@item{@defid{LUA_ERRERR}| error while running the @x{message handler}.}`

`@item{@defid{LUA_ERRSYNTAX}| syntax error during precompilation.}`

`@item{@defid{LUA_YIELD}| the thread (coroutine) yields.}`

`@item{@defid{LUA_ERRFILE}| a file-related error;  
e.g., it cannot open or read the file.}`

}

These constants are defined in the header file `@id{lua.h}`.

}

}

`@sect2{continuations|@title{Handling Yields in C}`

Internally, Lua uses the C `@id{longjmp}` facility to yield a coroutine.

Therefore, if a `@N{C function}` `@id{foo}` calls an API function and this API function yields (directly or indirectly by calling another function that yields), Lua cannot return to `@id{foo}` any more, because the `@id{longjmp}` removes its frame from the `@N{C stack}`.

To avoid this kind of problem, Lua raises an error whenever it tries to yield across an API call, except for three functions: `@Lid{lua_yieldk}`, `@Lid{lua_callk}`, and `@Lid{lua_pcallk}`. All those functions receive a `@def{continuation function}` (as a parameter named `@id{k}`) to continue execution after a yield.

We need to set some terminology to explain continuations. We have a `@N{C function}` called from Lua which we will call the `@emph{original function}`. This original function then calls one of those three functions in the C API, which we will call the `@emph{callee function}`, that then yields the current thread. This can happen when the callee function is `@Lid{lua_yieldk}`, or when the callee function is either `@Lid{lua_callk}` or `@Lid{lua_pcallk}` and the function called by them yields.

Suppose the running thread yields while executing the callee function. After the thread resumes, it eventually will finish running the callee function. However, the callee function cannot return to the original function, because its frame in the `@N{C stack}` was destroyed by the yield. Instead, Lua calls a `@def{continuation function}`, which was given as an argument to the callee function. As the name implies, the continuation function should continue the task of the original function.

As an illustration, consider the following function:

```
@verbatim{
int original_function (lua_State *L) {
...   /* code 1 */
status = lua_pcall(L, n, m, h); /* calls Lua */
...   /* code 2 */
}
}
```

Now we want to allow the Lua code being run by `@Lid{lua_pcall}` to yield. First, we can rewrite our function like here:



```
@verbatim{
int k (lua_State *L, int status, lua_KContext ctx) {
... /* code 2 */
}
```

```
int original_function (lua_State *L) {
... /* code 1 */
return k(L, lua_pcall(L, n, m, h), ctx);
}
}
```

In the above code,

the new function `@id{k}` is a

`@emph{continuation function}` (with type `@Lid{lua_KFunction}`),  
which

should do all the work that the original function  
was doing after calling `@Lid{lua_pcall}`.

Now, we must inform Lua that it must call `@id{k}` if the Lua code  
being executed by `@Lid{lua_pcall}` gets interrupted in some way  
(errors or yielding),

so we rewrite the code as here,

replacing `@Lid{lua_pcall}` by `@Lid{lua_pcallk}`:

```
@verbatim{
int original_function (lua_State *L) {
... /* code 1 */
return k(L, lua_pcallk(L, n, m, h, ctx2, k), ctx1);
}
}
```

Note the external, explicit call to the continuation:

Lua will call the continuation only if needed, that is,  
in case of errors or resuming after a yield.

If the called function returns normally without ever yielding,

`@Lid{lua_pcallk}` (and `@Lid{lua_callk}`) will also return normally.

(Of course, instead of calling the continuation in that case,  
you can do the equivalent work directly inside the original function.)

Besides the Lua state,

the continuation function has two other parameters:

the final status of the call and the context value

(`@id{ctx}`) that

was passed originally to `@Lid{lua_pcallk}`.

Lua does not use this context value;

it only passes this value from the original function to the  
continuation function.

For `@Lid{lua_pcallk}`,

the status is the same value that would be returned by `@Lid{lua_pcallk}`,  
except that it is `@Lid{LUA_YIELD}` when being executed after a yield  
(instead of `@Lid{LUA_OK}`).

For `@Lid{lua_yieldk}` and `@Lid{lua_callk}`,

the status is always `@Lid{LUA_YIELD}` when Lua calls the continuation.  
 (For these two functions,  
 Lua will not call the continuation in case of errors,  
 because they do not handle errors.)  
 Similarly, when using `@Lid{lua_callk}`,  
 you should call the continuation function  
 with `@Lid{LUA_OK}` as the status.  
 (For `@Lid{lua_yieldk}`, there is not much point in calling  
 directly the continuation function,  
 because `@Lid{lua_yieldk}` usually does not return.)

Lua treats the continuation function as if it were the original function.  
 The continuation function receives the same Lua stack  
 from the original  
 function,  
 in the same state it would be if the callee function had returned.  
 (For instance,  
 after a `@Lid{lua_callk}` the function and its arguments are  
 removed from the stack and replaced by the results from the call.)  
 It also has the same upvalues.  
 Whatever it returns is handled by Lua as if it were the return  
 of the original function.

}

@sect2{@title{Functions and Types}

Here we list all functions and types from the `@N{C API}` in  
 alphabetical order.

Each function has an indicator like this:

`@apii{o,p,x}`

The first field, `@T{o}`,  
 is how many elements the function pops from the stack.  
 The second field, `@T{p}`,  
 is how many elements the function pushes onto the stack.  
 (Any function always pushes its results after popping its arguments.)  
 A field in the form `@T{x|y}` means the function can push (or pop)  
`@T{x}` or `@T{y}` elements,  
 depending on the situation;  
 an interrogation mark `@Char{?}` means that  
 we cannot know how many elements the function pops/pushes  
 by looking only at its arguments.  
 (For  
 instance, they may depend on what is in the stack.)  
 The third field, `@T{x}`,  
 tells whether the function may raise errors:  
`@Char{-}` means the function never raises any error;

@Char{m} means the function may raise only out-of-memory errors;  
 @Char{v} means the function may raise the errors explained in the text;  
 @Char{e} means the function can run arbitrary Lua code,  
 either directly or through metamethods,  
 and therefore may raise any errors.

```
@APIEntry{int lua_absindex (lua_State *L, int idx);|
@apii{0,0,-}
```

Converts the @x{acceptable index} @id{idx}  
 into an equivalent @x{absolute index}  
 (that is, one that does not depend on the stack size).

```
}
```

```
@APIEntry{
typedef void * (*lua_Alloc) (void *ud,
                             void *ptr,
                             size_t osize,
                             size_t nsize);|
```

The type of the @x{memory-allocation function} used by Lua states.  
 The allocator function must provide a  
 functionality similar to @id{realloc},  
 but not exactly the  
 same.

Its arguments are

@id{ud}, an opaque pointer passed to @Lid{lua\_newstate};  
 @id{ptr}, a pointer to the block being allocated/reallocated/freed;  
 @id{osize}, the original size of the block or some code about what  
 is being allocated;  
 and @id{nsize}, the new size of the block.

When @id{ptr} is not @id{NULL},  
 @id{osize} is the size of the block pointed by @id{ptr},  
 that is, the size given when it was allocated or reallocated.

When @id{ptr} is @id{NULL},  
 @id{osize} encodes the kind of object that Lua is allocating.  
 @id{osize} is any of  
 @Lid{LUA\_TSTRING}, @Lid{LUA\_TTABLE}, @Lid{LUA\_TFUNCTION},  
 @Lid{LUA\_TUSERDATA}, or @Lid{LUA\_TTHREAD} when (and only when)  
 Lua is creating a new object of that type.  
 When @id{osize} is some other value,  
 Lua is allocating memory for something else.

Lua assumes the following behavior from the allocator function:

When @id{nsiz} is zero,  
the allocator must behave like @id{free}  
and then return @id{NULL}.

When @id{nsiz} is not zero,  
the allocator must behave  
like @id{realloc}.  
In particular, the allocator returns @id{NULL}  
if and only if it cannot fulfill the request.

Here is a simple implementation for the @x{allocator function}.  
It is used in the auxiliary library by @Lid{luaL\_newstate}.

```
@verbatim{
static void *l_alloc (void *ud, void *ptr, size_t osize,
                      size_t nsiz) {
    (void)ud; (void)osize; /* not used */
    if (nsiz == 0) {
        free(ptr);
        return NULL;
    }
    else
        return realloc(ptr, nsiz);
}
}
```

Note that @N{ISO C} ensures  
that @T{free(NULL)} has no effect and that  
@T{realloc(NULL,size)} is equivalent to @T{malloc(size)}.

```
}
```

```
@APIEntry{void lua_arith (lua_State *L, int op);|
@apii{2|1,1,e}
```

Performs an arithmetic or bitwise operation over the two values  
(or one, in the case of negations)  
at the top of the stack,  
with the value on the top being the second operand,  
pops these values, and pushes the result of the operation.  
The function follows the semantics of the corresponding Lua  
operator  
(that is, it may call metamethods).

The value of @id{op} must be one of the following constants:  
@description{

@item{@defid{LUA\_OPADD}| performs addition (@T{+})}

```

@item{@defid{LUA_OPSUB}| performs subtraction (@T{-})}
@item{@defid{LUA_OPMUL}| performs multiplication (@T{*})}
@item{@defid{LUA_OPDIV}| performs float division (@T{/})}
@item{@defid{LUA_OPIDIV}| performs floor division (@T{//})}
@item{@defid{LUA_OPMOD}| performs modulo (@T{%})}
@item{@defid{LUA_OPPOW}| performs exponentiation (@T{^})}
@item{@defid{LUA_OPUNM}| performs mathematical negation (unary @T{-})}
@item{@defid{LUA_OPBNOT}| performs bitwise NOT (@T{~})}
@item{@defid{LUA_OPBAND}| performs bitwise AND (@T{&})}
@item{@defid{LUA_OPBOR}| performs bitwise OR (@T{|})}
@item{@defid{LUA_OPBXOR}| performs bitwise exclusive OR (@T{~})}
@item{@defid{LUA_OPSHL}| performs left shift (@T{<<})}
@item{@defid{LUA_OPSHR}| performs right shift (@T{>>})}

```

```

}

```

```

}

```

```

@APIEntry{lua_CFunction lua_atpanic (lua_State *L, lua_CFunction
panicf);|
@apii{0,0,-}

```

Sets a new panic function and returns the old one @see{C-error}.

```

}

```

```

@APIEntry{void lua_call (lua_State *L, int nargs, int nresults);|
@apii{nargs+1,nresults,e}

```

Calls a function.

Like regular Lua calls,

@id{lua\_call} respects the @idx{\_\_call} metamethod.

So, here the word @Q{function}

means any callable value.

To do a call you must use the following protocol:

first, the function to be called is pushed onto the stack;

then, the arguments to the call are pushed

in direct order;

that is, the first argument is pushed first.

Finally you call @Lid{lua\_call};

@id{nargs} is the number of arguments that you pushed onto the stack.

When the function returns,

all arguments and the function value are popped

and the call results are pushed onto the stack.

The number of results is adjusted to @id{nresults},

unless @id{nresults} is @defid{LUA\_MULTRET}.

In this case, all results from the function are pushed;

Lua takes care that the returned values fit into the stack space,  
but  
it does not ensure any extra space in the stack.  
The function results are pushed onto the stack in direct order  
(the first result is pushed first),  
so that after the call the last result is on the top of the stack.

Any error while calling and running the function is propagated upwards  
(with a `@id{longjmp}`).

The following example shows how the host program can do the  
equivalent to this Lua code:

```
@verbatim{
```

```
a = f("how", t.x, 14)
```

```
}
```

Here it is `@N{in C}`:

```
@verbatim{
```

```
lua_getglobal(L, "f");          /* function to be called */
```

```
lua_pushliteral(L, "how");      /* 1st argument */
```

```
lua_getglobal(L, "t");         /* table to be indexed */
```

```
lua_getfield(L, -1, "x");      /* push result of t.x (2nd arg) */
```

```
lua_remove(L, -2);            /* remove 't' from the stack */
```

```
lua_pushinteger(L, 14);        /* 3rd argument */
```

```
lua_call(L, 3, 1);            /* call 'f' with 3 arguments and 1 result */
```

```
lua_setglobal(L, "a");         /* set global
```

```
'a' */
```

```
}
```

Note that the code above is `@emph{balanced}`:

at its end, the stack is back to its original configuration.

This is considered good programming practice.

```
}
```

```
@APIEntry{
```

```
void lua_callk (lua_State *L,
```

```
    int nargs,
```

```
    int nresults,
```

```
    lua_KContext ctx,
```

```
    lua_KFunction k);|
```

```
@apii{nargs + 1,nresults,e}
```

This function behaves exactly like `@Lid{lua_call}`,

but allows the called function to yield `@see{continuations}`.

```
}
```

```
@APIEntry{typedef int (*lua_CFunction) (lua_State *L);|
```

Type for @N{C functions}.

In order to communicate properly with Lua,  
a @N{C function} must use the following protocol,  
which defines the way parameters and results are passed:  
a @N{C function} receives its arguments from Lua in its stack  
in direct order (the first argument is pushed first).  
So, when the function starts,  
@T{lua\_gettop(L)} returns the number of arguments received by the function.  
The first argument (if any) is at index 1  
and its last argument  
is at index @T{lua\_gettop(L)}.  
To return values to Lua, a @N{C function} just pushes them onto the stack,  
in direct order (the first result is pushed first),  
and returns in C the number of results.  
Any other value in the stack below the results will be properly  
discarded by Lua.  
Like a Lua function, a @N{C function} called by Lua can also return  
many results.

As an example, the following function receives a variable number  
of numeric arguments and returns their average and their sum:

```
@verbatim{
static int foo (lua_State *L) {
    int n = lua_gettop(L); /* number of arguments */
    lua_Number sum = 0.0;
    int i;
    for (i = 1; i <= n; i++) {
        if (!lua_isnumber(L, i)) {
            lua_pushliteral(L, "incorrect argument");
            lua_error(L);
        }
        sum += lua_tonumber(L, i);
    }
    lua_pushnumber(L, sum/n); /* first result */
    lua_pushnumber(L, sum); /* second result */
    return 2; /* number of results */
}
}
```

```
@APIEntry{int lua_checkstack (lua_State
*L, int n);|
@api{0,0,-}
```

Ensures that the stack has space for at least @id{n} extra elements, that is, that you can safely push up to @id{n} values into it. It returns false if it cannot fulfill the request, either because it would cause the stack to be greater than a fixed maximum size (typically at least several thousand elements) or because it cannot allocate memory for the extra space. This function never shrinks the stack; if the stack already has space for the extra elements, it is left unchanged.

```
}
```

```
@APIEntry{void lua_close (lua_State *L);|
@apii{0,0,-}}
```

Close all active to-be-closed variables in the main thread, release all objects in the given Lua state (calling the corresponding garbage-collection metamethods, if any), and frees all dynamic memory used by this state.

On several platforms, you may not need to call this function, because all resources are naturally released when the host program ends. On the other hand, long-running programs that create multiple states, such as daemons or web servers, will probably need to close states as soon as they are not needed.

```
}
```

```
@APIEntry{void lua_closeslot (lua_State *L, int index);|
@apii{0,0,e}}
```

Close the to-be-closed slot at the given index and set its value to @nil. The index must be the last index previously marked to be closed @see{lua\_toclose} that is still active (that is, not closed yet).

A @idx{\_\_close} metamethod cannot yield when called through this function.

(This function was introduced in @N{release 5.4.3}.)

```
}
```

```
@APIEntry{int lua_closethread (lua_State *L, lua_State *from);|
@apii{0,?, -}}
```



Resets a thread, cleaning its call stack and closing all pending to-be-closed variables.

Returns a status code:

@Lid{LUA\_OK} for no errors in the thread  
(either the original error that stopped the thread or errors in closing methods),  
or an error status otherwise.

In case of error,

leaves the error object on the top of the stack.

The parameter @id{from} represents the coroutine that is resetting @id{L}.

If

there is no such coroutine,  
this parameter can be @id{NULL}.

(This function was introduced in @N{release 5.4.6}.)

}

@APIEntry{int lua\_compare (lua\_State \*L, int index1, int index2, int op);|  
@apii{0,0,e}}

Compares two Lua values.

Returns 1 if the value at index @id{index1} satisfies @id{op}  
when compared with the value at index @id{index2},  
following the semantics of the corresponding Lua operator  
(that is, it may call metamethods).

Otherwise @N{returns 0}.

Also @N{returns 0} if any of the indices is not valid.

The value of @id{op} must be one of the following constants:

@description{

@item{@defid{LUA\_OPEQ}| compares for equality (@T{==})}

@item{@defid{LUA\_OPLT}| compares for less than (@T{<})}

@item{@defid{LUA\_OPLE}| compares for less or equal (@T{<=})}

}

}

@APIEntry{void lua\_concat (lua\_State \*L, int n);|  
@apii{n,1,e}}

Concatenates the @id{n} values at the top of the stack,  
pops them, and leaves the result on the top.

If @N{@T{n} is 1}, the result is the single value on the

stack  
(that is, the function does nothing);  
if @id{n} is 0, the result is the empty string.  
Concatenation is performed following the usual semantics of Lua  
@see{concat}.

}

@APIEntry{void lua\_copy (lua\_State \*L, int fromidx, int toidx);|  
@apii{0,0,-}}

Copies the element at index @id{fromidx}  
into the valid index @id{toidx},  
replacing the value at that position.  
Values at other positions are not affected.

}

@APIEntry{void lua\_createtable (lua\_State \*L, int narr, int nrec);|  
@apii{0,1,m}}

Creates a new empty table and pushes it onto the stack.  
Parameter @id{narr} is a hint for how many elements the table  
will have as a sequence;  
parameter @id{nrec} is a hint for how many other elements  
the table will have.  
Lua may use these hints to preallocate memory for the new table.  
This preallocation may help performance when you know in advance  
how many elements the table will have.  
Otherwise you can use the function @Lid{lua\_newtable}.

}

@APIEntry{int lua\_dump (lua\_State \*L,

lua\_Writer writer,  
void \*data,  
int strip);|

@apii{0,0,-}}

Dumps a function as a binary chunk.  
Receives a Lua function on the top of the stack  
and produces a binary chunk that,  
if loaded again,  
results in a function equivalent to the one dumped.  
As it produces parts of the chunk,  
@Lid{lua\_dump} calls function @id{writer} @seeC{lua\_Writer}  
with the given @id{data}

to write them.

If `@id{strip}` is true,  
the binary representation may not include all debug information  
about the function,  
to save space.

The value returned is the error code returned by the last  
call to the writer;  
`@N{0 means}` no errors.

This function does not pop the Lua function from the stack.

}

`@APIEntry{int lua_error (lua_State *L);|`  
`@apii{1,0,v}`

Raises a Lua error,  
using the value on the top of the stack as the error object.  
This function does a long jump,  
and therefore never returns  
`@seeC{luaL_error}`.

}

`@APIEntry{int lua_gc (lua_State *L, int what, ...);|`  
`@apii{0,0,-}`

Controls  
the garbage collector.

This function performs several tasks,  
according to the value of the parameter `@id{what}`.  
For options that need extra arguments,  
they are listed after the option.  
`@description{`

`@item{@id{LUA_GCCOLLECT}}|`  
Performs a full garbage-collection cycle.  
}

`@item{@id{LUA_GCSTOP}}|`  
Stops the garbage collector.  
}

`@item{@id{LUA_GCRESTART}}|`  
Restarts the garbage collector.

}

@item{@id{LUA\_GCCOUNT}|

Returns the current amount of memory (in Kbytes) in use by Lua.

}

@item{@id{LUA\_GCCOUNTB}|

Returns the remainder of dividing the current amount of bytes of memory in use by Lua by 1024.

}

@item{@id{LUA\_GCSTEP} @T{(int stepsize)}|

Performs an incremental step of garbage collection, corresponding to the allocation of @id{stepsize} Kbytes.

}

@item{@id{LUA\_GCISRUNNING}|

Returns a boolean that tells whether the collector is running (i.e., not stopped).

}

@item{@id{LUA\_GCINC} (int pause, int stepmul, stepsize)|

Changes the collector to incremental mode

with the

given parameters @see{incmode}.

Returns the previous mode (@id{LUA\_GCGEN} or @id{LUA\_GCINC}).

}

@item{@id{LUA\_GCGEN} (int minormul, int majormul)|

Changes the collector to generational mode

with the given parameters @see{genmode}.

Returns the previous mode (@id{LUA\_GCGEN} or @id{LUA\_GCINC}).

}

}

For more details about these options,

see @Lid{collectgarbage}.

This function should not be called by a finalizer.

}

@APIEntry{lua\_Alloc lua\_getallocf (lua\_State \*L, void \*\*ud);|

@apii{0,0,-}

Returns the @x{memory-allocation function} of a given state.

If @id{ud} is not @id{NULL}, Lua stores in @T{\*ud} the

opaque pointer given when the memory-allocator function was set.

```
}
```

```
@APIEntry{int lua_getfield (lua_State *L, int index, const char *k);|  
@apii{0,1,e}
```

Pushes onto the stack the value `@T{t[k]}`,  
where `@id{t}` is the value at the given index.  
As in Lua, this function may trigger a metamethod  
for the `@Q{index}` event `@see{metatable}`.

Returns the type of the pushed value.

```
}
```

```
@APIEntry{void  
*lua_getextraspace (lua_State *L);|  
@apii{0,0,-}
```

Returns a pointer to a raw memory area associated with the  
given Lua state.  
The application can use this area for any purpose;  
Lua does not use it for anything.

Each new thread has this area initialized with a copy  
of the area of the `@x{main thread}`.

By default, this area has the size of a pointer to void,  
but you can recompile Lua with a different size for this area.  
(See `@id{LUA_EXTRASPACE}` in `@id{luaconf.h}`.)

```
}
```

```
@APIEntry{int lua_getglobal (lua_State *L, const char *name);|  
@apii{0,1,e}
```

Pushes onto the stack the value of the global `@id{name}`.  
Returns the type of that value.

```
}
```

```
@APIEntry{int lua_geti (lua_State *L, int index, lua_Integer i);|  
@apii{0,1,e}
```

Pushes onto the stack the value `@T{t[i]}`,  
where `@id{t}` is the value at the given index.  
As in Lua, this function may trigger a metamethod  
for the `@Q{index}` event `@see{metatable}`.

Returns the type of the pushed value.

}

```
@APIEntry{int lua_getmetatable (lua_State *L, int index);|
@apii{0,0|1,-}}
```

If

the value at the given index has a metatable,  
the function pushes that metatable onto the stack and @N{returns 1}.

Otherwise,

the function @N{returns 0} and pushes nothing on the stack.

}

```
@APIEntry{int lua_gettable (lua_State *L, int index);|
@apii{1,1,e}}
```

Pushes onto the stack the value @T{t[k]},  
where @id{t} is the value at the given index  
and @id{k} is the value on the top of the stack.

This function pops the key from the stack,  
pushing the resulting value in its place.  
As in Lua, this function may trigger a metamethod  
for the @Q{index} event @see{metatable}.

Returns the type of the pushed value.

}

```
@APIEntry{int lua_gettop (lua_State *L);|
@apii{0,0,-}}
```

Returns the index of the top element in the stack.  
Because indices start @N{at 1},  
this result is equal to the number of elements in the stack;  
in particular, @N{0 means} an empty stack.

}

```
@APIEntry{int lua_getiuservalue (lua_State *L, int index, int n);|
@apii{0,1,-}}
```

Pushes onto the stack the @id{n}-th  
user value associated with the  
full userdata at the given index and

returns the type of the pushed value.

If the userdata does not have that value,  
pushes @nil and returns @Lid{LUA\_TNONE}.

}

@APIEntry{void lua\_insert (lua\_State \*L, int index);|  
@apii{1,1,-}}

Moves the top element into the given valid index,  
shifting up the elements above this index to open space.  
This function cannot be called with a pseudo-index,  
because a pseudo-index is not an actual stack position.

}

@APIEntry{typedef @ldots lua\_Integer;|

The type of integers in Lua.

By default this type is @id{long long},  
(usually a 64-bit two-complement integer),  
but that can be changed to @id{long} or @id{int}  
(usually a 32-bit two-complement integer).  
(See @id{LUA\_INT\_TYPE} in @id{luaconf.h}.)

Lua also defines the constants

@defid{LUA\_MININTEGER} and @defid{LUA\_MAXINTEGER},  
with the minimum and the maximum values that fit in this type.

}

@APIEntry{int lua\_isboolean (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns 1  
if the value at the given index is a boolean,  
and @N{0 otherwise}.

}

@APIEntry{int lua\_isfunction (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns 1 if the value at the given index is a @N{C function},  
and @N{0 otherwise}.

}

```
@APIEntry{int lua_isfunction (lua_State *L, int index);|
@apii{0,0,-}}
```

Returns 1 if the value at the given index is a function  
(either C or Lua), and @N{0 otherwise}.

}

```
@APIEntry{int lua_isinteger (lua_State *L, int index);|
@apii{0,0,-}}
```

Returns 1 if the value at the given index is an integer  
(that is, the value is a number and is represented as an integer),  
and @N{0 otherwise}.

}

```
@APIEntry{int lua_islightuserdata (lua_State *L, int index);|
@apii{0,0,-}}
```

Returns 1 if the value at the given index is a light userdata,  
and @N{0 otherwise}.

}

```
@APIEntry{int lua_isnil (lua_State *L, int index);|
@apii{0,0,-}}
```

Returns 1 if the value at the given index is @nil,  
and @N{0 otherwise}.

}

```
@APIEntry{int lua_isnone (lua_State *L, int index);|
@apii{0,0,-}}
```

Returns  
1 if the given index is not valid,  
and @N{0 otherwise}.

}

```
@APIEntry{int lua_isnoneornil (lua_State *L, int index);|
@apii{0,0,-}}
```

Returns 1 if the given index is not valid



or if the value at this index is @nil,  
and @N{0 otherwise}.

}

@APIEntry{int lua\_isnumber (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns 1 if the value at the given index is a number  
or a string convertible to a number,  
and @N{0 otherwise}.

}

@APIEntry{int lua\_isstring (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns 1 if the value at the given index is a string  
or a number (which is always convertible to a string),  
and @N{0 otherwise}.

}

@APIEntry{int lua\_istable (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns 1 if the value at the given index is a table,  
and @N{0 otherwise}.

}

@APIEntry{int lua\_isthread (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns 1 if the value at the given index is a thread,  
and @N{0 otherwise}.

}

@APIEntry{int lua\_isuserdata (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns  
1 if the value at the given index is a userdata  
(either full or light), and @N{0 otherwise}.

}

```
@APIEntry{int lua_isyieldable (lua_State *L);|
@apii{0,0,-}}
```

Returns 1 if the given coroutine can yield,  
and @N{0 otherwise}.

```
}
```

```
@APIEntry{typedef @ldots lua_KContext;|
```

The type for continuation-function contexts.

It must be a numeric type.

This type is defined as @id{intptr\_t}

when @id{intptr\_t} is available,

so that it can store pointers too.

Otherwise, it is defined as @id{ptrdiff\_t}.

```
}
```

```
@APIEntry{
typedef int (*lua_KFunction) (lua_State *L, int status, lua_KContext ctx);|
```

Type for continuation functions @see{continuations}.

```
}
```

```
@APIEntry{void lua_len (lua_State *L, int index);|
@apii{0,1,e}}
```

Returns the length of the value at the given index.

It is equivalent to the @Char{#} operator in Lua @see{len-op} and  
may trigger a metamethod for the @Q{length} event @see{metatable}.

The result is pushed on the stack.

```
}
```

```
@APIEntry{
int lua_load (lua_State *L,
              lua_Reader reader,
              void *data,
              const char *chunkname,
              const char *mode);|
@apii{0,1,-}}
```

Loads a Lua chunk without running it.

If there are no errors,

@id{lua\_load} pushes the compiled chunk as a Lua  
function on top of the stack.

Otherwise, it pushes an error message.

The `@id{lua_load}` function uses a user-supplied `@id{reader}` function to read the chunk `@seeC{lua_Reader}`.

The `@id{data}` argument is an opaque value passed to the reader function.

The `@id{chunkname}` argument gives a name to the chunk, which is used for error messages and in debug information `@see{debugI}`.

`@id{lua_load}` automatically detects whether the chunk is text or binary and loads it accordingly (see program `@idx{luac}`).

The string `@id{mode}` works as in function `@Lid{load}`, with the addition that

a `@id{NULL}` value is equivalent to the string `@St{bt}`.

`@id{lua_load}` uses the stack internally, so the reader function must always leave the stack unmodified when returning.

`@id{lua_load}` can return

`@Lid{LUA_OK}`,

`@Lid{LUA_ERRSYNTAX}`, or `@Lid{LUA_ERRMEM}`.

The function may also return other values corresponding to errors raised by the read function `@see{statuscodes}`.

If the resulting function has upvalues, its first upvalue is set to the value of the `@x{global environment}` stored at index `@id{LUA_RIDX_GLOBALS}` in the registry `@see{registry}`.

When loading main chunks,

this upvalue will be the `@id{_ENV}` variable `@see{globalenv}`.

Other upvalues are initialized with `@nil`.

}

`@APIEntry{lua_State *lua_newstate (lua_Alloc f, void *ud);|`

`@apii{0,0,-}`

Creates a new independent state and returns its main thread.

Returns `@id{NULL}` if it cannot create the state (due to lack of memory).

The argument `@id{f}` is the `@x{allocator function}`;

Lua will do all memory allocation for this state through this function `@seeF{lua_Alloc}`.

The second argument, `@id{ud}`, is an opaque pointer that Lua passes to the allocator in every call.

}

```
@APIEntry{void lua_newtable (lua_State *L);|
@apii{0,1,m}}
```

Creates

a new empty table and pushes it onto the stack.

It is equivalent to @T{lua\_createtable(L, 0, 0)}.

```
}
```

```
@APIEntry{lua_State *lua_newthread (lua_State *L);|
@apii{0,1,m}}
```

Creates a new thread, pushes it on the stack,

and returns a pointer to a @Lid{lua\_State} that represents this new thread.

The new thread returned by this function shares with the original thread

its global environment,

but has an independent execution stack.

Threads are subject to garbage collection,

like any Lua object.

```
}
```

```
@APIEntry{void *lua_newuserdatauv (lua_State *L, size_t size, int nuvalue);|
@apii{0,1,m}}
```

This function creates and pushes on the stack a new full userdata,

with @id{nuvalue} associated Lua values, called @id{user values},

plus an associated block of raw memory with @id{size} bytes.

(The user values can be set and read with the functions

@Lid{lua\_setiuservalue} and @Lid{lua\_getiuservalue}.)

The function returns the address of the block of memory.

Lua ensures that this address is valid as long as

the

corresponding userdata is alive @see{GC}.

Moreover, if the userdata is marked for finalization @see{finalizers},

its address is valid at least until the call to its finalizer.

```
}
```

```
@APIEntry{int lua_next (lua_State *L, int index);|
@apii{1,2|0,v}}
```

Pops a key from the stack,

and pushes a key@En{ }value pair from the table at the given index,

the @Q{next} pair after the given key.

If there are no more elements in the table,

then @Lid{lua\_next} @N{returns 0} and pushes nothing.

A typical table traversal looks like this:

```
@verbatim{
/* table is in the stack at index 't' */
lua_pushnil(L); /* first key */
while (lua_next(L, t) != 0) {
/* uses 'key' (at index -2) and 'value' (at index -1) */
printf("%s - %s\n",
    lua_typename(L, lua_type(L, -2)),
    lua_typename(L, lua_type(L, -1)));
/* removes 'value'; keeps 'key' for next iteration */
lua_pop(L, 1);
}
}
```

While traversing a table,  
avoid calling @Lid{lua\_tolstring} directly on a key,  
unless you know that the key is  
actually a string.  
Recall that @Lid{lua\_tolstring} may change  
the value at the given index;  
this confuses the next call to @Lid{lua\_next}.

This function may raise an error if the given key  
is neither @nil nor present in the table.  
See function @Lid{next} for the caveats of modifying  
the table during its traversal.

```
}
```

```
@APIEntry{typedef @ldots lua_Number;|
```

The type of floats in Lua.

By default this type is double,  
but that can be changed to a single float or a long double.  
(See @id{LUA\_FLOAT\_TYPE} in @id{luaconf.h}.)

```
}
```

```
@APIEntry{int lua_numbertointeger (lua_Number n, lua_Integer *p);|
```

Tries to convert a Lua float to a Lua integer;  
the float @id{n} must have an integral value.  
If that value is within the range of Lua integers,  
it is converted to an integer and assigned to @T{\*p}.  
The macro results in a boolean indicating whether the

conversion was successful.

(Note that this range test can be tricky to do correctly without this macro, due to rounding.)

This macro may evaluate its arguments more than once.

}

```
@APIEntry{int lua_pcall (lua_State *L, int nargs, int nresults, int msgh);|
@apii{nargs + 1,nresults|1,-}
```

Calls a function (or a callable object) in protected mode.

Both @id{nargs} and @id{nresults} have the same meaning as in @Lid{lua\_call}.

If there are no errors during the call,

@Lid{lua\_pcall} behaves exactly like @Lid{lua\_call}.

However, if there is any error,

@Lid{lua\_pcall} catches it,

pushes a single value on the stack (the error object),

and returns an error code.

Like @Lid{lua\_call},

@Lid{lua\_pcall} always removes the function

and its arguments from the stack.

If @id{msgh} is 0,

then the error object returned on the stack

is exactly the original error object.

Otherwise, @id{msgh} is the stack index of a

@emph{message handler}.

(This index cannot be a pseudo-index.)

In case of runtime errors,

this handler will be called with the error object

and its return value will be the object

returned on the stack by @Lid{lua\_pcall}.

Typically, the message

handler is used to add more debug

information to the error object, such as a stack traceback.

Such information cannot be gathered after the return of @Lid{lua\_pcall},

since by then the stack has unwound.

The @Lid{lua\_pcall} function returns one of the following status codes:

@Lid{LUA\_OK}, @Lid{LUA\_ERRRUN}, @Lid{LUA\_ERRMEM}, or @Lid{LUA\_ERRERR}.

}

```
@APIEntry{
int lua_pcallk (lua_State *L,
               int nargs,
               int nresults,
               int msgch,
               lua_KContext ctx,
               lua_KFunction k);|
@apii{nargs + 1,nresults|1,-}
```

This function behaves exactly like @Lid{lua\_pcall},  
except that it allows the called function to yield @see{continuations}.

```
}
```

```
@APIEntry{void lua_pop (lua_State *L, int n);|
@apii{n,0,e}
```

Pops @id{n} elements from the stack.  
It is implemented as a macro over @Lid{lua\_settop}.

```
}
```

```
@APIEntry{void lua_pushboolean (lua_State *L, int b);|
@apii{0,1,-}
```

Pushes a boolean value with value @id{b} onto the stack.

```
}
```

```
@APIEntry{void
lua_pushcclosure (lua_State *L, lua_CFunction fn, int n);|
@apii{n,1,m}
```

Pushes a new @N{C closure} onto the stack.  
This function receives a pointer to a @N{C function}  
and pushes onto the stack a Lua value of type @id{function} that,  
when called, invokes the corresponding @N{C function}.  
The parameter @id{n} tells how many upvalues this function will have  
@see{c-closure}.

Any function to be callable by Lua must  
follow the correct protocol to receive its parameters  
and return its results @seeC{lua\_CFunction}.

When a @N{C function} is created,  
it is possible to associate some values with it,  
the so called upvalues;  
these upvalues are then accessible to the function whenever it is called.

This association is called a `@x{@N{C closure}}` `@see{c-closure}`.  
 To create a `@N{C closure}`,  
 first the initial values for its upvalues must be pushed onto the stack.  
 (When there are multiple upvalues, the first value is pushed first.)  
 Then `@Lid{lua_pushcclosure}`  
 is called to create and push the `@N{C`  
`function}` onto the stack,  
 with the argument `@id{n}` telling how many values will be  
 associated with the function.  
`@Lid{lua_pushcclosure}` also pops these values from the stack.

The maximum value for `@id{n}` is 255.

When `@id{n}` is zero,  
 this function creates a `@def{light @N{C function}}`,  
 which is just a pointer to the `@N{C function}`.  
 In that case, it never raises a memory error.

}

```
@APIEntry{void lua_pushcfunction (lua_State *L, lua_CFunction f);|
@apii{0,1,-}}
```

Pushes a `@N{C function}` onto the stack.  
 This function is equivalent to `@Lid{lua_pushcclosure}` with no upvalues.

}

```
@APIEntry{const char *lua_pushfstring (lua_State *L, const char *fmt, ...);|
@apii{0,1,v}}
```

Pushes onto the stack a formatted string  
 and returns a pointer to this string `@see{constchar}`.  
 It is similar to the `@ANSI{sprintf}`,  
 but has two important differences.  
 First,  
 you do not have to allocate space for the result;  
 the result is a Lua string and Lua takes care of memory allocation  
 (and deallocation, through garbage  
 collection).  
 Second,  
 the conversion specifiers are quite restricted.  
 There are no flags, widths, or precisions.  
 The conversion specifiers can only be  
`@Char{%%}` (inserts the character `@Char{%}`),  
`@Char{%s}` (inserts a zero-terminated string, with no size restrictions),  
`@Char{%f}` (inserts a `@Lid{lua_Number}`),  
`@Char{%I}` (inserts a `@Lid{lua_Integer}`),



`@Char{%p}` (inserts a pointer),  
`@Char{%d}` (inserts an `@T{int}`),  
`@Char{%c}` (inserts an `@T{int}` as a one-byte character), and  
`@Char{%U}` (inserts a `@T{long int}` as a `@x{UTF-8}` byte sequence).

This function may raise errors due to memory overflow  
 or an invalid conversion specifier.

}

`@APIEntry{void lua_pushglobaltable (lua_State *L);|`  
`@apii{0,1,-}`

Pushes the `@x{global environment}` onto the stack.

}

`@APIEntry{void lua_pushinteger (lua_State *L, lua_Integer n);|`  
`@apii{0,1,-}`

Pushes an integer with value `@id{n}` onto the stack.

}

`@APIEntry{void lua_pushlightuserdata (lua_State *L, void *p);|`  
`@apii{0,1,-}`

Pushes a light userdata onto the stack.

Userdata

represent `@N{C values}` in Lua.

A `@def{light userdata}` represents a pointer, a `@T{void*}`.

It is a value (like a number):

you do not create it, it has no individual metatable,

and it is not collected (as it was never created).

A light userdata is equal to `@Q{any}`

light userdata with the same `@N{C address}`.

}

`@APIEntry{const char *lua_pushliteral (lua_State *L, const char *s);|`  
`@apii{0,1,m}`

This macro is equivalent to `@Lid{lua_pushstring}`,  
 but should be used only when `@id{s}` is a literal string.  
 (Lua may optimize this case.)

}

```
@APIEntry{const char *lua_pushlstring (lua_State *L, const char *s, size_t len);|
@apii{0,1,m}
```

Pushes the string pointed to by @id{s} with size @id{len} onto the stack.

Lua will make or reuse an internal copy of the given string, so the memory at @id{s} can be freed or reused immediately after the function returns.

The string can contain any binary data, including @x{embedded zeros}.

Returns a pointer to the internal copy of the string @see{constchar}.

```
}
```

```
@APIEntry{void
lua_pushnil (lua_State *L);|
@apii{0,1,-}
```

Pushes a nil value onto the stack.

```
}
```

```
@APIEntry{void lua_pushnumber (lua_State *L, lua_Number n);|
@apii{0,1,-}
```

Pushes a float with value @id{n} onto the stack.

```
}
```

```
@APIEntry{const char *lua_pushstring (lua_State *L, const char *s);|
@apii{0,1,m}
```

Pushes the zero-terminated string pointed to by @id{s} onto the stack.

Lua will make or reuse an internal copy of the given string, so the memory at @id{s} can be freed or reused immediately after the function returns.

Returns a pointer to the internal copy of the string @see{constchar}.

If @id{s} is @id{NULL}, pushes @nil and returns @id{NULL}.

```
}
```

```
@APIEntry{int lua_pushthread (lua_State *L);|
@apii{0,1,-}
```

Pushes the thread represented by @id{L} onto the stack.  
Returns 1 if this thread is the @x{main thread} of its state.

}

@APIEntry{void lua\_pushvalue (lua\_State \*L, int index);|  
@apii{0,1,-}}

Pushes a copy of the element at the given index  
onto the stack.

}

@APIEntry{  
const  
char \*lua\_pushvfstring (lua\_State \*L,  
                        const char \*fmt,  
                        va\_list argp);|  
@apii{0,1,v}}

Equivalent to @Lid{lua\_pushfstring}, except that it receives a @id{va\_list}  
instead of a variable number of arguments.

}

@APIEntry{int lua\_rawequal (lua\_State \*L, int index1, int index2);|  
@apii{0,0,-}}

Returns 1 if the two values in indices @id{index1} and  
@id{index2} are primitively equal  
(that is, equal without calling the @idx{\_\_eq} metamethod).  
Otherwise @N{returns 0}.  
Also @N{returns 0} if any of the indices are not valid.

}

@APIEntry{int lua\_rawget (lua\_State \*L, int index);|  
@apii{1,1,-}}

Similar to @Lid{lua\_gettable}, but does a raw access  
(i.e., without metamethods).  
The value at @id{index} must be a table.

}

@APIEntry{int lua\_rawgeti (lua\_State \*L, int index, lua\_Integer n);|  
@apii{0,1,-}}

Pushes onto the stack the value `@T{t[n]}`,  
where `@id{t}` is the table at the given index.  
The access is raw,  
that is, it does not use  
the `@idx{__index}` metavalue.

Returns the type of the pushed value.

}

@APIEntry{int lua\_rawgetp (lua\_State \*L, int index, const void \*p);|  
@apii{0,1,-}}

Pushes onto the stack the value `@T{t[k]}`,  
where `@id{t}` is the table at the given index and  
`@id{k}` is the pointer `@id{p}` represented as a light userdata.  
The access is raw;  
that is, it does not use the `@idx{__index}` metavalue.

Returns the type of the pushed value.

}

@APIEntry{lua\_Unsigned lua\_rawlen (lua\_State \*L, int index);|  
@apii{0,0,-}}

Returns the raw `@Q{length}` of the value at the given index:  
for strings, this is the string length;  
for tables, this is the result of the length operator (`@Char{#}`)  
with no metamethods;  
for userdata, this is the size of the block of memory allocated  
for the userdata.  
For other values, this call `@N{returns 0}`.

}

@APIEntry{void lua\_rawset (lua\_State \*L, int index);|  
@apii{2,0,m}}

Similar to `@Lid{lua_settable}`, but does a raw assignment  
(i.e., without metamethods).  
The value at `@id{index}` must  
be a table.

}

@APIEntry{void lua\_rawseti (lua\_State \*L, int index, lua\_Integer i);|

```
@apii{1,0,m}
```

Does the equivalent of `@T{t[i] = v}`,  
where `@id{t}` is the table at the given index  
and `@id{v}` is the value on the top of the stack.

This function pops the value from the stack.  
The assignment is raw,  
that is, it does not use the `@idx{__newindex}` metavalue.

```
}
```

```
@APIEntry{void lua_rawsetp (lua_State *L, int index, const void *p);|  
@apii{1,0,m}
```

Does the equivalent of `@T{t[p] = v}`,  
where `@id{t}` is the table at the given index,  
`@id{p}` is encoded as a light userdata,  
and `@id{v}` is the value on the top of the stack.

This function pops the value from the stack.  
The assignment is raw,  
that is, it does not use the `@idx{__newindex}` metavalue.

```
}
```

```
@APIEntry{  
typedef const char * (*lua_Reader) (lua_State *L,  
                                     void *data,  
                                     size_t *size);|
```

The reader function used by `@Lid{lua_load}`.  
Every time `@Lid{lua_load}` needs another piece of  
the chunk,  
it calls the reader,  
passing along its `@id{data}` parameter.  
The reader must return a pointer to a block of memory  
with a new piece of the chunk  
and set `@id{size}` to the block size.  
The block must exist until the reader function is called again.  
To signal the end of the chunk,  
the reader must return `@id{NULL}` or set `@id{size}` to zero.  
The reader function may return pieces of any size greater than zero.

```
}
```

```
@APIEntry{void lua_register (lua_State *L, const char *name, lua_CFunction f);|  
@apii{0,0,e}
```

Sets the @N{C function} @id{f} as the new value of global @id{name}.

It is defined as a macro:

```
@verbatim{
#define lua_register(L,n,f) \
    (lua_pushcfunction(L, f), lua_setglobal(L, n))
}

}
```

```
@APIEntry{void lua_remove (lua_State *L, int index);|
```

```
@apii{1,0,-}
```

Removes the element at the given valid index,  
shifting down the elements above this index to fill the gap.

This function cannot be called with a pseudo-index,  
because a pseudo-index is not an actual stack position.

```
}
```

```
@APIEntry{void
```

```
lua_replace (lua_State *L, int index);|
```

```
@apii{1,0,-}
```

Moves the top element into the given valid index  
without shifting any element  
(therefore replacing the value at that given index),  
and then pops the top element.

```
}
```

```
@APIEntry{int lua_resetthread (lua_State *L);|
```

```
@apii{0,?, -}
```

This function is deprecated;  
it is equivalent to @Lid{lua\_closethread} with  
@id{from} being @id{NULL}.

```
}
```

```
@APIEntry{int lua_resume (lua_State *L, lua_State *from, int nargs,
                        int *nresults);|
```

```
@apii{?,?, -}
```

Starts and resumes a coroutine in the given thread @id{L}.

To start a coroutine,  
you push the main function plus any arguments

onto the empty stack of the thread.  
 then you call `@Lid{lua_resume}`,  
 with `@id{nargs}` being the number of arguments.  
 This call returns when the coroutine suspends or finishes its execution.  
 When it returns,  
`@id{*nresults}` is updated and  
 the top of the stack contains  
 the `@id{*nresults}` values passed to `@Lid{lua_yield}`  
 or returned by the body function.  
`@Lid{lua_resume}`  
 returns  
`@Lid{LUA_YIELD}` if the coroutine yields,  
`@Lid{LUA_OK}` if the coroutine finishes its execution  
 without errors,  
 or an error code in case of errors `@see{statuscodes}`.  
 In case of errors,  
 the error object is on the top of the stack.

To resume a coroutine,  
 you remove the `@id{*nresults}` yielded values from its stack,  
 push the values to be passed as results from `@id{yield}`,  
 and then call `@Lid{lua_resume}`.

The parameter `@id{from}` represents the coroutine that is resuming `@id{L}`.  
 If there is no such coroutine,  
 this parameter can be `@id{NULL}`.

}

`@APIEntry{void lua_rotate (lua_State *L, int idx, int n);|`  
`@apii{0,0,-}`

Rotates the stack elements between the valid index `@id{idx}`  
 and the top of the stack.  
 The elements are rotated `@id{n}` positions in the direction of the top,  
 for a positive `@id{n}`,  
 or `@T{-n}` positions in the direction of the bottom,  
 for a negative `@id{n}`.  
 The absolute value of `@id{n}` must not be greater than the size  
 of the slice being rotated.  
 This function  
 cannot be called with a pseudo-index,  
 because a pseudo-index is not an actual stack position.

}

`@APIEntry{void lua_setallocf (lua_State *L, lua_Alloc f, void *ud);|`  
`@apii{0,0,-}`

Changes the `@x{allocator function}` of a given state to `@id{f}` with user data `@id{ud}`.

}

```
@APIEntry{void lua_setfield (lua_State *L, int index, const char *k);|
@apii{1,0,e}
```

Does the equivalent to `@T{t[k] = v}`,  
where `@id{t}` is the value at the given index  
and `@id{v}` is the value on the top of the stack.

This function pops the value from the stack.  
As in Lua, this function may trigger a metamethod  
for the `@Q{newindex}` event `@see{metatable}`.

}

```
@APIEntry{void lua_setglobal (lua_State *L, const char *name);|
@apii{1,0,e}
```

Pops a value from the stack and  
sets it as the new value of global `@id{name}`.

}

```
@APIEntry{void lua_seti (lua_State *L, int index, lua_Integer n);|
@apii{1,0,e}
```

Does the equivalent to `@T{t[n] = v}`,  
where `@id{t}` is the value at the given index  
and `@id{v}` is the value on the top of  
the stack.

This function pops the value from the stack.  
As in Lua, this function may trigger a metamethod  
for the `@Q{newindex}` event `@see{metatable}`.

}

```
@APIEntry{int lua_setiuservalue (lua_State *L, int index, int n);|
@apii{1,0,-}
```

Pops a value from the stack and sets it as  
the new `@id{n}`-th user value associated to the  
full userdata at the given index.  
Returns 0 if the userdata does not have that value.



```
}
```

```
@APIEntry{int lua_setmetatable (lua_State *L, int index);|  
@apii{1,0,-}}
```

Pops a table or @nil from the stack and  
sets that value as the new metatable for the value at the given index.  
(@nil means no metatable.)

(For historical reasons, this function returns an @id{int},  
which now is always 1.)

```
}
```

```
@APIEntry{void lua_settable (lua_State *L, int index);|  
@apii{2,0,e}}
```

Does the equivalent to @T{t[k] = v},  
where @id{t} is the value at the given index,  
@id{v} is the value on the top of the stack,  
and @id{k} is the value just below the top.

This function pops both the key and the value  
from the stack.  
As in Lua, this function may trigger a metamethod  
for the @Q{newindex} event @see{metatable}.

```
}
```

```
@APIEntry{void lua_settop (lua_State *L, int index);|  
@apii{?,?,e}}
```

Accepts any index, @N{or 0},  
and sets the stack top to this index.  
If the new top is greater than the old one,  
then the new elements are filled with @nil.  
If @id{index} @N{is 0}, then all stack elements are removed.

This function can run arbitrary code when removing an index  
marked as to-be-closed from the stack.

```
}
```

```
@APIEntry{void lua_setwarnf (lua_State *L, lua_WarnFunction f, void *ud);|  
@apii{0,0,-}}
```

Sets the @x{warning function} to be used by Lua to emit warnings

@see{lua\_WarnFunction}.

The @id{ud} parameter sets the value @id{ud} passed to the warning function.

}

@APIEntry{typedef struct lua\_State lua\_State;|

An opaque structure that points to a thread and indirectly (through the thread) to the whole state of a Lua interpreter.

The Lua library is fully reentrant:

it has no global variables.

All

information about a state is accessible through this structure.

A pointer to this structure must be passed as the first argument to every function in the library, except to @Lid{lua\_newstate}, which creates a Lua state from scratch.

}

@APIEntry{int lua\_status (lua\_State \*L);|

@apii{0,0,-}

Returns the status of the thread @id{L}.

The status can be @Lid{LUA\_OK} for a normal thread,

an error code if the thread finished the execution

of a @Lid{lua\_resume} with an error,

or @Lid{LUA\_YIELD} if the thread is suspended.

You can call functions only in threads with status @Lid{LUA\_OK}.

You can resume threads with status @Lid{LUA\_OK}

(to start a new coroutine) or @Lid{LUA\_YIELD}

(to resume a coroutine).

}

@APIEntry{size\_t lua\_stringtonumber (lua\_State \*L, const char \*s);|

@apii{0,1,-}

Converts the zero-terminated string @id{s} to a number,

pushes that number into the stack,

and returns the total size of the string,

that is, its length plus one.

The conversion can result in an integer

or a float,

according to the lexical conventions of Lua @see{lexical}.

The string may have leading and trailing whitespaces and a sign.  
If the string is not a valid numeral,  
returns 0 and pushes nothing.  
(Note that the result can be used as a boolean,  
true if the conversion succeeds.)

}

```
@APIEntry{int lua_toboolean (lua_State *L, int index);|  
@apii{0,0,-}}
```

Converts the Lua value at the given index to a @N{C boolean}  
value (@N{0 or 1}).

Like all tests in Lua,

@Lid{lua\_toboolean} returns true for any Lua value  
different from @false and @nil;  
otherwise it returns false.

(If you want to accept only actual boolean values,  
use @Lid{lua\_isboolean} to test the value's type.)

}

```
@APIEntry{lua_CFunction lua_tocfunction (lua_State *L, int index);|  
@apii{0,0,-}}
```

Converts a value at the given index to a @N{C function}.  
That value must be a @N{C function};  
otherwise, returns @id{NULL}.

}

```
@APIEntry{void lua_toclose (lua_State *L, int index);|  
@apii{0,0,v}}
```

Marks the given index in the stack as a  
to-be-closed

slot @see{to-be-closed}.

Like a to-be-closed variable in Lua,  
the value at that slot in the stack will be closed  
when it goes out of scope.

Here, in the context of a C function,  
to go out of scope means that the running function returns to Lua,  
or there is an error,

or the slot is removed from the stack through

@Lid{lua\_settop} or @Lid{lua\_pop},  
or there is a call to @Lid{lua\_closeslot}.

A slot marked as to-be-closed should not be removed from the stack  
by any other function in the API except @Lid{lua\_settop} or @Lid{lua\_pop},

unless previously deactivated by @Lid{lua\_closeslot}.

This function raises an error if the value at the given slot  
neither has a @idx{\_\_close} metamethod nor is a false value.

This function should not be called for an index  
that is equal to or below an active to-be-closed slot.

Note that, both in case of errors and of a regular return,  
by the time the @idx{\_\_close} metamethod runs,  
the @N{C stack} was already unwound,  
so that any automatic @N{C variable}  
declared in the calling function  
(e.g., a buffer) will be out of scope.

}

```
@APIEntry{lua_Integer lua_tointeger (lua_State *L, int index);|
@apii{0,0,-}
```

Equivalent to @Lid{lua\_tointegerx} with @id{isnum} equal to @id{NULL}.

}

```
@APIEntry{lua_Integer lua_tointegerx (lua_State *L, int index, int *isnum);|
@apii{0,0,-}
```

Converts the Lua value at the given index  
to the signed integral type @Lid{lua\_Integer}.  
The Lua value must be an integer,  
or a number or string convertible to an integer @see{coercion};  
otherwise, @id{lua\_tointegerx} @N{returns 0}.

If @id{isnum} is not @id{NULL},  
its referent is assigned a boolean value that  
indicates whether the operation succeeded.

}

```
@APIEntry{const char *lua_tolstring (lua_State *L, int index, size_t *len);|
@apii{0,0,m}
```

Converts the Lua value at the given index to a @N{C string}.  
If @id{len} is not @id{NULL},  
it sets @T{\*len} with the string length.  
The Lua value must be a string or a number;  
otherwise, the function returns @id{NULL}.  
If

the value is a number,  
then @id{lua\_tolstring} also  
@emph{changes the actual value in the stack to a string}.  
(This change confuses @Lid{lua\_next}  
when @id{lua\_tolstring} is applied to keys during a table traversal.)

@id{lua\_tolstring} returns a pointer  
to a string inside the Lua state @see{constchar}.  
This string always has a zero (@Char{\0})  
after its last character (as @N{in C}),  
but can contain other zeros in its body.

This function can raise memory errors only  
when converting a number to a string  
(as then it may create a new string).

}

@APIEntry{lua\_Number lua\_tonumber (lua\_State \*L, int index);|  
@apii{0,0,-}}

Equivalent to @Lid{lua\_tonumberx} with @id{isnum} equal to @id{NULL}.

}

@APIEntry{lua\_Number lua\_tonumberx (lua\_State \*L, int index, int \*isnum);|  
@apii{0,0,-}}

Converts the Lua value at the given index  
to the @N{C type} @Lid{lua\_Number} @seeC{lua\_Number}.  
The Lua value must be a number or a string convertible to a number  
@see{coercion};  
otherwise, @Lid{lua\_tonumberx}  
@N{returns 0}.

If @id{isnum} is not @id{NULL},  
its referent is assigned a boolean value that  
indicates whether the operation succeeded.

}

@APIEntry{const void \*lua\_topointer (lua\_State \*L, int index);|  
@apii{0,0,-}}

Converts the value at the given index to a generic  
@N{C pointer} (@T{void\*}).  
The value can be a userdata, a table, a thread, a string, or a function;  
otherwise, @id{lua\_topointer} returns @id{NULL}.

Different objects will give different pointers.

There is no way to convert the pointer back to its original value.

Typically this function is used only for hashing and debug information.

```
}
```

```
@APIEntry{const char *lua_tolstring (lua_State *L, int index);|
@apii{0,0,m}
```

Equivalent to @Lid{lua\_tolstring} with @id{len} equal to @id{NULL}.

```
}
```

```
@APIEntry{lua_State *lua_tothread (lua_State *L, int index);|
@apii{0,0,-}
```

Converts the value at the given index to a Lua thread  
(represented as @T{lua\_State\*}).

This value must be a thread;

otherwise, the function returns @id{NULL}.

```
}
```

```
@APIEntry{void
*lua_touserdata (lua_State *L, int index);|
@apii{0,0,-}
```

If the value at the given index is a full userdata,  
returns its memory-block address.

If the value is a light userdata,  
returns its value (a pointer).

Otherwise, returns @id{NULL}.

```
}
```

```
@APIEntry{int lua_type (lua_State *L, int index);|
@apii{0,0,-}
```

Returns the type of the value in the given valid index,  
or @id{LUA\_TNONE} for a non-valid but acceptable index.

The types returned by @Lid{lua\_type} are coded by the following constants  
defined in @id{lua.h}:

```
@defid{LUA_TNIL},
@defid{LUA_TNUMBER},
@defid{LUA_TBOOLEAN},
@defid{LUA_TSTRING},
@defid{LUA_TTABLE},
```

```
@defid{LUA_TFUNCTION},
@defid{LUA_TUSERDATA},
@defid{LUA_TTHREAD},
and
@defid{LUA_TLIGHTUSERDATA}.
```

```
}
```

```
@APIEntry{const char *lua_typename (lua_State *L, int tp);|
@apii{0,0,-}}
```

Returns the name of the type encoded by the value @id{tp}, which must be one the values returned by @Lid{lua\_type}.

```
}
```

```
@APIEntry{typedef @ldots lua_Unsigned;|
```

The unsigned version of @Lid{lua\_Integer}.

```
}
```

```
@APIEntry{int
lua_upvalueindex (int i);|
@apii{0,0,-}}
```

Returns the pseudo-index that represents the @id{i}-th upvalue of the running function @see{c-closure}.  
@id{i} must be in the range @M{[1,256]}.

```
}
```

```
@APIEntry{lua_Number lua_version (lua_State *L);|
@apii{0,0,-}}
```

Returns the version number of this core.

```
}
```

```
@APIEntry{
typedef void (*lua_WarnFunction) (void *ud, const char *msg, int tocont);|
```

The type of @x{warning function}s, called by Lua to emit warnings.  
The first parameter is an opaque pointer set by @Lid{lua\_setwarnf}.  
The second parameter is the warning message.  
The third parameter is a boolean that indicates whether the message is

to be continued by the message in the next call.

See @Lid{warn} for more details about warnings.

}

```
@APIEntry{
void lua_warning (lua_State *L, const char *msg, int tocont);|
@apii{0,0,-}
```

Emits a warning with the given message.

A message in a call with @id{tocont} true should be continued in another call to this function.

See

@Lid{warn} for more details about warnings.

}

```
@APIEntry{
typedef int (*lua_Writer) (lua_State *L,
                           const void* p,
                           size_t sz,
                           void* ud);|
```

The type of the writer function used by @Lid{lua\_dump}.  
Every time @Lid{lua\_dump} produces another piece of chunk,  
it calls the writer,  
passing along the buffer to be written (@id{p}),  
its size (@id{sz}),  
and the @id{ud} parameter supplied to @Lid{lua\_dump}.

The writer returns an error code:

@N{0 means} no errors;  
any other value means an error and stops @Lid{lua\_dump} from  
calling the writer again.

}

```
@APIEntry{void lua_xmove (lua_State *from, lua_State *to, int n);|
@apii{?,?,-}
```

Exchange values between different threads of the same state.

This function pops @id{n} values from the stack @id{from},  
and pushes them onto the stack @id{to}.

}



```
@APIEntry{int lua_yield (lua_State *L, int nresults);|
@apii{?,?,v}
```

This function is equivalent to @Lid{lua\_yieldk},  
but it has  
no continuation @see{continuations}.  
Therefore, when the thread resumes,  
it continues the function that called  
the function calling @id{lua\_yield}.  
To avoid surprises,  
this function should be called only in a tail call.

```
}
```

```
@APIEntry{
int lua_yieldk (lua_State *L,
               int nresults,
               lua_KContext ctx,
               lua_KFunction k);|
@apii{?,?,v}
```

Yields a coroutine (thread).

When a @N{C function} calls @Lid{lua\_yieldk},  
the running coroutine suspends its execution,  
and the call to @Lid{lua\_resume} that started this coroutine returns.  
The parameter @id{nresults} is the number of values from the stack  
that will be passed as results to @Lid{lua\_resume}.

When the coroutine is resumed again,  
Lua calls the given @x{continuation function} @id{k} to continue  
the execution of the @N{C function} that yielded @see{continuations}.  
This continuation function receives the same stack  
from the previous function,  
with the @id{n} results removed and  
replaced by the arguments  
passed to @Lid{lua\_resume}.  
Moreover,  
the continuation function receives the value @id{ctx}  
that was passed to @Lid{lua\_yieldk}.

Usually, this function does not return;  
when the coroutine eventually resumes,  
it continues executing the continuation function.  
However, there is one special case,  
which is when this function is called

from inside a line or a count hook `@see{debugI}`.  
 In that case, `@id{lua_yieldk}` should be called with no continuation  
 (probably in the form of `@Lid{lua_yield}`) and no results,  
 and the hook should return immediately after the call.  
 Lua will yield and,  
 when the coroutine resumes again,  
 it will continue the normal execution  
 of the (Lua) function that triggered the hook.

This function can raise an error if it is called from a thread  
 with a pending C call with no continuation function  
 (what is called a `@emphx{C-call boundary}`),  
 or it is called from a thread that is not running inside a resume  
 (typically the main thread).

}

}

`@sect2{debugI @title{The Debug  
 Interface}`

Lua has no built-in debugging facilities.  
 Instead, it offers a special interface  
 by means of functions and `@emph{hooks}`.  
 This interface allows the construction of different  
 kinds of debuggers, profilers, and other tools  
 that need `@Q{inside information}` from the interpreter.

```
@APIEntry{
typedef struct lua_Debug {
  int event;
  const char *name;      /* (n) */
  const char *namewhat;  /* (n) */
  const char *what;      /* (S) */
  const char *source;    /* (S) */
  size_t srclen;         /* (S) */
  int currentline;       /* (l) */
  int linedefined;       /* (S) */
  int lastlinedefined;   /* (S) */
  unsigned char nups;    /* (u) number of upvalues */
  unsigned char nparams; /* (u) number of parameters */
  char isvararg;         /* (u) */
  char istailcall;       /* (t) */
  unsigned short ftransfer; /* (r) index of first value transferred */
  unsigned short ntransfer; /* (r) number of transferred values
```

```

*/
char short_src[LUA_IDSIZE]; /* (S) */
/* private part */
@rep{other fields}
} lua_Debug;
|

```

A structure used to carry different pieces of information about a function or an activation record.

@Lid{lua\_getstack} fills only the private part of this structure, for later use.

To fill the other fields of @Lid{lua\_Debug} with useful information, you must call @Lid{lua\_getinfo} with an appropriate parameter.

(Specifically, to get a field,

you must add the letter between parentheses in the field's comment to the parameter @id{what} of @Lid{lua\_getinfo}.)

The fields of @Lid{lua\_Debug} have the following meaning:

@description{

@item{@id{source}|

the source of the chunk that created the function.

If @T{source} starts with a @Char{@At},

it means that the function was defined in a file where

the file name follows the @Char{@At}.

If @T{source} starts with a @Char{=},

the remainder of its contents describes the source in a user-dependent manner.

Otherwise,

the function was defined in a string

where

@T{source} is that string.

}

@item{@id{srclen}|

The length of the string @id{source}.

}

@item{@id{short\_src}|

a @Q{printable} version of @T{source}, to be used in error messages.

}

@item{@id{linedefined}|

the line number where the definition of the function starts.

}

@item{@id{lastlinedefined}|

the line number where the definition of the function ends.

}

@item{@id{what}|  
the string @T{"Lua"} if the function is a Lua function,  
@T{"C"} if it is a @N{C function},  
@T{"main"} if it is the main part of a chunk.  
}

@item{@id{currentline}|  
the current line where the given function is executing.  
When no line information is available,  
@T{currentline} is set to @num{-1}.  
}

@item{@id{name}|  
a reasonable name for the given function.  
Because functions in Lua are first-class values,  
they do not have a fixed name:  
some functions can be the value of multiple global variables,  
while others can be stored only in a table field.  
The @T{lua\_getinfo} function checks how the function was  
called  
to find a suitable name.  
If it cannot find a name,  
then @id{name} is set to @id{NULL}.  
}

@item{@id{namewhat}|  
explains the @T{name} field.  
The value of @T{namewhat} can be  
@T{"global"}, @T{"local"}, @T{"method"},  
@T{"field"}, @T{"upvalue"}, or @T{""} (the empty string),  
according to how the function was called.  
(Lua uses the empty string when no other option seems to apply.)  
}

@item{@id{istailcall}|  
true if this function invocation was called by a tail call.  
In this case, the caller of this level is not in the stack.  
}

@item{@id{nups}|  
the number of upvalues of the function.  
}

@item{@id{nparams}|  
the number of parameters of the function  
(always @N{0 for} @N{C functions}).  
}

```
@item{@id{isvararg}|
true if the function is a variadic function
(always true for @N{C functions}).
}
```

```
@item{@id{ftransfer}|
the index in the stack of the first value being @Q{transferred},
that is, parameters in a call or return values in a return.
(The other values are in consecutive indices.)
Using this
index, you can access and modify these values
through @Lid{lua_getlocal} and @Lid{lua_setlocal}.
This field is only meaningful during a
call hook, denoting the first parameter,
or a return hook, denoting the first value being returned.
(For call hooks, this value is always 1.)
}
```

```
@item{@id{ntransfer}|
The number of values being transferred (see previous item).
(For calls of Lua functions,
this value is always equal to @id{nparams}.)
}
```

```
}
```

```
}
```

```
@APIEntry{lua_Hook lua_gethook (lua_State *L);|
@apii{0,0,-}
```

Returns the current hook function.

```
}
```

```
@APIEntry{int lua_gethookcount (lua_State *L);|
@apii{0,0,-}
```

Returns the current hook count.

```
}
```

```
@APIEntry{int lua_gethookmask (lua_State *L);|
@apii{0,0,-}
```

Returns the current hook mask.

```
}
```

```
@APIEntry{int lua_getinfo (lua_State *L, const char *what, lua_Debug *ar);|
@apii{0|1,0|1|2,m}
```

Gets information about a specific function or function invocation.

To get information about a function invocation,  
the parameter `@id{ar}` must be a valid activation  
record that was  
filled by a previous call to `@Lid{lua_getstack}` or  
given as argument to a hook `@seeC{lua_Hook}`.

To get information about a function, you push it onto the stack  
and start the `@id{what}` string with the character `@Char{>}`.

(In that case,

`@id{lua_getinfo}` pops the function from the top of the stack.)

For instance, to know in which line a function `@id{f}` was defined,  
you can write the following code:

```
@verbatim{
lua_Debug ar;
lua_getglobal(L, "f"); /* get global 'f' */
lua_getinfo(L, ">S", &ar);
printf("%d\n", ar.linedefined);
}
```

Each character in the string `@id{what}`  
selects some fields of the structure `@id{ar}` to be filled or  
a value to be pushed on the stack.  
(These characters are also documented in the declaration of  
the structure `@Lid{lua_Debug}`,  
between parentheses in the comments following each field.)  
`@description{`

```
@item{@Char{f}|
pushes onto the stack the function that is
running at the given level;
}
```

```
@item{@Char{l}| fills in the field @id{currentline};
}
```

```
@item{@Char{n}|
fills in the fields @id{name} and @id{namewhat};
}
```

```
@item{@Char{r}| fills in the fields @id{ftransfer} and @id{ntransfer};
}
```

```
@item{@Char{S}|
fills in the fields @id{source}, @id{short_src},
@id{linedefined}, @id{lastlinedefined}, and @id{what};
}
```

```
@item{@Char{t}| fills in the field @id{istailcall};
}
```

```
@item{@Char{u}| fills in the fields
@id{nups}, @id{nparams}, and @id{isvararg};
}
```

```
@item{@Char{L}|
pushes onto the stack a table whose indices are
the lines on the function with some associated code,
that is, the lines where you can put a break point.
(Lines with no code include empty lines and comments.)
If this option is given together with option @Char{f},
its table is pushed after the function.
This is the only option that can raise a memory error.
}
```

```
}
```

This function returns 0 to signal an invalid option in @id{what};  
even then the valid options are handled correctly.

```
}
```

```
@APIEntry{const char *lua_getlocal (lua_State *L, const lua_Debug *ar, int n);|
@apii{0,0|1,-}}
```

**Gets**  
information about a local variable or a temporary value  
of a given activation record or a given function.

In the first case,  
the parameter @id{ar} must be a valid activation record that was  
filled by a previous call to @Lid{lua\_getstack} or  
given as argument to a hook @seeC{lua\_Hook}.  
The index @id{n} selects which local variable to inspect;  
see @Lid{debug.getlocal} for details about variable indices  
and names.

@Lid{lua\_getlocal} pushes the variable's value onto the stack  
and returns its name.

In the second case, @id{ar} must be @id{NULL} and the function to be inspected must be on the top of the stack.

In this case, only parameters of Lua functions are visible (as there is no information about what variables are active) and no values are pushed onto the stack.

Returns @id{NULL} (and pushes nothing) when the index is greater than the number of active local variables.

}

```
@APIEntry{int lua_getstack (lua_State *L, int level, lua_Debug *ar);|
@apii{0,0,-}}
```

Gets information about the interpreter runtime stack.

This function fills parts of a @Lid{lua\_Debug} structure with an identification of the @emph{activation record} of the function executing at a given level. @N{Level 0} is the current running function, whereas level @M{n+1} is the function that has called level @M{n} (except for tail calls, which do not count in the stack). When called with a level greater than the stack depth, @Lid{lua\_getstack} returns 0; otherwise it returns 1.

}

```
@APIEntry{const char *lua_getupvalue (lua_State *L, int funcindex, int n);|
@apii{0,0|1,-}}
```

Gets information about the @id{n}-th upvalue of the closure at index @id{funcindex}. It pushes the upvalue's value onto the stack and returns its name. Returns @id{NULL} (and pushes nothing) when the index @id{n} is greater than the number of upvalues.

See @Lid{debug.getupvalue} for more information about upvalues.

}

```
@APIEntry{typedef void (*lua_Hook) (lua_State *L, lua_Debug *ar);|
```

Type for debugging hook functions.



Whenever a hook is called, its `@id{ar}` argument has its field `@id{event}` set to the specific event that triggered the hook. Lua identifies these events with the following constants: `@defid{LUA_HOOKCALL}`, `@defid{LUA_HOOKRET}`, `@defid{LUA_HOOKTAILCALL}`, `@defid{LUA_HOOKLINE}`, and `@defid{LUA_HOOKCOUNT}`. Moreover, for line events, the field `@id{currentline}` is also set. To get the value of any other field in `@id{ar}`, the hook must call `@Lid{lua_getinfo}`.

For call events, `@id{event}` can be `@id{LUA_HOOKCALL}`, the normal value, or `@id{LUA_HOOKTAILCALL}`, for a tail call; in this case, there will be no corresponding return event.

While Lua is running a hook, it disables other calls to hooks. Therefore, if a hook calls back Lua to execute a function or a chunk, this execution occurs without any calls to hooks.

Hook functions cannot have continuations, that is, they cannot call `@Lid{lua_yieldk}`, `@Lid{lua_pcallk}`, or `@Lid{lua_callk}` with a non-null `@id{k}`.

Hook functions can yield under the following conditions:

Only count and line events can yield; to yield, a hook function must finish its execution calling `@Lid{lua_yield}` with `@id{nresults}` equal to zero (that is, with no values).

}

```
@APIEntry{void lua_sethook (lua_State *L, lua_Hook f, int mask, int count);|
@apii{0,0,-}
```

Sets the debugging hook function.

Argument `@id{f}` is the hook function. `@id{mask}` specifies on which events the hook will be called: it is formed by a bitwise OR of the constants `@defid{LUA_MASKCALL}`, `@defid{LUA_MASKRET}`, `@defid{LUA_MASKLINE}`, and `@defid{LUA_MASKCOUNT}`. The `@id{count}` argument is only meaningful when the mask includes `@id{LUA_MASKCOUNT}`.

For each event, the hook is called as explained below:

@description{

@item{The call hook| is called when the interpreter calls a function.  
The hook is called just after Lua enters the new function.  
}

@item{The return hook| is called when the interpreter returns from a function.  
The hook is called just before Lua leaves the function.  
}

@item{The line hook| is called  
when the interpreter is about to  
start the execution of a new line of code,  
or when it jumps back in the code (even to the same line).  
This event only happens while Lua is executing a Lua function.  
}

@item{The count hook| is called after the interpreter executes every  
@T{count} instructions.  
This event only happens while Lua is executing a Lua function.  
}  
}

Hooks are disabled by setting @id{mask} to zero.  
}

@APIEntry{const char \*lua\_setlocal (lua\_State \*L, const lua\_Debug \*ar, int n);|  
@apii{0|1,0,-}}

Sets the value of a local variable of a given activation record.  
It assigns the value on the top of the stack  
to the variable and returns its name.  
It also pops the value from the stack.

Returns @id{NULL} (and pops nothing)  
when the index is greater than  
the number of active local variables.

Parameters @id{ar} and @id{n} are as in the function @Lid{lua\_getlocal}.  
}

@APIEntry{const char \*lua\_setupvalue (lua\_State \*L, int funcindex, int n);|  
@apii{0|1,0,-}}

Sets the value of a closure's

upvalue.

It assigns the value on the top of the stack  
to the upvalue and returns its name.

It also pops the value from the stack.

Returns @id{NULL} (and pops nothing)  
when the index @id{n} is greater than the number of upvalues.

Parameters @id{funcindex} and @id{n} are as in  
the function @Lid{lua\_getupvalue}.

}

```
@APIEntry{void *lua_upvalueid (lua_State *L, int funcindex, int n);|
@apii{0,0,-}
```

Returns a unique identifier for the upvalue numbered @id{n}  
from the closure at index @id{funcindex}.

These unique identifiers allow a program to check whether different  
closures share upvalues.

Lua closures that share an upvalue  
(that is, that access a same external local variable)  
will return identical ids for those upvalue indices.

Parameters @id{funcindex} and @id{n} are as in  
the function @Lid{lua\_getupvalue},  
but @id{n} cannot be greater than the number of upvalues.

}

```
@APIEntry{
void lua_upvaluejoin (lua_State *L, int funcindex1, int n1,
                    int
                    funcindex2, int n2);|
@apii{0,0,-}
```

Make the @id{n1}-th upvalue of the Lua closure at index @id{funcindex1}  
refer to the @id{n2}-th upvalue of the Lua closure at index @id{funcindex2}.

}

}

}

```
@C{-----}
```

@sect1{auxlib|@title{The Auxiliary Library}}

@simplesect{

@index{luauxlib.h}

The @def{auxiliary library} provides several convenient functions to interface C with Lua.

While the basic API provides the primitive functions for all interactions between C and Lua, the auxiliary library provides higher-level functions for some common tasks.

All functions and types from the auxiliary library are defined in header file @id{luauxlib.h} and have a prefix @id{luaL\_}.

All functions in the auxiliary library are built on top of the basic API, and so they provide nothing that cannot be done with that API. Nevertheless, the use of the auxiliary library ensures more consistency to your code.

Several functions in the auxiliary library use internally some extra stack slots. When a function in the auxiliary library uses less than five slots, it does not check the stack size; it simply assumes that there are enough slots.

Several functions in the auxiliary library are used to check @N{C function} arguments. Because the error message is formatted for arguments (e.g., @St{bad argument #1}), you should not use these functions for other stack values.

Functions called @id{luaL\_check\*} always raise an error if the check is not satisfied.

}

@sect2{@title{Functions and Types}}

Here we list all functions and types from the auxiliary library in alphabetical order.

```
@APIEntry{void luaL_addchar (luaL_Buffer *B, char c);|
@apii{?,?,m}
```

Adds the byte @id{c} to the buffer @id{B}  
@seeC{luaL\_Buffer}.

```
}
```

```
@APIEntry{
const void luaL_addgsub (luaL_Buffer *B, const char *s,
                        const char *p, const char *r);|
@apii{?,?,m}
```

Adds a copy of the string @id{s} to the buffer @id{B} @seeC{luaL\_Buffer},  
replacing any  
occurrence of the string @id{p}  
with the string @id{r}.

```
}
```

```
@APIEntry{void luaL_addlstring (luaL_Buffer *B, const char *s, size_t l);|
@apii{?,?,m}
```

Adds the string pointed to by @id{s} with length @id{l} to  
the buffer @id{B}  
@seeC{luaL\_Buffer}.

The string can contain @x{embedded zeros}.

```
}
```

```
@APIEntry{void luaL_addsize (luaL_Buffer *B, size_t n);|
@apii{?,?,-}
```

Adds to the buffer @id{B}  
a string of length @id{n} previously copied to the  
buffer area @seeC{luaL\_prepbuffer}.

```
}
```

```
@APIEntry{void luaL_addstring (luaL_Buffer *B, const char *s);|
@apii{?,?,m}
```

Adds the zero-terminated string pointed to by @id{s}  
to the buffer @id{B}  
@seeC{luaL\_Buffer}.

```
}
```

```
@APIEntry{void luaL_addvalue (luaL_Buffer *B);|
@apii{?,?,m}
```

Adds the value on the top of the stack  
to the buffer @id{B}  
@seeC{luaL\_Buffer}.  
Pops the value.

This is the only function on string buffers that can (and must)  
be called with an extra element on the stack,  
which is the value to be added to the buffer.

```
}
```

```
@APIEntry{
void luaL_argcheck
(lua_State *L,
    int cond,
    int arg,
    const char *extramsg);|
@apii{0,0,v}
```

Checks whether @id{cond} is true.  
If it is not, raises an error with a standard message @seeF{luaL\_argerror}.

```
}
```

```
@APIEntry{int luaL_argerror (lua_State *L, int arg, const char *extramsg);|
@apii{0,0,v}
```

Raises an error reporting a problem with argument @id{arg}  
of the @N{C function} that called it,  
using a standard message  
that includes @id{extramsg} as a comment:  
@verbatim{  
bad argument #@rep{arg} to '@rep{funcname}' (@rep{extramsg})  
}  
This function never returns.

```
}
```

```
@APIEntry{
void luaL_argexpected (lua_State *L,
    int cond,
    int arg,
    const char *tname);|
@apii{0,0,v}
```

Checks whether @id{cond} is true.

If it is not, raises an error about the type of the argument @id{arg} with a standard message @seeF{luaL\_typeerror}.

}

@APIEntry{typedef struct luaL\_Buffer luaL\_Buffer;|

Type for

a @def{string buffer}.

A string buffer allows @N{C code} to build Lua strings piecemeal.

Its pattern of use is as follows:

@itemize{

@item{First declare a variable @id{b} of type @Lid{luaL\_Buffer}.)}

@item{Then initialize it with a call @T{luaL\_buffinit(L, &b)}.)}

@item{

Then add string pieces to the buffer calling any of the @id{luaL\_add\*} functions.

}

@item{

Finish by calling @T{luaL\_pushresult(&b)}.

This call leaves the final string on the top of the stack.

}

}

If you know beforehand the maximum size of the resulting string, you can use the buffer like this:

@itemize{

@item{First declare a variable @id{b} of type @Lid{luaL\_Buffer}.)}

@item{Then initialize it and preallocate a space of size @id{sz} with a call @T{luaL\_buffinitsize(L, &b, sz)}.)}

@item{Then produce the string into that space.}

@item{

Finish by calling @T{luaL\_pushresultsize(&b, sz)}, where @id{sz} is the total size of the resulting string copied into that space (which may be less than or equal to the preallocated

```

size).
}

}

```

During its normal operation,  
a string buffer uses a variable number of stack slots.  
So, while using a buffer, you cannot assume that you know where  
the top of the stack is.  
You can use the stack between successive calls to buffer operations  
as long as that use is balanced;  
that is,  
when you call a buffer operation,  
the stack is at the same level  
it was immediately after the previous buffer operation.  
(The only exception to this rule is @Lid{luaL\_addvalue}.)  
After calling @Lid{luaL\_pushresult},  
the stack is back to its level when the buffer was initialized,  
plus the final string on its top.

```

}

```

```

@APIEntry{char *luaL_buffaddr (luaL_Buffer *B);|
@apii{0,0,-}

```

Returns the address of the current content of buffer @id{B}  
@seeC{luaL\_Buffer}.  
Note that any addition to the buffer may invalidate this address.

```

}

```

```

@APIEntry{void luaL_buffinit (lua_State *L, luaL_Buffer *B);|
@apii{0,?, -}

```

Initializes a buffer @id{B}  
@seeC{luaL\_Buffer}.  
This function does not allocate any space;  
the  
buffer must be declared as a variable.

```

}

```

```

@APIEntry{size_t luaL_bufflen (luaL_Buffer *B);|
@apii{0,0,-}

```

Returns the length of the current content of buffer @id{B}  
@seeC{luaL\_Buffer}.



}

```
@APIEntry{char *luaL_buffinitsize (lua_State *L, luaL_Buffer *B, size_t sz);|
@apii{?,?,m}
```

Equivalent to the sequence

```
@Lid{luaL_buffinit}, @Lid{luaL_prepbuffsize}.
```

}

```
@APIEntry{void luaL_buffsub (luaL_Buffer *B, int n);|
@apii{?,?,-}
```

Removes @id{n} bytes from the buffer @id{B}

```
@seeC{luaL_Buffer}.
```

The buffer must have at least that many bytes.

}

```
@APIEntry{int luaL_callmeta (lua_State *L, int obj, const char *e);|
@apii{0,0|1,e}
```

Calls a metamethod.

If the object at index @id{obj} has a metatable and this

metatable has a field @id{e},

this function calls this field passing the object as its only argument.

In this case this function returns true and pushes onto the stack the value returned by the call.

If there is no metatable or no metamethod,

this function returns false without pushing any value on the stack.

}

```
@APIEntry{void luaL_checkany (lua_State *L, int arg);|
@apii{0,0,v}
```

Checks whether the function has an argument

of any type (including @nil) at position @id{arg}.

}

```
@APIEntry{lua_Integer luaL_checkinteger (lua_State *L, int arg);|
@apii{0,0,v}
```

Checks whether the function argument @id{arg} is an integer

(or can be converted to an integer)

and returns this integer.

```
}
```

```
@APIEntry{const char *luaL_checklstring (lua_State *L, int arg, size_t *l);|
@apii{0,0,v}
```

Checks whether the function argument @id{arg} is a string  
and returns this string;  
if @id{l} is not @id{NULL} fills its referent  
with the string's length.

This function uses @Lid{lua\_tolstring} to get its result,  
so all conversions and caveats of that function apply here.

```
}
```

```
@APIEntry{lua_Number luaL_checknumber (lua_State *L, int arg);|
@apii{0,0,v}
```

Checks whether the function argument @id{arg} is a number  
and returns this number converted to a @id{lua\_Number}.

```
}
```

```
@APIEntry{
int luaL_checkoption (lua_State
*L,
    int arg,
    const char *def,
    const char *const lst[]);|
@apii{0,0,v}
```

Checks whether the function argument @id{arg} is a string and  
searches for this string in the array @id{lst}  
(which must be NULL-terminated).  
Returns the index in the array where the string was found.  
Raises an error if the argument is not a string or  
if the string cannot be found.

If @id{def} is not @id{NULL},  
the function uses @id{def} as a default value when  
there is no argument @id{arg} or when this argument is @nil.

This is a useful function for mapping strings to @N{C enums}.  
(The usual convention in Lua libraries is  
to use strings instead of numbers to select options.)

}

```
@APIEntry{void luaL_checkstack (lua_State *L, int sz, const char *msg);|
@apii{0,0,v}
```

Grows the stack size to @T{top + sz} elements,  
raising an error if the stack cannot grow to that size.  
@id{msg} is an additional text to go into the error message  
(or @id{NULL} for no  
additional text).

}

```
@APIEntry{const char *luaL_checkstring (lua_State *L, int arg);|
@apii{0,0,v}
```

Checks whether the function argument @id{arg} is a string  
and returns this string.

This function uses @Lid{lua\_tolstring} to get its result,  
so all conversions and caveats of that function apply here.

}

```
@APIEntry{void luaL_checktype (lua_State *L, int arg, int t);|
@apii{0,0,v}
```

Checks whether the function argument @id{arg} has type @id{t}.  
See @Lid{lua\_type} for the encoding of types for @id{t}.

}

```
@APIEntry{void *luaL_checkudata (lua_State *L, int arg, const char *tname);|
@apii{0,0,v}
```

Checks whether the function argument @id{arg} is a userdata  
of the type @id{tname} @seeC{luaL\_newmetatable} and  
returns the userdata's memory-block address @seeC{lua\_touserdata}.

}

```
@APIEntry{void luaL_checkversion (lua_State *L);|
@apii{0,0,v}
```

Checks whether the code making the call and the Lua library being called  
are using the same version of Lua and the same numeric types.

}

```
@APIEntry{int
luaL_dofile (lua_State *L, const char *filename);|
@apii{0,?,m}
```

Loads and runs the given file.

It is defined as the following macro:

```
@verbatim{
(luaL_loadfile(L, filename) || lua_pcall(L, 0, LUA_MULTRET, 0))
}
It @N{returns 0} (@Lid{LUA_OK}) if there are no errors,
or 1 in case of errors.

}
```

```
@APIEntry{int luaL_dostring (lua_State *L, const char *str);|
@apii{0,?,-}
```

Loads and runs the given string.

It is defined as the following macro:

```
@verbatim{
(luaL_loadstring(L, str) || lua_pcall(L, 0, LUA_MULTRET, 0))
}
It @N{returns 0} (@Lid{LUA_OK}) if there are no errors,
or 1 in case of errors.

}
```

```
@APIEntry{int luaL_error (lua_State *L, const char *fmt, ...);|
@apii{0,0,v}
```

Raises an error.

The error message format is given by @id{fmt}

plus any extra arguments,

following the same rules of @Lid{lua\_pushfstring}.

It also adds at the beginning of the message the file name and

the line number where the error occurred,

if this information is available.

This function never returns,

but it is an

idiom to use it in @N{C functions}

as @T{return luaL\_error(@rep{args})}.

```
}
```

```
@APIEntry{int luaL_execresult (lua_State *L, int stat);|
@apii{0,3,m}
```

This function produces the return values for process-related functions in the standard library (@Lid{os.execute} and @Lid{io.close}).

}

```
@APIEntry{
int luaL_fileresult (lua_State *L, int stat, const char *fname);|
@apii{0,1|3,m}
```

This function produces the return values for file-related functions in the standard library (@Lid{io.open}, @Lid{os.rename}, @Lid{file:seek}, etc.).

}

```
@APIEntry{int luaL_getmetafield (lua_State *L, int obj, const char *e);|
@apii{0,0|1,m}
```

Pushes onto the stack the field @id{e} from the metatable of the object at index @id{obj} and returns the type of the pushed value. If the object does not have a metatable, or if the metatable does not have this field, pushes nothing and returns @id{LUA\_TNIL}.

}

```
@APIEntry{int luaL_getmetatable (lua_State *L, const char *tname);|
@apii{0,1,m}
```

Pushes onto the stack the metatable associated with the name @id{tname} in the registry @seeC{luaL\_newmetatable}, or @nil if there is no metatable associated with that name. Returns the type of the pushed value.

}

```
@APIEntry{int luaL_getsubtable (lua_State *L, int idx, const char *fname);|
@apii{0,1,e}
```

Ensures that the value @T{t[fname]}, where @id{t} is the value at index @id{idx}, is a table, and pushes that table onto the stack. Returns true if it finds a previous table there and false if it creates a new table.

```
}
```

```
@APIEntry{  
const char *luaL_gsub (lua_State *L,  
    const char *s,  
    const char *p,  
    const char *r);|  
@apii{0,1,m}
```

Creates a copy of string @id{s},  
replacing any occurrence of the string @id{p}  
with the string @id{r}.  
Pushes the resulting string on the stack and returns it.

```
}
```

```
@APIEntry{lua_Integer luaL_len (lua_State *L, int index);|  
@apii{0,0,e}
```

Returns the @Q{length} of the value at the given index  
as a number;  
it is equivalent to the  
@Char{#} operator in Lua @see{len-op}.  
Raises an error if the result of the operation is not an integer.  
(This case can only happen through metamethods.)

```
}
```

```
@APIEntry{  
int luaL_loadbuffer (lua_State *L,  
    const char *buff,  
    size_t sz,  
    const char *name);|  
@apii{0,1,-}
```

Equivalent to @Lid{luaL\_loadbufferx} with @id{mode} equal to @id{NULL}.

```
}
```

```
@APIEntry{  
int luaL_loadbufferx (lua_State *L,  
    const char *buff,  
    size_t sz,  
    const char *name,  
    const char *mode);|  
@apii{0,1,-}
```

Loads a buffer as a Lua chunk.

This function uses @Lid{lua\_load} to load the chunk in the buffer pointed to by @id{buff} with size @id{sz}.

This function returns the same results as @Lid{lua\_load}.

@id{name} is the chunk name,

used for debug information and error messages.

The string @id{mode} works as in the function @Lid{lua\_load}.

}

```
@APIEntry{int luaL_loadfile (lua_State
    *L, const char *filename);|
@apii{0,1,m}
```

Equivalent to @Lid{luaL\_loadfilex} with @id{mode} equal to @id{NULL}.

}

```
@APIEntry{int luaL_loadfilex (lua_State *L, const char *filename,
    const char *mode);|
@apii{0,1,m}
```

Loads a file as a Lua chunk.

This function uses @Lid{lua\_load} to load the chunk in the file named @id{filename}.

If @id{filename} is @id{NULL},

then it loads from the standard input.

The first line in the file is ignored if it starts with a @T{#}.

The string @id{mode} works as in the function @Lid{lua\_load}.

This function returns the same results as @Lid{lua\_load}

or @Lid{LUA\_ERRFILE} for file-related errors.

As @Lid{lua\_load}, this function only loads the chunk;

it does not run it.

}

```
@APIEntry{int luaL_loadstring (lua_State *L, const char *s);|
@apii{0,1,-}
```

Loads a string as a Lua chunk.

This function uses @Lid{lua\_load} to load the chunk in the zero-terminated string @id{s}.

This function returns the same results as

@Lid{lua\_load}.

Also as @Lid{lua\_load}, this function only loads the chunk;  
it does not run it.

}

```
@APIEntry{void luaL_newlib (lua_State *L, const luaL_Reg l[]);|
@apii{0,1,m}
```

Creates a new table and registers there  
the functions in the list @id{1}.

It is implemented as the following macro:

```
@verbatim{
(luaL_newlibtable(L,l), luaL_setfuncs(L,l,0))
}
```

The array @id{1} must be the actual array,  
not a pointer to it.

}

```
@APIEntry{void luaL_newlibtable (lua_State *L, const luaL_Reg l[]);|
@apii{0,1,m}
```

Creates a new table with a size optimized  
to store all entries in the array @id{1}  
(but does not actually store them).

It is intended to be used in conjunction with @Lid{luaL\_setfuncs}  
@seeF{luaL\_newlib}.

It is implemented as a macro.

The array @id{1} must be the actual array,  
not a pointer to it.

}

```
@APIEntry{int luaL_newmetatable (lua_State *L, const char *tname);|
@apii{0,1,m}
```

If the registry already has the key @id{tname},  
returns 0.

Otherwise,  
creates a new table to be used as a



metatable for userdata,  
adds to this new table the pair @T{\_\_name = tname},  
adds to the registry the pair @T{[tname] = new table},  
and returns 1.

In both cases,  
the function pushes onto the stack the final value associated  
with @id{tname} in the registry.

}

@APIEntry{lua\_State \*luaL\_newstate (void);|  
@apii{0,0,-}}

Creates a new Lua state.

It calls @Lid{lua\_newstate} with an  
allocator based on the @N{ISO C} allocation functions  
and then sets a warning function and a panic function @see{C-error}  
that print messages to the standard error output.

Returns the new state,  
or @id{NULL} if there is a @x{memory allocation error}.

}

@APIEntry{void luaL\_openlibs (lua\_State \*L);|  
@apii{0,0,e}}

Opens all standard Lua libraries into the given state.

}

@APIEntry{  
T luaL\_opt (L, func, arg, dflt);|  
@apii{0,0,-}}

This macro is defined as follows:

@verbatim{  
(lua\_isnoneornil(L,(arg)) ? (dflt) : func(L,(arg)))  
}

In words, if the argument @id{arg} is nil or absent,  
the macro results in the default

@id{dflt}.

Otherwise, it results in the result of calling @id{func}  
with the state @id{L} and the argument index @id{arg} as  
arguments.

Note that it evaluates the expression @id{dflt} only if needed.

}

```
@APIEntry{
lua_Integer luaL_optinteger (lua_State *L,
                           int arg,
                           lua_Integer d);|
@apii{0,0,v}
```

If the function argument @id{arg} is an integer  
(or it is convertible to an integer),  
returns this integer.  
If this argument is absent or is @nil,  
returns @id{d}.  
Otherwise, raises an error.

}

```
@APIEntry{
const char *luaL_optlstring (lua_State *L,
                           int arg,
                           const char *d,
                           size_t *l);|
@apii{0,0,v}
```

If the function argument @id{arg} is a string,  
returns this string.  
If this argument is absent or is @nil,  
returns @id{d}.  
Otherwise, raises an error.

If @id{l} is not @id{NULL},  
fills its referent with the result's length.  
If the result is @id{NULL}  
(only  
possible when returning @id{d} and @T{d == NULL}),  
its length is considered zero.

This function uses @Lid{lua\_tolstring} to get its result,  
so all conversions and caveats of that function apply here.

}

```
@APIEntry{lua_Number luaL_optnumber (lua_State *L, int arg, lua_Number d);|
@apii{0,0,v}
```

If the function argument @id{arg} is a number,  
returns this number as a @id{lua\_Number}.  
If this argument is absent or is @nil,

returns @id{d}.

Otherwise, raises an error.

}

@APIEntry{  
const char \*luaL\_optstring (lua\_State \*L,  
                          int arg,  
                          const char \*d);|  
@apii{0,0,v}

If the function argument @id{arg} is a string,  
returns this string.

If this argument is absent or is @nil,  
returns @id{d}.

Otherwise, raises an error.

}

@APIEntry{char \*luaL\_prepbuffer (luaL\_Buffer \*B);|  
@apii{?,?,m}

Equivalent to @Lid{luaL\_prepbuffsize}  
with the predefined size @defid{LUAL\_BUFFERSIZE}.

}

@APIEntry{char \*luaL\_prepbuffsize (luaL\_Buffer \*B, size\_t sz);|  
@apii{?,?,m}

Returns  
an address to a space of size @id{sz}  
where you can copy a string to be added to buffer @id{B}  
@seeC{luaL\_Buffer}.

After copying the string into this space you must call  
@Lid{luaL\_addsize} with the size of the string to actually add  
it to the buffer.

}

@APIEntry{void luaL\_pushfail (lua\_State \*L);|  
@apii{0,1,-}

Pushes the @fail value onto the stack @see{libraries}.

}

@APIEntry{void luaL\_pushresult (luaL\_Buffer \*B);|

@apii{?,1,m}

Finishes the use of buffer @id{B} leaving the final string on the top of the stack.

}

@APIEntry{void luaL\_pushresultsz (luaL\_Buffer \*B, size\_t sz);|  
@apii{?,1,m}

Equivalent to the sequence @Lid{luaL\_addsize}, @Lid{luaL\_pushresult}.

}

@APIEntry{int luaL\_ref (lua\_State \*L, int t);|  
@apii{1,0,m}

Creates and returns a @def{reference},  
in the table at index @id{t},  
for the object on the top of the stack (and pops the object).

A reference is a unique integer key.  
As long as you do not manually add integer keys into the table @id{t},  
@Lid{luaL\_ref}  
ensures the uniqueness of the key it returns.  
You can retrieve an object referred by the reference @id{r}  
by calling @T{lua\_rawgeti(L, t, r)}.  
The function @Lid{luaL\_unref} frees a reference.

If the object on the top of the stack is @nil,  
@Lid{luaL\_ref} returns the constant @defid{LUA\_REFNIL}.  
The constant @defid{LUA\_NOREF} is guaranteed to be different  
from any reference returned by @Lid{luaL\_ref}.

}

@APIEntry{  
typedef struct luaL\_Reg {  
const char \*name;  
lua\_CFunction func;  
} luaL\_Reg;  
|

Type for arrays of functions to be registered by  
@Lid{luaL\_setfuncs}.  
@id{name} is the function name and @id{func} is a pointer to  
the function.  
Any array of @Lid{luaL\_Reg} must end with a sentinel entry

in which both @id{name} and @id{func} are @id{NULL}.

}

```
@APIEntry{  
void luaL_requiref (lua_State *L, const char *modname,  
                  lua_CFunction openf, int glb);|  
@apii{0,1,e}
```

If @T{package.loaded[modname]} is not true,  
calls the function @id{openf} with the string @id{modname}  
as an argument  
and sets the call result to @T{package.loaded[modname]},  
as if that function has been called through @Lid{require}.

If @id{glb} is true,  
also stores the module into the global @id{modname}.

Leaves a copy of the module on the stack.

}

```
@APIEntry{void luaL_setfuncs (lua_State *L, const luaL_Reg *l, int nup);|  
@apii{nup,0,m}
```

Registers all functions in the array @id{l}  
@seeC{luaL\_Reg} into the table on the top of the stack  
(below optional upvalues, see next).

When @id{nup} is not zero,  
all functions are created with @id{nup} upvalues,  
initialized with copies of the @id{nup} values  
previously pushed on the stack  
on top of the library table.  
These values are popped from the stack after the registration.

A function with a @id{NULL} value represents a placeholder,  
which is filled with @false.

}

```
@APIEntry{void luaL_setmetatable (lua_State *L, const char *tname);|  
@apii{0,0,-}
```

Sets the metatable of the object on the top of the stack  
as the metatable associated  
with name @id{tname}  
in the registry @seeC{luaL\_newmetatable}.

```
}
```

```
@APIEntry{  
typedef struct luaL_Stream {  
    FILE *f;  
    lua_CFunction closef;  
} luaL_Stream;  
|
```

The standard representation for @x{file handles}  
used by the standard I/O library.

A file handle is implemented as a full userdata,  
with a metatable called @id{LUA\_FILEHANDLE}  
(where @id{LUA\_FILEHANDLE} is a macro with the actual metatable's name).  
The metatable is created by the I/O library  
@seeF{luaL\_newmetatable}.

This userdata must start with the structure @id{luaL\_Stream};  
it can contain other data after this initial structure.  
The field @id{f} points to the corresponding C stream  
(or it can be @id{NULL} to indicate an incompletely created handle).  
The field @id{closef} points to a Lua function  
that will be called to close the stream  
when the handle is closed or collected;  
this function receives the file handle as its sole argument and  
must return either a true value, in case of success,  
or a false value plus an error message,  
in case of error.  
Once Lua calls this field,  
it changes the field value to @id{NULL}  
to signal that the handle is closed.

```
}
```

```
@APIEntry{void *luaL_testudata (lua_State *L, int arg, const char *tname);|  
@apii{0,0,m}
```

This function works like @Lid{luaL\_checkudata},  
except that, when the test fails,  
it returns @id{NULL} instead of raising an error.

```
}
```

```
@APIEntry{const char *luaL_tolstring (lua_State *L, int idx, size_t *len);|  
@apii{0,1,e}
```

Converts any Lua value at the given index to a @N{C string} in a reasonable format.

The resulting string is pushed onto the stack and also returned by the function @see{constchar}.

If @id{len} is not @id{NULL}, the function also sets @T{\*len} with the string length.

If the value has a metatable with a @idx{\_\_tostring} field, then @id{luaL\_tolstring} calls the corresponding metamethod with the value as argument, and uses the result of the call as its result.

}

```
@APIEntry{
void luaL_traceback (lua_State *L, lua_State *L1, const char *msg,

    int level);|
@apii{0,1,m}
```

Creates and pushes a traceback of the stack @id{L1}.

If @id{msg} is not @id{NULL}, it is appended at the beginning of the traceback.

The @id{level} parameter tells at which level to start the traceback.

}

```
@APIEntry{int luaL_typeerror (lua_State *L, int arg, const char *tname);|
@apii{0,0,v}
```

Raises a type error for the argument @id{arg}

of the @N{C function} that called it,

using a standard message;

@id{tname} is a @Q{name} for the expected type.

This function never returns.

}

```
@APIEntry{const char *luaL_typename (lua_State *L, int index);|
@apii{0,0,-}
```

Returns the name of the type of the value at the given index.

}

```
@APIEntry{void luaL_unref (lua_State *L, int t, int ref);|
@apii{0,0,-}
```

Releases the reference @id{ref} from the table at index @id{t}  
@seeC{luaL\_unref}.

The entry is removed from the table,  
so that the referred object can be collected.  
The reference @id{ref} is also freed to be used again.

If @id{ref} is @Lid{LUA\_NOREF} or @Lid{LUA\_REFNIL},  
@Lid{luaL\_unref}  
does nothing.

}

@APIEntry{void luaL\_where (lua\_State \*L, int lvl);|  
@apii{0,1,m}}

Pushes onto the stack a string identifying the current position  
of the control at level @id{lvl} in the call stack.

Typically this string has the following format:

@verbatim{  
@rep{chunkname}:@rep{currentline}:  
}

@N{Level 0} is the running function,  
@N{level 1} is the function that called the running function,  
etc.

This function is used to build a prefix for error messages.

}

}

}

@C{-----}  
@sect1{libraries| @title{The Standard Libraries}}

@simplesect{

The standard Lua libraries provide useful functions  
that are implemented @N{in C} through the @N{C API}.  
Some of these functions provide essential services to the language  
(e.g., @Lid{type} and @Lid{getmetatable});  
others provide access to outside services (e.g., I/O);  
and others could be implemented in Lua itself,  
but that for different reasons  
deserve



an implementation in C (e.g., `@Lid{table.sort}`).

All libraries are implemented through the official `@N{C API}` and are provided as separate `@N{C modules}`.

Unless otherwise noted,

these library functions do not adjust its number of arguments to its expected parameters.

For instance, a function documented as `@T{foo(arg)}` should not be called without an argument.

The notation `@fail` means a false value representing some kind of failure.

(Currently, `@fail` is equal to `@nil`,

but that may change in future versions.

The recommendation is to always test the success of these functions with `@T{(not status)}`, instead of `@T{(status == nil)}`.)

Currently, Lua has the following standard libraries:

`@itemize{`

`@item{@link{predefined|basic library};}`

`@item{@link{corolib|coroutine library};}`

`@item{@link{packlib|package library};}`

`@item{@link{strlib|string manipulation};}`

`@item{@link{utf8|basic UTF-8 support};}`

`@item{@link{tablib|table manipulation};}`

`@item{@link{mathlib|mathematical functions}  
(sin, log, etc.);}`

`@item{@link{iolib|input and output};}`

`@item{@link{oslib|operating system facilities};}`

`@item{@link{debuglib|debug facilities}.}`

`}`

Except for the basic and the package libraries, each library provides all its functions as fields of a global table or as methods of its objects.

To have access to these libraries,

the @N{C host} program should call the @Lid{luaL\_openlibs} function, which opens all standard libraries.

Alternatively,

the host program can open them individually by using

@Lid{luaL\_requiref} to call

@defid{luaopen\_base} (for the basic library),

@defid{luaopen\_package} (for the package library),

@defid{luaopen\_coroutine} (for the coroutine library),

@defid{luaopen\_string} (for the string library),

@defid{luaopen\_utf8} (for the UTF-8 library),

@defid{luaopen\_table} (for the table library),

@defid{luaopen\_math} (for the mathematical library),

@defid{luaopen\_io} (for the I/O library),

@defid{luaopen\_os} (for the operating system library),

and @defid{luaopen\_debug}

(for the debug library).

These functions are declared in @defid{lualib.h}.

}

## @sect2{predefined| @title{Basic Functions}}

The basic library provides core functions to Lua.

If you do not include this library in your application, you should check carefully whether you need to provide implementations for some of its facilities.

@LibEntry{assert (v [, message])|

Raises an error if

the value of its argument @id{v} is false (i.e., @nil or @false); otherwise, returns all its arguments.

In case of error,

@id{message} is the error object;

when absent, it defaults to @St{assertion failed!}

}

@LibEntry{collectgarbage ([opt [, arg]])|

This function is a generic interface to the garbage collector.

It performs different functions according to its first argument, @id{opt}:

@description{

@item{@St{collect}|

Performs a full garbage-collection cycle.

This is the default option.

}

@item{@St{stop}|

Stops automatic execution of the garbage collector.

The collector will run only when explicitly

invoked,

until a call to restart it.

}

@item{@St{restart}|

Restarts automatic execution of the garbage collector.

}

@item{@St{count}|

Returns the total memory in use by Lua in Kbytes.

The value has a fractional part,

so that it multiplied by 1024

gives the exact number of bytes in use by Lua.

}

@item{@St{step}|

Performs a garbage-collection step.

The step @Q{size} is controlled by @id{arg}.

With a zero value,

the collector will perform one basic (indivisible) step.

For non-zero values,

the collector will perform as if that amount of memory

(in Kbytes) had been allocated by Lua.

Returns @true if the step finished a collection cycle.

}

@item{@St{isrunning}|

Returns a boolean that tells whether the collector is running

(i.e., not stopped).

}

@item{@St{incremental}|

Change the collector mode to incremental.

This option can be followed by three numbers:

the garbage-collector pause,

the step multiplier,

and the step size @see{incmode}.

A zero means to not change that value.

}

@item{@St{generational}|

Change

the collector mode to generational.

This option can be followed by two numbers:

the garbage-collector minor multiplier

and the major multiplier @see{genmode}.

A zero means to not change that value.

}

}

See @See{GC} for more details about garbage collection

and some of these options.

This function should not be called by a finalizer.

}

@LibEntry{dofile ([filename])|

Opens the named file and executes its content as a Lua chunk.

When called without arguments,

@id{dofile} executes the content of the standard input (@id{stdin}).

Returns all values returned by the chunk.

In case of errors, @id{dofile} propagates the error

to its caller.

(That is, @id{dofile} does not run in protected mode.)

}

@LibEntry{error (message [, level])|

Raises an error @see{error} with @id{message} as the error object.

This function never returns.

Usually, @id{error} adds some information about the error position at the beginning of the message, if the message is a string.

The @id{level}

argument specifies how to get the error position.

With @N{level 1} (the default), the error position is where the

@id{error} function was called.

@N{Level 2} points the error to where the function

that called @id{error} was called; and so on.

Passing a @N{level 0} avoids the addition of error position information to the message.

}

@LibEntry{\_G|

A global variable (not a function) that

holds the @x{global environment} @see{globalenv}.

Lua itself does not use this variable;

changing its value does not affect any environment,

nor vice versa.

}

@LibEntry{getmetatable (object)|

If @id{object} does not have a metatable, returns @nil.

Otherwise,

if the object's metatable has a @idx{\_\_metatable} field,  
returns the associated value.

Otherwise, returns the metatable of the given object.

}

@LibEntry{ipairs (t)|

Returns three values (an iterator function, the table @id{t}, and 0)  
so that the construction

@verbatim{

for i,v in ipairs(t) do @rep{body} end

}

will iterate over the key@En{ }value

pairs

(@T{1,t[1]}), (@T{2,t[2]}), @ldots,

up to the first absent index.

}

@LibEntry{load (chunk [, chunkname [, mode [, env]])]|

Loads a chunk.

If @id{chunk} is a string, the chunk is this string.

If @id{chunk} is a function,

@id{load} calls it repeatedly to get the chunk pieces.

Each call to @id{chunk} must return a string that concatenates  
with previous results.

A return of an empty string, @nil, or no value signals the end of the chunk.

If there are no syntactic errors,

@id{load} returns the compiled chunk as a function;

otherwise, it returns @fail plus the error message.

When you load a main chunk,

the resulting function will always have exactly one upvalue,

the @id{\_ENV} variable @see{globalenv}.

However,

when you load a binary chunk created from a function @seeF{string.dump},

the resulting function can have an arbitrary number of upvalues, and there is no guarantee that its first upvalue will be the `@id{_ENV}` variable.  
(A non-main function may not even have an `@id{_ENV}` upvalue.)

Regardless, if the resulting function has any upvalues, its first upvalue is set to the value of `@id{env}`, if that parameter is given, or to the value of the `@x{global environment}`. Other upvalues are initialized with `@nil`. All upvalues are fresh, that is, they are not shared with any other function.

`@id{chunkname}` is used as the name of the chunk for error messages and debug information `@see{debugI}`.  
When absent, it defaults to `@id{chunk}`, if `@id{chunk}` is a string, or to `@St{=(load)}` otherwise.

The string `@id{mode}` controls whether the chunk can be text or binary (that is, a precompiled chunk).  
It may be the string `@St{b}` (only `@x{binary chunk}s`), `@St{t}` (only text chunks), or `@St{bt}` (both binary and text).  
The default is `@St{bt}`.

It is safe to load malformed binary chunks;  
`@id{load}` signals an appropriate error.  
However,  
Lua does not check the consistency of the code inside binary chunks; running maliciously crafted bytecode can crash the interpreter.

}

`@LibEntry{loadfile`  
`([filename [, mode [, env]]])`

Similar to `@Lid{load}`,  
but gets the chunk from file `@id{filename}`  
or from the standard input,  
if no file name is given.

}

`@LibEntry{next (table [, index])}`

Allows a program to traverse all fields of a table.

Its first argument is a table and its second argument is an index in this table.  
 A call to `@id{next}` returns the next index of the table and its associated value.  
 When called with `@nil` as its second argument, `@id{next}` returns an initial index and its associated value.  
 When called with the last index, or with `@nil` in an empty table, `@id{next}` returns `@nil`.  
 If the second argument is absent, then it is interpreted as `@nil`.  
 In particular, you can use `@T{next(t)}` to check whether a table is empty.

The order in which the indices are enumerated is not specified, *@emph{even for numeric indices}*.  
 (To traverse a table in numerical order, use a numerical `@Rw{for}`.)

You should not assign any value to a non-existent field in a table during its traversal.  
 You may however modify existing fields.  
 In particular, you may set existing fields to `nil`.

}

`@LibEntry{pairs (t)|`

If `@id{t}` has a metamethod `@idx{__pairs}`, calls it with `@id{t}` as argument and returns the first three results from the call.

Otherwise,  
 returns three values: the `@Lid{next}` function, the table `@id{t}`, and `@nil`, so that the construction  
`@verbatim{  
 for k,v in pairs(t) do @rep{body} end  
}`  
 will iterate over all `key@En{}` value pairs of table `@id{t}`.

See function `@Lid{next}` for the caveats of modifying the table during its traversal.

}

`@LibEntry{pcall (f [, arg1, @Cdots])|`

Calls the function `@id{f}` with  
 the given arguments in `@emphx{protected mode}`.  
 This means that any error `@N{inside @T{f}}` is not propagated;  
 instead, `@id{pcall}` catches the error  
 and returns a status code.  
 Its first result is the status code (a boolean),  
 which is `@true` if the call succeeds without errors.  
 In such case, `@id{pcall}` also returns all results from the call,  
 after this first result.  
 In  
 case of any error, `@id{pcall}` returns `@false` plus the error object.  
 Note that errors caught by `@id{pcall}` do not call a message handler.

}

`@LibEntry{print (@Cdots)|`  
 Receives any number of arguments  
 and prints their values to `@id{stdout}`,  
 converting each argument to a string  
 following the same rules of `@Lid{tostring}`.

The function `@id{print}` is not intended for formatted output,  
 but only as a quick way to show a value,  
 for instance for debugging.  
 For complete control over the output,  
 use `@Lid{string.format}` and `@Lid{io.write}`.

}

`@LibEntry{rawequal (v1, v2)|`  
 Checks whether `@id{v1}` is equal to `@id{v2}`,  
 without invoking the `@idx{__eq}` metamethod.  
 Returns a boolean.

}

`@LibEntry{rawget (table, index)|`  
 Gets the real value of `@T{table[index]}`,  
 without using the `@idx{__index}` metavalue.  
`@id{table}` must be a table;  
`@id{index}` may be any value.

}

`@LibEntry{rawlen (v)|`  
 Returns the length of the object `@id{v}`,  
 which must be a table or a string,  
 without invoking the `@idx{__len}` metamethod.



Returns  
an integer.

}

@LibEntry{rawset (table, index, value)|  
Sets the real value of @T{table[index]} to @id{value},  
without using the @idx{\_\_newindex} metavalue.  
@id{table} must be a table,  
@id{index} any value different from @nil and @x{NaN},  
and @id{value} any Lua value.

This function returns @id{table}.

}

@LibEntry{select (index, @Cdots)|

If @id{index} is a number,  
returns all arguments after argument number @id{index};  
a negative number indexes from the end (@num{-1} is the last argument).  
Otherwise, @id{index} must be the string @T{"#"},  
and @id{select} returns the total number of extra arguments it received.

}

@LibEntry{setmetatable (table, metatable)|

Sets the metatable for the given table.  
If @id{metatable} is @nil,  
removes the metatable of the given table.  
If the original metatable has a @idx{\_\_metatable} field,  
raises an error.

This function returns @id{table}.

To change the metatable of other types from Lua code,  
you must use the @link{debuglib|debug library}.

}

@LibEntry{tonumber  
(e [, base])|

When called with no @id{base},  
@id{tonumber} tries to convert its argument to a number.  
If the argument is already a number or  
a string convertible to a number,

then `@id{tonumber}` returns this number;  
otherwise, it returns `@fail`.

The conversion of strings can result in integers or floats,  
according to the lexical conventions of Lua `@see{lexical}`.  
The string may have leading and trailing spaces and a sign.

When called with `@id{base}`,  
then `@id{e}` must be a string to be interpreted as  
an integer numeral in that base.  
The base may be any integer between 2 and 36, inclusive.  
In bases `@N{above 10}`, the letter `@Char{A}` (in either upper or lower case)  
`@N{represents 10}`, `@Char{B}` `@N{represents 11}`, and so forth,  
with `@Char{Z}` representing 35.  
If the string `@id{e}` is not a valid numeral in the given base,  
the function returns `@fail`.

}

`@LibEntry{tostring (v)|`

Receives a value of any type and  
converts it to a string in a human-readable format.

If the metatable  
of `@id{v}` has a `@idx{__tostring}` field,  
then `@id{tostring}` calls the corresponding value  
with `@id{v}` as argument,  
and uses the result of the call as its result.  
Otherwise, if the metatable of `@id{v}` has a `@idx{__name}` field  
with a string value,  
`@id{tostring}` may use that string in its final result.

For complete control of how numbers are converted,  
use `@Lid{string.format}`.

}

`@LibEntry{type (v)|`

Returns the type of its only argument, coded as a string.  
The possible results of this function are  
`@St{nil}` (a string, not the value `@nil`),  
`@St{number}`,  
`@St{string}`,  
`@St{boolean}`,  
`@St{table}`,  
`@St{function}`,

```
@St{thread},  
and @St{userdata}.
```

```
}
```

```
@LibEntry{_VERSION|
```

A global variable (not a function) that holds a string containing the running Lua version. The current value of this variable is @St{Lua 5.4}.

```
}
```

```
@LibEntry{warn (msg1, @Cdots)|
```

Emits a warning with a message composed by the concatenation of all its arguments (which should be strings).

By convention,  
a one-piece message starting  
with @Char{@At}  
is intended to be a @emph{control message},  
which is a message to the warning system itself.  
In particular, the standard warning function in Lua  
recognizes the control messages @St{@At{}off},  
to stop the emission of warnings,  
and @St{@At{}on}, to (re)start the emission;  
it ignores unknown control messages.

```
}
```

```
@LibEntry{xpcall (f, msg1 [, arg1, @Cdots])|
```

This function is similar to @Lid{pcall},  
except that it sets a new @x{message handler} @id{msg1}.

```
}
```

```
}
```

```
@sect2{corolib| @title{Coroutine Manipulation}
```

This library comprises the operations to manipulate coroutines,  
which come inside the table @defid{coroutine}.  
See @See{coroutine} for a general description of coroutines.

```
@LibEntry{coroutine.close (co)|
```

Closes coroutine `@id{co}`,  
that is,  
closes all its pending to-be-closed variables  
and puts the coroutine in a dead state.  
The given coroutine must be dead or suspended.  
In case of error  
(either the original error that stopped the coroutine or  
errors in closing  
methods),  
returns `@false` plus the error object;  
otherwise returns `@true`.

}

`@LibEntry{coroutine.create (f)|`

Creates a new coroutine, with body `@id{f}`.  
`@id{f}` must be a function.  
Returns this new coroutine,  
an object with type `@T{"thread"}`.

}

`@LibEntry{coroutine.isyieldable ([co])|`

Returns `@true` when the coroutine `@id{co}` can yield.  
The default for `@id{co}` is the running coroutine.

A coroutine is yieldable if it is not the main thread and  
it is not inside a non-yieldable `@N{C function}`.

}

`@LibEntry{coroutine.resume (co [, val1, @Cdots])|`

Starts or continues the execution of coroutine `@id{co}`.  
The first time you resume a coroutine,  
it starts running its body.  
The values `@id{val1}`, `@ldots` are passed  
as the arguments to the body function.  
If the coroutine has yielded,  
`@id{resume}` restarts it;  
the values `@id{val1}`, `@ldots` are passed  
as the results from the yield.

If the coroutine runs without any errors,  
`@id{resume}` returns `@true` plus any values passed to `@id{yield}`

(when the coroutine  
yields) or any values returned by the body function  
(when the coroutine terminates).  
If there is any error,  
@id{resume} returns @false plus the error message.

}

@LibEntry{coroutine.running ()|

Returns the running coroutine plus a boolean,  
@true when the running coroutine is the main one.

}

@LibEntry{coroutine.status (co)|

Returns the status of the coroutine @id{co}, as a string:  
@T{"running"},  
if the coroutine is running  
(that is, it is the one that called @id{status});  
@T{"suspended"}, if the coroutine is suspended in a call to @id{yield},  
or if it has not started running yet;  
@T{"normal"} if the coroutine is active but not running  
(that is, it has resumed another coroutine);  
and @T{"dead"} if the coroutine has finished its body function,  
or if it has stopped with an error.

}

@LibEntry{coroutine.wrap (f)|

Creates a new coroutine, with body @id{f};  
@id{f} must be a function.  
Returns a function that resumes the coroutine each time it is called.  
Any arguments passed to this  
function behave as the  
extra arguments to @id{resume}.  
The function returns the same values returned by @id{resume},  
except the first boolean.  
In case of error,  
the function closes the coroutine and propagates the error.

}

@LibEntry{coroutine.yield (@Cdots)|

Suspends the execution of the calling coroutine.

Any arguments to `@id{yield}` are passed as extra results to `@id{resume}`.

}

}

`@sect2{packlib| @title{Modules}}`

The package library provides basic facilities for loading modules in Lua.

It exports one function directly in the global environment:

`@Lid{require}`.

Everything else is exported in the table `@defid{package}`.

`@LibEntry{require (modname)|`

Loads the given module.

The function starts by looking into the `@Lid{package.loaded}` table to determine whether `@id{modname}` is already loaded.

If it is, then `@id{require}` returns the value stored at `@T{package.loaded[modname]}`.

(The absence of a second result in this case signals that this call did not have to load the module.)

Otherwise,

it tries to find a `@emph{loader}` for the module.

To find a loader,

`@id{require}` is guided by the table `@Lid{package.searchers}`.

Each item in this table is a search function, that searches for the module in a particular way.

By changing this table,

we can change how `@id{require}` looks for a module.

The following explanation is based on the default configuration for `@Lid{package.searchers}`.

First `@id{require}` queries `@T{package.preload[modname]}`.

If it has a value,

this value (which must be a function) is the loader.

Otherwise `@id{require}` searches for a Lua loader using the path stored in `@Lid{package.path}`.

If that also fails, it searches for a `@N{C loader}` using the path stored in `@Lid{package.cpath}`.

If that also fails,

it tries an `@emph{all-in-one}` loader `@seeF{package.searchers}`.

Once a loader is found,

`@id{require}` calls the loader with two arguments:

`@id{modname}` and an extra value,  
a `@emph{loader data}`,  
also returned by the searcher.  
The loader data can be any value useful  
to the module;  
for the default searchers,  
it indicates where the loader was found.  
(For instance, if the loader came from a file,  
this extra value is the file path.)  
If the loader returns any non-nil value,  
`@id{require}` assigns the returned value to `@T{package.loaded[modname]}`.  
If the loader does not return a non-nil value and  
has not assigned any value to `@T{package.loaded[modname]}`,  
then `@id{require}` assigns `@true` to this entry.  
In any case, `@id{require}` returns the  
final value of `@T{package.loaded[modname]}`.  
Besides that value, `@id{require}` also returns as a second result  
the loader data returned by the searcher,  
which indicates how `@id{require}` found the module.

If there is any error loading or running the module,  
or if it cannot find any loader for the module,  
then `@id{require}` raises an error.

}

`@LibEntry{package.config|`

A string describing some compile-time configurations for packages.

This string is a sequence of lines:

`@itemize{`

`@item{The first line is the @x{directory  
separator} string.`

Default is `@Char{\}` for `@x{Windows}` and `@Char{/}` for all other systems.}

`@item{The second line is the character that separates templates in a path.`

Default is `@Char{;}.}`

`@item{The third line is the string that marks the  
substitution points in a template.`

Default is `@Char{?}.}`

`@item{The fourth line is a string that, in a path in @x{Windows},  
is replaced by the executable's directory.`

Default is `@Char{!}.}`

`@item{The fifth line is a mark to ignore all text after it`

when building the @id{luaopen\_} function name.

Default is @Char{-}.

}

}

@LibEntry{package.cpath|

A string with the path used by @Lid{require}

to search for a @N{C loader}.

Lua initializes the @N{C path} @Lid{package.cpath} in the same way

it initializes the Lua path @Lid{package.path},

using the environment variable @defid{LUA\_CPATH\_5\_4},

or the environment variable @defid{LUA\_CPATH},

or a default path defined in @id{luaconf.h}.

}

@LibEntry{package.loaded|

A table used by @Lid{require} to control

which

modules are already loaded.

When you require a module @id{modname} and

@T{package.loaded[modname]} is not false,

@Lid{require} simply returns the value stored there.

This variable is only a reference to the real table;

assignments to this variable do not change the

table used by @Lid{require}.

The real table is stored in the C registry @see{registry},

indexed by the key @defid{LUA\_LOADED\_TABLE}, a string.

}

@LibEntry{package.loadlib (libname, funcname)|

Dynamically links the host program with the @N{C library} @id{libname}.

If @id{funcname} is @St{\*},

then it only links with the library,

making the symbols exported by the library

available to other dynamically linked libraries.

Otherwise,

it looks for a function @id{funcname} inside the library

and returns this function as a @N{C function}.



So, @id{funcname} must follow the @Lid{lua\_CFunction} prototype  
@seeC{lua\_CFunction}.

This is a low-level function.

It completely bypasses the package and module system.

Unlike @Lid{require},

it

does not perform any path searching and

does not automatically add extensions.

@id{libname} must be the complete file name of the @N{C library},

including if necessary a path and an extension.

@id{funcname} must be the exact name exported by the @N{C library}

(which may depend on the @N{C compiler} and linker used).

This functionality is not supported by @N{ISO C}.

As such, it is only available on some platforms

(Windows, Linux, Mac OS X, Solaris, BSD,

plus other Unix systems that support the @id{dlfcn} standard).

This function is inherently insecure,

as it allows Lua to call any function in any readable dynamic  
library in the system.

(Lua calls any function assuming the function

has a proper prototype and respects a proper protocol

@see{lua\_CFunction}.

Therefore,

calling an arbitrary function in an arbitrary dynamic library

more often than not results in an access violation.)

}

@LibEntry{package.path|

A string with the path used by @Lid{require}

to search for a Lua

loader.

At start-up, Lua initializes this variable with

the value of the environment variable @defid{LUA\_PATH\_5\_4} or

the environment variable @defid{LUA\_PATH} or

with a default path defined in @id{luaconf.h},

if those environment variables are not defined.

A @St{;;} in the value of the environment variable

is replaced by the default path.

}

@LibEntry{package.preload|

A table to store loaders for specific modules

@seeF{require}.

This variable is only a reference to the real table;

assignments to this variable do not change the

table used by @Lid{require}.

The real table is stored in the C registry @see{registry},

indexed by the key @defid{LUA\_PRELOAD\_TABLE}, a string.

}

@LibEntry{package.searchers|

A table used by @Lid{require} to control how to find modules.

Each entry in this table is a @def{searcher function}.

When looking for a module,

@Lid{require} calls each of these searchers in ascending order,  
with the module name (the argument given to @Lid{require}) as its  
sole argument.

If

the searcher finds the module,

it returns another function, the module @def{loader},

plus an extra value, a @emph{loader data},

that will be passed to that loader and

returned as a second result by @Lid{require}.

If it cannot find the module,

it returns a string explaining why

(or @nil if it has nothing to say).

Lua initializes this table with four searcher functions.

The first searcher simply looks for a loader in the

@Lid{package.preload} table.

The second searcher looks for a loader as a Lua library,

using the path stored at @Lid{package.path}.

The search is done as described in function @Lid{package.searchpath}.

The third searcher looks for a loader as a @N{C library},

using the path given by the variable @Lid{package.cpath}.

Again,

the search is done as described in function @Lid{package.searchpath}.

For instance,

if the @N{C path} is the string

@verbatim{

"/?.so;/??.dll;/usr/local/?/init.so"

}  
 the searcher for module @id{foo}  
 will try to open the files @T{./foo.so},  
 @T{./foo.dll},  
 and @T{/usr/local/foo/init.so}, in that order.  
 Once it finds a @N{C library},  
 this searcher first uses a dynamic link facility to link the  
 application with the library.  
 Then it tries to find a @N{C function} inside the library to  
 be used as the loader.  
 The name of this @N{C function} is the string @St{luaopen\_  
 concatenated with a copy of the module name where each dot  
 is replaced by an underscore.  
 Moreover, if the module name has a hyphen,  
 its suffix after (and including) the first hyphen is removed.  
 For instance, if the module name is @id{a.b.c-v2.1},  
 the function name will be @id{luaopen\_a\_b\_c}.

The fourth searcher tries an @def{all-in-one loader}.  
 It searches the @N{C path} for a library for  
 the root name of the given module.  
 For instance, when requiring @id{a.b.c},  
 it will search for a @N{C library} for @id{a}.  
 If found, it looks into it for an open function for  
 the submodule;  
 in our example, that would be @id{luaopen\_a\_b\_c}.  
 With this facility, a package can pack  
 several @N{C submodules}  
 into one single library,  
 with each submodule keeping its original open function.

All searchers except the first one (preload) return as the extra value  
 the file path where the module was found,  
 as returned by @Lid{package.searchpath}.  
 The first searcher always returns the string @St{:preload:}.

Searchers should raise no errors and have no side effects in Lua.  
 (They may have side effects in C,  
 for instance by linking the application with a library.)

}

@LibEntry{package.searchpath (name, path [, sep [, rep]])|

Searches for the given @id{name} in the given @id{path}.

A path is a string containing a sequence of  
 @emph{templates} separated by semicolons.

For each template,  
the function replaces each interrogation mark (if any)  
in the template with a copy of @id{name}  
wherein all occurrences of @id{sep}  
(a dot, by default)  
were replaced by @id{rep}  
(the system's directory separator, by default),  
and then tries to open the resulting file name.

For instance, if  
the path is the string  
@verbatim{  
"./?.lua;./?.lc;/usr/local/?/init.lua"  
}  
the search for the name @id{foo.a}  
will try to open the files  
@T{./foo/a.lua}, @T{./foo/a.lc}, and  
@T{/usr/local/foo/a/init.lua}, in that order.

Returns the resulting name of the first file that it can  
open in read mode (after closing the file),  
or @fail plus an error message if none succeeds.  
(This error message lists all file names it tried to open.)

}

}

@sect2{strlib| @title{String Manipulation}

@simplesect{

This library provides generic functions for string manipulation,  
such as finding and extracting substrings, and pattern matching.  
When indexing a string in Lua, the first character is at @N{position 1}  
(not @N{at 0}, as in C).  
Indices are allowed to be negative and are interpreted as indexing backwards,  
from the end of the string.  
Thus, the last character is at position @num{-1}, and so on.

The string library provides all its functions inside the table  
@defid{string}.  
It also sets a @x{metatable for  
strings}  
where the @idx{\_\_index} field points to the @id{string} table.  
Therefore, you can use the string functions in object-oriented style.  
For instance, @T{string.byte(s,i)}  
can be written as @T{s:byte(i)}.

The string library assumes one-byte character encodings.

`@LibEntry{string.byte (s [, i [, j]])}`

Returns the internal numeric codes of the characters `@T{s[i]}`,  
`@T{s[i+1]}`, `@ldots`, `@T{s[j]}`.

The default value for `@id{i}` `@N{is 1}`;

the default value for `@id{j}` `@N{is @id{i}}`.

These indices are corrected

following the same rules of function `@Lid{string.sub}`.

Numeric codes are not necessarily portable across platforms.

}

`@LibEntry{string.char (@Cdots)}`

Receives zero or more integers.

Returns a string with length equal to the number of arguments,  
in which each character has the internal numeric code equal  
to its corresponding argument.

Numeric codes are not necessarily portable across platforms.

}

`@LibEntry{string.dump (function [, strip])}`

Returns a string containing a binary  
representation

(a `@emph{binary chunk}`)

of the given function,

so that a later `@Lid{load}` on this string returns

a copy of the function (but with new upvalues).

If `@id{strip}` is a true value,

the binary representation may not include all debug information  
about the function,

to save space.

Functions with upvalues have only their number of upvalues saved.

When (re)loaded,

those upvalues receive fresh instances.

(See the `@Lid{load}` function for details about

how these upvalues are initialized.

You can use the debug library to serialize

and reload the upvalues of a function

in a way adequate to your needs.)

}

@LibEntry{string.find (s, pattern [, init [, plain]])|

Looks for the first match of

@id{pattern} @see{pm} in the string @id{s}.

If it finds a match, then @id{find} returns the indices @N{of @T{s}} where this occurrence starts and ends;

otherwise, it returns @fail.

A third, optional numeric argument @id{init} specifies

where to start the search;

its default value @N{is 1} and can

be negative.

A @true as a fourth, optional argument @id{plain}

turns off the pattern matching facilities,

so the function does a plain @Q{find substring} operation,

with no characters in @id{pattern} being considered magic.

If the pattern has captures,

then in a successful match

the captured values are also returned,

after the two indices.

}

@LibEntry{string.format (formatstring, @Cdots)|

Returns a formatted version of its variable number of arguments

following the description given in its first argument,

which must be a string.

The format string follows the same rules as the @ANSI{sprintf}.

The only differences are that the conversion specifiers and modifiers

@id{F}, @id{n}, @T{\*}, @id{h}, @id{L}, and @id{l} are not supported

and that there is an extra specifier, @id{q}.

Both width and precision, when present,

are limited to two digits.

The specifier @id{q} formats booleans, nil, numbers, and strings

in a way that the result is a valid constant in Lua source code.

Booleans and nil

are written in the obvious way

(@id{true}, @id{false}, @id{nil}).

Floats are written in hexadecimal,

to preserve full precision.

A string is written between double quotes,

using escape sequences when necessary to ensure that

it can safely be read back by the Lua interpreter.

For instance, the call

```
@verbatim{
string.format('%q', 'a string with "quotes" and \n new line')
}
```

may produce the string:

```
@verbatim{
"a string with \"quotes\" and \
new line"
}
```

This specifier does not support modifiers (flags, width, precision).

The conversion specifiers

`@id{A}`, `@id{a}`, `@id{E}`, `@id{e}`, `@id{f}`,  
`@id{G}`, and `@id{g}` all expect a number as argument.

The specifiers `@id{c}`, `@id{d}`,

`@id{i}`, `@id{o}`, `@id{u}`, `@id{X}`, and `@id{x}`

expect an integer.

When Lua is compiled with a C89 compiler,  
the specifiers `@id{A}` and `@id{a}` (hexadecimal floats)  
do not support modifiers.

The specifier `@id{s}` expects a string;

if its argument is not a string,

it is converted to one following the same rules of `@Lid{tostring}`.

If

the specifier has any modifier,

the corresponding string argument should not contain `@x{embedded zeros}`.

The specifier `@id{p}` formats the pointer

returned by `@Lid{lua_topointer}`.

That gives a unique string identifier for tables, userdata,  
threads, strings, and functions.

For other values (numbers, nil, booleans),  
this specifier results in a string representing  
the pointer `@id{NULL}`.

}

`@LibEntry{string.gmatch (s, pattern [, init])}`

Returns an iterator function that,

each time it is called,

returns the next captures from `@id{pattern}` `@see{pm}`  
over the string `@id{s}`.

If `@id{pattern}` specifies no captures,

then the whole match is produced in each call.

A third, optional numeric argument `@id{init}` specifies  
where to start the search;

its default value `@N{is 1}` and can be negative.

As an example, the following loop  
will iterate over all the words from string `@id{s}`,  
printing one per line:

```
@verbatim{
s = "hello world from Lua"
for w in string.gmatch(s, "%a+") do
  print(w)
end
}
```

The next  
example collects all pairs `@T{key=value}` from the  
given string into a table:

```
@verbatim{
t = {}
s = "from=world, to=Lua"
for k, v in string.gmatch(s, "(%w+)=(%w+)") do
  t[k] = v
end
}
```

For this function, a caret `@Char{^}` at the start of a pattern does not  
work as an anchor, as this would prevent the iteration.

}

`@LibEntry{string.gsub (s, pattern, repl [, n])|`

Returns a copy of `@id{s}`

in which all (or the first `@id{n}`, if given)

occurrences of the `@id{pattern}` `@see{pm}` have been  
replaced by a replacement string specified by `@id{repl}`,  
which can be a string, a table, or a function.

`@id{gsub}` also returns, as its second value,  
the total number of matches that occurred.

The name `@id{gsub}` comes from `@emph{Global SUBstitution}`.

If `@id{repl}` is a string, then its value is used for replacement.

The `@N{character @T{}}` works as an escape character:

any sequence in `@id{repl}` of the form `@T{%%@rep{d}}`,

with `@rep{d}` between 1 and 9,

stands for the value of the `@rep{d}`-th captured substring;  
the

sequence `@T{%0}` stands for the whole match;

the sequence `@T{%%}` stands for a `@N{single @T{}}`.

If `@id{repl}` is a table, then the table is queried for every match,  
using the first capture as the key.

If `@id{repl}` is a function, then this function is called every time a



match occurs, with all captured substrings passed as arguments, in order.

In any case,  
if the pattern specifies no captures,  
then it behaves as if the whole pattern was inside a capture.

If the value returned by the table query or by the function call is a string or a number,  
then it is used as the replacement string;  
otherwise, if it is `@Rw{false}` or `@nil`,  
then there is no replacement  
(that is, the original match is kept in the string).

Here are some examples:

```
@verbatim{
```

```
x = string.gsub("hello world", "(%w+)", "%1 %1")  
--> x="hello hello world world"
```

```
x = string.gsub("hello world", "%w+", "%0 %0", 1)  
--> x="hello hello world"
```

```
x = string.gsub("hello world from Lua", "(%w+)%s*(%w+)", "%2 %1")  
--> x="world hello Lua  
from"
```

```
x = string.gsub("home = $HOME, user = $USER", "%$(%w+)", os.getenv)  
--> x="home = /home/roberto, user = roberto"
```

```
x = string.gsub("4+5 = $return 4+5$", "%$(.)%$", function (s)  
    return load(s)()  
end)  
--> x="4+5 = 9"
```

```
local t = {name="lua", version="5.4"}  
x = string.gsub("$name-$version.tar.gz", "%$(%w+)", t)  
--> x="lua-5.4.tar.gz"  
}  
  
}
```

```
@LibEntry{string.len (s)|
```

Receives a string and returns its length.  
The empty string `@T{""}` has length 0.  
Embedded zeros are counted,  
so `@T{"a\000bc\000"}` has length 5.

}

@LibEntry{string.lower (s)|

Receives a string and returns a copy of this string with all uppercase letters changed to lowercase.

All other characters are left unchanged.

The definition of what an uppercase letter is depends on the current locale.

}

@LibEntry{string.match (s, pattern [, init])|

Looks for the first @emph{match} of the @id{pattern} @see{pm} in the string @id{s}.

If it finds one, then @id{match} returns the captures from the pattern;

otherwise it returns @fail.

If @id{pattern} specifies no captures, then the whole match is returned.

A third, optional numeric argument @id{init} specifies where to start the search; its default value @N{is 1} and can be negative.

}

@LibEntry{string.pack (fmt, v1, v2, @Cdots)|

Returns a binary string containing the values @id{v1}, @id{v2}, etc. serialized in binary form (packed) according to the format string @id{fmt} @see{pack}.

}

@LibEntry{string.packsize (fmt)|

Returns the length of a string resulting from @Lid{string.pack} with the given format.

The format string cannot have the variable-length options @Char{s} or @Char{z} @see{pack}.

}

@LibEntry{string.rep (s, n [, sep])|

Returns a string that is the concatenation of @id{n} copies of the string @id{s} separated by the string @id{sep}.

The default value for `@id{sep}` is the empty string  
(that is, no separator).  
Returns the empty string if `@id{n}` is not positive.

(Note that it is very easy to exhaust the memory of your machine  
with a single  
call to this function.)

}

@LibEntry{string.reverse (s)|

Returns a string that is the string `@id{s}` reversed.

}

@LibEntry{string.sub (s, i [, j])|

Returns the substring of `@id{s}` that  
starts at `@id{i}` and continues until `@id{j}`;  
`@id{i}` and `@id{j}` can be negative.  
If `@id{j}` is absent, then it is assumed to be equal to `@num{-1}`  
(which is the same as the string length).  
In particular,  
the call `@T{string.sub(s,1,j)}` returns a prefix of `@id{s}`  
with length `@id{j}`,  
and `@T{string.sub(s, -i)}` (for a positive `@id{i}`)  
returns a suffix of `@id{s}`  
with length `@id{i}`.

If, after the translation of negative indices,  
`@id{i}` is less than 1,  
it is corrected to 1.  
If `@id{j}` is greater than the string length,  
it is corrected to that length.  
If, after these corrections,  
`@id{i}` is greater than `@id{j}`,  
the function returns the empty string.

}

@LibEntry{string.unpack (fmt, s [, pos])|

Returns the values packed in string `@id{s}` @seeF{string.pack}  
according to the format string `@id{fmt}` @see{pack}.

An

optional `@id{pos}` marks where  
to start reading in `@id{s}` (default is 1).

After the read values,  
this function also returns the index of the first unread byte in @id{s}.

}

@LibEntry{string.upper (s)|

Receives a string and returns a copy of this string with all  
lowercase letters changed to uppercase.  
All other characters are left unchanged.  
The definition of what a lowercase letter is depends on the current locale.

}

}

@sect3{pm| @title{Patterns}

@simplesect{

Patterns in Lua are described by regular strings,  
which are interpreted as patterns by the pattern-matching functions  
@Lid{string.find},  
@Lid{string.gmatch},  
@Lid{string.gsub},  
and @Lid{string.match}.  
This section describes the syntax and the meaning  
(that is, what they match) of these strings.

}

@sect4{@title{Character Class:}

A @def{character class} is used to represent a set of characters.  
The following combinations are allowed in describing a character class:  
@description{

@item{@rep{x}|  
(where @rep{x} is not one  
of the @emphx{magic characters}  
@T{^\$()%.[]\*+-.?})  
represents the character @emph{x} itself.  
}

@item{@T{.}| (a dot) represents all characters.}

@item{@T{%a}| represents all letters.}

@item{@T{%c}| represents all control characters.}

@item{@T{%d}| represents all digits.}

@item{@T{%g}| represents all printable characters except space.}

@item{@T{%l}| represents all lowercase letters.}

@item{@T{%p}| represents all punctuation characters.}

@item{@T{%s}| represents all space characters.}

@item{@T{%u}| represents all uppercase letters.}

@item{@T{%w}| represents all alphanumeric characters.}

@item{@T{%x}| represents all hexadecimal digits.}

@item{@T{%@rep{x}}| (where @rep{x} is any non-alphanumeric character)  
represents the character @rep{x}.

This is the standard way to escape the magic characters.

Any non-alphanumeric character

(including all punctuation characters, even the non-magical)

can be preceded by a @Char{%} to represent itself in a pattern.

}

@item{@T{[@rep{set}]}|

represents

the class which is the union of all

characters in @rep{set}.

A range of characters can be specified by  
separating the end characters of the range,  
in ascending order, with a @Char{-}.

All classes @T{%}@emph{x} described above can also be used as  
components in @rep{set}.

All other characters in @rep{set} represent themselves.

For example, @T{[%w\_]} (or @T{[\_%w]})

represents all alphanumeric characters plus the underscore,

@T{[0-7]} represents the octal digits,

and @T{[0-7%l%-]} represents the octal digits plus  
the lowercase letters plus the @Char{-} character.

You can put a closing square bracket in a set  
by positioning it as the first character in the set.

You can put a hyphen in a set

by positioning it as the first or the last character in the set.

(You can also use an escape for both cases.)

The interaction between ranges and classes is not defined.

Therefore, patterns like `@T{[%a-z]}` or `@T{[a-%]}`

have no meaning.

}

`@item{@T{[^@rep{set}]}`

represents the complement of `@rep{set}`,

where

`@rep{set}` is interpreted as above.

}

}

For all classes represented by single letters (`@T{%a}`, `@T{%c}`, etc.),

the corresponding uppercase letter represents the complement of the class.

For instance, `@T{%S}` represents all non-space characters.

The definitions of letter, space, and other character groups

depend on the current locale.

In particular, the class `@T{[a-z]}` may not be equivalent to `@T{%l}`.

}

`@sect4{@title{Pattern Item:}`

A `@def{pattern item}` can be

`@itemize{`

`@item{`

a single character class,

which matches any single character in the class;

}

`@item{`

a single character class followed by `@Char{*}`,

which matches sequences of zero or more characters in the class.

These repetition items will always match the longest possible sequence;

}

`@item{`

a single character class followed by `@Char{+}`,

which matches sequences of one or more characters in the class.

These repetition items will always match the longest possible sequence;

}

`@item{`

a single character class followed

by `@Char{-}`,

which also matches sequences of zero or more characters in the class.

Unlike `@Char{*}`,

these repetition items will always match the shortest possible sequence;

}

@item{

a single character class followed by @Char{?},

which matches zero or one occurrence of a character in the class.

It always matches one occurrence if possible;

}

@item{

@T{%@rep{n}}, for @rep{n} between 1 and 9;

such item matches a substring equal to the @rep{n}-th captured string  
(see below);

}

@item{

@T{%b@rep{xy}}, where @rep{x} and @rep{y} are two distinct characters;

such item matches strings that start @N{with @rep{x}}, end @N{with @rep{y}},

and where the @rep{x} and @rep{y} are @emph{balanced}.

This means that, if one reads the string from left to right,

counting @M{+1} for an @rep{x} and @M{-1} for a @rep{y},

the ending @rep{y} is the first @rep{y} where the count reaches 0.

For instance, the item @T{%b()} matches expressions with

balanced parentheses.

}

@item{

@T{%f[@rep{set}]}, a @def{frontier

pattern};

such item matches an empty string at any position such that

the next character belongs to @rep{set}

and the previous character does not belong to @rep{set}.

The set @rep{set} is interpreted as previously described.

The beginning and the end of the subject are handled as if

they were the character @Char{\0}.

}

}

}

@sect4{@title{Pattern:}}

A @def{pattern} is a sequence of pattern items.

A caret @Char{^} at the beginning of a pattern anchors the match at the  
beginning of the subject string.

A @Char{\$} at the end of a pattern anchors the match at the  
end of the subject string.

At other positions,

@Char{^} and @Char{\$} have no special meaning and represent themselves.

}

@sect4{@title{Captures:}}

A pattern can contain sub-patterns enclosed in parentheses;  
they describe @def{captures}.

When a match succeeds, the substrings of the subject string  
that match captures are stored (@emph{captured}) for future use.  
Captures are numbered according to their left parentheses.

For instance,

in the pattern @T{"a\*(.)%w(%s\*)"}  
the part of the string matching @T{"a\*(.)%w(%s\*)"} is  
stored as the first capture, and therefore has @N{number 1};  
the character matching @St{.} is captured with @N{number 2},  
and the part matching @St{%s\*} has @N{number 3}.

As a special case, the capture @T{} captures  
the current string position (a number).

For instance, if we apply the pattern @T{"()aa()"} on the  
string @T{"flaaap"}, there will be two captures: @N{3 and 5}.

}

@sect4{@title{Multiple matches:}}

The function @Lid{string.gsub} and the iterator @Lid{string.gmatch}  
match multiple occurrences of the given pattern in the subject.

For these functions,

a new match is considered valid only  
if it ends at least one byte after the end of the previous match.

In other words, the pattern machine never accepts the  
empty string as a match immediately after another match.

As an example,

consider the results of the following code:

@verbatim{

> string.gsub("abc", "()a\*()", print);

--> 1 2

--> 3

3

--> 4 4

}

The second and third results come from Lua matching an empty  
string after @Char{b} and another one after @Char{c}.

Lua does not match an empty string after @Char{a},  
because it would end at the same position of the previous match.

}



}

@sect3{pack| @title{Format Strings for Pack and Unpack}

The first argument to @Lid{string.pack},  
@Lid{string.packsize}, and @Lid{string.unpack}  
is a format string,  
which describes the layout of the structure being created or read.

A format string is a sequence of conversion options.

The conversion options are as follows:

```
@description{
@item{@T{<}|sets little endian}
@item{@T{>}|sets big endian}
@item{@T{=}|sets native endian}
@item{@T{![@rep{n}]}|sets maximum alignment to @id{n}
(default is native alignment)}
@item{@T{b}|a signed byte (@id{char})}
@item{@T{B}|an unsigned byte (@id{char})}
@item{@T{h}|a signed @id{short} (native size)}
@item{@T{H}|an unsigned @id{short} (native size)}
@item{@T{l}|a signed @id{long} (native size)}
@item{@T{L}|an
  unsigned @id{long} (native size)}
@item{@T{j}|a @id{lua_Integer}}
@item{@T{J}|a @id{lua_Unsigned}}
@item{@T{T}|a @id{size_t} (native size)}
@item{@T{i[@rep{n}]}|a signed @id{int} with @id{n} bytes
(default is native size)}
@item{@T{I[@rep{n}]}|an unsigned @id{int} with @id{n} bytes
(default is native size)}
@item{@T{f}|a @id{float} (native size)}
@item{@T{d}|a @id{double} (native size)}
@item{@T{n}|a @id{lua_Number}}
@item{@T{c[@rep{n}]}|a fixed-sized string with @id{n} bytes}
@item{@T{z}|a zero-terminated string}
@item{@T{s[@emph{n}]}|a string preceded by its length
coded as an unsigned integer with @id{n} bytes
(default is a @id{size_t})}
@item{@T{x}|one byte of padding}
@item{@T{X[@rep{op}]}|an empty item that aligns
according to option @id{op}
(which is otherwise ignored)}
@item{@Char{ }|(space) ignored}
}
```

(A @St{[@rep{n}]} means an optional integral numeral.)

Except for padding, spaces, and configurations

(options @St{xX <=>!}),

each option corresponds to an argument in @Lid{string.pack}

or

a result in @Lid{string.unpack}.

For options @St{!@rep{n}}, @St{s@rep{n}}, @St{i@rep{n}}, and @St{I@rep{n}}, @id{n} can be any integer between 1 and 16.

All integral options check overflows;

@Lid{string.pack} checks whether the given value fits in the given size;

@Lid{string.unpack} checks whether the read value fits in a Lua integer.

For the unsigned options,

Lua integers are treated as unsigned values too.

Any format string starts as if prefixed by @St{!1=},

that is,

with maximum alignment of 1 (no alignment)

and native endianness.

Native endianness assumes that the whole system is either big or little endian.

The packing functions will not emulate correctly the behavior of mixed-endian formats.

Alignment works as follows:

For each option,

the format gets extra padding until the data starts

at an offset that is a multiple of the minimum between the

option size and the maximum alignment;

this minimum must be a power of 2.

Options @St{c} and @St{z} are not aligned;

option

@St{s} follows the alignment of its starting integer.

All padding is filled with zeros by @Lid{string.pack}

and ignored by @Lid{string.unpack}.

}

}

@sect2{utf8| @title{UTF-8 Support}

This library provides basic support for @x{UTF-8} encoding.

It provides all its functions inside the table @defid{utf8}.

This library does not provide any support for @x{Unicode} other than the handling of the encoding.

Any operation that needs the meaning of a character,

such as character classification, is outside its scope.

Unless stated otherwise,  
all functions that expect a byte position as a parameter  
assume that the given position is either the start of a byte sequence  
or one plus the length of the subject string.  
As in the string library,  
negative indices count from the end of the string.

Functions that create byte sequences  
accept all values up to `@T{0x7FFFFFFF}`,  
as defined in the original UTF-8 specification;  
that implies byte sequences of up to six bytes.

Functions that interpret  
byte sequences only accept  
valid sequences (well formed and not overlong).  
By default, they only accept byte sequences  
that result in valid Unicode code points,  
rejecting values greater than `@T{10FFFF}` and surrogates.  
A boolean argument `@id{lax}`, when available,  
lifts these checks,  
so that all values up to `@T{0x7FFFFFFF}` are accepted.  
(Not well formed and overlong sequences are still rejected.)

`@LibEntry{utf8.char (@Cdots)|`

Receives zero or more integers,  
converts each one to its corresponding UTF-8 byte sequence  
and returns a string with the concatenation of all these sequences.

`}`

`@LibEntry{utf8.charpattern|`

The pattern (a string, not a function) `@St{[\0-\x7F\xC2-\xFD][\x80-\xBF]*}`  
`@see{pm}`,  
which matches exactly one UTF-8 byte sequence,  
assuming that the subject is a valid UTF-8 string.

`}`

`@LibEntry{utf8.codes (s [, lax])|`

Returns values so that the construction  
`@verbatim{`  
`for p, c in utf8.codes(s) do @rep{body} end`  
`}`

will iterate over all UTF-8 characters in string `@id{s}`,  
 with  
`@id{p}` being the position (in bytes) and `@id{c}` the code point  
 of each character.  
 It raises an error if it meets any invalid byte sequence.

}

`@LibEntry{utf8.codepoint (s [, i [, j [, lax]]])|`

Returns the code points (as integers) from all characters in `@id{s}`  
 that start between byte position `@id{i}` and `@id{j}` (both included).  
 The default for `@id{i}` is 1 and for `@id{j}` is `@id{i}`.  
 It raises an error if it meets any invalid byte sequence.

}

`@LibEntry{utf8.len (s [, i [, j [, lax]]])|`

Returns the number of UTF-8 characters in string `@id{s}`  
 that start between positions `@id{i}` and `@id{j}` (both inclusive).  
 The default for `@id{i}` is `@num{1}` and for `@id{j}` is `@num{-1}`.  
 If it finds any invalid byte sequence,  
 returns `@fail` plus the position of the first invalid byte.

}

`@LibEntry{utf8.offset (s, n [, i])|`

Returns the position (in bytes) where the encoding of the  
`@id{n}`-th character of `@id{s}`  
 (counting from position `@id{i}`) starts.  
 A negative `@id{n}` gets characters before position `@id{i}`.  
 The  
 default for `@id{i}` is 1 when `@id{n}` is non-negative  
 and `@T{#s + 1}` otherwise,  
 so that `@T{utf8.offset(s, -n)}` gets the offset of the  
`@id{n}`-th character from the end of the string.  
 If the specified character is neither in the subject  
 nor right after its end,  
 the function returns `@fail`.

As a special case,  
 when `@id{n}` is 0 the function returns the start of the encoding  
 of the character that contains the `@id{i}`-th byte of `@id{s}`.

This function assumes that `@id{s}` is a valid UTF-8 string.

```
}
```

```
}
```

@sect2{tablib| @title{Table Manipulation}}

This library provides generic functions for table manipulation.  
It provides all its functions inside the table @defid{table}.

Remember that, whenever an operation needs the length of a table,  
all caveats about the length operator apply @see{len-op}.  
All functions ignore non-numeric keys  
in the tables given as arguments.

@LibEntry{table.concat (list [, sep [, i [, j]])|}

Given a list where all elements are strings or numbers,  
returns the string  
@T{list[i]..sep..list[i+1] @Cdots sep..list[j]}.  
The default value for @id{sep} is the empty string,  
the default for @id{i} is 1,  
and the default for @id{j} is @T{#list}.  
If @id{i} is greater than @id{j}, returns the empty string.

```
}
```

@LibEntry{table.insert (list, [pos,] value)|}

Inserts element @id{value} at position @id{pos} in @id{list},  
shifting up the elements  
@T{list[pos], list[pos+1], @Cdots, list[#list]}.  
The default value for @id{pos} is @T{#list+1},  
so that a call @T{table.insert(t,x)} inserts @id{x} at the end  
of the list @id{t}.

```
}
```

@LibEntry{table.move (a1, f, e, t [,a2])|}

Moves elements from the table @id{a1} to the table @id{a2},  
performing the equivalent to the following  
multiple assignment:  
@T{a2[t],@Cdots = a1[f],@Cdots,a1[e]}.  
The default for @id{a2} is @id{a1}.  
The destination range can overlap with the source range.  
The number of elements to be moved must fit in a Lua integer.

Returns the destination table `@id{a2}`.

}

`@LibEntry{table.pack (@Cdots)|`

Returns

a new table with all arguments stored into keys 1, 2, etc.  
and with a field `@St{n}` with the total number of arguments.  
Note that the resulting table may not be a sequence,  
if some arguments are `@nil`.

}

`@LibEntry{table.remove (list [, pos])|`

Removes from `@id{list}` the element at position `@id{pos}`,  
returning the value of the removed element.

When `@id{pos}` is an integer between 1 and `@T{#list}`,  
it shifts down the elements

`@T{list[pos+1], list[pos+2], @Cdots, list[#list]}`  
and erases element `@T{list[#list]}`;

The index `@id{pos}` can also be 0 when `@T{#list}` is 0,  
or `@T{#list + 1}`.

The default value for `@id{pos}` is `@T{#list}`,  
so that a call `@T{table.remove(1)}` removes the last element  
of the list `@id{l}`.

}

`@LibEntry{table.sort (list [, comp])|`

Sorts the list elements in a given order, *@emph{in-place}*,  
from `@T{list[1]}` to `@T{list[#list]}`.

If `@id{comp}` is given,

then it must be a function that receives two list elements  
and returns true when the first element must come  
before the second in

the final order,

so that, after the sort,

`@T{i <= j}` implies `@T{not comp(list[j],list[i])}`.

If `@id{comp}` is not given,

then the standard Lua operator `@T{<}` is used instead.

The `@id{comp}` function must define a consistent order;  
more formally, the function must define a strict weak order.  
(A weak order is similar to a total order,

but it can equate different elements for comparison purposes.)

The sort algorithm is not stable:

Different elements considered equal by the given order  
may have their relative positions changed by the sort.

}

@LibEntry{table.unpack (list [, i [, j]])|

Returns the elements from the given list.

This function is equivalent to

```
@verbatim{
return list[i], list[i+1], @Cdots, list[j]
}
```

By default, @id{i} @N{is 1} and @id{j} is @T{#list}.

}

}

@sect2{mathlib| @title{Mathematical Functions}}

This library provides basic mathematical functions.

It provides all its functions and constants inside the table @defid{math}.

Functions with the annotation @St{integer/float}

give

integer results for integer arguments

and float results for non-integer arguments.

The rounding functions

@Lid{math.ceil}, @Lid{math.floor}, and @Lid{math.modf}

return an integer when the result fits in the range of an integer,  
or a float otherwise.

@LibEntry{math.abs (x)|

Returns the maximum value between @id{x} and @id{-x}. (integer/float)

}

@LibEntry{math.acos (x)|

Returns the arc cosine of @id{x} (in radians).

}

@LibEntry{math.asin (x)|

Returns the arc sine of  $\text{@id}\{x\}$  (in radians).

}

`@LibEntry{math.atan (y [, x])|`

`@index{atan} @index{atan2}`

Returns the arc tangent of  $\text{@T}\{y/x\}$  (in radians),  
using the signs of both arguments to find the  
quadrant of the result.

It also handles correctly the case of  $\text{@id}\{x\}$  being zero.

The default value for  $\text{@id}\{x\}$  is 1,  
so that the call `@T{math.atan(y)}`  
returns the arc tangent of  $\text{@id}\{y\}$ .

}

`@LibEntry{math.ceil (x)|`

Returns the smallest integral value greater than or equal to  $\text{@id}\{x\}$ .

}

`@LibEntry{math.cos (x)|`

Returns the cosine of  
 $\text{@id}\{x\}$  (assumed to be in radians).

}

`@LibEntry{math.deg (x)|`

Converts the angle  $\text{@id}\{x\}$  from radians to degrees.

}

`@LibEntry{math.exp (x)|`

Returns the value  $\text{@M}\{e^{\text{@sp}\{x\}}\}$   
(where  $\text{@id}\{e\}$  is the base of natural logarithms).

}

`@LibEntry{math.floor (x)|`

Returns the largest integral value less than or equal to  $\text{@id}\{x\}$ .



}

@LibEntry{math.fmod (x, y)|

Returns the remainder of the division of @id{x} by @id{y} that rounds the quotient towards zero. (integer/float)

}

@LibEntry{math.huge|

The float value @idx{HUGE\_VAL},  
a value greater than any other numeric value.

}

@LibEntry{math.log (x [, base])|

Returns the logarithm of @id{x} in the given base.  
The default for @id{base} is @M{e}  
(so that the function returns the natural logarithm of @id{x}).

}

@LibEntry{math.max (x, @Cdots)|

Returns the argument with the maximum value,  
according to the Lua operator @T{<}.

}

@LibEntry{math.maxinteger|

An integer with the maximum value for an integer.

}

@LibEntry{math.min (x, @Cdots)|

Returns  
the argument with the minimum value,  
according to the Lua operator @T{<}.

}

@LibEntry{math.mininteger|

An integer with the minimum value for an integer.

}

@LibEntry{math.modf (x)|

Returns the integral part of @id{x} and the fractional part of @id{x}.  
Its second result is always a float.

}

@LibEntry{math.pi|

The value of @M{@pi}.

}

@LibEntry{math.rad (x)|

Converts the angle @id{x} from degrees to radians.

}

@LibEntry{math.random ([m [, n]])|

When called without arguments,  
returns a pseudo-random float with uniform distribution  
in the range @C{() @M{[0,1)}. @C{[]}

When called with two integers @id{m} and @id{n},  
@id{math.random} returns a pseudo-random integer  
with uniform distribution in the range @M{[m, n]}.

The call @T{math.random(n)}, for a positive @id{n},  
is equivalent to @T{math.random(1,n)}.

The call @T{math.random(0)} produces an integer with  
all bits (pseudo)random.

This function uses the @idx{xoshiro256\*\*} algorithm to produce  
pseudo-random 64-bit integers,  
which

are the results of calls with @N{argument 0}.

Other results (ranges and floats)

are unbiased extracted from these integers.

Lua initializes its pseudo-random generator with the equivalent of  
a call to @Lid{math.randomseed} with no arguments,  
so that @id{math.random} should generate  
different sequences of results each time the program runs.

}

@LibEntry{math.randomseed ([x [, y]])|

When called with at least one argument,  
the integer parameters `@id{x}` and `@id{y}` are  
joined into a 128-bit `@emphx{seed}` that  
is used to reinitialize the pseudo-random generator;  
equal seeds produce equal sequences of numbers.  
The default for `@id{y}` is zero.

When called with no arguments,  
Lua generates a seed with  
a weak attempt for randomness.

This function returns the two seed components  
that were effectively used,  
so that setting them again repeats the sequence.

To ensure a required level of randomness to the initial state  
(or contrarily, to have a deterministic sequence,  
for instance when debugging  
a program),  
you should call `@Lid{math.randomseed}` with explicit arguments.

}

`@LibEntry{math.sin (x)|`

Returns the sine of `@id{x}` (assumed to be in radians).

}

`@LibEntry{math.sqrt (x)|`

Returns the square root of `@id{x}`.  
(You can also use the expression `@T{x^0.5}` to compute this value.)

}

`@LibEntry{math.tan (x)|`

Returns the tangent of `@id{x}` (assumed to be in radians).

}

`@LibEntry{math.tointeger (x)|`

If the value `@id{x}` is convertible to an integer,  
returns that integer.  
Otherwise, returns `@fail`.

}

@LibEntry{math.type (x)|

Returns @St{integer} if @id{x} is an integer,  
@St{float} if it is a float,  
or @fail if @id{x} is not a number.

}

@LibEntry{math.ult (m, n)|

Returns a boolean,  
@true if and only if integer @id{m} is below integer @id{n} when  
they are compared as @x{unsigned integers}.

}

}

@sect2{iolib| @title{Input and Output Facilities}}

The I/O library provides two different styles for file manipulation.  
The first one uses implicit file handles;  
that is, there  
are operations to set a default input file and a  
default output file,  
and all input/output operations are done over these default files.  
The second style uses explicit file handles.

When using implicit file handles,  
all operations are supplied by table @defid{io}.  
When using explicit file handles,  
the operation @Lid{io.open} returns a file handle  
and then all operations are supplied as methods of the file handle.

The metatable for file handles provides metamethods  
for @idx{\_\_gc} and @idx{\_\_close} that try  
to close the file when called.

The table @id{io} also provides  
three predefined file handles with their usual meanings from C:  
@defid{io.stdin}, @defid{io.stdout}, and @defid{io.stderr}.  
The I/O library never closes these files.

Unless otherwise stated,  
all I/O functions return @fail on failure,

plus an error message as a second result and  
a system-dependent error code as a third result,  
and some non-false value on success.  
On non-POSIX systems,  
the computation of the error message  
and error code  
in case of errors  
may be not `@x{thread safe}`,  
because they rely on the global C variable `@id{errno}`.

`@LibEntry{io.close ([file])|`

Equivalent to `@T{file:close()}`.  
Without a `@id{file}`, closes the default output file.

`}`

`@LibEntry{io.flush ()|`

Equivalent to `@T{io.output():flush()}`.

`}`

`@LibEntry{io.input ([file])|`

When called with a file name, it opens the named file (in text mode),  
and sets its handle as the default input file.

When called with a file handle,  
it simply sets this file handle as the default input file.

When called without arguments,  
it returns the current default input file.

In case of errors this function raises the error,  
instead of returning an error code.

`}`

`@LibEntry{io.lines ([filename, @Cdots])|`

Opens the given file name in read mode  
and returns an iterator function that  
works like `@T{file:lines(@Cdots)}` over the opened file.

When the iterator function fails to read any value,  
it automatically closes the file.

Besides the iterator function,

`@id{io.lines}`

returns three other values:  
two `@nil` values as placeholders,

plus the created file handle.

Therefore, when used in a generic `@Rw{for}` loop, the file is closed also if the loop is interrupted by an error or a `@Rw{break}`.

The call `@T{io.lines()}` (with no file name) is equivalent to `@T{io.input():lines("")}`;

that is, it iterates over the lines of the default input file.

In this case, the iterator does not close the file when the loop ends.

In case of errors opening the file, this function raises the error, instead of returning an error code.

```
}
```

```
@LibEntry{io.open (filename [, mode])|
```

This function opens a file, in the mode specified in the string `@id{mode}`.

In case of success, it returns a new file handle.

The `@id{mode}` string can be any of the following:

```
@description{
```

```
@item{@St{r}| read mode (the default);}
```

```
@item{@St{w}| write mode;}
```

```
@item{@St{a}| append mode;}
```

```
@item{@St{r+}| update mode, all previous data is preserved;}
```

```
@item{@St{w+}| update mode, all previous data is  
erased;}
```

```
@item{@St{a+}| append update mode, previous data is preserved,  
writing is only allowed at the end of file.}
```

```
}
```

The `@id{mode}` string can also have a `@Char{b}` at the end, which is needed in some systems to open the file in binary mode.

```
}
```

```
@LibEntry{io.output ([file])|
```

Similar to `@Lid{io.input}`, but operates over the default output file.

```
}
```

```
@LibEntry{io.popen (prog [, mode])|
```

This function is system dependent and is not available

on all platforms.

Starts the program `@id{prog}` in a separated process and returns a file handle that you can use to read data from this program (if `@id{mode}` is `@T{"r"}`, the default) or to write data to this program (if `@id{mode}` is `@T{"w"}`).

}

`@LibEntry{io.read (@Cdots)|`

Equivalent to `@T{io.input():read(@Cdots)}`.

}

`@LibEntry{io.tmpfile ()|`

In case of success,  
returns a handle for a temporary file.  
This file is opened in update mode  
and it is automatically removed when the program ends.

}

`@LibEntry{io.type (obj)|`

Checks whether `@id{obj}`  
is a valid file handle.  
Returns the string `@T{"file"}` if `@id{obj}` is an open file handle,  
`@T{"closed file"}` if `@id{obj}` is a closed file handle,  
or `@fail` if `@id{obj}` is not a file handle.

}

`@LibEntry{io.write (@Cdots)|`

Equivalent to `@T{io.output():write(@Cdots)}`.

}

`@LibEntry{file:close ()|`

Closes `@id{file}`.  
Note that files are automatically closed when  
their handles are garbage collected,  
but that takes an unpredictable amount of time to happen.

When closing a file handle created with `@Lid{io.popen}`,  
`@Lid{file:close}` returns the same values  
returned by `@Lid{os.execute}`.

```
}
```

```
@LibEntry{file:flush ()|
```

Saves any written data to `@id{file}`.

```
}
```

```
@LibEntry{file:lines (@Cdots)|
```

Returns an iterator function that,  
each time it is called,  
reads the file according to the given formats.

When no format is given,  
uses `@St{1}` as a default.

As an example, the construction

```
@verbatim{  
for c in file:lines(1) do @rep{body} end  
}
```

will iterate over all characters of the file,  
starting at the current  
position.

Unlike `@Lid{io.lines}`, this function does not close the file  
when the loop ends.

```
}
```

```
@LibEntry{file:read (@Cdots)|
```

Reads the file `@id{file}`,  
according to the given formats, which specify what to read.

For each format,  
the function returns a string or a number with the characters read,  
or `@fail` if it cannot read data with the specified format.

(In this latter case,  
the function does not read subsequent formats.)

When called without arguments,  
it uses a default format that reads the next line  
(see below).

The available formats are

```
@description{
```



```
@item{@St{n}|
reads a numeral and returns it as a float or an integer,
following the lexical conventions of Lua.
(The numeral may have leading whitespaces and a sign.)
This format always reads the longest input sequence that
is a valid prefix for a numeral;
if that prefix does not form a valid numeral
(e.g., an empty string, @St{0x}, or @St{3.4e-})
or it is too long (more than 200 characters),
it is discarded and the format returns @fail.
}
```

```
@item{@St{a}|
reads
the whole file, starting at the current position.
On end of file, it returns the empty string;
this format never fails.
}
```

```
@item{@St{l}|
reads the next line skipping the end of line,
returning @fail on end of file.
This is the default format.
}
```

```
@item{@St{L}|
reads the next line keeping the end-of-line character (if present),
returning @fail on end of file.
}
```

```
@item{@emph{number}|
reads a string with up to this number of bytes,
returning @fail on end of file.
If @id{number} is zero,
it reads nothing and returns an empty string,
or @fail on end of file.
}
```

```
}
The formats @St{l} and @St{L} should be used only for text files.
}
```

```
@LibEntry{file:seek ([whence [, offset]])}
```

```
Sets and gets the file position,
measured from the beginning of the file,
to the position given by @id{offset} plus a base
```

specified by the string @id{whence}, as follows:

```
@description{
@item{@St{set}| base is position 0 (beginning of the file);}
@item{@St{cur}| base is current position;}
@item{@St{end}|
base is end of file;}
}
```

In case of success, @id{seek} returns the final file position, measured in bytes from the beginning of the file.

If @id{seek} fails, it returns @fail, plus a string describing the error.

The default value for @id{whence} is @T{"cur"}, and for @id{offset} is 0.

Therefore, the call @T{file:seek()} returns the current file position, without changing it; the call @T{file:seek("set")} sets the position to the beginning of the file (and returns 0); and the call @T{file:seek("end")} sets the position to the end of the file, and returns its size.

```
}
```

```
@LibEntry{file:setvbuf (mode [, size])|
```

Sets the buffering mode for a file.

There are three available modes:

```
@description{
@item{@St{no}| no buffering.}
@item{@St{full}| full buffering.}
@item{@St{line}| line buffering.}
}
```

For the last two cases,

@id{size} is a hint for the size of the buffer, in bytes.

The default is an appropriate size.

The specific behavior of each mode is non portable; check the underlying

@ANSI{setvbuf} in your platform for more details.

```
}
```

```
@LibEntry{file:write (@Cdots)|
```

Writes the value of each of its arguments to @id{file}.

The arguments must be strings or numbers.

In case of success, this function returns @id{file}.

}

}

@sect2{oslib| @title{Operating System Facilities}}

This library is implemented through table @defid{os}.

@LibEntry{os.clock ()|

Returns an approximation of the amount in seconds of CPU time used by the program,  
as returned by the underlying @ANSI{clock}.

}

@LibEntry{os.date ([format [, time]])|

Returns a string or a table containing date and time,  
formatted according to the given string @id{format}.

If the @id{time} argument is present,  
this is the time to be formatted  
(see the @Lid{os.time} function for a description of this value).  
Otherwise, @id{date} formats the current time.

If @id{format} starts with @Char{!},  
then the date is formatted in Coordinated Universal Time.  
After this optional character,  
if @id{format} is the string @St{\*t},  
then

@id{date} returns a table with the following fields:  
@id{year}, @id{month} (1@En{ }12), @id{day} (1@En{ }31),  
@id{hour} (0@En{ }23), @id{min} (0@En{ }59),  
@id{sec} (0@En{ }61, due to leap seconds),  
@id{yday} (weekday, 1@En{ }7, Sunday @N{is 1}),  
@id{yday} (day of the year, 1@En{ }366),  
and @id{isdst} (daylight saving flag, a boolean).  
This last field may be absent  
if the information is not available.

If @id{format} is not @St{\*t},  
then @id{date} returns the date as a string,  
formatted according to the same rules as the @ANSI{strftime}.

If `@id{format}` is absent, it defaults to `@St{%c}`,  
which gives a human-readable date and time representation  
using the current locale.

On non-POSIX systems,  
this function may be not `@x{thread safe}`  
because of its reliance on `@CId{gmtime}` and `@CId{localtime}`.

}

`@LibEntry{os.difftime (t2, t1)|`

Returns the difference, in seconds,  
from time `@id{t1}` to time `@id{t2}`  
(where the times are values returned by `@Lid{os.time}`).  
In `@x{POSIX}`, `@x{Windows}`, and  
some other systems,  
this value is exactly `@id{t2}@M{-}@id{t1}`.

}

`@LibEntry{os.execute ([command])|`

This function is equivalent to the `@ANSI{system}`.  
It passes `@id{command}` to be executed by an operating system shell.  
Its first result is `@true`  
if the command terminated successfully,  
or `@fail` otherwise.  
After this first result  
the function returns a string plus a number,  
as follows:  
`@description{`

`@item{@St{exit}|`  
the command terminated normally;  
the following number is the exit status of the command.  
}

`@item{@St{signal}|`  
the command was terminated by a signal;  
the following number is the signal that terminated the command.  
}

}

When called without a `@id{command}`,  
`@id{os.execute}` returns a boolean that is true if a shell is available.

}

@LibEntry{os.exit ([code [, close]])|

Calls the @ANSI{exit} to terminate the host program.

If @id{code} is @true,

the returned status is @idx{EXIT\_SUCCESS};

if @id{code} is @false,

the returned status is @idx{EXIT\_FAILURE};

if @id{code} is a number,

the

returned status is this number.

The default value for @id{code} is @true.

If the optional second argument @id{close} is true,

the function closes the Lua state before exiting @seeF{lua\_close}.

}

@LibEntry{os.getenv (varname)|

Returns the value of the process environment variable @id{varname}

or @fail if the variable is not defined.

}

@LibEntry{os.remove (filename)|

Deletes the file (or empty directory, on @x{POSIX} systems)  
with the given name.

If this function fails, it returns @fail

plus a string describing the error and the error code.

Otherwise, it returns true.

}

@LibEntry{os.rename (oldname, newname)|

Renames the file or directory named @id{oldname} to @id{newname}.

If this function fails, it returns @fail,

plus a string describing the error and the error code.

Otherwise, it returns true.

}

@LibEntry{os.setlocale (locale [, category])|

Sets the current locale of the program.

@id{locale} is a system-dependent string specifying a locale;

@id{category} is an optional

string describing which category to change:

@T{"all"}, @T{"collate"}, @T{"ctype"},

@T{"monetary"}, @T{"numeric"}, or @T{"time"};

the default category is @T{"all"}.

The function returns the name of the new locale,

or @fail if the request cannot be honored.

If @id{locale} is the empty string,

the current locale is set to an implementation-defined native locale.

If @id{locale} is the string @St{C},

the current locale is set to the standard C locale.

When called with @nil as the first argument,

this function only returns the name of the current locale

for the given category.

This function may be not @x{thread safe}

because of its reliance on @Cid{setlocale}.

}

@LibEntry{os.time ([table])|

Returns the current time when called without arguments,

or a time representing the local date and time specified by the given table.

This table must have fields @id{year}, @id{month}, and @id{day},

and may have fields

@id{hour} (default is 12),

@id{min} (default is 0),

@id{sec} (default is 0),

and

@id{isdst} (default is @nil).

Other fields are ignored.

For a description of these fields, see the @Lid{os.date} function.

When the function is called,

the values in these fields do not need to be inside their valid ranges.

For instance, if @id{sec} is -10,

it means 10 seconds before the time specified by the other fields;

if @id{hour} is 1000,

it means 1000 hours after the time specified by the other fields.

The returned value is a number, whose meaning depends on your system.

In @x{POSIX}, @x{Windows}, and some other systems,

this number counts the number

of seconds since some given start time (the `@Q{epoch}`).

In other systems, the meaning is not specified,  
and the number returned by `@id{time}` can be used only as an argument to  
`@Lid{os.date}` and `@Lid{os.difftime}`.

When called with a table,  
`@id{os.time}` also normalizes all the fields  
documented in the `@Lid{os.date}` function,  
so that they represent the same time as before the call  
but with values inside their valid ranges.

}

`@LibEntry{os.tmpname`  
`()`

Returns a string with a file name that can  
be used for a temporary file.  
The file must be explicitly opened before its use  
and explicitly removed when no longer needed.

In `@x{POSIX}` systems,  
this function also creates a file with that name,  
to avoid security risks.  
(Someone else might create the file with wrong permissions  
in the time between getting the name and creating the file.)  
You still have to open the file to use it  
and to remove it (even if you do not use it).

When possible,  
you may prefer to use `@Lid{io.tmpfile}`,  
which automatically removes the file when the program ends.

}

}

`@sect2{debuglib| @title{The Debug Library}`

This library provides  
the functionality of the `@link{debugI|debug interface}` to Lua programs.  
You should exert care when using this library.  
Several of its functions  
violate basic assumptions about Lua code  
(e.g., that variables local to a function  
cannot be accessed from outside;  
that userdata metatables cannot be changed by Lua

code;  
that Lua programs do not crash)  
and therefore can compromise otherwise secure code.  
Moreover, some functions in this library may be slow.

All functions in this library are provided  
inside the `@defid{debug}` table.

All functions that operate over a thread  
have an optional first argument which is the  
thread to operate over.

The default is always the current thread.

`@LibEntry{debug.debug ()|`

Enters an interactive mode with the user,  
running each string that the user enters.  
Using simple commands and other debug facilities,  
the user can inspect global and local variables,  
change their values, evaluate expressions, and so on.  
A line containing only the word `@id{cont}` finishes this function,  
so that the caller continues its execution.

Note that commands for `@id{debug.debug}` are not lexically nested  
within any function and so have no direct access to local variables.

`}`

`@LibEntry{debug.gethook ([thread])|`

Returns the current hook settings of the thread, as three values:  
the current  
hook function, the current hook mask,  
and the current hook count,  
as set by the `@Lid{debug.sethook}` function.

Returns `@fail` if there is no active hook.

`}`

`@LibEntry{debug.getinfo ([thread,] f [, what])|`

Returns a table with information about a function.  
You can give the function directly  
or you can give a number as the value of `@id{f}`,  
which means the function running at level `@id{f}` of the call stack  
of the given thread:  
`@N{level 0}` is the current function (`@id{getinfo}` itself);



@N{level 1} is the function that called @id{getinfo}  
(except for tail calls, which do not count in the stack);  
and so on.

If @id{f} is a number greater than the number of active functions,  
then @id{getinfo} returns @fail.

The returned table can contain all the fields returned by @Lid{lua\_getinfo},  
with the string @id{what} describing which fields to fill in.

The default for @id{what} is to get all information available,  
except the table of valid lines.

The option @Char{f}  
adds a field named @id{func} with  
the function itself.

The option @Char{L} adds a field named @id{activelines}  
with the table of valid lines,

provided the function is a Lua function.

If the function has no debug information,  
the table is empty.

For instance, the expression @T{debug.getinfo(1,"n").name} returns  
a name for the current function,  
if a reasonable name can be found,  
and the expression @T{debug.getinfo(print)}  
returns a table with all available information  
about the @Lid{print} function.

}

@LibEntry{debug.getlocal ([thread,] f, local)|

This function returns the name and the value of the local variable  
with index @id{local} of the function at level @id{f} of the stack.  
This function accesses not only explicit local variables,  
but also parameters and temporary values.

The first parameter or local variable has @N{index 1}, and so on,  
following the order that they are declared in the code,  
counting only the variables that are active  
in the current scope of the function.

Compile-time constants may not appear  
in this listing,

if they were optimized away by the compiler.

Negative indices refer to vararg arguments;

@num{-1} is the first vararg argument.

The function returns @fail

if there is no variable with the given index,

and raises an error when called with a level out of range.

(You can call @Lid{debug.getinfo} to check whether the level is valid.)

Variable names starting with @Char{() (open parenthesis) @C{}} represent variables with no known names (internal variables such as loop control variables, and variables from chunks saved without debug information).

The parameter @id{f} may also be a function. In that case, @id{getlocal} returns only the name of function parameters.

}

@LibEntry{debug.getmetatable (value)|

Returns the metatable of the given @id{value} or @nil if it does not have a metatable.

}

@LibEntry{debug.getregistry ()|

Returns the registry table @see{registry}.

}

@LibEntry{debug.getupvalue (f, up)|

This function returns the name and the value of the upvalue with

index @id{up} of the function @id{f}.

The function returns @fail if there is no upvalue with the given index.

(For Lua functions, upvalues are the external local variables that the function uses, and that are consequently included in its closure.)

For @N{C functions}, this function uses the empty string @T{""} as a name for all upvalues.

Variable name @Char{?} (interrogation mark) represents variables with no known names (variables from chunks saved without debug information).

}

@LibEntry{debug.getuservalue (u, n)|

Returns the @id{n}-th user value associated

to the userdata `@id{u}` plus a boolean,  
`@false` if the userdata does not have that value.

}

`@LibEntry{debug.sethook ([thread,] hook, mask [, count])|`

Sets the given function as the debug hook.

The string `@id{mask}` and the number `@id{count}` describe  
when the hook will be called.

The string mask may have any combination of the following characters,  
with the given meaning:

`@description{`

`@item{@Char{c}|` the hook is called every  
time Lua calls a function;`}`

`@item{@Char{r}|` the hook is called every time Lua returns from a function;`}`

`@item{@Char{l}|` the hook is called every time Lua enters a new line of code.`}`  
`}`

Moreover,

with a `@id{count}` different from zero,  
the hook is called also after every `@id{count}` instructions.

When called without arguments,

`@Lid{debug.sethook}` turns off the hook.

When the hook is called, its first parameter is a string  
describing the event that has triggered its call:

`@T{"call"}`, `@T{"tail call"}`, `@T{"return"}`,

`@T{"line"}`, and `@T{"count"}`.

For line events,

the hook also gets the new line number as its second parameter.

Inside a hook,

you can call `@id{getinfo}` with `@N{level 2}` to get more information about  
the running function.

(`@N{Level 0}` is the `@id{getinfo}` function,

and `@N{level 1}` is the hook function.)

}

`@LibEntry{debug.setlocal ([thread,] level, local, value)|`

This function assigns the value `@id{value}` to the local variable  
with index `@id{local}` of the function at level `@id{level}`  
of the stack.

The function returns `@fail` if there is no local  
variable with the given index,

and raises an error when called with a `@id{level}` out of range.

(You can call `@id{getinfo}` to check whether the level is valid.)

Otherwise, it returns the name of the local variable.

See @Lid{debug.getlocal} for more information about variable indices and names.

}

@LibEntry{debug.setmetatable (value, table)|

Sets the metatable for the given @id{value} to the given @id{table} (which can be @nil).

Returns @id{value}.

}

@LibEntry{debug.setupvalue (f, up, value)|

This function assigns the value @id{value} to the upvalue with index @id{up} of the function @id{f}.

The function returns @fail if there is no upvalue with the given index.

Otherwise, it returns the name of the upvalue.

See @Lid{debug.getupvalue} for more information about upvalues.

}

@LibEntry{debug.setuservalue (udata, value, n)|

Sets the given @id{value} as the @id{n}-th user value associated to the given @id{udata}.

@id{udata}

must be a full userdata.

Returns @id{udata},

or @fail if the userdata does not have that value.

}

@LibEntry{debug.traceback ([thread,] [message [, level]])|

If @id{message} is present but is neither a string nor @nil, this function returns @id{message} without further processing.

Otherwise,

it returns a string with a traceback of the call stack.

The optional @id{message} string is appended at the beginning of the traceback.

An optional @id{level} number tells at which level

to start the traceback  
(default is 1, the function calling @id{traceback}).

}

@LibEntry{debug.upvalueid (f, n)|

Returns a unique identifier (as a light userdata)  
for the upvalue numbered @id{n}  
from the given function.

These unique identifiers allow a program to check whether different  
closures share upvalues.

Lua closures that share an upvalue  
(that is, that access a same external local variable)  
will return identical ids for those upvalue indices.

}

@LibEntry{debug.upvaluejoin (f1, n1, f2, n2)|

Make  
the @id{n1}-th upvalue of the Lua closure @id{f1}  
refer to the @id{n2}-th upvalue of the Lua closure @id{f2}.

}

}

}

@C{-----}  
@sect1{lua-sa| @title{Lua Standalone}}

Although Lua has been designed as an extension language,  
to be embedded in a host @N{C program},  
it is also frequently used as a standalone language.  
An interpreter for Lua as a standalone language,  
called simply @id{lua},  
is provided with the standard distribution.  
The @x{standalone interpreter} includes  
all standard libraries.

Its usage is:

@verbatim{  
lua [options] [script [args]]  
}

The options are:

```

@description{
@item{@T{-e @rep{stat}}| execute string @rep{stat};}
@item{@T{-i}| enter interactive mode after running @rep{script};}
@item{@T{-l @rep{mod}}| @Q{require} @rep{mod} and assign the
result to global @rep{mod};}
@item{@T{-l @rep{g=mod}}| @Q{require} @rep{mod} and assign the
result to global @rep{g};}
@item{@T{-v}| print version information;}
@item{@T{-E}|
ignore environment variables;}
@item{@T{-W}| turn warnings on;}
@item{@T{--}| stop handling options;}
@item{@T{-}| execute @id{stdin} as a file and stop handling options.}
}
(The form @T{-l @rep{g=mod}} was introduced in @N{release 5.4.4}.)

```

After handling its options, @id{lua} runs the given @emph{script}.

When called without arguments,

@id{lua} behaves as @T{lua -v -i}

when the standard input (@id{stdin}) is a terminal,

and as @T{lua -} otherwise.

When called without the option @T{-E},

the interpreter checks for an environment variable @defid{LUA\_INIT\_5\_4}

(or @defid{LUA\_INIT} if the versioned name is not defined)

before running any argument.

If the variable content has the format @T{@At@rep{filename}},

then @id{lua} executes the file.

Otherwise, @id{lua} executes the string itself.

When called with the option @T{-E},

Lua does not consult any environment variables.

In particular,

the values of @Lid{package.path} and @Lid{package.cpath}

are set with the default

paths defined in @id{luaconf.h}.

To signal to the libraries that this option is on,

the stand-alone interpreter sets the field

@idx{"LUA\_NOENV"} in the registry to a true value.

Other libraries may consult this field for the same purpose.

The options @T{-e}, @T{-l}, and @T{-W} are handled in the order they appear.

For instance, an invocation like

```

@verbatim{
$ lua -e 'a=1' -llib1 script.lua
}

```

will first set @id{a} to 1, then require the library @id{lib1},

and finally run the file `@id{script.lua}` with no arguments.  
(Here `@T{$}` is the shell prompt. Your prompt may be different.)

Before running any code,  
`@id{lua}` collects all command-line arguments  
in a global table called `@id{arg}`.  
The script name goes to index 0,  
the first argument after the script name goes to index 1,  
and so on.

Any arguments before the script name  
(that is, the interpreter name plus its options)  
go to negative indices.

For instance, in the call

```
@verbatim{
$ lua -la b.lua t1 t2
}
```

the table is like this:

```
@verbatim{
arg
= { [-2] = "lua", [-1] = "-la",
    [0] = "b.lua",
    [1] = "t1", [2] = "t2" }
}
```

If there is no script in the call,  
the interpreter name goes to index 0,  
followed by the other arguments.

For instance, the call

```
@verbatim{
$ lua -e "print(arg[1])"
}
```

will print `@St{-e}`.

If there is a script,  
the script is called with arguments  
`@T{arg[1]}`, `@Cdots`, `@T{arg[#arg]}`.

Like all chunks in Lua,  
the script is compiled as a variadic function.

In interactive mode,  
Lua repeatedly prompts and waits for a line.  
After reading a line,  
Lua first try to interpret the line as an expression.  
If it succeeds, it prints its value.  
Otherwise, it interprets the line as a statement.  
If you write an incomplete statement,  
the interpreter waits for its completion  
by issuing a different prompt.

If the global variable `@defid{_PROMPT}` contains a string,

then its value is used as the prompt.  
Similarly, if the global variable `@defid{_PROMPT2}` contains a string,  
its value is used as the secondary prompt  
(issued  
during incomplete statements).

In case of unprotected errors in the script,  
the interpreter reports the error to the standard error stream.  
If the error object is not a string but  
has a metamethod `@idx{__tostring}`,  
the interpreter calls this metamethod to produce the final message.  
Otherwise, the interpreter converts the error object to a string  
and adds a stack traceback to it.  
When warnings are on,  
they are simply printed in the standard error output.

When finishing normally,  
the interpreter closes its main Lua state  
`@seeF{lua_close}`.  
The script can avoid this step by  
calling `@Lid{os.exit}` to terminate.

To allow the use of Lua as a  
script interpreter in Unix systems,  
Lua skips the first line of a file chunk if it starts with `@T{#}`.  
Therefore, Lua scripts can be made into executable programs  
by using `@T{chmod +x}` and `@N{the @T{#!}}` form,  
as in

```
@verbatim{
#!/usr/local/bin/lua
}
```

Of course,  
the location of the Lua interpreter may be different in your machine.

If `@id{lua}` is in your

`@id{PATH}`,

then

```
@verbatim{
#!/usr/bin/env lua
}
```

is a more portable solution.

```
}
```

`@sect1{incompat| @title{Incompatibilities with the Previous Version}`

`@simplesect{`



Here we list the incompatibilities that you may find when moving a program from @N{Lua 5.3} to @N{Lua 5.4}.

You can avoid some incompatibilities by compiling Lua with appropriate options (see file @id{luaconf.h}).

However,

all these compatibility options will be removed in the future.

More often than not,

compatibility issues arise when these compatibility options are removed.

So, whenever you have the chance,

you should try to test your code with a version of Lua compiled with all compatibility options turned off.

That will ease transitions to newer versions of Lua.

Lua versions can always change the C API in ways that do not imply source-code changes in a program, such as the numeric values for constants or the implementation of functions as macros.

Therefore,

you should never assume that binaries are compatible between different

Lua versions.

Always recompile clients of the Lua API when using a new version.

Similarly, Lua versions can always change the internal representation of precompiled chunks; precompiled chunks are not compatible between different Lua versions.

The standard paths in the official distribution may change between versions.

}

@sect2{@title{Incompatibilities in the Language}

@itemize{

@item{

The coercion of strings to numbers in arithmetic and bitwise operations has been removed from the core language.

The string library does a similar job for arithmetic (but not for bitwise) operations using the string metamethods.

However, unlike in previous versions, the new implementation preserves the implicit type of the numeral in the string.

For instance, the result of `@T{"1" + "2"}` now is an integer,  
not a float.

`@item{`  
Literal decimal integer constants that overflow are read as floats,  
instead of wrapping around.  
You can use hexadecimal notation for such constants if you  
want  
the old behavior  
(reading them as integers with wrap around).  
`}`

`@item{`  
The use of the `@idx{__lt}` metamethod to emulate `@idx{__le}`  
has been removed.  
When needed, this metamethod must be explicitly defined.  
`}`

`@item{`  
The semantics of the numerical `@Rw{for}` loop  
over integers changed in some details.  
In particular, the control variable never wraps around.  
`}`

`@item{`  
A label for a `@Rw{goto}` cannot be declared where a label with the same  
name is visible, even if this other label is declared in an enclosing  
block.  
`}`

`@item{`  
When finalizing an object,  
Lua does not ignore `@idx{__gc}` metamethods that are not functions.  
Any value will be called, if present.  
(Non-callable values will generate a warning,  
like any other error when calling a finalizer.)  
`}`

`}`

`}`

`@sect2{@title{Incompatibilities in the Libraries}`  
`@itemize{`

`@item{`  
The function `@Lid{print}` does not call `@Lid{tostring}`

to format its arguments;  
instead, it has this functionality hardwired.  
You should use `@idx{__tostring}` to modify how values  
are printed.  
}

@item{  
The pseudo-random number generator used by the function `@Lid{math.random}`  
now starts with a somewhat random seed.  
Moreover, it uses a different algorithm.  
}

@item{  
By default, the decoding functions in the `@Lid{utf8}` library  
do not accept surrogates as valid code points.  
An extra parameter in these functions makes them more permissive.  
}

@item{  
The options `@St{setpause}` and `@St{setstepmul}`  
of the function `@Lid{collectgarbage}` are deprecated.  
You should use the new option `@St{incremental}` to set them.  
}

@item{  
The function `@Lid{io.lines}` now returns four values,  
instead of just one.  
That can be a problem when it is used as the sole  
argument to another function that has optional parameters,  
such as in `@T{load(io.lines(filename, "L"))}`.  
To fix that issue,  
you can wrap the call into parentheses,  
to adjust its number of results to one.  
}

}

}

@sect2{@title{Incompatibilities in the API}

@itemize{

@item{  
Full userdata now has an arbitrary number of associated  
user values.  
Therefore, the functions `@id{lua_newuserdata}`,  
`@id{lua_setuservalue}`, and `@id{lua_getuservalue}` were

replaced by @Lid{lua\_newuserdatauv},  
@Lid{lua\_setiuservalue}, and @Lid{lua\_getiuservalue},  
which have an extra argument.

For compatibility, the old names still work as macros assuming  
one single user value.

Note, however, that userdata with zero user values  
are more efficient memory-wise.

}

@item{

The function @Lid{lua\_resume} has an extra parameter.

This out parameter returns the number of values on  
the top of the stack that were yielded or returned by the coroutine.

(In previous versions,  
those values were the entire stack.)

}

@item{

The function @Lid{lua\_version} returns the version number,  
instead of an address of the version number.

The Lua core should work correctly with libraries using their  
own static copies of the same core,  
so there is no need to check whether they are using the same  
address space.

}

@item{

The constant @id{LUA\_ERRGCMM} was removed.

Errors in

finalizers are never propagated;  
instead, they generate a warning.

}

@item{

The options @idx{LUA\_GCSETPAUSE} and @idx{LUA\_GCSETSTEPMUL}  
of the function @Lid{lua\_gc} are deprecated.

You should use the new option @id{LUA\_GCINC} to set them.

}

}

}

}

@C{[=====]}

@sect1{BNF| @title{The Complete Syntax of Lua}

Here is the complete syntax of Lua in extended BNF.

As usual in extended BNF,

@bnfNter{A} means 0 or more @bnfNter{A}s,

and @bnfNter{[A]} means an optional @bnfNter{A}.

(For operator precedences, see @See{prec};

for a description of the terminals

@bnfNter{Name}, @bnfNter{Numeral},

and @bnfNter{LiteralString}, see @See{lexical}.)

@index{grammar}

@Produc{

@producname{chunk}@producbody{block}

@producname{block}@producbody{@bnfrep{stat} @bnfopt{retstat}}

@producname{stat}@producbody{

@bnfter{;}

@OrNL varlist @bnfter{=} explist

@OrNL functioncall

@OrNL label

@OrNL @Rw{break}

@OrNL @Rw{goto} Name

@OrNL @Rw{do} block

@Rw{end}

@OrNL @Rw{while} exp @Rw{do} block @Rw{end}

@OrNL @Rw{repeat} block @Rw{until} exp

@OrNL @Rw{if} exp @Rw{then} block

@bnfrep{@Rw{elseif} exp @Rw{then} block}

@bnfopt{@Rw{else} block} @Rw{end}

@OrNL @Rw{for} @bnfNter{Name} @bnfter{=} exp @bnfter{,} exp @bnfopt{@bnfter{,} exp}

@Rw{do} block @Rw{end}

@OrNL @Rw{for} namelist @Rw{in} explist @Rw{do} block @Rw{end}

@OrNL @Rw{function} funcname funcbody

@OrNL @Rw{local} @Rw{function} @bnfNter{Name} funcbody

@OrNL @Rw{local} attnamelist @bnfopt{@bnfter{=} explist}

}

@producname{attnamelist}@producbody{

@bnfNter{Name} attrib @bnfrep{@bnfter{,} @bnfNter{Name} attrib}}

@producname{attrib}@producbody{@bnfopt{@bnfter{<} @bnfNter{Name} @bnfter{>}}}

@producname{retstat}@producbody{@Rw{return}

@bnfopt{explist} @bnfopt{@bnfter{;}}}

@producname{label}@producbody{@bnfter{::} Name @bnfter{::}}

@producname{funcname}@producbody{@bnfNter{Name} @bnfrep{@bnfter{.} @bnfNter{Name}}}

@bnfopt{@bnfter{:} @bnfNter{Name}}}

@producname{varlist}@producbody{var @bnfrep{@bnfter{,} var}}

@producname{var}@producbody{  
@bnfNter{Name}  
@Or prefixexp @bnfter{[] exp @bnfter{[]}  
@Or prefixexp @bnfter{.} @bnfNter{Name}  
}

@producname{namelist}@producbody{@bnfNter{Name} @bnfrep{@bnfter{,} @bnfNter{Name}}}

@producname{explist}@producbody{exp @bnfrep{@bnfter{,} exp}}

@producname{exp}@producbody{  
@Rw{nil}  
@Or @Rw{false}  
@Or @Rw{true}  
@Or @bnfNter{Numeral}  
@Or @bnfNter{LiteralString}  
@Or @bnfter{...}  
@Or functiondef  
@OrNL prefixexp  
@Or tableconstructor  
@Or exp binop exp  
@Or unop exp  
}

@producname{prefixexp}@producbody{var @Or functioncall @Or @bnfter{() exp @bnfter{())}}

@producname{functioncall}@producbody{  
prefixexp args  
@Or prefixexp @bnfter{:} @bnfNter{Name} args  
}

@producname{args}@producbody{  
@bnfter{() @bnfopt{explist} @bnfter{())}  
@Or tableconstructor  
@Or @bnfNter{LiteralString}  
}

@producname{functiondef}@producbody{@Rw{function} funcbody}

```

@producname{funcbody}@producbody{@bnfter{()
@bnfopt{parlist} @bnfter{)}} block @Rw{end}}

@producname{parlist}@producbody{namelist @bnfopt{@bnfter{,} @bnfter{...}}
@Or @bnfter{...}}

@producname{tableconstructor}@producbody{@bnfter{@Open} @bnfopt{fieldlist} @bnfter{@Close}}

@producname{fieldlist}@producbody{field @bnfrep{fieldsep field} @bnfopt{fieldsep}}

@producname{field}@producbody{@bnfter{[] exp @bnfter{[] @bnfter{=} exp @Or @bnfNter{Name}
@bnfter{=} exp @Or exp}

@producname{fieldsep}@producbody{@bnfter{,} @Or @bnfter{;}}

@producname{binop}@producbody{
@bnfter{+} @Or @bnfter{-} @Or @bnfter{*} @Or @bnfter{/} @Or @bnfter{//}
@Or @bnfter{^} @Or @bnfter{%}
@OrNL
@bnfter{&} @Or @bnfter{~} @Or @bnfter{[] @Or @bnfter{>>} @Or @bnfter{<<}
@Or @bnfter{..}
@OrNL
@bnfter{<} @Or @bnfter{<=} @Or @bnfter{>} @Or @bnfter{>=}
@Or @bnfter{==} @Or @bnfter{~=}
@OrNL
@Rw{and} @Or @Rw{or}}

@producname{unop}@producbody{@bnfter{-} @Or @Rw{not} @Or @bnfter{#} @Or
@bnfter{~}}

}

}

@C{=====}

}
@C{]-----}

```

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

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```
# Automatically generated by apkgbuild-cpan, template 4
# Contributor: Valery Kartel <valery.kartel@gmail.com>
# Maintainer: Celeste <cielesti@protonmail.com>
maintainer="Celeste <cielesti@protonmail.com>"
pkgname=perl-bsd-resource
pkgver=1.2911
pkgrel=10
#_pkgreal is used by apkgbuild-cpan to find modules at MetaCpan
_pkgreal=BSD-Resource
pkgdesc="Perl extension implements the BSD process resource limit functions"
```



```

url="https://metacpan.org/release/BSD-Resource/"
arch="all"
license="Artistic-2.0 OR LGPL-2.0"
depends="perl"
makedepends="perl-dev"
subpackages="$pkgname-doc"
source="https://cpan.metacpan.org/authors/id/J/JH/JHI/BSD-Resource-$pkgver.tar.gz"
builddir="$srcdir/$_pkgreal-$pkgver"

build() {
    export CFLAGS=$(perl -MConfig -E 'say $Config{ccflags}')
    PERL_MM_USE_DEFAULT=1 perl -I. Makefile.PL \
        INSTALLDIRS=vendor \
        NO_PACKLIST=1 \
        NO_PERLLOCAL=1
    make
}

check() {
    export CFLAGS=$(perl -MConfig -E 'say $Config{ccflags}')
    make test
}

package() {
    make DESTDIR="$pkgdir" install
}

sha512sums="
d0032d41c7c0468ed1c6d8f57b885f6cb97a5039d754c8cb60b2067daedaf53bd15fb6561a3d0f828df16dfa5417f663b
8065ba65f4fea16dc9262728b3b6b85
    BSD-Resource-1.2911.tar.gz
"

# Contributor: Maxim Karasev <begs@disroot.org>
# Maintainer: mio <miyopan@e.email>
pkgname=bsd-games
pkgver=3.3
pkgrel=2
pkgdesc="traditional text mode games from BSD"
url="https://bsd-games.sourceforge.io/"
arch="all"
license="BSD-3-Clause"
install="$pkgname.post-install"
makedepends="ncurses-dev coreutils" # configure causes busybox expr error
subpackages="$pkgname-doc"
source="https://sourceforge.net/projects/bsd-games/files/bsd-games-$pkgver.tar.gz
0001-bsd-games-scores-dir.patch
"

options="!check" # no tests

```

```

build() {
# some GNU autoconf options are ignored, but it works
./configure \
--build=$CBUILD \
--host=$CHOST \
--prefix=/usr \
--sysconfdir=/etc \
--mandir=/usr/share/man \
--scoredir=/usr/share/$pkgname
make
}

package() {
make DESTDIR="$pkgdir" install
install -Dm644 LICENSE "$pkgdir"/usr/share/licenses/bsd-games/LICENSE
}

```

```

sha512sums="
aaf36d09d4fe68514a5c279063d7e77a9a9a84c447037cba974b29faa07eb80c2aab2379d0699c196b5c27ffe1b2bb2c6
8d3390143e0e62d5e3d210ccfb61294
bsd-games-3.3.tar.gz
e1def0d4835a877242c4173fae862e278a7858738e0bacacbb045a42bcabec2aa7c72d000bbd2421ce35fe66cdc1f52c0
577b7e278029ca5ed50f7aab22319f6 0001-bsd-games-scores-dir.patch
"

```

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```

# Maintainer: Natanael Copa <ncopa@alpinelinux.org>
pkgname=libart-lgpl
pkgver=2.3.21
pkgrel=8
pkgdesc="A library for high-performance 2D graphics"
url="https://www.levien.com/libart/"
arch="all"
options="!check" # No test suite.
license="LGPL-2.0-or-later"
subpackages="$pkgname-dev"
source="https://download.gnome.org/sources/libart-lgpl/2.3/libart-lgpl-$pkgver.tar.bz2"
"

builddir="$srcdir"/libart-lgpl-$pkgver

prepare() {
    update_config_sub
    default_prepare
}

build() {
    ./configure \
        --build=$CBUILD \
        --host=$CHOST \
        --prefix=/usr
    make
}

package() {
    make DESTDIR="$pkgdir" install
}

sha512sums="8a632a6a4da59e5e8c02ec2f5a57e36d182b325b46513765425e5f171ff9ae326af1b133725beba28f7e7
6654309e001aee9bace727b5b4c8589405256a3c020 libart-lgpl-2.3.21.tar.bz2"
mini_sendmail - accept email on behalf of real sendmail

```

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# Contributor: Carlo Landmeter <clandmeter@alpinelinux.org>

# Maintainer: Kevin Daudt <kdaudt@alpinelinux.org>

pkgname=spdx-licenses

pkgver=3.26.0

pkgrel=0

pkgdesc="Various data formats for the SPDX License List"

url="https://spdx.org/"

arch="noarch"

options="!check" # no test suite

license="CC-BY-3.0"

source="license-list-data-\$pkgver.tar.gz::https://github.com/spdx/license-list-data/archive/v\$pkgver.tar.gz"

builddir="\$srcdir/license-list-data-\$pkgver"

subpackages="\$pkgname-list"

\_types="html json rdfa rdft rdfturtle rdfxml template text"

for type in \$\_types; do

subpackages="\$subpackages \$pkgname-\$type:\_subpkg"

done

package() {

mkdir -p "\$pkgdir"

}

\_subpkg() {

local type=\${subpkgname/\$pkgname-/}

pkgdesc="\$pkgdesc (\$type)"

install\_if="\$pkgname=\$pkgver-r\$pkgrel"

mkdir -p "\$subpkgdir"/usr/share/spdx

cp -r "\$builddir"/\$type "\$subpkgdir"/usr/share/spdx/

}

list() {

pkgdesc="\$pkgdesc (licence list)"

mkdir -p "\$subpkgdir"/usr/share/spdx

local i; for i in "\$builddir"/text/\*.txt;

```

do
  local license=${i##*/}
  echo ${license%.*} >> "$subpkgdir"/usr/share/spdx/license.lst
done
}

sha512sums="
67e618d4642dfe4f366935d9514d6f7941d3711e77c49bc1b340ac572d36015981b8f10c72a9f80f1d83e132ae7e5093c
0155e0c0e786e4777ee16d1cb7b885a  license-list-data-3.26.0.tar.gz
"

# Contributor: Patrycja Rosa <alpine@ptrcnll.me>
# Maintainer: Patrycja Rosa <alpine@ptrcnll.me>
pkgname=bsd-compat-headers
pkgver=0.7.2
pkgrel=6
pkgdesc="BSD compatibility headers (cdefs, queue, tree)"
url="https://gitlab.alpinelinux.org/alpine/aports"
arch="noarch"
license="BSD-2-Clause AND BSD-3-Clause"
source="
cdefs.h
queue.h
tree.h
"

builddir="$srcdir"
options="!check" # just headers

package() {
  mkdir -p "$pkgdir"
  install -Dm644 -t "$pkgdir"/usr/include/sys \
    cdefs.h queue.h tree.h
}

sha512sums="
37c8fc73c7aea7b490f7850927e2bb91d12137c9e59e22c084146d515696dbc7973b5de92f4c987ba080dd2502ba8312
7006442c3f019b6447a620c0cae73178  cdefs.h
2f0d5e6e4dc3350285cf17009265dddcbe12431c111868eea39bc8cb038ab7c1f2acacbb21735c4e9d4a1fd106a8fc0f86
11ea33987d4faba37dde5ce6da0750  queue.h
d9ac210d81feb8ad2655bc80fb065d3fe20ae4417b32b4a1711e6738a4870140005c13373b5d1846ef3ce5ae6da45f2da
cef2092881eded0a2e94f6a07752ef3  tree.h
"

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```

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The Kohonen neural network code for color optimization was written by Anthony Dekker.

Parts Copyright (c) 1995 by C. Blanc and C. Schlick

The X-Spline code was written Carole Blanc (blanc@labri.u-bordeaux.fr) and Christophe Schlick (schlick@labri.u-bordeaux.fr) starting from an initial implementation done by C. Feuille, S. Grosbois, L. Maziere and L. Minihot as a student practice (Universite Bordeaux, France). For additional information about X-splines, see:

"X-Splines: A Spline Model Designed for the End User" by C. Blanc and C. Schlick, Proceedings of SIGGRAPH'95

<http://dept-info.labri.u-bordeaux.fr/~schlick/DOC/sig1.html>

# Contributor: Dhruvin Gandhi <contact@dhruvin>

# Maintainer: Patrycja Rosa <alpine@ptrcnull.me>

pkgname=py3-license-expression

\_pkgname=license\_expression

pkgver=30.4.1

pkgrel=0

pkgdesc="Library to parse, compare, simplify and normalize license expressions"

url="https://github.com/nexB/license-expression"

arch="noarch"

license="Apache-2.0"

depends="python3 py3-boolean.py"

makedepends="py3-setuptools py3-setuptools\_scm py3-gpep517 py3-wheel"

checkdepends="py3-pytest py3-pytest-xdist"

subpackages="\$pkgname-pyc"

source="https://files.pythonhosted.org/packages/source/l/\_pkgname/\_pkgname-\$pkgver.tar.gz"

builddir="\$srcdir/\_pkgname-\$pkgver"

build() {

gpep517 build-wheel \

--wheel-dir .dist \

--output-fd 3 3>&1 >&2

}

check() {

python3 -m venv --clear --without-pip --system-site-packages .testenv

.testenv/bin/python3 -m installer .dist/\*.whl

.testenv/bin/python3 -m pytest

```

}

package() {
    python3 -m installer -d "$pkgdir" \
        .dist/*.whl
}

sha512sums="
114c630f098939757e49187e35b4e54883266a2ee9ca283724992420ef4c860f9606a8342da0ab74d93627c10805f312
fda3f699cbc7c4fbd47a71e220440fb0
    license_expression-30.4.1.tar.gz
"

/* $NetBSD: queue.h,v 1.70 2015/11/02 15:21:23 christos Exp $ */

/*
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 *
 * @(#)queue.h 8.5 (Berkeley) 8/20/94
 */

#ifdef _SYS_QUEUE_H_
#define _SYS_QUEUE_H_

```

```

/*
* This file defines five types of data structures: singly-linked lists,
* lists, simple queues, tail queues, and circular queues.
*
* A singly-linked list is headed by a single forward pointer. The
* elements are singly linked for minimum space and
* pointer manipulation
* overhead at the expense of O(n) removal for arbitrary elements. New
* elements can be added to the list after an existing element or at the
* head of the list. Elements being removed from the head of the list
* should use the explicit macro for this purpose for optimum
* efficiency. A singly-linked list may only be traversed in the forward
* direction. Singly-linked lists are ideal for applications with large
* datasets and few or no removals or for implementing a LIFO queue.
*
* A list is headed by a single forward pointer (or an array of forward
* pointers for a hash table header). The elements are doubly linked
* so that an arbitrary element can be removed without a need to
* traverse the list. New elements can be added to the list before
* or after an existing element or at the head of the list. A list
* may only be traversed in the forward direction.
*
* A simple queue is headed by a pair of pointers, one the head of the
* list and the
* other to the tail of the list. The elements are singly
* linked to save space, so elements can only be removed from the
* head of the list. New elements can be added to the list after
* an existing element, at the head of the list, or at the end of the
* list. A simple queue may only be traversed in the forward direction.
*
* A tail queue is headed by a pair of pointers, one to the head of the
* list and the other to the tail of the list. The elements are doubly
* linked so that an arbitrary element can be removed without a need to
* traverse the list. New elements can be added to the list before or
* after an existing element, at the head of the list, or at the end of
* the list. A tail queue may be traversed in either direction.
*
* A circle queue is headed by a pair of pointers, one to the head of the
* list and the other to the tail of the list. The elements are doubly
* linked so that an arbitrary element can be removed without a need to
* traverse the list. New elements
* can be added to the list before or after
* an existing element, at the head of the list, or at the end of the list.
* A circle queue may be traversed in either direction, but has a more
* complex end of list detection.
*
* For details on the use of these macros, see the queue(3) manual page.

```



```

*/

/*
* Include the definition of NULL only on NetBSD because sys/null.h
* is not available elsewhere. This conditional makes the header
* portable and it can simply be dropped verbatim into any system.
* The caveat is that on other systems some other header
* must provide NULL before the macros can be used.
*/
#ifdef __NetBSD__
#include <sys/null.h>
#endif

#if defined(QUEUEDEBUG)
# if defined(_KERNEL)
#  define QUEUEDEBUG_ABORT(...) panic(__VA_ARGS__)
# else
#  include <err.h>
#  define QUEUEDEBUG_ABORT(...) err(1, __VA_ARGS__)
# endif
#endif

/*
* Singly-linked List definitions.
*/
#define SLIST_HEAD(name, type) \
struct name { \
    struct type *slh_first; /* first \
    element */ \
}

#define SLIST_HEAD_INITIALIZER(head) \
{ NULL }

#define SLIST_ENTRY(type) \
struct { \
    struct type *sle_next; /* next element */ \
}

/*
* Singly-linked List access methods.
*/
#define SLIST_FIRST(head) ((head)->slh_first)
#define SLIST_END(head) NULL
#define SLIST_EMPTY(head) ((head)->slh_first == NULL)
#define SLIST_NEXT(elm, field) ((elm)->field.sle_next)

#define SLIST_FOREACH(var, head, field) \

```

```

for((var) = (head)->slh_first;  \
    (var) != SLIST_END(head);  \
    (var) = (var)->field.sle_next)

#define SLIST_FOREACH_SAFE(var, head, field, tvar) \
for ((var) = SLIST_FIRST((head));  \
    (var) != SLIST_END(head) &&  \
    ((tvar) = SLIST_NEXT((var), field), 1);  \
    (var) = (tvar))

/*
 * Singly-linked List functions.
 */
#define SLIST_INIT(head) do {  \
    (head)->slh_first = SLIST_END(head);  \
} while (/*CONSTCOND*/0)

#define SLIST_INSERT_AFTER(slistelm, elm, field) do {  \
    (elm)->field.sle_next = (slistelm)->field.sle_next;  \
    (slistelm)->field.sle_next  \
    = (elm);  \
} while (/*CONSTCOND*/0)

#define SLIST_INSERT_HEAD(head, elm, field) do {  \
    (elm)->field.sle_next = (head)->slh_first;  \
    (head)->slh_first = (elm);  \
} while (/*CONSTCOND*/0)

#define SLIST_REMOVE_AFTER(slistelm, field) do {  \
    (slistelm)->field.sle_next =  \
        SLIST_NEXT(SLIST_NEXT((slistelm), field), field);  \
} while (/*CONSTCOND*/0)

#define SLIST_REMOVE_HEAD(head, field) do {  \
    (head)->slh_first = (head)->slh_first->field.sle_next;  \
} while (/*CONSTCOND*/0)

#define SLIST_REMOVE(head, elm, type, field) do {  \
    if ((head)->slh_first == (elm)) {  \
        SLIST_REMOVE_HEAD((head), field);  \
    }  \
    else {  \
        struct type *curelm = (head)->slh_first;  \
        while(curelm->field.sle_next != (elm))  \
            curelm = curelm->field.sle_next;  \
        curelm->field.sle_next =  \
            curelm->field.sle_next->field.sle_next;  \
    }  \
}

```

```

} while (/*CONSTCOND*/0)

/*
 * List definitions.
 */
#define LIST_HEAD(name, type) \
struct name { \
    struct type *lh_first; /* first element */ \
}

#define LIST_HEAD_INITIALIZER(head) \
{ NULL }

#define LIST_ENTRY(type) \
struct { \
    struct type *le_next; /* next element */ \
    struct type **le_prev; /* address of previous next element */ \
}

/*
 * List access methods.
 */
#define LIST_FIRST(head) ((head)->lh_first)
#define LIST_END(head) NULL
#define LIST_EMPTY(head) ((head)->lh_first == LIST_END(head))
#define LIST_NEXT(elm, field) ((elm)->field.le_next)

#define LIST_FOREACH(var, head, field) \
for ((var) = ((head)->lh_first); \
     (var) != LIST_END(head); \
     (var) = ((var)->field.le_next))

#define LIST_FOREACH_SAFE(var, head, field, tvar) \
for ((var) = LIST_FIRST((head)); \
     (var) != LIST_END(head) && \
     ((tvar) = LIST_NEXT((var), field), 1); \
     (var) = (tvar))

#define LIST_MOVE(head1, head2) do { \
    LIST_INIT((head2)); \
    if (!LIST_EMPTY((head1))) \
    { \
        (head2)->lh_first = (head1)->lh_first; \
        LIST_INIT((head1)); \
    } \
} while (/*CONSTCOND*/0)

```

```

/*
 * List functions.
 */
#if defined(QUEUEDEBUG)
#define QUEUEDEBUG_LIST_INSERT_HEAD(head, elm, field) \
if ((head)->lh_first && \
    (head)->lh_first->field.le_prev != &(head)->lh_first) \
    QUEUEDEBUG_ABORT("LIST_INSERT_HEAD %p %s:%d", (head), \
        __FILE__, __LINE__);
#define QUEUEDEBUG_LIST_OP(elm, field) \
if ((elm)->field.le_next && \
    (elm)->field.le_next->field.le_prev != \
    &(elm)->field.le_next) \
    QUEUEDEBUG_ABORT("LIST_* forw %p %s:%d", (elm), \
        __FILE__, __LINE__); \
if (*(elm)->field.le_prev != (elm)) \
    QUEUEDEBUG_ABORT("LIST_* back %p %s:%d", (elm), \
        __FILE__, __LINE__);
#define QUEUEDEBUG_LIST_POSTREMOVE(elm, field) \
(elm)->field.le_next = (void *)1L; \
(elm)->field.le_prev = (void *)1L;
#else
#define QUEUEDEBUG_LIST_INSERT_HEAD(head, elm, field)
#define QUEUEDEBUG_LIST_OP(elm,
    field)
#define QUEUEDEBUG_LIST_POSTREMOVE(elm, field)
#endif

#define LIST_INIT(head) do { \
    (head)->lh_first = LIST_END(head); \
} while (/*CONSTCOND*/0)

#define LIST_INSERT_AFTER(listelm, elm, field) do { \
    QUEUEDEBUG_LIST_OP((listelm), field) \
    if (((elm)->field.le_next = (listelm)->field.le_next) != \
        LIST_END(head)) \
        (listelm)->field.le_next->field.le_prev = \
            &(elm)->field.le_next; \
    (listelm)->field.le_next = (elm); \
    (elm)->field.le_prev = &(listelm)->field.le_next; \
} while (/*CONSTCOND*/0)

#define LIST_INSERT_BEFORE(listelm, elm, field) do { \
    QUEUEDEBUG_LIST_OP((listelm), field) \
    (elm)->field.le_prev = (listelm)->field.le_prev; \
    (elm)->field.le_next = (listelm); \
    *(listelm)->field.le_prev = (elm); \
    (listelm)->field.le_prev = &(elm)->field.le_next; \
} while (/*CONSTCOND*/0)

```

```

} while (/*CONSTCOND*/0)

#define LIST_INSERT_HEAD(head, elm, field) do { \
    QUEUEDEBUG_LIST_INSERT_HEAD((head), (elm), field) \
    if (((elm)->field.le_next \
    = (head)->lh_first) != LIST_END(head))\
        (head)->lh_first->field.le_prev = &(elm)->field.le_next;\
    (head)->lh_first = (elm); \
    (elm)->field.le_prev = &(head)->lh_first; \
} while (/*CONSTCOND*/0)

#define LIST_REMOVE(elm, field) do { \
    QUEUEDEBUG_LIST_OP((elm), field) \
    if ((elm)->field.le_next != NULL) \
        (elm)->field.le_next->field.le_prev = \
            (elm)->field.le_prev; \
    *(elm)->field.le_prev = (elm)->field.le_next; \
    QUEUEDEBUG_LIST_POSTREMOVE((elm), field) \
} while (/*CONSTCOND*/0)

#define LIST_REPLACE(elm, elm2, field) do { \
    if (((elm2)->field.le_next = (elm)->field.le_next) != NULL) \
        (elm2)->field.le_next->field.le_prev = \
            &(elm2)->field.le_next; \
    (elm2)->field.le_prev = (elm)->field.le_prev; \
    *(elm2)->field.le_prev = (elm2); \
    QUEUEDEBUG_LIST_POSTREMOVE((elm), field) \
} while (/*CONSTCOND*/0)

/*
 * Simple queue definitions.
 */
#define SIMPLEQ_HEAD(name, type) \
struct name { \
    struct \
    type *sqh_first; /* first element */ \
    struct type **sqh_last; /* addr of last next element */ \
}

#define SIMPLEQ_HEAD_INITIALIZER(head) \
{ NULL, &(head).sqh_first }

#define SIMPLEQ_ENTRY(type) \
struct { \
    struct type *sqe_next; /* next element */ \
}

/*

```

```

* Simple queue access methods.
*/

#define SIMPLEQ_FIRST(head) ((head)->sqh_first)
#define SIMPLEQ_END(head) NULL
#define SIMPLEQ_EMPTY(head) ((head)->sqh_first == SIMPLEQ_END(head))
#define SIMPLEQ_NEXT(elm, field) ((elm)->field.sqe_next)

#define SIMPLEQ_FOREACH(var, head, field) \
for ((var) = ((head)->sqh_first); \
     (var) != SIMPLEQ_END(head); \
     (var) = ((var)->field.sqe_next))

#define SIMPLEQ_FOREACH_SAFE(var, head, field, next) \
for ((var) = ((head)->sqh_first); \
     (var) != SIMPLEQ_END(head) && \
     ((next = ((var)->field.sqe_next)), 1); \
     (var) = (next))

/*
* Simple queue functions.
*/

#define SIMPLEQ_INIT(head) do { \
(head)->sqh_first = NULL; \
(head)->sqh_last \
= &(head)->sqh_first; \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_INSERT_HEAD(head, elm, field) do { \
if (((elm)->field.sqe_next = (head)->sqh_first) == NULL) \
(head)->sqh_last = &(elm)->field.sqe_next; \
(head)->sqh_first = (elm); \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_INSERT_TAIL(head, elm, field) do { \
(elm)->field.sqe_next = NULL; \
*(head)->sqh_last = (elm); \
(head)->sqh_last = &(elm)->field.sqe_next; \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_INSERT_AFTER(head, listelm, elm, field) do { \
if (((elm)->field.sqe_next = (listelm)->field.sqe_next) == NULL) \
(head)->sqh_last = &(elm)->field.sqe_next; \
(listelm)->field.sqe_next = (elm); \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_REMOVE_HEAD(head, field) do { \
if (((head)->sqh_first = (head)->sqh_first->field.sqe_next) == NULL) \
(head)->sqh_last = &(head)->sqh_first; \

```

```

} while (/*CONSTCOND*/0)

#define SIMPLEQ_REMOVE_AFTER(head, elm, field) do { \
    if \
    (((elm)->field.sqe_next = (elm)->field.sqe_next->field.sqe_next) \
     == NULL) \
    (head)->sqh_last = &(elm)->field.sqe_next; \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_REMOVE(head, elm, type, field) do { \
    if ((head)->sqh_first == (elm)) { \
        SIMPLEQ_REMOVE_HEAD((head), field); \
    } else { \
        struct type *curelm = (head)->sqh_first; \
        while (curelm->field.sqe_next != (elm)) \
            curelm = curelm->field.sqe_next; \
        if ((curelm->field.sqe_next = \
            curelm->field.sqe_next->field.sqe_next) == NULL) \
            (head)->sqh_last = &(curelm)->field.sqe_next; \
    } \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_CONCAT(head1, head2) do { \
    if (!SIMPLEQ_EMPTY((head2))) { \
        *(head1)->sqh_last = (head2)->sqh_first; \
        (head1)->sqh_last = (head2)->sqh_last; \
        SIMPLEQ_INIT((head2)); \
    } \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_LAST(head, type, field) \
    (SIMPLEQ_EMPTY((head)) ? \
     NULL : \
     ((struct type \
      *)((void *) \
        ((char *)((head)->sqh_last) - offsetof(struct type, field))))

/*
 * Tail queue definitions.
 */
#define _TAILQ_HEAD(name, type, qual) \
    struct name { \
        qual type *tqh_first; /* first element */ \
        qual type *qual *tqh_last; /* addr of last next element */ \
    }
#define TAILQ_HEAD(name, type) _TAILQ_HEAD(name, struct type,)

#define TAILQ_HEAD_INITIALIZER(head) \

```

```

{ TAILQ_END(head), &(head).tqh_first }

#define _TAILQ_ENTRY(type, qual) \
struct { \
    qual type *tqe_next; /* next element */ \
    qual type *qual *tqe_prev; /* address of previous next element */ \
}

#define TAILQ_ENTRY(type) _TAILQ_ENTRY(struct type,)

/*
 * Tail queue access methods.
 */

#define TAILQ_FIRST(head) ((head)->tqh_first)
#define TAILQ_END(head) (NULL)
#define TAILQ_NEXT(elm, field) ((elm)->field.tqe_next)
#define TAILQ_LAST(head, headname) \
    (((struct headname *) (void *) ((head)->tqh_last))->tqh_last)
#define TAILQ_PREV(elm, headname, field) \
    (((struct headname *) (void *) ((elm)->field.tqe_prev))->tqh_last)
#define TAILQ_EMPTY(head) (TAILQ_FIRST(head) == TAILQ_END(head))

#define TAILQ_FOREACH(var, head, field) \
    for ((var) = ((head)->tqh_first); \
        (var) != TAILQ_END(head); \
        (var) = ((var)->field.tqe_next))

#define TAILQ_FOREACH_SAFE(var, head, field, next) \
    for ((var) = ((head)->tqh_first); \
        (var) != TAILQ_END(head) && \
        ((next) = TAILQ_NEXT(var, field), 1); (var) = (next))

#define TAILQ_FOREACH_REVERSE(var, head, headname, field) \
    for ((var) = TAILQ_LAST((head), headname); \
        (var) != TAILQ_END(head); \
        (var) = TAILQ_PREV((var), headname, field))

#define TAILQ_FOREACH_REVERSE_SAFE(var, head, headname, field, prev) \
    for ((var) = TAILQ_LAST((head), headname); \
        (var) != TAILQ_END(head) && \
        ((prev) = TAILQ_PREV((var), headname, field), 1); (var) = (prev))

/*
 * Tail queue functions.
 */

#if defined(QUEUEDEBUG)
#define QUEUEDEBUG_TAILQ_INSERT_HEAD(head,

```



```

elm, field) \
if ((head)->tqh_first && \
    (head)->tqh_first->field.tqe_prev != &(head)->tqh_first) \
    QUEUEDEBUG_ABORT("TAILQ_INSERT_HEAD %p %s:%d", (head), \
        __FILE__, __LINE__);
#define QUEUEDEBUG_TAILQ_INSERT_TAIL(head, elm, field) \
if (*(head)->tqh_last != NULL) \
    QUEUEDEBUG_ABORT("TAILQ_INSERT_TAIL %p %s:%d", (head), \
        __FILE__, __LINE__);
#define QUEUEDEBUG_TAILQ_OP(elm, field) \
if ((elm)->field.tqe_next && \
    (elm)->field.tqe_next->field.tqe_prev != \
    &(elm)->field.tqe_next) \
    QUEUEDEBUG_ABORT("TAILQ_* forw %p %s:%d", (elm), \
        __FILE__, __LINE__); \
if (*(elm)->field.tqe_prev != (elm)) \
    QUEUEDEBUG_ABORT("TAILQ_* back %p %s:%d", (elm), \
        __FILE__, __LINE__);
#define QUEUEDEBUG_TAILQ_PREREMOVE(head, elm, field) \
if ((elm)->field.tqe_next == NULL && \
    (head)->tqh_last != &(elm)->field.tqe_next) \
    QUEUEDEBUG_ABORT("TAILQ_PREREMOVE head %p elm %p %s:%d", \
        (head), (elm), __FILE__, \
        __LINE__);
#define QUEUEDEBUG_TAILQ_POSTREMOVE(elm, field) \
(elm)->field.tqe_next = (void *)1L; \
(elm)->field.tqe_prev = (void *)1L;
#else
#define QUEUEDEBUG_TAILQ_INSERT_HEAD(head, elm, field)
#define QUEUEDEBUG_TAILQ_INSERT_TAIL(head, elm, field)
#define QUEUEDEBUG_TAILQ_OP(elm, field)
#define QUEUEDEBUG_TAILQ_PREREMOVE(head, elm, field)
#define QUEUEDEBUG_TAILQ_POSTREMOVE(elm, field)
#endif

#define TAILQ_INIT(head) do { \
    (head)->tqh_first = TAILQ_END(head); \
    (head)->tqh_last = &(head)->tqh_first; \
} while (/*CONSTCOND*/0)

#define TAILQ_INSERT_HEAD(head, elm, field) do { \
    QUEUEDEBUG_TAILQ_INSERT_HEAD((head), (elm), field) \
    if (((elm)->field.tqe_next = (head)->tqh_first) != TAILQ_END(head)) \
        (head)->tqh_first->field.tqe_prev = \
            &(elm)->field.tqe_next; \
    else \
        (head)->tqh_last = &(elm)->field.tqe_next; \
    (head)->tqh_first = (elm); \
} while (0)

```

```

(elm)->field.tqe_prev = &(head)->tqh_first; \
} while (/*CONSTCOND*/0)

#define TAILQ_INSERT_TAIL(head,
elm, field) do { \
    QUEUEDEBBUG_TAILQ_INSERT_TAIL((head), (elm), field) \
    (elm)->field.tqe_next = TAILQ_END(head); \
    (elm)->field.tqe_prev = (head)->tqh_last; \
    *(head)->tqh_last = (elm); \
    (head)->tqh_last = &(elm)->field.tqe_next; \
} while (/*CONSTCOND*/0)

#define TAILQ_INSERT_AFTER(head, listelm, elm, field) do { \
    QUEUEDEBBUG_TAILQ_OP((listelm), field) \
    if (((elm)->field.tqe_next = (listelm)->field.tqe_next) != \
        TAILQ_END(head)) \
        (elm)->field.tqe_next->field.tqe_prev = \
            &(elm)->field.tqe_next; \
    else \
        (head)->tqh_last = &(elm)->field.tqe_next; \
    (listelm)->field.tqe_next = (elm); \
    (elm)->field.tqe_prev = &(listelm)->field.tqe_next; \
} while (/*CONSTCOND*/0)

#define TAILQ_INSERT_BEFORE(listelm, elm, field) do { \
    QUEUEDEBBUG_TAILQ_OP((listelm), field) \
    (elm)->field.tqe_prev = (listelm)->field.tqe_prev; \
    (elm)->field.tqe_next = (listelm); \
    *(listelm)->field.tqe_prev = (elm); \
    (listelm)->field.tqe_prev \
    = &(elm)->field.tqe_next; \
} while (/*CONSTCOND*/0)

#define TAILQ_REMOVE(head, elm, field) do { \
    QUEUEDEBBUG_TAILQ_PREREMOVE((head), (elm), field) \
    QUEUEDEBBUG_TAILQ_OP((elm), field) \
    if (((elm)->field.tqe_next) != TAILQ_END(head)) \
        (elm)->field.tqe_next->field.tqe_prev = \
            (elm)->field.tqe_prev; \
    else \
        (head)->tqh_last = (elm)->field.tqe_prev; \
    *(elm)->field.tqe_prev = (elm)->field.tqe_next; \
    QUEUEDEBBUG_TAILQ_POSTREMOVE((elm), field); \
} while (/*CONSTCOND*/0)

#define TAILQ_REPLACE(head, elm, elm2, field) do { \
    if (((elm2)->field.tqe_next = (elm)->field.tqe_next) != \
        TAILQ_END(head)) \

```

```

        (elm2)->field.tqe_next->field.tqe_prev = \
            &(elm2)->field.tqe_next; \
    else \
        (head)->tqh_last = &(elm2)->field.tqe_next; \
        (elm2)->field.tqe_prev = (elm)->field.tqe_prev; \
        *(elm2)->field.tqe_prev = (elm2); \
    QUEUEDEBUG_TAILQ_POSTREMOVE((elm),
    field); \
} while (/*CONSTCOND*/0)

#define TAILQ_CONCAT(head1, head2, field) do { \
    if (!TAILQ_EMPTY(head2)) { \
        *(head1)->tqh_last = (head2)->tqh_first; \
        (head2)->tqh_first->field.tqe_prev = (head1)->tqh_last; \
        (head1)->tqh_last = (head2)->tqh_last; \
        TAILQ_INIT((head2)); \
    } \
} while (/*CONSTCOND*/0)

/*
 * Singly-linked Tail queue declarations.
 */
#define STAILQ_HEAD(name, type) \
struct name { \
    struct type *stqh_first; /* first element */ \
    struct type **stqh_last; /* addr of last next element */ \
}

#define STAILQ_HEAD_INITIALIZER(head) \
{ NULL, &(head).stqh_first }

#define STAILQ_ENTRY(type) \
struct { \
    struct type *stqe_next; /* next element */ \
}

/*
 * Singly-linked Tail queue access methods.
 */
#define STAILQ_FIRST(head) ((head)->stqh_first)
#define STAILQ_END(head) NULL
#define STAILQ_NEXT(elm, field) ((elm)->field.stqe_next)
#define STAILQ_EMPTY(head) (STAILQ_FIRST(head) \
    == STAILQ_END(head))

/*
 * Singly-linked Tail queue functions.
 */

```

```

#define STAILQ_INIT(head) do { \
    (head)->stqh_first = NULL; \
    (head)->stqh_last = &(head)->stqh_first; \
} while (/*CONSTCOND*/0)

#define STAILQ_INSERT_HEAD(head, elm, field) do { \
    if (((elm)->field.stqe_next = (head)->stqh_first) == NULL) \
        (head)->stqh_last = &(elm)->field.stqe_next; \
    (head)->stqh_first = (elm); \
} while (/*CONSTCOND*/0)

#define STAILQ_INSERT_TAIL(head, elm, field) do { \
    (elm)->field.stqe_next = NULL; \
    *(head)->stqh_last = (elm); \
    (head)->stqh_last = &(elm)->field.stqe_next; \
} while (/*CONSTCOND*/0)

#define STAILQ_INSERT_AFTER(head, listelm, elm, field) do { \
    if (((elm)->field.stqe_next = (listelm)->field.stqe_next) == NULL) \
        (head)->stqh_last = &(elm)->field.stqe_next; \
    (listelm)->field.stqe_next = (elm); \
} while (/*CONSTCOND*/0)

#define STAILQ_REMOVE_HEAD(head, field) do { \
    if (((head)->stqh_first = (head)->stqh_first->field.stqe_next) \
        == NULL) \
        (head)->stqh_last = &(head)->stqh_first; \
} while (/*CONSTCOND*/0)

#define STAILQ_REMOVE(head, elm, type, field) do { \
    if ((head)->stqh_first == (elm)) { \
        STAILQ_REMOVE_HEAD((head), field); \
    } else { \
        struct type *curelm = (head)->stqh_first; \
        while (curelm->field.stqe_next != (elm)) \
            curelm = curelm->field.stqe_next; \
        if ((curelm->field.stqe_next = \
            curelm->field.stqe_next->field.stqe_next) == NULL) \
            (head)->stqh_last = &(curelm)->field.stqe_next; \
    } \
} while (/*CONSTCOND*/0)

#define STAILQ_FOREACH(var, head, field) \
    for ((var) = ((head)->stqh_first); \
        (var); \
        (var) = ((var)->field.stqe_next))

#define STAILQ_FOREACH_SAFE(var, head, field, tvar) \

```

```

for ((var) = STAILQ_FIRST((head)); \
    (var) && ((tvar) = STAILQ_NEXT((var), field), 1); \
    (var) = (tvar))

#define STAILQ_CONCAT(head1, head2) do { \
    if (!STAILQ_EMPTY((head2))) { \
        *(head1)->stqh_last \
        = (head2)->stqh_first; \
        (head1)->stqh_last = (head2)->stqh_last; \
        STAILQ_INIT((head2)); \
    } \
} while (/*CONSTCOND*/0)

#define STAILQ_LAST(head, type, field) \
(STAILQ_EMPTY((head)) ? \
    NULL : \
    ((struct type *) (void *) \
    ((char *) ((head)->stqh_last) - offsetof(struct type, field))))

#ifdef _KERNEL
/*
 * Circular queue definitions. Do not use. We still keep the macros
 * for compatibility but because of pointer aliasing issues their use
 * is discouraged!
 */

/*
 * __launder_type(): We use this ugly hack to work around the the compiler
 * noticing that two types may not alias each other and elide tests in code.
 * We hit this in the CIRCLEQ macros when comparing 'struct name *' and
 * 'struct type *' (see CIRCLEQ_HEAD()). Modern compilers (such as GCC
 * 4.8) declare these comparisons as always false, causing the code to
 * not run as designed.
 *
 * This hack is only to be used for comparisons and thus can be fully const.
 * Do not use for assignment.
 *
 * If we ever choose to change the ABI of the CIRCLEQ macros, we could fix
 * this by changing the head/tail sentinel values, but see the note above
 * this one.
 */
static __inline const void * __launder_type(const void *);
static __inline const void *
__launder_type(const void *__x)
{
    __asm __volatile("" : "+r" (__x));
    return __x;
}

```

```

}

#if defined(QEUEDEBUG)
#define QEUEDEBUG_CIRCLEQ_HEAD(head, field) \
if ((head)->cqh_first != CIRCLEQ_ENDC(head) && \
    (head)->cqh_first->field.cqe_prev != CIRCLEQ_ENDC(head)) \
    QEUEDEBUG_ABORT("CIRCLEQ head forw %p %s:%d", (head), \
        __FILE__, __LINE__); \
if ((head)->cqh_last != CIRCLEQ_ENDC(head) && \
    (head)->cqh_last->field.cqe_next != CIRCLEQ_ENDC(head)) \
    QEUEDEBUG_ABORT("CIRCLEQ head back %p %s:%d", (head), \
        __FILE__, __LINE__);
#define QEUEDEBUG_CIRCLEQ_ELM(head, elm, field) \
if ((elm)->field.cqe_next == CIRCLEQ_ENDC(head)) { \
    if ((head)->cqh_last != (elm)) \
        QEUEDEBUG_ABORT("CIRCLEQ \
elm last %p %s:%d", \
            (elm), __FILE__, __LINE__); \
} else { \
    if ((elm)->field.cqe_next->field.cqe_prev != (elm)) \
        QEUEDEBUG_ABORT("CIRCLEQ elm forw %p %s:%d", \
            (elm), __FILE__, __LINE__); \
} \
if ((elm)->field.cqe_prev == CIRCLEQ_ENDC(head)) { \
    if ((head)->cqh_first != (elm)) \
        QEUEDEBUG_ABORT("CIRCLEQ elm first %p %s:%d", \
            (elm), __FILE__, __LINE__); \
} else { \
    if ((elm)->field.cqe_prev->field.cqe_next != (elm)) \
        QEUEDEBUG_ABORT("CIRCLEQ elm prev %p %s:%d", \
            (elm), __FILE__, __LINE__); \
}
#define QEUEDEBUG_CIRCLEQ_POSTREMOVE(elm, field) \
(elm)->field.cqe_next = (void *)1L; \
(elm)->field.cqe_prev = (void *)1L;
#else
#define QEUEDEBUG_CIRCLEQ_HEAD(head, field)
#define QEUEDEBUG_CIRCLEQ_ELM(head, elm, field)
#define QEUEDEBUG_CIRCLEQ_POSTREMOVE(elm, field)
#endif

#define CIRCLEQ_HEAD(name, type) \
struct name { \
    struct type *cqh_first; /* \
first element */ \
    struct type *cqh_last; /* last element */ \
}

```

```

#define CIRCLEQ_HEAD_INITIALIZER(head) \
{ CIRCLEQ_END(&head), CIRCLEQ_END(&head) }

#define CIRCLEQ_ENTRY(type) \
struct { \
    struct type *cqe_next; /* next element */ \
    struct type *cqe_prev; /* previous element */ \
}

/*
 * Circular queue functions.
 */
#define CIRCLEQ_INIT(head) do { \
    (head)->cqh_first = CIRCLEQ_END(head); \
    (head)->cqh_last = CIRCLEQ_END(head); \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_INSERT_AFTER(head, listelm, elm, field) do { \
    QUEUEDEBDEBUG_CIRCLEQ_HEAD((head), field) \
    QUEUEDEBDEBUG_CIRCLEQ_ELM((head), (listelm), field) \
    (elm)->field.cqe_next = (listelm)->field.cqe_next; \
    (elm)->field.cqe_prev = (listelm); \
    if ((listelm)->field.cqe_next == CIRCLEQ_ENDC(head)) \
        (head)->cqh_last = (elm); \
    else \
        (listelm)->field.cqe_next->field.cqe_prev = (elm); \
    (listelm)->field.cqe_next = (elm); \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_INSERT_BEFORE(head, \
listelm, elm, field) do { \
    QUEUEDEBDEBUG_CIRCLEQ_HEAD((head), field) \
    QUEUEDEBDEBUG_CIRCLEQ_ELM((head), (listelm), field) \
    (elm)->field.cqe_next = (listelm); \
    (elm)->field.cqe_prev = (listelm)->field.cqe_prev; \
    if ((listelm)->field.cqe_prev == CIRCLEQ_ENDC(head)) \
        (head)->cqh_first = (elm); \
    else \
        (listelm)->field.cqe_prev->field.cqe_next = (elm); \
    (listelm)->field.cqe_prev = (elm); \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_INSERT_HEAD(head, elm, field) do { \
    QUEUEDEBDEBUG_CIRCLEQ_HEAD((head), field) \
    (elm)->field.cqe_next = (head)->cqh_first; \
    (elm)->field.cqe_prev = CIRCLEQ_END(head); \
    if ((head)->cqh_last == CIRCLEQ_ENDC(head)) \
        (head)->cqh_last = (elm); \
} while (/*CONSTCOND*/0)

```

```

else    \
    (head)->cqh_first->field.cqe_prev = (elm); \
    (head)->cqh_first = (elm);    \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_INSERT_TAIL(head, elm, field) do { \
    QUEUEDEBUG_CIRCLEQ_HEAD((head), field) \
    (elm)->field.cqe_next \
    = CIRCLEQ_END(head); \
    (elm)->field.cqe_prev = (head)->cqh_last; \
    if ((head)->cqh_first == CIRCLEQ_ENDC(head)) \
        (head)->cqh_first = (elm); \
    else \
        (head)->cqh_last->field.cqe_next = (elm); \
    (head)->cqh_last = (elm); \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_REMOVE(head, elm, field) do { \
    QUEUEDEBUG_CIRCLEQ_HEAD((head), field) \
    QUEUEDEBUG_CIRCLEQ_ELM((head), (elm), field) \
    if ((elm)->field.cqe_next == CIRCLEQ_ENDC(head)) \
        (head)->cqh_last = (elm)->field.cqe_prev; \
    else \
        (elm)->field.cqe_next->field.cqe_prev = \
            (elm)->field.cqe_prev; \
    if ((elm)->field.cqe_prev == CIRCLEQ_ENDC(head)) \
        (head)->cqh_first = (elm)->field.cqe_next; \
    else \
        (elm)->field.cqe_prev->field.cqe_next = \
            (elm)->field.cqe_next; \
    QUEUEDEBUG_CIRCLEQ_POSTREMOVE((elm), field) \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_FOREACH(var, head, field) \
    for ((var) = ((head)->cqh_first); \
        (var) != CIRCLEQ_ENDC(head); \
        (var) \
        = ((var)->field.cqe_next))

#define CIRCLEQ_FOREACH_REVERSE(var, head, field) \
    for ((var) = ((head)->cqh_last); \
        (var) != CIRCLEQ_ENDC(head); \
        (var) = ((var)->field.cqe_prev))

/*
 * Circular queue access methods.
 */
#define CIRCLEQ_FIRST(head) ((head)->cqh_first)

```



```

#define CIRCLEQ_LAST(head) ((head)->cqh_last)
/* For comparisons */
#define CIRCLEQ_ENDC(head) (__lauder_type(head))
/* For assignments */
#define CIRCLEQ_END(head) ((void *)(head))
#define CIRCLEQ_NEXT(elm, field) ((elm)->field.cqe_next)
#define CIRCLEQ_PREV(elm, field) ((elm)->field.cqe_prev)
#define CIRCLEQ_EMPTY(head) \
    (CIRCLEQ_FIRST(head) == CIRCLEQ_ENDC(head))

#define CIRCLEQ_LOOP_NEXT(head, elm, field) \
    (((elm)->field.cqe_next == CIRCLEQ_ENDC(head)) \
     ? ((head)->cqh_first) \
     : (elm->field.cqe_next))
#define CIRCLEQ_LOOP_PREV(head, elm, field) \
    (((elm)->field.cqe_prev == CIRCLEQ_ENDC(head)) \
     ? ((head)->cqh_last) \
     : \
     (elm->field.cqe_prev))
#endif /* !_KERNEL */

#endif /* !_SYS_QUEUE_H_ */
# Contributor: Fabian Affolter <fabian@affolter-engineering.ch>
# Maintainer: Fabian Affolter <fabian@affolter-engineering.ch>
pkgname=py3-flake8-copyright
_pkgname=flake8-copyright
pkgver=0.2.4
pkgrel=3
pkgdesc="Extension for flake8 which checks for copyrights"
options="!check" # No testsuite
url="https://github.com/savoirfairelinux/flake8-copyright"
arch="noarch"
license="MIT"
depends="py3-flake8 py3-setuptools"
makedepends="py3-gpep517 py3-wheel"
subpackages="$pkgname-pyc"
source="https://files.pythonhosted.org/packages/source/${_pkgname:0:1}/${_pkgname}/${_pkgname}-${pkgver}.tar.gz"
buildid="srcdir"/$_pkgname-$pkgver

replaces="py-flake8-copyright" # Backwards compatibility
provides="py-flake8-copyright=${pkgver}-r${pkgrel}" # Backwards compatibility

build() {
    gpep517 build-wheel \
        --wheel-dir .dist \
        --output-fd 3 3>&1 >&2
}

```

```

package() {
    gpep517 install-wheel --destdir "$pkgdir" \
        .dist/*.whl
}

sha512sums="
a6ab47e1bb715618f075c51f398e18180404871b3b0faf1c2d30701d5203db6bc23771bf22ffb5bafcd8ee856b9b64237
b316bd503ae7dceed6ca284ccd5a74d
flake8-copyright-0.2.4.tar.gz
"

#ifndef _SYS_CDEFS_H_
#define _SYS_CDEFS_H_

#warning usage of non-standard #include <sys/cdefs.h> is deprecated

#undef __P
#undef __PMT

#define __P(args) args
#define __PMT(args) args

#define __CONCAT(x,y) x ## y
#define __STRING(x) #x

#ifdef __cplusplus
# define __BEGIN_DECLS extern "C" {
# define __END_DECLS }
#else
# define __BEGIN_DECLS
# define __END_DECLS
#endif

#if defined(__GNUC__) && !defined(__cplusplus)
# define __THROW __attribute__((__nothrow__))
# define __NTH(fct) __attribute__((__nothrow__)) fct
#else
# define __THROW
# define __NTH(fct) fct
#endif

#endif /* _SYS_CDEFS_H_ */

# Maintainer: fossdd <fossdd@pwned.life>
pkgname=cargo-license
pkgver=0.6.1
pkgrel=1
pkgdesc="Cargo subcommand to see license of dependencies"
url="https://github.com/onur/cargo-license"
arch="all"

```

```

license="MIT"
makedepends="cargo cargo-auditable"
source="$pkgname-$pkgver.tar.gz::https://crates.io/api/v1/crates/cargo-license/$pkgver/download"

prepare() {
    default_prepare

    cargo fetch --target="$CTARGET" --locked
}

build() {
    cargo auditable build --release --frozen
}

check() {
    cargo test --frozen
}

package() {
    install -Dm755 target/release/cargo-license -t "$pkgdir"/usr/bin
}

sha512sums="
36215145e79965be090ae2f5ce6f5eb208465eb67a94c26bed1fe70a131c46c6dc35695e30852759b7366883fbc3caf00
272d796ac634f0a5e1d49232b6b29d5  cargo-license-0.6.1.tar.gz
"

/* $NetBSD: tree.h,v 1.20 2013/09/14 13:20:45 joerg Exp $ */
/* $OpenBSD: tree.h,v 1.13 2011/07/09 00:19:45 pirofti Exp $ */
/* Modified by Void Linux. */
/*
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* AUTHOR BE LIABLE FOR ANY DIRECT, INDIRECT,
* INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT

```

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

```
#ifndef _SYS_TREE_H_
#define _SYS_TREE_H_
```

```
#ifdef __GNUC__
#define __GNUC_PREREQ__(x, y) \
  ((__GNUC__ == (x) && __GNUC_MINOR__ >= (y)) || \
   (__GNUC__ > (x)))
#else
#define __GNUC_PREREQ__(x, y) 0
#endif
```

```
#if __GNUC_PREREQ__(2, 7) || defined(__lint__)
#define _sys_tree_h_unused __attribute__((__unused__))
#else
#define _sys_tree_h_unused /* delete */
#endif
```

/\*

\* This file defines data structures for different types of trees:  
 \* splay trees and red-black trees.  
 \*  
 \* A splay tree is a self-organizing  
 data structure. Every operation  
 \* on the tree causes a splay to happen. The splay moves the requested  
 \* node to the root of the tree and partly rebalances it.  
 \*  
 \* This has the benefit that request locality causes faster lookups as  
 \* the requested nodes move to the top of the tree. On the other hand,  
 \* every lookup causes memory writes.  
 \*  
 \* The Balance Theorem bounds the total access time for m operations  
 \* and n inserts on an initially empty tree as  $O((m + n)\lg n)$ . The  
 \* amortized cost for a sequence of m accesses to a splay tree is  $O(\lg n)$ ;  
 \*  
 \* A red-black tree is a binary search tree with the node color as an  
 \* extra attribute. It fulfills a set of conditions:  
 \* - every search path from the root to a leaf consists of the  
 \* same number of black nodes,  
 \* - each red node (except for the root) has a black parent,  
 \* - each leaf node is black.  
 \*

```

* Every operation on a red-black tree is bounded as  $O(\lg n)$ .
* The maximum height of a red-black tree is  $2\lg(n+1)$ .
*/

#define SPLAY_HEAD(name, type) \
struct name { \
    struct type *sph_root; /* root of the tree */ \
}

#define SPLAY_INITIALIZER(root) \
{ NULL }

#define SPLAY_INIT(root) do { \
    (root)->sph_root = NULL; \
} while (/*CONSTCOND*/ 0)

#define SPLAY_ENTRY(type) \
struct { \
    struct type *spe_left; /* left element */ \
    struct type *spe_right; /* right element */ \
}

#define SPLAY_LEFT(elm, field) (elm)->field.spe_left
#define SPLAY_RIGHT(elm, field) (elm)->field.spe_right
#define SPLAY_ROOT(head) (head)->sph_root
#define SPLAY_EMPTY(head) (SPLAY_ROOT(head) == NULL)

/* SPLAY_ROTATE_{LEFT,RIGHT} expect that tmp hold SPLAY_{RIGHT,LEFT} */
#define SPLAY_ROTATE_RIGHT(head, tmp, field) do { \
    SPLAY_LEFT((head)->sph_root, field) = SPLAY_RIGHT(tmp, field); \
    SPLAY_RIGHT(tmp, field) = (head)->sph_root; \
    (head)->sph_root = tmp; \
} while (/*CONSTCOND*/ 0)

#define SPLAY_ROTATE_LEFT(head, tmp, field) do { \
    SPLAY_RIGHT((head)->sph_root, \
    field) = SPLAY_LEFT(tmp, field); \
    SPLAY_LEFT(tmp, field) = (head)->sph_root; \
    (head)->sph_root = tmp; \
} while (/*CONSTCOND*/ 0)

#define SPLAY_LINKLEFT(head, tmp, field) do { \
    SPLAY_LEFT(tmp, field) = (head)->sph_root; \
    tmp = (head)->sph_root; \
    (head)->sph_root = SPLAY_LEFT((head)->sph_root, field); \
} while (/*CONSTCOND*/ 0)

#define SPLAY_LINKRIGHT(head, tmp, field) do { \

```

```

    SPLAY_RIGHT(tmp, field) = (head)->sph_root; \
    tmp = (head)->sph_root; \
    (head)->sph_root = SPLAY_RIGHT((head)->sph_root, field); \
} while (/*CONSTCOND*/ 0)

#define SPLAY_ASSEMBLE(head, node, left, right, field) do { \
    SPLAY_RIGHT(left, field) = SPLAY_LEFT((head)->sph_root, field); \
    SPLAY_LEFT(right, field) = SPLAY_RIGHT((head)->sph_root, field); \
    SPLAY_LEFT((head)->sph_root, field) = SPLAY_RIGHT(node, field); \
    SPLAY_RIGHT((head)->sph_root, field) = SPLAY_LEFT(node, field); \
} while (/*CONSTCOND*/ 0)

/* Generates prototypes and inline functions */

#define
    SPLAY_PROTOTYPE(name, type, field, cmp) \
void name##_SPLAY(struct name *, struct type *); \
void name##_SPLAY_MINMAX(struct name *, int); \
struct type *name##_SPLAY_INSERT(struct name *, struct type *); \
struct type *name##_SPLAY_REMOVE(struct name *, struct type *); \
\
/* Finds the node with the same key as elm */ \
static __inline struct type * \
name##_SPLAY_FIND(struct name *head, struct type *elm) \
{ \
    if (SPLAY_EMPTY(head)) \
        return(NULL); \
    name##_SPLAY(head, elm); \
    if ((cmp)(elm, (head)->sph_root) == 0) \
        return (head->sph_root); \
    return (NULL); \
} \
\
static __inline _sys_tree_h_unused struct type * \
name##_SPLAY_NEXT(struct name *head, struct type *elm) \
{ \
    name##_SPLAY(head, elm); \
    if (SPLAY_RIGHT(elm, field) != NULL) { \
        elm = SPLAY_RIGHT(elm, field); \
        while (SPLAY_LEFT(elm, field) != NULL) { \
            elm = SPLAY_LEFT(elm, field); \
        } \
    } \
    else \
        elm = NULL; \
    return (elm); \
} \
\

```

```

static _sys_tree_h_unused __inline struct type * \
name##_SPLAY_MIN_MAX(struct name *head, int val) \
{ \
    name##_SPLAY_MINMAX(head, val); \
    return (SPLAY_ROOT(head)); \
}

/* Main splay operation.
 * Moves node close to the key of elm to top
 */
#define SPLAY_GENERATE(name, type, field, cmp) \
struct type * \
name##_SPLAY_INSERT(struct name *head, struct type *elm) \
{ \
    if (SPLAY_EMPTY(head)) { \
        SPLAY_LEFT(elm, field) = SPLAY_RIGHT(elm, field) = NULL; \
    } else { \
        int __comp; \
        name##_SPLAY(head, elm); \
        __comp = (cmp)(elm, (head)->sph_root); \
        if (__comp < 0) { \
            SPLAY_LEFT(elm, field) = SPLAY_LEFT((head)->sph_root, field); \
            SPLAY_RIGHT(elm, field) = (head)->sph_root; \
            SPLAY_LEFT((head)->sph_root, field) = NULL; \
        } else if (__comp > 0) { \
            SPLAY_RIGHT(elm, \
field) = SPLAY_RIGHT((head)->sph_root, field); \
            SPLAY_LEFT(elm, field) = (head)->sph_root; \
            SPLAY_RIGHT((head)->sph_root, field) = NULL; \
        } else \
            return ((head)->sph_root); \
    } \
    (head)->sph_root = (elm); \
    return (NULL); \
} \
\
struct type * \
name##_SPLAY_REMOVE(struct name *head, struct type *elm) \
{ \
    struct type *__tmp; \
    if (SPLAY_EMPTY(head)) \
        return (NULL); \
    name##_SPLAY(head, elm); \
    if ((cmp)(elm, (head)->sph_root) == 0) { \
        if (SPLAY_LEFT((head)->sph_root, field) == NULL) { \
            (head)->sph_root = SPLAY_RIGHT((head)->sph_root, field); \
        } else { \
            __tmp = SPLAY_RIGHT((head)->sph_root, field); \

```

```

(head)->sph_root = SPLAY_LEFT((head)->sph_root, field);\
name##_SPLAY(head, elm); \
SPLAY_RIGHT((head)->sph_root, field) = __tmp; \
} \
return (elm); \
} \
return (NULL); \
} \
\
void \
name##_SPLAY(struct
name *head, struct type *elm) \
{ \
struct type __node, *__left, *__right, *__tmp; \
int __comp; \
\
SPLAY_LEFT(&__node, field) = SPLAY_RIGHT(&__node, field) = NULL;\
__left = __right = &__node; \
\
while ((__comp = (cmp)(elm, (head)->sph_root)) != 0) { \
if (__comp < 0) { \
__tmp = SPLAY_LEFT((head)->sph_root, field);\
if (__tmp == NULL) \
break; \
if ((cmp)(elm, __tmp) < 0){ \
SPLAY_ROTATE_RIGHT(head, __tmp, field);\
if (SPLAY_LEFT((head)->sph_root, field) == NULL)\
break; \
} \
SPLAY_LINKLEFT(head, __right, field); \
} else if (__comp > 0) { \
__tmp = SPLAY_RIGHT((head)->sph_root, field);\
if (__tmp == NULL) \
break; \
if ((cmp)(elm, __tmp) > 0){ \
SPLAY_ROTATE_LEFT(head, __tmp, field);\
if (SPLAY_RIGHT((head)->sph_root, field) == NULL)\
break; \
} \
SPLAY_LINKRIGHT(head, __left, field); \
} \
} \
SPLAY_ASSEMBLE(head,
&__node, __left, __right, field); \
} \
\
/* Splay with either the minimum or the maximum element \
* Used to find minimum or maximum element in tree. \

```



```

*/
\
void name##_SPLAY_MINMAX(struct name *head, int __comp) \
{
\
struct type __node, *__left, *__right, *__tmp; \
\
SPLAY_LEFT(&__node, field) = SPLAY_RIGHT(&__node, field) = NULL;\
__left = __right = &__node; \
\
while (1) { \
if (__comp < 0) { \
__tmp = SPLAY_LEFT((head)->sph_root, field);\
if (__tmp == NULL) \
break; \
if (__comp < 0){ \
SPLAY_ROTATE_RIGHT(head, __tmp, field);\
if (SPLAY_LEFT((head)->sph_root, field) == NULL)\
break; \
} \
SPLAY_LINKLEFT(head, __right, field); \
} else if (__comp > 0) { \
__tmp = SPLAY_RIGHT((head)->sph_root, field);\
if (__tmp == NULL) \
break; \
if (__comp > 0) { \
SPLAY_ROTATE_LEFT(head, __tmp, field);\
if (SPLAY_RIGHT((head)->sph_root, field) == NULL)\
break; \
} \
SPLAY_LINKRIGHT(head, __left, field); \
} \
} \
SPLAY_ASSEMBLE(head, &__node, __left, __right, field); \
}

```

```

#define SPLAY_NEGINF -1

```

```

#define SPLAY_INF 1

```

```

#define SPLAY_INSERT(name, x, y) name##_SPLAY_INSERT(x, y)

```

```

#define SPLAY_REMOVE(name, x, y) name##_SPLAY_REMOVE(x, y)

```

```

#define SPLAY_FIND(name, x, y) name##_SPLAY_FIND(x, y)

```

```

#define SPLAY_NEXT(name, x, y) name##_SPLAY_NEXT(x, y)

```

```

#define SPLAY_MIN(name, x) (SPLAY_EMPTY(x) ? NULL \

```

```

: name##_SPLAY_MIN_MAX(x, SPLAY_NEGINF))

```

```

#define SPLAY_MAX(name, x) (SPLAY_EMPTY(x) ? NULL \

```

```

: name##_SPLAY_MIN_MAX(x, SPLAY_INF))

```

```

#define SPLAY_FOREACH(x, name, head) \

```

```

for ((x) = SPLAY_MIN(name, head); \
    (x) != NULL; \
    (x) = SPLAY_NEXT(name, head, x))

/* Macros that define a red-black tree */
#define RB_HEAD(name, type) \
struct name { \
    struct type *rbh_root; /* root of the tree */ \
}

#define RB_INITIALIZER(root) \
{ \
    NULL \
}

#define RB_INIT(root) do { \
    (root)->rbh_root = NULL; \
} while (/*CONSTCOND*/ 0)

#define RB_BLACK 0
#define RB_RED 1
#define RB_ENTRY(type) \
struct { \
    struct type *rbe_left; /* left element */ \
    struct type *rbe_right; /* right element */ \
    struct type *rbe_parent; /* parent element */ \
    int rbe_color; /* node color */ \
}

#define RB_LEFT(elm, field) (elm)->field.rbe_left
#define RB_RIGHT(elm, field) (elm)->field.rbe_right
#define RB_PARENT(elm, field) (elm)->field.rbe_parent
#define RB_COLOR(elm, field) (elm)->field.rbe_color
#define RB_ROOT(head) (head)->rbh_root
#define RB_EMPTY(head) (RB_ROOT(head) == NULL)

#define RB_SET(elm, parent, field) do { \
    RB_PARENT(elm, field) = parent; \
    RB_LEFT(elm, field) = RB_RIGHT(elm, field) = NULL; \
    RB_COLOR(elm, field) = RB_RED; \
} while (/*CONSTCOND*/ 0)

#define RB_SET_BLACKRED(black, red, field) do { \
    RB_COLOR(black, field) = RB_BLACK; \
    RB_COLOR(red, field) \
    = RB_RED; \
} while (/*CONSTCOND*/ 0)

#ifndef RB_AUGMENT

```

```

#define RB_AUGMENT(x) do { } while (/*CONSTCOND*/ 0)
#endif

#define RB_ROTATE_LEFT(head, elm, tmp, field) do { \
    (tmp) = RB_RIGHT(elm, field); \
    if ((RB_RIGHT(elm, field) = RB_LEFT(tmp, field)) != NULL) { \
        RB_PARENT(RB_LEFT(tmp, field), field) = (elm); \
    } \
    RB_AUGMENT(elm); \
    if ((RB_PARENT(tmp, field) = RB_PARENT(elm, field)) != NULL) { \
        if ((elm) == RB_LEFT(RB_PARENT(elm, field), field)) \
            RB_LEFT(RB_PARENT(elm, field), field) = (tmp); \
        else \
            RB_RIGHT(RB_PARENT(elm, field), field) = (tmp); \
    } else \
        (head)->rbh_root = (tmp); \
    RB_LEFT(tmp, field) = (elm); \
    RB_PARENT(elm, field) = (tmp); \
    RB_AUGMENT(tmp); \
    if ((RB_PARENT(tmp, field))) \
        RB_AUGMENT(RB_PARENT(tmp, field)); \
} while (/*CONSTCOND*/ 0)

#define RB_ROTATE_RIGHT(head, elm, tmp, field) do { \
    (tmp) = RB_LEFT(elm, field); \
    if ((RB_LEFT(elm, field) = RB_RIGHT(tmp, field)) \
        != NULL) { \
        RB_PARENT(RB_RIGHT(tmp, field), field) = (elm); \
    } \
    RB_AUGMENT(elm); \
    if ((RB_PARENT(tmp, field) = RB_PARENT(elm, field)) != NULL) { \
        if ((elm) == RB_LEFT(RB_PARENT(elm, field), field)) \
            RB_LEFT(RB_PARENT(elm, field), field) = (tmp); \
        else \
            RB_RIGHT(RB_PARENT(elm, field), field) = (tmp); \
    } else \
        (head)->rbh_root = (tmp); \
    RB_RIGHT(tmp, field) = (elm); \
    RB_PARENT(elm, field) = (tmp); \
    RB_AUGMENT(tmp); \
    if ((RB_PARENT(tmp, field))) \
        RB_AUGMENT(RB_PARENT(tmp, field)); \
} while (/*CONSTCOND*/ 0)

/* Generates prototypes and inline functions */
#define RB_PROTOTYPE(name, type, field, cmp) \
    RB_PROTOTYPE_INTERNAL(name, type, field, cmp,)
#define RB_PROTOTYPE_STATIC(name, type, field, cmp) \

```

```

RB_PROTOTYPE_INTERNAL(name, type, field, cmp, _sys_tree_h_unused static)
#define RB_PROTOTYPE_INTERNAL(name, type, field, cmp, attr) \
attr void name##_RB_INSERT_COLOR(struct name *, struct
type *); \
attr void name##_RB_REMOVE_COLOR(struct name *, struct type *, struct type *);\
attr struct type *name##_RB_REMOVE(struct name *, struct type *); \
attr struct type *name##_RB_INSERT(struct name *, struct type *); \
attr struct type *name##_RB_FIND(struct name *, struct type *); \
attr struct type *name##_RB_NFIND(struct name *, struct type *); \
attr struct type *name##_RB_NEXT(struct type *); \
attr struct type *name##_RB_PREV(struct type *); \
attr struct type *name##_RB_MINMAX(struct name *, int); \
\

/* Main rb operation.
* Moves node close to the key of elm to top
*/
#define RB_GENERATE(name, type, field, cmp) \
RB_GENERATE_INTERNAL(name, type, field, cmp,)
#define RB_GENERATE_STATIC(name, type, field, cmp) \
RB_GENERATE_INTERNAL(name, type, field, cmp, _sys_tree_h_unused static)
#define RB_GENERATE_INTERNAL(name, type, field, cmp, attr) \
attr void \
name##_RB_INSERT_COLOR(struct name *head, struct type *elm) \
{ \
struct type
*parent, *gparent, *tmp; \
while ((parent = RB_PARENT(elm, field)) != NULL && \
RB_COLOR(parent, field) == RB_RED) { \
gparent = RB_PARENT(parent, field); \
if (parent == RB_LEFT(gparent, field)) { \
tmp = RB_RIGHT(gparent, field); \
if (tmp && RB_COLOR(tmp, field) == RB_RED) { \
RB_COLOR(tmp, field) = RB_BLACK; \
RB_SET_BLACKRED(parent, gparent, field);\
elm = gparent; \
continue; \
} \
if (RB_RIGHT(parent, field) == elm) { \
RB_ROTATE_LEFT(head, parent, tmp, field);\
tmp = parent; \
parent = elm; \
elm = tmp; \
} \
RB_SET_BLACKRED(parent, gparent, field); \
RB_ROTATE_RIGHT(head, gparent, tmp, field); \
} else { \
tmp = RB_LEFT(gparent, field); \

```

```

if (tmp && RB_COLOR(tmp, field) == RB_RED) { \
    RB_COLOR(tmp, field) = RB_BLACK; \
    RB_SET_BLACKRED(parent, gparent, field);\
    elm = gparent; \
    continue; \
} \
if (RB_LEFT(parent, field) == elm)
{ \
    RB_ROTATE_RIGHT(head, parent, tmp, field);\
    tmp = parent; \
    parent = elm; \
    elm = tmp; \
} \
RB_SET_BLACKRED(parent, gparent, field); \
RB_ROTATE_LEFT(head, gparent, tmp, field);\
} \
} \
RB_COLOR(head->rbh_root, field) = RB_BLACK; \
} \
\
attr void \
name##_RB_REMOVE_COLOR(struct name *head, struct type *parent, struct type *elm) \
{ \
    struct type *tmp; \
    while ((elm == NULL || RB_COLOR(elm, field) == RB_BLACK) && \
        elm != RB_ROOT(head)) { \
        if (RB_LEFT(parent, field) == elm) { \
            tmp = RB_RIGHT(parent, field); \
            if (RB_COLOR(tmp, field) == RB_RED) { \
                RB_SET_BLACKRED(tmp, parent, field); \
                RB_ROTATE_LEFT(head, parent, tmp, field);\
                tmp = RB_RIGHT(parent, field); \
            } \
            if ((RB_LEFT(tmp, field) == NULL || \
                RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) && \
                (RB_RIGHT(tmp, field) == NULL || \
                RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK)) {\
                RB_COLOR(tmp, field) = RB_RED; \
                elm = parent; \
                parent = RB_PARENT(elm, field); \
            } else { \
                if (RB_RIGHT(tmp, field) == NULL || \
                    RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK) {\
                    struct type *oleft; \
                    if ((oleft = RB_LEFT(tmp, field)) \
                        != NULL) \
                        RB_COLOR(oleft, field) = RB_BLACK;\

```

```

RB_COLOR(tmp, field) = RB_RED; \
RB_ROTATE_RIGHT(head, tmp, oleft, field);\
tmp = RB_RIGHT(parent, field); \
} \
RB_COLOR(tmp, field) = RB_COLOR(parent, field);\
RB_COLOR(parent, field) = RB_BLACK; \
if (RB_RIGHT(tmp, field)) \
    RB_COLOR(RB_RIGHT(tmp, field), field) = RB_BLACK;\
RB_ROTATE_LEFT(head, parent, tmp, field);\
elm = RB_ROOT(head); \
break; \
} \
} else { \
    tmp = RB_LEFT(parent, field); \
    if (RB_COLOR(tmp, field) == RB_RED) { \
        RB_SET_BLACKRED(tmp, parent, field); \
        RB_ROTATE_RIGHT(head, parent, tmp, field);\
        tmp
= RB_LEFT(parent, field); \
    } \
    if ((RB_LEFT(tmp, field) == NULL || \
        RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) &&\
        (RB_RIGHT(tmp, field) == NULL || \
        RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK)) {\
        RB_COLOR(tmp, field) = RB_RED; \
        elm = parent; \
        parent = RB_PARENT(elm, field); \
    } else { \
        if (RB_LEFT(tmp, field) == NULL || \
            RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) {\
            struct type *oright; \
            if ((oright = RB_RIGHT(tmp, field)) \
                != NULL) \
                RB_COLOR(oright, field) = RB_BLACK;\
            RB_COLOR(tmp, field) = RB_RED; \
            RB_ROTATE_LEFT(head, tmp, oright, field);\
            tmp = RB_LEFT(parent, field); \
        } \
        RB_COLOR(tmp, field) = RB_COLOR(parent, field);\
        RB_COLOR(parent, field) = RB_BLACK; \
        if (RB_LEFT(tmp, field)) \
            RB_COLOR(RB_LEFT(tmp, field), field) = RB_BLACK;\
        RB_ROTATE_RIGHT(head, parent, tmp, field);\
        elm = RB_ROOT(head); \
        break; \
    } \
} \
} \
} \

```

```

if
(elm)    \
    RB_COLOR(elm, field) = RB_BLACK; \
}      \
    \
attr struct type *    \
name##_RB_REMOVE(struct name *head, struct type *elm) \
{      \
    struct type *child, *parent, *old = elm; \
    int color;    \
    if (RB_LEFT(elm, field) == NULL) \
        child = RB_RIGHT(elm, field); \
    else if (RB_RIGHT(elm, field) == NULL) \
        child = RB_LEFT(elm, field); \
    else {      \
        struct type *left; \
        elm = RB_RIGHT(elm, field); \
        while ((left = RB_LEFT(elm, field)) != NULL) \
            elm = left; \
        child = RB_RIGHT(elm, field); \
        parent = RB_PARENT(elm, field); \
        color = RB_COLOR(elm, field); \
        if (child) \
            RB_PARENT(child, field) = parent; \
        if (parent) { \
            if (RB_LEFT(parent, field) == elm) \
                RB_LEFT(parent, field) = child; \
            else \
                RB_RIGHT(parent, field) = child; \
            RB_AUGMENT(parent); \
        } else \
            RB_ROOT(head)
= child; \
    if (RB_PARENT(elm, field) == old) \
        parent = elm; \
    (elm)->field = (old)->field; \
    if (RB_PARENT(old, field)) { \
        if (RB_LEFT(RB_PARENT(old, field), field) == old)\
            RB_LEFT(RB_PARENT(old, field), field) = elm;\
        else \
            RB_RIGHT(RB_PARENT(old, field), field) = elm;\
        RB_AUGMENT(RB_PARENT(old, field)); \
    } else \
        RB_ROOT(head) = elm; \
    RB_PARENT(RB_LEFT(old, field), field) = elm; \
    if (RB_RIGHT(old, field)) \
        RB_PARENT(RB_RIGHT(old, field), field) = elm; \
    if (parent) { \

```

```

    left = parent; \
    do { \
        RB_AUGMENT(left); \
    } while ((left = RB_PARENT(left, field)) != NULL); \
} \
goto color; \
} \
parent = RB_PARENT(elm, field); \
color = RB_COLOR(elm, field); \
if (child) \
    RB_PARENT(child, field) = parent; \
if (parent) { \
    if (RB_LEFT(parent, field) == elm) \
        RB_LEFT(parent, field) = child; \
    else \
        RB_RIGHT(parent,
field) = child; \
    RB_AUGMENT(parent); \
} else \
    RB_ROOT(head) = child; \
color: \
if (color == RB_BLACK) \
    name##_RB_REMOVE_COLOR(head, parent, child); \
return (old); \
} \
\
/* Inserts a node into the RB tree */ \
attr struct type * \
name##_RB_INSERT(struct name *head, struct type *elm) \
{ \
    struct type *tmp; \
    struct type *parent = NULL; \
    int comp = 0; \
    tmp = RB_ROOT(head); \
    while (tmp) { \
        parent = tmp; \
        comp = (cmp)(elm, parent); \
        if (comp < 0) \
            tmp = RB_LEFT(tmp, field); \
        else if (comp > 0) \
            tmp = RB_RIGHT(tmp, field); \
        else \
            return (tmp); \
    } \
    RB_SET(elm, parent, field); \
    if (parent != NULL) { \
        if (comp < 0) \
            RB_LEFT(parent, field) = elm; \

```



```

else    \
    RB_RIGHT(parent, field) = elm; \
    RB_AUGMENT(parent); \
} else    \
    RB_ROOT(head) = elm; \
name##_RB_INSERT_COLOR(head,
elm); \
return (NULL); \
} \
\

/* Finds the node with the same key as elm */ \
attr struct type * \
name##_RB_FIND(struct name *head, struct type *elm) \
{ \
    struct type *tmp = RB_ROOT(head); \
    int comp; \
    while (tmp) { \
        comp = cmp(elm, tmp); \
        if (comp < 0) \
            tmp = RB_LEFT(tmp, field); \
        else if (comp > 0) \
            tmp = RB_RIGHT(tmp, field); \
        else \
            return (tmp); \
    } \
    return (NULL); \
} \
\

/* Finds the first node greater than or equal to the search key */ \
attr struct type * \
name##_RB_NFIND(struct name *head, struct type *elm) \
{ \
    struct type *tmp = RB_ROOT(head); \
    struct type *res = NULL; \
    int comp; \
    while (tmp) { \
        comp = cmp(elm, tmp); \
        if (comp < 0) { \
            res = tmp; \
            tmp = RB_LEFT(tmp, field); \
        } \
        else if (comp > 0) \
            tmp =
RB_RIGHT(tmp, field); \
        else \
            return (tmp); \
    } \
    return (res); \
}

```

```

}    \
    \
/* ARGSUSED */    \
attr struct type *    \
name##_RB_NEXT(struct type *elm)    \
{    \
if (RB_RIGHT(elm, field)) {    \
elm = RB_RIGHT(elm, field);    \
while (RB_LEFT(elm, field))    \
elm = RB_LEFT(elm, field);    \
} else {    \
if (RB_PARENT(elm, field) &&    \
(elm == RB_LEFT(RB_PARENT(elm, field), field))) \
elm = RB_PARENT(elm, field);    \
else {    \
while (RB_PARENT(elm, field) &&    \
(elm == RB_RIGHT(RB_PARENT(elm, field), field))) \
elm = RB_PARENT(elm, field);    \
elm = RB_PARENT(elm, field);    \
}    \
}    \
return (elm);    \
}    \
    \
/* ARGSUSED */    \
attr struct type *    \
name##_RB_PREV(struct type *elm)    \
{    \
if (RB_LEFT(elm, field)) {    \
elm = RB_LEFT(elm, field);    \
while (RB_RIGHT(elm, field))    \
elm = RB_RIGHT(elm, field);    \
}
else {    \
if (RB_PARENT(elm, field) &&    \
(elm == RB_RIGHT(RB_PARENT(elm, field), field))) \
elm = RB_PARENT(elm, field);    \
else {    \
while (RB_PARENT(elm, field) &&    \
(elm == RB_LEFT(RB_PARENT(elm, field), field))) \
elm = RB_PARENT(elm, field);    \
elm = RB_PARENT(elm, field);    \
}    \
}    \
return (elm);    \
}    \
    \
attr struct type *    \

```

```

name##_RB_MINMAX(struct name *head, int val) \
{ \
    struct type *tmp = RB_ROOT(head); \
    struct type *parent = NULL; \
    while (tmp) { \
        parent = tmp; \
        if (val < 0) \
            tmp = RB_LEFT(tmp, field); \
        else \
            tmp = RB_RIGHT(tmp, field); \
    } \
    return (parent); \
}

#define RB_NEGINF -1
#define RB_INF 1

#define RB_INSERT(name, x, y) name##_RB_INSERT(x, y)
#define RB_REMOVE(name, x, y) name##_RB_REMOVE(x, y)
#define RB_FIND(name, x, y) name##_RB_FIND(x, y)
#define RB_NFIND(name, x, y) name##_RB_NFIND(x, \
y)
#define RB_NEXT(name, x, y) name##_RB_NEXT(y)
#define RB_PREV(name, x, y) name##_RB_PREV(y)
#define RB_MIN(name, x) name##_RB_MINMAX(x, RB_NEGINF)
#define RB_MAX(name, x) name##_RB_MINMAX(x, RB_INF)

#define RB_FOREACH(x, name, head) \
for ((x) = RB_MIN(name, head); \
(x) != NULL; \
(x) = name##_RB_NEXT(x))

#define RB_FOREACH_FROM(x, name, y) \
for ((x) = (y); \
((x) != NULL) && ((y) = name##_RB_NEXT(x), (x) != NULL); \
(x) = (y))

#define RB_FOREACH_SAFE(x, name, head, y) \
for ((x) = RB_MIN(name, head); \
((x) != NULL) && ((y) = name##_RB_NEXT(x), (x) != NULL); \
(x) = (y))

#define RB_FOREACH_REVERSE(x, name, head) \
for ((x) = RB_MAX(name, head); \
(x) != NULL; \
(x) = name##_RB_PREV(x))

#define RB_FOREACH_REVERSE_FROM(x, name, y) \

```

```

for ((x) = (y);    \
    ((x) != NULL) && ((y) = name##_RB_PREV(x), (x) != NULL); \
    (x) = (y))

#define RB_FOREACH_REVERSE_SAFE(x, name,
head, y) \
for ((x) = RB_MAX(name, head);    \
    ((x) != NULL) && ((y) = name##_RB_PREV(x), (x) != NULL); \
    (x) = (y))

#endif /* _SYS_TREE_H_ */
pkgname=linux-headers
pkgver=6.14.2 # Follow the latest Linux stable
_kernver=${pkgver%.*}
pkgrel=0
pkgdesc="Linux system headers"
url="https://kernel.org/"
arch="all" # Headers are architecture specific
license="GPL-2.0-only"
makedepends="perl"
options="!check !dbg !strip !tracedeps !archcheck"
source="https://kernel.org/pub/linux/kernel/v6.x/linux-${_kernver}.tar.xz
revert-broken-uapi.patch
0003-remove-inclusion-of-sysinfo.h-in-kernel.h.patch

```

## 1.131 autocommand 2.2.2

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Version 3, 29 June 2007

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## 1.132 jaraco.text 3.12.1

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# 1.133 python-certifi 2024.08.30

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This package contains a modified version of ca-bundle.crt:

ca-bundle.crt -- Bundle of CA Root Certificates

This is a bundle of X.509 certificates of public Certificate Authorities (CA). These were automatically extracted from Mozilla's root certificates file (certdata.txt). This file can be found in the mozilla source tree:

<https://hg.mozilla.org/mozilla-central/file/tip/security/nss/lib/ckfw/builtins/certdata.txt>

It contains the certificates in PEM format and therefore can be directly used with curl / libcurl / php\_curl, or with an Apache+mod\_ssl webserver for SSL client authentication. Just configure this file as the SSLCACertificateFile.#

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@(#) \$RCSfile: certdata.txt,v \$ \$Revision: 1.80 \$ \$Date: 2011/11/03 15:11:58 \$

# 1.134 dhcping 1.2-r3

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Non Maintainer Upload of this Package

-----

If you plan to work on an NMU for this package, read the following closely. It can save you and me some grief.

1. At first, contact the maintainer (i.e. send a mail to [joey@debian.org](mailto:joey@debian.org), do not cc or bounce a mail, send a plain mail, not copied to any mailing list or the BTS) and ask about the status of the bug you are considering to work on.
2. In this mail include all information relevant for this problem, i.e. include a description of the bug and not only its bug number.
3. If the maintainer is not able or willing to fix the problem or

does not respond within four days, continue with step 4.

4. Work on the bug and prepare a patch. Do not upload into the Debian archive.
5. Send the entire patch, together with enough explanations, to the maintainer for reviewing and ask him for permission of an NMU using this patch.
6. IF AND ONLY IF the maintainer approves the patch (or doesn't respond within four days), upload the NMU to the incoming directory and send the patch to the BTS. If the NMU is not approved, go back to 4. or add the NMU to your homepage, but do not upload it to the Debian archive.
7. Properly sized and well-written patches sent to the BTS are always appreciated, even if they are rejected later. They demonstrate a potential solution which could probably improved into a real solution.
8. NEVER change the way a package is maintained in an NMU, i.e. don't remove `dh_*` stuff or switch to `dh_*` respectively. This rule applies to all NMU's, not only to an NMU for this package.

These rules always apply. They even apply if somebody declares NMUs as ok and reduces regular NMU rules to a delay of zero days. Unless I'm on vacation or on a show I am reachable via mail, so there is hardly a reason not to contact me.

This is the Debian GNU prepackaged version of `dhcping`, an administrative tool for finding out if a DHCP server is still up and running.

The source of the Debian package is managed through CVS. It is publically available at `<http://cvs.infodrom.org/dhcping/?cvsroot=debian>` or as `<:pserver:anonymous@cvs.infodrom.org/var/cvs/debian/dhcping/>`.

This package was put together by Martin Schulze `<joey@debian.org>`, from sources obtained from:

<http://www.mavetju.org/download/dhcping-1.2.tar.gz>

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## 1.137 liboping 1.10.0-r2

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# 1.139 iftop 0.17-r11

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Authors:

Paul Warren <pdw@ex-parrot.com>

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# 1.140 python-setuptools 80.9.0

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python -m validate_pyproject.pre_compile --output-dir=setuptools/config/_validate_pyproject --enable-plugins
setuptools.distutils --very-verbose -t setuptools=setuptools/config/setuptools.schema.json -t
distutils=setuptools/config/distutils.schema.json
```

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`fastjsonschema`

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <https://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <https://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

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| 2.0            | 1.6          | 2000      | BeOpen.com | no                  |
| 1.6.1          | 1.6          | 2001      | CNRI       | yes (2)             |
| 2.1            | 2.0+1.6.1    | 2001      | PSF        | no                  |
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```
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```

```
This program comes
```

```
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```

```
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```

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## 1.146 skalibs 2.14.4.0-r0

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```
# Automatically generated by apkbuidl-cpan, template 4
# Contributor: Valery Kartel <valery.kartel@gmail.com>
# Maintainer: Celeste <cielesti@protonmail.com>
maintainer="Celeste <cielesti@protonmail.com>"
pkgname=perl-bud-resource
pkgver=1.2911
pkgrel=10
#_pkgreal is used by apkbuidl-cpan to find modules at MetaCpan
_pkgreal=BSD-Resource
pkgdesc="Perl extension implements the BSD process resource limit functions"
url="https://metacpan.org/release/BSD-Resource/"
arch="all"
license="Artistic-2.0 OR LGPL-2.0"
depends="perl"
makedepends="perl-dev"
subpackages="$pkgname-doc"
source="https://cpan.metacpan.org/authors/id/J/JH/JHI/BSD-Resource-$pkgver.tar.gz"
buildid="$srcdir/$_pkgreal-$pkgver"
```

```
build() {
    export CFLAGS=$(perl -MConfig -E 'say $Config{ccflags}')
    PERL_MM_USE_DEFAULT=1 perl -I. Makefile.PL \
    INSTALLDIRS=vendor \
    NO_PACKLIST=1 \
    NO_PERLLOCAL=1
    make
```

```

}

check() {
    export CFLAGS=$(perl -MConfig -E 'say $Config{ccflags}')
    make test
}

package() {
    make DESTDIR="$pkgdir" install
}

sha512sums="
d0032d41c7c0468ed1c6d8f57b885f6cb97a5039d754c8cb60b2067daedaf53bd15fb6561a3d0f828df16dfa5417f663b
8065ba65f4fea16dc9262728b3b6b85
    BSD-Resource-1.2911.tar.gz
"

# Contributor: Maxim Karasev <begs@disroot.org>
# Maintainer: mio <miyopan@e.email>
pkgname=bsd-games
pkgver=3.3
pkgrel=2
pkgdesc="traditional text mode games from BSD"
url="https://bsd-games.sourceforge.io/"
arch="all"
license="BSD-3-Clause"
install="$pkgname.post-install"
makedepends="ncurses-dev coreutils" # configure causes busybox expr error
subpackages="$pkgname-doc"
source="https://sourceforge.net/projects/bsd-games/files/bsd-games-$pkgver.tar.gz
0001-bsd-games-scores-dir.patch
"

options="!check" # no tests

build() {
    # some GNU autoconf options are ignored, but it works
    ./configure \
        --build=$CBUILD \
        --host=$CHOST \
        --prefix=/usr \
        --sysconfdir=/etc \
        --mandir=/usr/share/man \
        --sourcedir=/usr/share/$pkgname
    make
}

package() {
    make DESTDIR="$pkgdir" install
    install -Dm644 LICENSE "$pkgdir"/usr/share/licenses/bsd-games/LICENSE

```



```
}
```

```
sha512sums="
aaf36d09d4fe68514a5c279063d7e77a9a9a84c447037cba974b29faa07eb80c2aab2379d0699c196b5c27ffe1b2bb2c6
8d3390143e0e62d5e3d210ccfb61294
bsd-games-3.3.tar.gz
e1def0d4835a877242c4173fae862e278a7858738e0bacacbb045a42bcabec2aa7c72d000bbd2421ce35fe66cdc1f52c0
577b7e278029ca5ed50f7aab22319f6 0001-bsd-games-scores-dir.patch
"
```

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```
# Maintainer: Natanael Copa <ncopa@alpinelinux.org>
```

```
pkgname=libart-lgpl
```

```
pkgver=2.3.21
```

```
pkgrel=8
```

```
pkgdesc="A library for high-performance 2D graphics"
```

```
url="https://www.levien.com/libart/"
```

```
arch="all"
```

```
options="!check" # No test suite.
```

```
license="LGPL-2.0-or-later"
```

```
subpackages="$pkgname-dev"
```

```
source="https://download.gnome.org/sources/libart-lgpl/2.3/libart-lgpl-$pkgver.tar.bz2"
```

```
"
```

```
builddir="$srcdir"/libart-lgpl-$pkgver
```

```
prepare() {
```

```
    update_config_sub
```

```
default_prepare
}
```

```
build() {
./configure \
--build=$CBUILD \
--host=$CHOST \
--prefix=/usr
make
}
```

```
package() {
make DESTDIR="$pkgdir" install
}
```

```
sha512sums="8a632a6a4da59e5e8c02ec2f5a57e36d182b325b46513765425e5f171ff9ae326af1b133725beba28f7e7
6654309e001aee9bace727b5b4c8589405256a3c020 libart_lgpl-2.3.21.tar.bz2"
mini_sendmail - accept email on behalf of real sendmail
```

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# Contributor: Carlo Landmeter <clandmeter@alpinelinux.org>

# Maintainer: Kevin Daudt <kdaudt@alpinelinux.org>

pkgname=spdx-licenses

pkgver=3.26.0

pkgrel=0

```

pkgdesc="Various data formats for the SPDX License List"
url="https://spdx.org/"
arch="noarch"
options="!check" # no test suite
license="CC-BY-3.0"
source="license-list-data-$pkgver.tar.gz::https://github.com/spdx/license-list-data/archive/v$pkgver.tar.gz"
builddir="$srcdir/license-list-data-$pkgver"
subpackages="$pkgname-list"

_types="html json rdfa rdft rdfturtle rdFXML template text"

for type in $_types; do
    subpackages="$subpackages $pkgname-$type:_subpkg"
done

package() {
    mkdir -p "$pkgdir"
}

_subpkg() {
    local type=${subpkgname/$pkgname-/}
    pkgdesc="$pkgdesc ($type)"
    install_if="$pkgname=$pkgver-r$pkgrel"
    mkdir -p "$subpkgdir"/usr/share/spdx
    cp -r "$builddir"/$type "$subpkgdir"/usr/share/spdx/
}

list() {
    pkgdesc="$pkgdesc (licence list)"
    mkdir -p "$subpkgdir"/usr/share/spdx
    local i; for i in "$builddir"/text/*.txt;
    do
        local license=${i##*/}
        echo ${license%.*} >> "$subpkgdir"/usr/share/spdx/license.lst
    done
}

sha512sums="
67e618d4642dfe4f366935d9514d6f7941d3711e77c49bc1b340ac572d36015981b8f10c72a9f80f1d83e132ae7e5093c
0155e0c0e786e4777ee16d1cb7b885a license-list-data-3.26.0.tar.gz
"

# Contributor: Patrycja Rosa <alpine@ptrcnll.me>
# Maintainer: Patrycja Rosa <alpine@ptrcnll.me>
pkgname=bsd-compat-headers
pkgver=0.7.2
pkgrel=6
pkgdesc="BSD compatibility headers (cdefs, queue, tree)"
url="https://gitlab.alpinelinux.org/alpine/aports"

```

```

arch="noarch"
license="BSD-2-Clause AND BSD-3-Clause"
source="
cdefs.h
queue.h
tree.h
"
builddir="$srcdir"
options="!check" # just headers

package() {
    mkdir -p "$pkgdir"
    install -Dm644 -t "$pkgdir"/usr/include/sys \
        cdefs.h queue.h tree.h
}
sha512sums="
37c8fc73c7aea7b490f7850927e2bb91d12137c9e59e22c084146d515696dbc7973b5de92f4c987ba080dd2502ba8312
7006442c3f019b6447a620c0cae73178 cdefs.h
2f0d5e6e4dc3350285cf17009265dddcbe12431c111868eea39bc8cb038ab7c1f2acacbb21735c4e9d4a1fd106a8fc0f86
11ea33987d4faba37dde5ce6da0750 queue.h
d9ac210d81feb8ad2655bc80fb065d3fe20ae4417b32b4a1711e6738a4870140005c13373b5d1846ef3ce5ae6da45f2da
cef2092881eded0a2e94f6a07752ef3 tree.h
"

```

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The Kohonen neural network code for color optimization was written by Anthony Dekker.

Parts Copyright (c) 1995 by C. Blanc and C. Schlick

The X-Spline code was written Carole Blanc (blanc@labri.u-bordeaux.fr) and Christophe Schlick (schlick@labri.u-

bordeaux.fr) starting from an initial implementation done by C. Feuille, S. Grosbois, L. Maziere and L. Minihot as a student practice (Universite Bordeaux, France). For additional information about X-splines, see:

"X-Splines: A Spline Model Designed for the End User" by C. Blanc and C. Schlick, Proceedings of SIGGRAPH'95

<http://dept-info.labri.u-bordeaux.fr/~schlick/DOC/sig1.html>

# Contributor: Dhruvin Gandhi <contact@dhruvin>

# Maintainer: Patrycja Rosa <alpine@ptrcnull.me>

pkgname=py3-license-expression

\_pkgname=license\_expression

pkgver=30.4.1

pkgrel=0

pkgdesc="Library to parse, compare, simplify and normalize license expressions"

url="https://github.com/nexB/license-expression"

arch="noarch"

license="Apache-2.0"

depends="python3 py3-boolean.py"

makedepends="py3-setuptools py3-setuptools\_scm py3-gp517 py3-wheel"

checkdepends="py3-pytest py3-pytest-xdist"

subpackages="\$pkgname-pyc"

source="https://files.pythonhosted.org/packages/source/l/\_pkgname/\_pkgname-\$pkgver.tar.gz"

builddir="\$srcdir/\$\_pkgname-\$pkgver"

```
build() {
    gp517 build-wheel \
        --wheel-dir .dist \
        --output-fd 3 3>&1 >&2
}
```

```
check() {
    python3 -m venv --clear --without-pip --system-site-packages .testenv
    .testenv/bin/python3 -m installer .dist/*.whl
    .testenv/bin/python3 -m pytest
}
```

```
package() {
    python3 -m installer -d "$pkgdir" \
        .dist/*.whl
}
```

```
sha512sums="
114c630f098939757e49187e35b4e54883266a2ee9ca283724992420ef4c860f9606a8342da0ab74d93627c10805f312
fda3f699cbc7c4fbd47a71e220440fb0
    license_expression-30.4.1.tar.gz
"
```

```
/* $NetBSD: queue.h,v 1.70 2015/11/02 15:21:23 christos Exp $ */
```

```
/*
```

```
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```

```
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```

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 \*  
 \* @(#)queue.h 8.5 (Berkeley) 8/20/94  
 \*/

```
#ifndef _SYS_QUEUE_H_
#define _SYS_QUEUE_H_
```

```
/*
 * This file defines five types of data structures: singly-linked lists,
 * lists, simple queues, tail queues, and circular queues.
 *
 * A singly-linked list is headed by a single forward pointer. The
 * elements are singly linked for minimum space and
 * pointer manipulation
 * overhead at the expense of O(n) removal for arbitrary elements. New
 * elements can be added to the list after an existing element or at the
 * head of the list. Elements being removed from the head of the list
 * should use the explicit macro for this purpose for optimum
 * efficiency. A singly-linked list may only be traversed in the forward
 * direction. Singly-linked lists are ideal for applications with large
 * datasets and few or no removals or for implementing a LIFO queue.
 *
 * A list is headed by a single forward pointer (or an array of forward
```

- \* pointers for a hash table header). The elements are doubly linked
- \* so that an arbitrary element can be removed without a need to
- \* traverse the list. New elements can be added to the list before
- \* or after an existing element or at the head of the list. A list
- \* may only be traversed in the forward direction.
- \*
- \* A simple queue is headed by a pair of pointers, one the head of the
- \* list and the
- other to the tail of the list. The elements are singly
- \* linked to save space, so elements can only be removed from the
- \* head of the list. New elements can be added to the list after
- \* an existing element, at the head of the list, or at the end of the
- \* list. A simple queue may only be traversed in the forward direction.
- \*
- \* A tail queue is headed by a pair of pointers, one to the head of the
- \* list and the other to the tail of the list. The elements are doubly
- \* linked so that an arbitrary element can be removed without a need to
- \* traverse the list. New elements can be added to the list before or
- \* after an existing element, at the head of the list, or at the end of
- \* the list. A tail queue may be traversed in either direction.
- \*
- \* A circle queue is headed by a pair of pointers, one to the head of the
- \* list and the other to the tail of the list. The elements are doubly
- \* linked so that an arbitrary element can be removed without a need to
- \* traverse the list. New elements
- can be added to the list before or after
- \* an existing element, at the head of the list, or at the end of the list.
- \* A circle queue may be traversed in either direction, but has a more
- \* complex end of list detection.
- \*
- \* For details on the use of these macros, see the queue(3) manual page.
- \*/
- /\*
- \* Include the definition of NULL only on NetBSD because sys/null.h
- \* is not available elsewhere. This conditional makes the header
- \* portable and it can simply be dropped verbatim into any system.
- \* The caveat is that on other systems some other header
- \* must provide NULL before the macros can be used.
- \*/
- #ifdef \_\_NetBSD\_\_
- #include <sys/null.h>
- #endif
- #if defined(QUEUEDEBUG)
- # if defined(\_KERNEL)
- # define QUEUEDEBUG\_ABORT(...) panic(\_\_VA\_ARGS\_\_)
- # else

```

# include <err.h>
# define QUEUEDEBUG_ABORT(...) err(1, __VA_ARGS__)
# endif
#endif

/*
 * Singly-linked List definitions.
 */
#define SLIST_HEAD(name, type) \
struct name { \
    struct type *slh_first; /* first \
    element */ \
}

#define SLIST_HEAD_INITIALIZER(head) \
{ NULL }

#define SLIST_ENTRY(type) \
struct { \
    struct type *sle_next; /* next element */ \
}

/*
 * Singly-linked List access methods.
 */
#define SLIST_FIRST(head) ((head)->slh_first)
#define SLIST_END(head) NULL
#define SLIST_EMPTY(head) ((head)->slh_first == NULL)
#define SLIST_NEXT(elm, field) ((elm)->field.sle_next)

#define SLIST_FOREACH(var, head, field) \
for((var) = (head)->slh_first; \
    (var) != SLIST_END(head); \
    (var) = (var)->field.sle_next)

#define SLIST_FOREACH_SAFE(var, head, field, tvar) \
for ((var) = SLIST_FIRST((head)); \
    (var) != SLIST_END(head) && \
    ((tvar) = SLIST_NEXT((var), field), 1); \
    (var) = (tvar))

/*
 * Singly-linked List functions.
 */
#define SLIST_INIT(head) do { \
    (head)->slh_first = SLIST_END(head); \
} while (/*CONSTCOND*/0)

```



```
#define SLIST_INSERT_AFTER(slistelm, elm, field) do { \
    (elm)->field.sle_next = (slistelm)->field.sle_next; \
    (slistelm)->field.sle_next \
    = (elm); \
} while (/*CONSTCOND*/0)
```

```
#define SLIST_INSERT_HEAD(head, elm, field) do { \
    (elm)->field.sle_next = (head)->slh_first; \
    (head)->slh_first = (elm); \
} while (/*CONSTCOND*/0)
```

```
#define SLIST_REMOVE_AFTER(slistelm, field) do { \
    (slistelm)->field.sle_next = \
        SLIST_NEXT(SLIST_NEXT((slistelm), field), field); \
} while (/*CONSTCOND*/0)
```

```
#define SLIST_REMOVE_HEAD(head, field) do { \
    (head)->slh_first = (head)->slh_first->field.sle_next; \
} while (/*CONSTCOND*/0)
```

```
#define SLIST_REMOVE(head, elm, type, field) do { \
    if ((head)->slh_first == (elm)) { \
        SLIST_REMOVE_HEAD((head), field); \
    } \
    else { \
        struct type *curelm = (head)->slh_first; \
        while(curelm->field.sle_next != (elm)) \
            curelm = curelm->field.sle_next; \
        curelm->field.sle_next = \
            curelm->field.sle_next->field.sle_next; \
    } \
} while (/*CONSTCOND*/0)
```

```
/*
```

```
* List definitions.
```

```
*/
```

```
#define LIST_HEAD(name, type) \
struct name { \
    struct type *lh_first; /* first element */ \
}
```

```
#define LIST_HEAD_INITIALIZER(head) \
{ NULL }
```

```
#define LIST_ENTRY(type) \
struct { \
    struct type *le_next; /* next element */ \
}
```

```

struct type **le_prev; /* address of previous next element */\
}

/*
 * List access methods.
 */
#define LIST_FIRST(head) ((head)->lh_first)
#define LIST_END(head) NULL
#define LIST_EMPTY(head) ((head)->lh_first == LIST_END(head))
#define LIST_NEXT(elm, field) ((elm)->field.le_next)

#define LIST_FOREACH(var, head, field) \
    for ((var) = ((head)->lh_first); \
         (var) != LIST_END(head); \
         (var) = ((var)->field.le_next))

#define LIST_FOREACH_SAFE(var, head, field, tvar) \
    for ((var) = LIST_FIRST((head)); \
         (var) != LIST_END(head) && \
         ((tvar) = LIST_NEXT((var), field), 1); \
         (var) = (tvar))

#define LIST_MOVE(head1, head2) do { \
    LIST_INIT((head2)); \
    if (!LIST_EMPTY((head1))) \
    { \
        (head2)->lh_first = (head1)->lh_first; \
        LIST_INIT((head1)); \
    } \
} while (/*CONSTCOND*/0)

/*
 * List functions.
 */
#ifdef QUEUEDEBDEBUG
#define QUEUEDEBDEBUG_LIST_INSERT_HEAD(head, elm, field) \
    if ((head)->lh_first && \
        (head)->lh_first->field.le_prev != &(head)->lh_first) \
        QUEUEDEBDEBUG_ABORT("LIST_INSERT_HEAD %p %s:%d", (head), \
            __FILE__, __LINE__);
#define QUEUEDEBDEBUG_LIST_OP(elm, field) \
    if ((elm)->field.le_next && \
        (elm)->field.le_next->field.le_prev != \
        &(elm)->field.le_next) \
        QUEUEDEBDEBUG_ABORT("LIST_* forw %p %s:%d", (elm), \
            __FILE__, __LINE__); \
    if (*(elm)->field.le_prev != (elm)) \
        QUEUEDEBDEBUG_ABORT("LIST_* back %p %s:%d", (elm), \

```

```

    __FILE__, __LINE__);
#define QUEUEDEBUG_LIST_POSTREMOVE(elm, field) \
    (elm)->field.le_next = (void *)1L; \
    (elm)->field.le_prev = (void *)1L;
#else
#define QUEUEDEBUG_LIST_INSERT_HEAD(head, elm, field)
#define QUEUEDEBUG_LIST_OP(elm,
    field)
#define QUEUEDEBUG_LIST_POSTREMOVE(elm, field)
#endif

#define LIST_INIT(head) do { \
    (head)->lh_first = LIST_END(head); \
} while (/*CONSTCOND*/0)

#define LIST_INSERT_AFTER(listelm, elm, field) do { \
    QUEUEDEBUG_LIST_OP((listelm), field) \
    if (((elm)->field.le_next = (listelm)->field.le_next) != \
        LIST_END(head)) \
        (listelm)->field.le_next->field.le_prev = \
            &(elm)->field.le_next; \
    (listelm)->field.le_next = (elm); \
    (elm)->field.le_prev = &(listelm)->field.le_next; \
} while (/*CONSTCOND*/0)

#define LIST_INSERT_BEFORE(listelm, elm, field) do { \
    QUEUEDEBUG_LIST_OP((listelm), field) \
    (elm)->field.le_prev = (listelm)->field.le_prev; \
    (elm)->field.le_next = (listelm); \
    *(listelm)->field.le_prev = (elm); \
    (listelm)->field.le_prev = &(elm)->field.le_next; \
} while (/*CONSTCOND*/0)

#define LIST_INSERT_HEAD(head, elm, field) do { \
    QUEUEDEBUG_LIST_INSERT_HEAD((head), (elm), field) \
    if (((elm)->field.le_next \
        = (head)->lh_first) != LIST_END(head)) \
        (head)->lh_first->field.le_prev = &(elm)->field.le_next; \
    (head)->lh_first = (elm); \
    (elm)->field.le_prev = &(head)->lh_first; \
} while (/*CONSTCOND*/0)

#define LIST_REMOVE(elm, field) do { \
    QUEUEDEBUG_LIST_OP((elm), field) \
    if ((elm)->field.le_next != NULL) \
        (elm)->field.le_next->field.le_prev = \
            (elm)->field.le_prev; \
    *(elm)->field.le_prev = (elm)->field.le_next; \
} while (/*CONSTCOND*/0)

```

```

QUEUEDEBUG_LIST_POSTREMOVE((elm), field) \
} while (/*CONSTCOND*/0)

#define LIST_REPLACE(elm, elm2, field) do { \
if (((elm2)->field.le_next = (elm)->field.le_next) != NULL) \
(elm2)->field.le_next->field.le_prev = \
    &(elm2)->field.le_next; \
(elm2)->field.le_prev = (elm)->field.le_prev; \
*(elm2)->field.le_prev = (elm2); \
QUEUEDEBUG_LIST_POSTREMOVE((elm), field) \
} while (/*CONSTCOND*/0)

/*
 * Simple queue definitions.
 */
#define SIMPLEQ_HEAD(name, type) \
struct name { \
    struct \
    type *sqh_first; /* first element */ \
    struct type **sqh_last; /* addr of last next element */ \
}

#define SIMPLEQ_HEAD_INITIALIZER(head) \
{ NULL, &(head).sqh_first }

#define SIMPLEQ_ENTRY(type) \
struct { \
    struct type *sqe_next; /* next element */ \
}

/*
 * Simple queue access methods.
 */
#define SIMPLEQ_FIRST(head) ((head)->sqh_first)
#define SIMPLEQ_END(head) NULL
#define SIMPLEQ_EMPTY(head) ((head)->sqh_first == SIMPLEQ_END(head))
#define SIMPLEQ_NEXT(elm, field) ((elm)->field.sqe_next)

#define SIMPLEQ_FOREACH(var, head, field) \
for ((var) = ((head)->sqh_first); \
    (var) != SIMPLEQ_END(head); \
    (var) = ((var)->field.sqe_next))

#define SIMPLEQ_FOREACH_SAFE(var, head, field, next) \
for ((var) = ((head)->sqh_first); \
    (var) != SIMPLEQ_END(head) && \
    ((next = ((var)->field.sqe_next)), 1); \
    (var) = (next))

```

```

/*
 * Simple queue functions.
 */
#define SIMPLEQ_INIT(head) do { \
    (head)->sqh_first = NULL; \
    (head)->sqh_last \
    = &(head)->sqh_first; \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_INSERT_HEAD(head, elm, field) do { \
    if (((elm)->field.sqe_next = (head)->sqh_first) == NULL) \
        (head)->sqh_last = &(elm)->field.sqe_next; \
    (head)->sqh_first = (elm); \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_INSERT_TAIL(head, elm, field) do { \
    (elm)->field.sqe_next = NULL; \
    *(head)->sqh_last = (elm); \
    (head)->sqh_last = &(elm)->field.sqe_next; \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_INSERT_AFTER(head, listelm, elm, field) do { \
    if (((elm)->field.sqe_next = (listelm)->field.sqe_next) == NULL) \
        (head)->sqh_last = &(elm)->field.sqe_next; \
    (listelm)->field.sqe_next = (elm); \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_REMOVE_HEAD(head, field) do { \
    if (((head)->sqh_first = (head)->sqh_first->field.sqe_next) == NULL) \
        (head)->sqh_last = &(head)->sqh_first; \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_REMOVE_AFTER(head, elm, field) do { \
    if \
        (((elm)->field.sqe_next = (elm)->field.sqe_next->field.sqe_next) \
         == NULL) \
        (head)->sqh_last = &(elm)->field.sqe_next; \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_REMOVE(head, elm, type, field) do { \
    if ((head)->sqh_first == (elm)) { \
        SIMPLEQ_REMOVE_HEAD((head), field); \
    } else { \
        struct type *curelm = (head)->sqh_first; \
        while (curelm->field.sqe_next != (elm)) \
            curelm = curelm->field.sqe_next; \
        if ((curelm->field.sqe_next = \

```

```

    curelm->field.sqe_next->field.sqe_next) == NULL) \
    (head)->sqh_last = &(curelm)->field.sqe_next; \
} \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_CONCAT(head1, head2) do { \
    if (!SIMPLEQ_EMPTY((head2))) { \
        *(head1)->sqh_last = (head2)->sqh_first; \
        (head1)->sqh_last = (head2)->sqh_last; \
        SIMPLEQ_INIT((head2)); \
    } \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_LAST(head, type, field) \
(SIMPLEQ_EMPTY((head)) ? \
    NULL : \
    ((struct type \
    *) (void *) \
    ((char *)((head)->sqh_last) - offsetof(struct type, field))))

/*
 * Tail queue definitions.
 */
#define _TAILQ_HEAD(name, type, qual) \
struct name { \
    qual type *tqh_first; /* first element */ \
    qual type *qual *tqh_last; /* addr of last next element */ \
}
#define TAILQ_HEAD(name, type) _TAILQ_HEAD(name, struct type,)

#define TAILQ_HEAD_INITIALIZER(head) \
{ TAILQ_END(head), &(head).tqh_first }

#define _TAILQ_ENTRY(type, qual) \
struct { \
    qual type *tqe_next; /* next element */ \
    qual type *qual *tqe_prev; /* address of previous next element */ \
}
#define TAILQ_ENTRY(type) _TAILQ_ENTRY(struct type,)

/*
 * Tail queue access methods.
 */
#define TAILQ_FIRST(head) ((head)->tqh_first)
#define TAILQ_END(head) (NULL)
#define TAILQ_NEXT(elm, field) ((elm)->field.tqe_next)
#define TAILQ_LAST(head, headname) \
    (((struct headname *) (void *)) ((head)->tqh_last))->tqh_last)

```

```

#define TAILQ_PREV(elm, headname, field) \
    (((struct headname \
    *) (void *) ((elm)->field.tqe_prev))->tqh_last)
#define TAILQ_EMPTY(head) (TAILQ_FIRST(head) == TAILQ_END(head))

#define TAILQ_FOREACH(var, head, field) \
    for ((var) = ((head)->tqh_first); \
        (var) != TAILQ_END(head); \
        (var) = ((var)->field.tqe_next))

#define TAILQ_FOREACH_SAFE(var, head, field, next) \
    for ((var) = ((head)->tqh_first); \
        (var) != TAILQ_END(head) && \
        ((next) = TAILQ_NEXT(var, field), 1); (var) = (next))

#define TAILQ_FOREACH_REVERSE(var, head, headname, field) \
    for ((var) = TAILQ_LAST((head), headname); \
        (var) != TAILQ_END(head); \
        (var) = TAILQ_PREV((var), headname, field))

#define TAILQ_FOREACH_REVERSE_SAFE(var, head, headname, field, prev) \
    for ((var) = TAILQ_LAST((head), headname); \
        (var) != TAILQ_END(head) && \
        ((prev) = TAILQ_PREV((var), headname, field), 1); (var) = (prev))

/*
 * Tail queue functions.
 */
#if defined(QUEUEDEBUG)
#define QUEUEDEBUG_TAILQ_INSERT_HEAD(head, \
    elm, field) \
    if ((head)->tqh_first && \
        (head)->tqh_first->field.tqe_prev != &(head)->tqh_first) \
        QUEUEDEBUG_ABORT("TAILQ_INSERT_HEAD %p %s:%d", (head), \
            __FILE__, __LINE__);
#define QUEUEDEBUG_TAILQ_INSERT_TAIL(head, elm, field) \
    if (*(head)->tqh_last != NULL) \
        QUEUEDEBUG_ABORT("TAILQ_INSERT_TAIL %p %s:%d", (head), \
            __FILE__, __LINE__);
#define QUEUEDEBUG_TAILQ_OP(elm, field) \
    if ((elm)->field.tqe_next && \
        (elm)->field.tqe_next->field.tqe_prev != \
        &(elm)->field.tqe_next) \
        QUEUEDEBUG_ABORT("TAILQ_* forw %p %s:%d", (elm), \
            __FILE__, __LINE__); \
    if (*(elm)->field.tqe_prev != (elm)) \
        QUEUEDEBUG_ABORT("TAILQ_* back %p %s:%d", (elm), \

```

```

    __FILE__, __LINE__);
#define QUEUEDEBUG_TAILQ_PREREMOVE(head, elm, field) \
    if ((elm)->field.tqe_next == NULL && \
        (head)->tqh_last != &(elm)->field.tqe_next) \
        QUEUEDEBUG_ABORT("TAILQ_PREREMOVE head %p elm %p %s:%d", \
            (head), (elm), __FILE__, \
            __LINE__);
#define QUEUEDEBUG_TAILQ_POSTREMOVE(elm, field) \
    (elm)->field.tqe_next = (void *)1L; \
    (elm)->field.tqe_prev = (void *)1L;
#else
#define QUEUEDEBUG_TAILQ_INSERT_HEAD(head, elm, field)
#define QUEUEDEBUG_TAILQ_INSERT_TAIL(head, elm, field)
#define QUEUEDEBUG_TAILQ_OP(elm, field)
#define QUEUEDEBUG_TAILQ_PREREMOVE(head, elm, field)
#define QUEUEDEBUG_TAILQ_POSTREMOVE(elm, field)
#endif

#define TAILQ_INIT(head) do { \
    (head)->tqh_first = TAILQ_END(head); \
    (head)->tqh_last = &(head)->tqh_first; \
} while (/*CONSTCOND*/0)

#define TAILQ_INSERT_HEAD(head, elm, field) do { \
    QUEUEDEBUG_TAILQ_INSERT_HEAD((head), (elm), field) \
    if (((elm)->field.tqe_next = (head)->tqh_first) != TAILQ_END(head)) \
        (head)->tqh_first->field.tqe_prev = \
            &(elm)->field.tqe_next; \
    else \
        (head)->tqh_last = &(elm)->field.tqe_next; \
    (head)->tqh_first = (elm); \
    (elm)->field.tqe_prev = &(head)->tqh_first; \
} while (/*CONSTCOND*/0)

#define TAILQ_INSERT_TAIL(head, \
    elm, field) do { \
    QUEUEDEBUG_TAILQ_INSERT_TAIL((head), (elm), field) \
    (elm)->field.tqe_next = TAILQ_END(head); \
    (elm)->field.tqe_prev = (head)->tqh_last; \
    *(head)->tqh_last = (elm); \
    (head)->tqh_last = &(elm)->field.tqe_next; \
} while (/*CONSTCOND*/0)

#define TAILQ_INSERT_AFTER(head, listelm, elm, field) do { \
    QUEUEDEBUG_TAILQ_OP((listelm), field) \
    if (((elm)->field.tqe_next = (listelm)->field.tqe_next) != \
        TAILQ_END(head)) \
        (elm)->field.tqe_next->field.tqe_prev = \

```



```

    &(elm)->field.tqe_next; \
else \
    (head)->tqh_last = &(elm)->field.tqe_next; \
    (listelm)->field.tqe_next = (elm); \
    (elm)->field.tqe_prev = &(listelm)->field.tqe_next; \
} while (/*CONSTCOND*/0)

#define TAILQ_INSERT_BEFORE(listelm, elm, field) do { \
    QUEUEDEBDEBUG_TAILQ_OP((listelm), field) \
    (elm)->field.tqe_prev = (listelm)->field.tqe_prev; \
    (elm)->field.tqe_next = (listelm); \
    *(listelm)->field.tqe_prev = (elm); \
    (listelm)->field.tqe_prev \
    = &(elm)->field.tqe_next; \
} while (/*CONSTCOND*/0)

#define TAILQ_REMOVE(head, elm, field) do { \
    QUEUEDEBDEBUG_TAILQ_PREREMOVE((head), (elm), field) \
    QUEUEDEBDEBUG_TAILQ_OP((elm), field) \
    if (((elm)->field.tqe_next) != TAILQ_END(head)) \
        (elm)->field.tqe_next->field.tqe_prev = \
            (elm)->field.tqe_prev; \
    else \
        (head)->tqh_last = (elm)->field.tqe_prev; \
    *(elm)->field.tqe_prev = (elm)->field.tqe_next; \
    QUEUEDEBDEBUG_TAILQ_POSTREMOVE((elm), field); \
} while (/*CONSTCOND*/0)

#define TAILQ_REPLACE(head, elm, elm2, field) do { \
    if (((elm2)->field.tqe_next = (elm)->field.tqe_next) != \
        TAILQ_END(head)) \
        (elm2)->field.tqe_next->field.tqe_prev = \
            &(elm2)->field.tqe_next; \
    else \
        (head)->tqh_last = &(elm2)->field.tqe_next; \
    (elm2)->field.tqe_prev = (elm)->field.tqe_prev; \
    *(elm2)->field.tqe_prev = (elm2); \
    QUEUEDEBDEBUG_TAILQ_POSTREMOVE((elm), \
    field); \
} while (/*CONSTCOND*/0)

#define TAILQ_CONCAT(head1, head2, field) do { \
    if (!TAILQ_EMPTY(head2)) { \
        *(head1)->tqh_last = (head2)->tqh_first; \
        (head2)->tqh_first->field.tqe_prev = (head1)->tqh_last; \
        (head1)->tqh_last = (head2)->tqh_last; \
        TAILQ_INIT((head2)); \
    } \
}

```

```

} while (/*CONSTCOND*/0)

/*
 * Singly-linked Tail queue declarations.
 */
#define STAILQ_HEAD(name, type)  \
struct name {                    \
    struct type *stqh_first; /* first element */ \
    struct type **stqh_last; /* addr of last next element */ \
}

#define STAILQ_HEAD_INITIALIZER(head)  \
{ NULL, &(head).stqh_first }

#define STAILQ_ENTRY(type)  \
struct {                    \
    struct type *stqe_next; /* next element */ \
}

/*
 * Singly-linked Tail queue access methods.
 */
#define STAILQ_FIRST(head) ((head)->stqh_first)
#define STAILQ_END(head) NULL
#define STAILQ_NEXT(elm, field) ((elm)->field.stqe_next)
#define STAILQ_EMPTY(head) (STAILQ_FIRST(head) \
== STAILQ_END(head))

/*
 * Singly-linked Tail queue functions.
 */
#define STAILQ_INIT(head) do { \
    (head)->stqh_first = NULL; \
    (head)->stqh_last = &(head)->stqh_first; \
} while (/*CONSTCOND*/0)

#define STAILQ_INSERT_HEAD(head, elm, field) do { \
    if (((elm)->field.stqe_next = (head)->stqh_first) == NULL) \
        (head)->stqh_last = &(elm)->field.stqe_next; \
    (head)->stqh_first = (elm); \
} while (/*CONSTCOND*/0)

#define STAILQ_INSERT_TAIL(head, elm, field) do { \
    (elm)->field.stqe_next = NULL; \
    *(head)->stqh_last = (elm); \
    (head)->stqh_last = &(elm)->field.stqe_next; \
} while (/*CONSTCOND*/0)

```

```
#define STAILQ_INSERT_AFTER(head, listelm, elm, field) do { \
    if (((elm)->field.stqe_next = (listelm)->field.stqe_next) == NULL)\
        (head)->stqh_last = &(elm)->field.stqe_next; \
    (listelm)->field.stqe_next = (elm); \
} while (/*CONSTCOND*/0)
```

```
#define STAILQ_REMOVE_HEAD(head, field) do { \
    if (((head)->stqh_first = (head)->stqh_first->field.stqe_next) \
        == NULL) \
        (head)->stqh_last = &(head)->stqh_first; \
} while (/*CONSTCOND*/0)
```

```
#define STAILQ_REMOVE(head, elm, type, field) do { \
    if ((head)->stqh_first == (elm)) { \
        STAILQ_REMOVE_HEAD((head), field); \
    } else { \
        struct type *curelm = (head)->stqh_first; \
        while (curelm->field.stqe_next != (elm)) \
            curelm = curelm->field.stqe_next; \
        if ((curelm->field.stqe_next = \
            curelm->field.stqe_next->field.stqe_next) == NULL) \
            (head)->stqh_last = &(curelm)->field.stqe_next; \
    } \
} while (/*CONSTCOND*/0)
```

```
#define STAILQ_FOREACH(var, head, field) \
    for ((var) = ((head)->stqh_first); \
        (var); \
        (var) = ((var)->field.stqe_next))
```

```
#define STAILQ_FOREACH_SAFE(var, head, field, tvar) \
    for ((var) = STAILQ_FIRST((head)); \
        (var) && ((tvar) = STAILQ_NEXT((var), field), 1); \
        (var) = (tvar))
```

```
#define STAILQ_CONCAT(head1, head2) do { \
    if (!STAILQ_EMPTY((head2))) { \
        *(head1)->stqh_last \
        = (head2)->stqh_first; \
        (head1)->stqh_last = (head2)->stqh_last; \
        STAILQ_INIT((head2)); \
    } \
} while (/*CONSTCOND*/0)
```

```
#define STAILQ_LAST(head, type, field) \
    (STAILQ_EMPTY((head)) ? \
    NULL : \
    ((struct type *) (void *) \
        ((head)->stqh_last->field.stqe_next)))
```

```
((char *)((head)->stqh_last) - offsetof(struct type, field))))
```

```
#ifndef _KERNEL
```

```
/*
```

```
* Circular queue definitions. Do not use. We still keep the macros
```

```
* for compatibility but because of pointer aliasing issues their use
```

```
* is discouraged!
```

```
*/
```

```
/*
```

```
* __launder_type(): We use this ugly hack to work around the the compiler
```

```
* noticing that two types may not alias each other and elide tests in code.
```

```
* We hit this in the CIRCLEQ macros when comparing 'struct name *' and
```

```
* 'struct type *' (see CIRCLEQ_HEAD()). Modern compilers (such as GCC
```

```
* 4.8) declare these comparisons as always false, causing the code to
```

```
* not run as designed.
```

```
*
```

```
* This hack is only to be used for comparisons and thus can be fully const.
```

```
* Do not use for assignment.
```

```
*
```

```
* If we ever choose to change the ABI of the CIRCLEQ macros, we could fix
```

```
* this by changing the head/tail sentinel values, but see the note above
```

```
* this one.
```

```
*/
```

```
static __inline const void * __launder_type(const void *);
```

```
static __inline const void *
```

```
__launder_type(const void *__x)
```

```
{
```

```
__asm __volatile("" : "+r" (__x));
```

```
return __x;
```

```
}
```

```
#if defined(QUEUEDEBUG)
```

```
#define QUEUEDEBUG_CIRCLEQ_HEAD(head, field) \
```

```
if ((head)->cqh_first != CIRCLEQ_ENDC(head) && \
```

```
(head)->cqh_first->field.cqe_prev != CIRCLEQ_ENDC(head)) \
```

```
QUEUEDEBUG_ABORT("CIRCLEQ head forw %p %s:%d", (head), \
```

```
__FILE__, __LINE__); \
```

```
if ((head)->cqh_last != CIRCLEQ_ENDC(head) && \
```

```
(head)->cqh_last->field.cqe_next != CIRCLEQ_ENDC(head)) \
```

```
QUEUEDEBUG_ABORT("CIRCLEQ head back %p %s:%d", (head), \
```

```
__FILE__, __LINE__);
```

```
#define QUEUEDEBUG_CIRCLEQ_ELM(head, elm, field) \
```

```
if ((elm)->field.cqe_next == CIRCLEQ_ENDC(head)) { \
```

```
if ((head)->cqh_last != (elm)) \
```

```
QUEUEDEBUG_ABORT("CIRCLEQ
```

```

elm last %p %s:%d", \
    (elm), __FILE__, __LINE__); \
} else { \
    if ((elm)->field.cqe_next->field.cqe_prev != (elm)) \
        QUEUEDEBUG_ABORT("CIRCLEQ elm forw %p %s:%d", \
            (elm), __FILE__, __LINE__); \
} \
if ((elm)->field.cqe_prev == CIRCLEQ_ENDC(head)) { \
    if ((head)->cqh_first != (elm)) \
        QUEUEDEBUG_ABORT("CIRCLEQ elm first %p %s:%d", \
            (elm), __FILE__, __LINE__); \
} else { \
    if ((elm)->field.cqe_prev->field.cqe_next != (elm)) \
        QUEUEDEBUG_ABORT("CIRCLEQ elm prev %p %s:%d", \
            (elm), __FILE__, __LINE__); \
}
#define QUEUEDEBUG_CIRCLEQ_POSTREMOVE(elm, field) \
    (elm)->field.cqe_next = (void *)1L; \
    (elm)->field.cqe_prev = (void *)1L;
#else
#define QUEUEDEBUG_CIRCLEQ_HEAD(head, field)
#define QUEUEDEBUG_CIRCLEQ_ELM(head, elm, field)
#define QUEUEDEBUG_CIRCLEQ_POSTREMOVE(elm, field)
#endif

#define CIRCLEQ_HEAD(name, type) \
struct name { \
    struct type *cqh_first; /* \
    first element */ \
    struct type *cqh_last; /* last element */ \
}

#define CIRCLEQ_HEAD_INITIALIZER(head) \
{ CIRCLEQ_END(&head), CIRCLEQ_END(&head) }

#define CIRCLEQ_ENTRY(type) \
struct { \
    struct type *cqe_next; /* next element */ \
    struct type *cqe_prev; /* previous element */ \
}

/*
 * Circular queue functions.
 */

#define CIRCLEQ_INIT(head) do { \
    (head)->cqh_first = CIRCLEQ_END(head); \
    (head)->cqh_last = CIRCLEQ_END(head); \
} while (/*CONSTCOND*/0)

```

```

#define CIRCLEQ_INSERT_AFTER(head, listelm, elm, field) do { \
    QUEUEDEBBUG_CIRCLEQ_HEAD((head), field) \
    QUEUEDEBBUG_CIRCLEQ_ELM((head), (listelm), field) \
    (elm)->field.cqe_next = (listelm)->field.cqe_next; \
    (elm)->field.cqe_prev = (listelm); \
    if ((listelm)->field.cqe_next == CIRCLEQ_ENDC(head)) \
        (head)->cqh_last = (elm); \
    else \
        (listelm)->field.cqe_next->field.cqe_prev = (elm); \
    (listelm)->field.cqe_next = (elm); \
} while (/*CONSTCOND*/0)

```

```

#define CIRCLEQ_INSERT_BEFORE(head,
listelm, elm, field) do { \
    QUEUEDEBBUG_CIRCLEQ_HEAD((head), field) \
    QUEUEDEBBUG_CIRCLEQ_ELM((head), (listelm), field) \
    (elm)->field.cqe_next = (listelm); \
    (elm)->field.cqe_prev = (listelm)->field.cqe_prev; \
    if ((listelm)->field.cqe_prev == CIRCLEQ_ENDC(head)) \
        (head)->cqh_first = (elm); \
    else \
        (listelm)->field.cqe_prev->field.cqe_next = (elm); \
    (listelm)->field.cqe_prev = (elm); \
} while (/*CONSTCOND*/0)

```

```

#define CIRCLEQ_INSERT_HEAD(head, elm, field) do { \
    QUEUEDEBBUG_CIRCLEQ_HEAD((head), field) \
    (elm)->field.cqe_next = (head)->cqh_first; \
    (elm)->field.cqe_prev = CIRCLEQ_END(head); \
    if ((head)->cqh_last == CIRCLEQ_ENDC(head)) \
        (head)->cqh_last = (elm); \
    else \
        (head)->cqh_first->field.cqe_prev = (elm); \
    (head)->cqh_first = (elm); \
} while (/*CONSTCOND*/0)

```

```

#define CIRCLEQ_INSERT_TAIL(head, elm, field) do { \
    QUEUEDEBBUG_CIRCLEQ_HEAD((head), field) \
    (elm)->field.cqe_next
= CIRCLEQ_END(head); \
    (elm)->field.cqe_prev = (head)->cqh_last; \
    if ((head)->cqh_first == CIRCLEQ_ENDC(head)) \
        (head)->cqh_first = (elm); \
    else \
        (head)->cqh_last->field.cqe_next = (elm); \
    (head)->cqh_last = (elm); \
} while (/*CONSTCOND*/0)

```

```

#define CIRCLEQ_REMOVE(head, elm, field) do { \
    QUEUEDEBUG_CIRCLEQ_HEAD((head), field) \
    QUEUEDEBUG_CIRCLEQ_ELM((head), (elm), field) \
    if ((elm)->field.cqe_next == CIRCLEQ_ENDC(head)) \
        (head)->cqh_last = (elm)->field.cqe_prev; \
    else \
        (elm)->field.cqe_next->field.cqe_prev = \
            (elm)->field.cqe_prev; \
    if ((elm)->field.cqe_prev == CIRCLEQ_ENDC(head)) \
        (head)->cqh_first = (elm)->field.cqe_next; \
    else \
        (elm)->field.cqe_prev->field.cqe_next = \
            (elm)->field.cqe_next; \
    QUEUEDEBUG_CIRCLEQ_POSTREMOVE((elm), field) \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_FOREACH(var, head, field) \
    for ((var) = ((head)->cqh_first); \
        (var) != CIRCLEQ_ENDC(head); \
        (var) \
        = ((var)->field.cqe_next))

#define CIRCLEQ_FOREACH_REVERSE(var, head, field) \
    for ((var) = ((head)->cqh_last); \
        (var) != CIRCLEQ_ENDC(head); \
        (var) = ((var)->field.cqe_prev))

/*
 * Circular queue access methods.
 */

#define CIRCLEQ_FIRST(head) ((head)->cqh_first)
#define CIRCLEQ_LAST(head) ((head)->cqh_last)
/* For comparisons */
#define CIRCLEQ_ENDC(head) (__launter_type(head))
/* For assignments */
#define CIRCLEQ_END(head) ((void *) (head))
#define CIRCLEQ_NEXT(elm, field) ((elm)->field.cqe_next)
#define CIRCLEQ_PREV(elm, field) ((elm)->field.cqe_prev)
#define CIRCLEQ_EMPTY(head) \
    (CIRCLEQ_FIRST(head) == CIRCLEQ_ENDC(head))

#define CIRCLEQ_LOOP_NEXT(head, elm, field) \
    (((elm)->field.cqe_next == CIRCLEQ_ENDC(head)) \
     ? ((head)->cqh_first) \
     : (elm)->field.cqe_next)
#define CIRCLEQ_LOOP_PREV(head, elm, field) \
    (((elm)->field.cqe_prev == CIRCLEQ_ENDC(head)) \

```

```

? ((head)->cqh_last) \
:
(elm->field.cqe_prev))
#endif /* !_KERNEL */

#endif /* !_SYS_QUEUE_H_ */
# Contributor: Fabian Affolter <fabian@affolter-engineering.ch>
# Maintainer: Fabian Affolter <fabian@affolter-engineering.ch>
pkgname=py3-flake8-copyright
_pkgname=flake8-copyright
pkgver=0.2.4
pkgrel=3
pkgdesc="Extension for flake8 which checks for copyrights"
options="!check" # No testsuite
url="https://github.com/savoirfairelinux/flake8-copyright"
arch="noarch"
license="MIT"
depends="py3-flake8 py3-setuptools"
makedepends="py3-gpep517 py3-wheel"
subpackages="$pkgname-pyc"
source="https://files.pythonhosted.org/packages/source/${_pkgname:0:1}/${_pkgname}/${_pkgname}-${pkgver}.tar.gz"
builddir="$srcdir"/$_pkgname-$pkgver

replaces="py-flake8-copyright" # Backwards compatibility
provides="py-flake8-copyright=$pkgver-r$pkgrel" # Backwards compatibility

build() {
    gpep517 build-wheel \
        --wheel-dir .dist \
        --output-fd 3 3>&1 >&2
}

package() {
    gpep517 install-wheel --destdir "$pkgdir" \
        .dist/*.whl
}

sha512sums="
a6ab47e1bb715618f075c51f398e18180404871b3b0faf1c2d30701d5203db6bc23771bf22ffb5bafcd8ee856b9b64237
b316bd503ae7dceed6ca284ccd5a74d
flake8-copyright-0.2.4.tar.gz
"

#ifndef _SYS_CDEFS_H_
#define _SYS_CDEFS_H_

#warning usage of non-standard #include <sys/cdefs.h> is deprecated

#undef __P

```



```

#undef __PMT

#define __P(args) args
#define __PMT(args) args

#define __CONCAT(x,y) x ## y
#define __STRING(x) #x

#ifdef __cplusplus
# define __BEGIN_DECLS extern "C" {
# define __END_DECLS }
#else
# define __BEGIN_DECLS
# define __END_DECLS
#endif

#if defined(__GNUC__) && !defined(__cplusplus)
# define __THROW __attribute__((__nothrow__))
# define __NTH(fct) __attribute__((__nothrow__)) fct
#else
# define __THROW
# define __NTH(fct) fct
#endif

#endif /* _SYS_CDEFS_H_ */
# Maintainer: fossdd <fossdd@pwned.life>
pkgname=cargo-license
pkgver=0.6.1
pkgrel=1
pkgdesc="Cargo subcommand to see license of dependencies"
url="https://github.com/onur/cargo-license"
arch="all"
license="MIT"
makedepends="cargo cargo-auditable"
source="$pkgname-$pkgver.tar.gz::https://crates.io/api/v1/crates/cargo-license/$pkgver/download"

prepare() {
    default_prepare

    cargo fetch --target="$CTARGET" --locked
}

build() {
    cargo auditable build --release --frozen
}

check() {
    cargo test --frozen

```

```

}

package() {
    install -Dm755 target/release/cargo-license -t "$pkgdir"/usr/bin
}

sha512sums="
36215145e79965be090ae2f5ce6f5eb208465eb67a94c26bed1fe70a131c46c6dc35695e30852759b7366883fbc3caf00
272d796ac634f0a5e1d49232b6b29d5  cargo-license-0.6.1.tar.gz
"

/* $NetBSD: tree.h,v 1.20 2013/09/14 13:20:45 joerg Exp $ */
/* $OpenBSD: tree.h,v 1.13 2011/07/09 00:19:45 pirofti Exp $ */
/* Modified by Void Linux. */
/*
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* THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.
*/

#ifdef _SYS_TREE_H_
#define _SYS_TREE_H_

#ifdef __GNUC__
#define __GNUC_PREREQ__(x, y) \
    ((__GNUC__ == (x) && __GNUC_MINOR__ >= (y)) || \
     (__GNUC__ > (x)))
#else
#define __GNUC_PREREQ__(x, y) 0

```

```

#endif

#if __GNUC_PREREQ__(2, 7) || defined(__lint__)
#define _sys_tree_h_unused __attribute__((__unused__))
#else
#define _sys_tree_h_unused /* delete */
#endif

/*
 * This file defines data structures for different types of trees:
 * splay trees and red-black trees.
 *
 * A splay tree is a self-organizing
 * data structure. Every operation
 * on the tree causes a splay to happen. The splay moves the requested
 * node to the root of the tree and partly rebalances it.
 *
 * This has the benefit that request locality causes faster lookups as
 * the requested nodes move to the top of the tree. On the other hand,
 * every lookup causes memory writes.
 *
 * The Balance Theorem bounds the total access time for m operations
 * and n inserts on an initially empty tree as  $O((m + n)\lg n)$ . The
 * amortized cost for a sequence of m accesses to a splay tree is  $O(\lg n)$ ;
 *
 * A red-black tree is a binary search tree with the node color as an
 * extra attribute. It fulfills a set of conditions:
 * - every search path from the root to a leaf consists of the
 *   same number of black nodes,
 * - each red node (except for the root) has a black parent,
 * - each leaf node is black.
 *
 * Every operation on a red-black tree is bounded as  $O(\lg n)$ .
 * The maximum height of a red-black tree is  $2\lg(n+1)$ .
 */

#define SPLAY_HEAD(name, type) \
struct name { \
    struct type *sph_root; /* root of the tree */ \
}

#define SPLAY_INITIALIZER(root) \
{ NULL }

#define SPLAY_INIT(root) do { \
    (root)->sph_root = NULL; \
} while (/*CONSTCOND*/ 0)

```

```

#define SPLAY_ENTRY(type)  \
struct {  \
    struct type *spe_left; /* left element */  \
    struct type *spe_right; /* right element */  \
}

#define SPLAY_LEFT(elm, field) (elm)->field.spe_left
#define SPLAY_RIGHT(elm, field) (elm)->field.spe_right
#define SPLAY_ROOT(head) (head)->sph_root
#define SPLAY_EMPTY(head) (SPLAY_ROOT(head) == NULL)

/* SPLAY_ROTATE_{LEFT,RIGHT} expect that tmp hold SPLAY_{RIGHT,LEFT} */
#define SPLAY_ROTATE_RIGHT(head, tmp, field) do {  \
    SPLAY_LEFT((head)->sph_root, field) = SPLAY_RIGHT(tmp, field); \
    SPLAY_RIGHT(tmp, field) = (head)->sph_root;  \
    (head)->sph_root = tmp;  \
} while (/*CONSTCOND*/ 0)

#define SPLAY_ROTATE_LEFT(head, tmp, field) do {  \
    SPLAY_RIGHT((head)->sph_root, \
    field) = SPLAY_LEFT(tmp, field); \
    SPLAY_LEFT(tmp, field) = (head)->sph_root;  \
    (head)->sph_root = tmp;  \
} while (/*CONSTCOND*/ 0)

#define SPLAY_LINKLEFT(head, tmp, field) do {  \
    SPLAY_LEFT(tmp, field) = (head)->sph_root;  \
    tmp = (head)->sph_root;  \
    (head)->sph_root = SPLAY_LEFT((head)->sph_root, field); \
} while (/*CONSTCOND*/ 0)

#define SPLAY_LINKRIGHT(head, tmp, field) do {  \
    SPLAY_RIGHT(tmp, field) = (head)->sph_root;  \
    tmp = (head)->sph_root;  \
    (head)->sph_root = SPLAY_RIGHT((head)->sph_root, field); \
} while (/*CONSTCOND*/ 0)

#define SPLAY_ASSEMBLE(head, node, left, right, field) do {  \
    SPLAY_RIGHT(left, field) = SPLAY_LEFT((head)->sph_root, field); \
    SPLAY_LEFT(right, field) = SPLAY_RIGHT((head)->sph_root, field); \
    SPLAY_LEFT((head)->sph_root, field) = SPLAY_RIGHT(node, field); \
    SPLAY_RIGHT((head)->sph_root, field) = SPLAY_LEFT(node, field); \
} while (/*CONSTCOND*/ 0)

/* Generates prototypes and inline functions */

#define

```

```

    SPLAY_PROTOTYPE(name, type, field, cmp) \
void name##_SPLAY(struct name *, struct type *); \
void name##_SPLAY_MINMAX(struct name *, int); \
struct type *name##_SPLAY_INSERT(struct name *, struct type *); \
struct type *name##_SPLAY_REMOVE(struct name *, struct type *); \
\
/* Finds the node with the same key as elm */ \
static __inline struct type * \
name##_SPLAY_FIND(struct name *head, struct type *elm) \
{ \
    if (SPLAY_EMPTY(head)) \
        return(NULL); \
    name##_SPLAY(head, elm); \
    if ((cmp)(elm, (head->sph_root) == 0) \
        return (head->sph_root); \
    return (NULL); \
} \
\
static __inline _sys_tree_h_unused struct type * \
name##_SPLAY_NEXT(struct name *head, struct type *elm) \
{ \
    name##_SPLAY(head, elm); \
    if (SPLAY_RIGHT(elm, field) != NULL) { \
        elm = SPLAY_RIGHT(elm, field); \
        while (SPLAY_LEFT(elm, field) != NULL) { \
            elm = SPLAY_LEFT(elm, field); \
        } \
    } \
    else \
        elm = NULL; \
    return (elm); \
} \
\
static _sys_tree_h_unused __inline struct type * \
name##_SPLAY_MIN_MAX(struct name *head, int val) \
{ \
    name##_SPLAY_MINMAX(head, val); \
    return (SPLAY_ROOT(head)); \
} \
\
/* Main splay operation.
 * Moves node close to the key of elm to top
 */
#define SPLAY_GENERATE(name, type, field, cmp) \
struct type * \
name##_SPLAY_INSERT(struct name *head, struct type *elm) \
{ \
    if (SPLAY_EMPTY(head)) { \

```

```

    SPLAY_LEFT(elm, field) = SPLAY_RIGHT(elm, field) = NULL; \
} else { \
    int __comp; \
    name##_SPLAY(head, elm); \
    __comp = (cmp)(elm, (head)->sph_root); \
    if(__comp < 0) { \
        SPLAY_LEFT(elm, field) = SPLAY_LEFT((head)->sph_root, field);\
        SPLAY_RIGHT(elm, field) = (head)->sph_root; \
        SPLAY_LEFT((head)->sph_root, field) = NULL; \
    } else if (__comp > 0) { \
        SPLAY_RIGHT(elm,
field) = SPLAY_RIGHT((head)->sph_root, field);\
        SPLAY_LEFT(elm, field) = (head)->sph_root; \
        SPLAY_RIGHT((head)->sph_root, field) = NULL; \
    } else \
        return ((head)->sph_root); \
} \
(head)->sph_root = (elm); \
return (NULL); \
} \
\
struct type * \
name##_SPLAY_REMOVE(struct name *head, struct type *elm) \
{ \
    struct type *__tmp; \
    if (SPLAY_EMPTY(head)) \
        return (NULL); \
    name##_SPLAY(head, elm); \
    if ((cmp)(elm, (head)->sph_root) == 0) { \
        if (SPLAY_LEFT((head)->sph_root, field) == NULL) { \
            (head)->sph_root = SPLAY_RIGHT((head)->sph_root, field);\
        } else { \
            __tmp = SPLAY_RIGHT((head)->sph_root, field);\
            (head)->sph_root = SPLAY_LEFT((head)->sph_root, field);\
            name##_SPLAY(head, elm); \
            SPLAY_RIGHT((head)->sph_root, field) = __tmp; \
        } \
        return (elm); \
    } \
    return (NULL); \
} \
\
void \
name##_SPLAY(struct
name *head, struct type *elm) \
{ \
    struct type __node, *__left, *__right, *__tmp; \
    int __comp; \

```

```

\
SPLAY_LEFT(&__node, field) = SPLAY_RIGHT(&__node, field) = NULL;\
__left = __right = &__node; \
\
while ((__comp = (cmp)(elm, (head)->sph_root)) != 0) { \
if (__comp < 0) { \
__tmp = SPLAY_LEFT((head)->sph_root, field);\
if (__tmp == NULL) \
break; \
if ((cmp)(elm, __tmp) < 0){ \
SPLAY_ROTATE_RIGHT(head, __tmp, field);\
if (SPLAY_LEFT((head)->sph_root, field) == NULL)\
break; \
} \
SPLAY_LINKLEFT(head, __right, field);\
} else if (__comp > 0) { \
__tmp = SPLAY_RIGHT((head)->sph_root, field);\
if (__tmp == NULL) \
break; \
if ((cmp)(elm, __tmp) > 0){ \
SPLAY_ROTATE_LEFT(head, __tmp, field);\
if (SPLAY_RIGHT((head)->sph_root, field) == NULL)\
break; \
} \
SPLAY_LINKRIGHT(head, __left, field);\
} \
} \
SPLAY_ASSEMBLE(head,
&__node, __left, __right, field);\
} \
\
/* Splay with either the minimum or the maximum element \
* Used to find minimum or maximum element in tree. \
*/ \
void name##_SPLAY_MINMAX(struct name *head, int __comp) \
{ \
struct type __node, *__left, *__right, *__tmp; \
\
SPLAY_LEFT(&__node, field) = SPLAY_RIGHT(&__node, field) = NULL;\
__left = __right = &__node; \
\
while (1) { \
if (__comp < 0) { \
__tmp = SPLAY_LEFT((head)->sph_root, field);\
if (__tmp == NULL) \
break; \
if (__comp < 0){ \
SPLAY_ROTATE_RIGHT(head, __tmp, field);\

```

```

    if (SPLAY_LEFT((head)->sph_root, field) == NULL)\
        break;  \
}  \
SPLAY_LINKLEFT(head, __right, field); \
} else if (__comp > 0) {  \
    __tmp = SPLAY_RIGHT((head)->sph_root, field);\
    if (__tmp == NULL)  \
        break;  \
    if (__comp > 0) {  \
        SPLAY_ROTATE_LEFT(head, __tmp, field);\
        if (SPLAY_RIGHT((head)->sph_root,
field) == NULL)\
            break;  \
    }  \
    SPLAY_LINKRIGHT(head, __left, field); \
}  \
}  \
SPLAY_ASSEMBLE(head, &__node, __left, __right, field); \
}

#define SPLAY_NEGINF -1
#define SPLAY_INF 1

#define SPLAY_INSERT(name, x, y) name##_SPLAY_INSERT(x, y)
#define SPLAY_REMOVE(name, x, y) name##_SPLAY_REMOVE(x, y)
#define SPLAY_FIND(name, x, y) name##_SPLAY_FIND(x, y)
#define SPLAY_NEXT(name, x, y) name##_SPLAY_NEXT(x, y)
#define SPLAY_MIN(name, x) (SPLAY_EMPTY(x) ? NULL \
    : name##_SPLAY_MIN_MAX(x, SPLAY_NEGINF))
#define SPLAY_MAX(name, x) (SPLAY_EMPTY(x) ? NULL \
    : name##_SPLAY_MIN_MAX(x, SPLAY_INF))

#define SPLAY_FOREACH(x, name, head)  \
    for ((x) = SPLAY_MIN(name, head);  \
        (x) != NULL;  \
        (x) = SPLAY_NEXT(name, head, x))

/* Macros that define a red-black tree */
#define RB_HEAD(name, type)  \
struct name {  \
    struct type *rbh_root; /* root of the tree */ \
}

#define RB_INITIALIZER(root)  \
{  \
    NULL }

#define RB_INIT(root) do {  \

```



```

(root)->rbh_root = NULL;  \
} while (/*CONSTCOND*/ 0)

#define RB_BLACK 0
#define RB_RED 1
#define RB_ENTRY(type)  \
struct {  \
    struct type *rbe_left; /* left element */ \
    struct type *rbe_right; /* right element */ \
    struct type *rbe_parent; /* parent element */ \
    int rbe_color; /* node color */ \
}

#define RB_LEFT(elm, field) (elm)->field.rbe_left
#define RB_RIGHT(elm, field) (elm)->field.rbe_right
#define RB_PARENT(elm, field) (elm)->field.rbe_parent
#define RB_COLOR(elm, field) (elm)->field.rbe_color
#define RB_ROOT(head) (head)->rbh_root
#define RB_EMPTY(head) (RB_ROOT(head) == NULL)

#define RB_SET(elm, parent, field) do {  \
    RB_PARENT(elm, field) = parent;  \
    RB_LEFT(elm, field) = RB_RIGHT(elm, field) = NULL; \
    RB_COLOR(elm, field) = RB_RED;  \
} while (/*CONSTCOND*/ 0)

#define RB_SET_BLACKRED(black, red, field) do {  \
    RB_COLOR(black, field) = RB_BLACK;  \
    RB_COLOR(red, field) \
    = RB_RED;  \
} while (/*CONSTCOND*/ 0)

#ifndef RB_AUGMENT
#define RB_AUGMENT(x) do {} while (/*CONSTCOND*/ 0)
#endif

#define RB_ROTATE_LEFT(head, elm, tmp, field) do {  \
    (tmp) = RB_RIGHT(elm, field);  \
    if ((RB_RIGHT(elm, field) = RB_LEFT(tmp, field)) != NULL) { \
        RB_PARENT(RB_LEFT(tmp, field), field) = (elm); \
    }  \
    RB_AUGMENT(elm);  \
    if ((RB_PARENT(tmp, field) = RB_PARENT(elm, field)) != NULL) { \
        if ((elm) == RB_LEFT(RB_PARENT(elm, field), field)) \
            RB_LEFT(RB_PARENT(elm, field), field) = (tmp); \
        else  \
            RB_RIGHT(RB_PARENT(elm, field), field) = (tmp); \
    } else  \

```

```

(head)->rbh_root = (tmp); \
RB_LEFT(tmp, field) = (elm); \
RB_PARENT(elm, field) = (tmp); \
RB_AUGMENT(tmp); \
if ((RB_PARENT(tmp, field))) \
    RB_AUGMENT(RB_PARENT(tmp, field)); \
} while (/*CONSTCOND*/ 0)

#define RB_ROTATE_RIGHT(head, elm, tmp, field) do { \
    (tmp) = RB_LEFT(elm, field); \
    if ((RB_LEFT(elm, field) = RB_RIGHT(tmp, field)) \
        != NULL) { \
        RB_PARENT(RB_RIGHT(tmp, field), field) = (elm); \
    } \
    RB_AUGMENT(elm); \
    if ((RB_PARENT(tmp, field) = RB_PARENT(elm, field)) != NULL) { \
        if ((elm) == RB_LEFT(RB_PARENT(elm, field), field)) \
            RB_LEFT(RB_PARENT(elm, field), field) = (tmp); \
        else \
            RB_RIGHT(RB_PARENT(elm, field), field) = (tmp); \
    } else \
        (head)->rbh_root = (tmp); \
    RB_RIGHT(tmp, field) = (elm); \
    RB_PARENT(elm, field) = (tmp); \
    RB_AUGMENT(tmp); \
    if ((RB_PARENT(tmp, field))) \
        RB_AUGMENT(RB_PARENT(tmp, field)); \
} while (/*CONSTCOND*/ 0)

/* Generates prototypes and inline functions */
#define RB_PROTOTYPE(name, type, field, cmp) \
    RB_PROTOTYPE_INTERNAL(name, type, field, cmp,)
#define RB_PROTOTYPE_STATIC(name, type, field, cmp) \
    RB_PROTOTYPE_INTERNAL(name, type, field, cmp, _sys_tree_h_unused static)
#define RB_PROTOTYPE_INTERNAL(name, type, field, cmp, attr) \
    attr void name##_RB_INSERT_COLOR(struct name *, struct \
        type *); \
    attr void name##_RB_REMOVE_COLOR(struct name *, struct type *, struct type *); \
    attr struct type *name##_RB_REMOVE(struct name *, struct type *); \
    attr struct type *name##_RB_INSERT(struct name *, struct type *); \
    attr struct type *name##_RB_FIND(struct name *, struct type *); \
    attr struct type *name##_RB_NFIND(struct name *, struct type *); \
    attr struct type *name##_RB_NEXT(struct type *); \
    attr struct type *name##_RB_PREV(struct type *); \
    attr struct type *name##_RB_MINMAX(struct name *, int); \
    \

/* Main rb operation.

```

```

* Moves node close to the key of elm to top
*/
#define RB_GENERATE(name, type, field, cmp) \
    RB_GENERATE_INTERNAL(name, type, field, cmp,)
#define RB_GENERATE_STATIC(name, type, field, cmp) \
    RB_GENERATE_INTERNAL(name, type, field, cmp, _sys_tree_h_unused static)
#define RB_GENERATE_INTERNAL(name, type, field, cmp, attr) \
    attr void \
name##_RB_INSERT_COLOR(struct name *head, struct type *elm) \
{ \
    struct type \
    *parent, *gparent, *tmp; \
    while ((parent = RB_PARENT(elm, field)) != NULL && \
        RB_COLOR(parent, field) == RB_RED) { \
        gparent = RB_PARENT(parent, field); \
        if (parent == RB_LEFT(gparent, field)) { \
            tmp = RB_RIGHT(gparent, field); \
            if (tmp && RB_COLOR(tmp, field) == RB_RED) { \
                RB_COLOR(tmp, field) = RB_BLACK; \
                RB_SET_BLACKRED(parent, gparent, field);\
                elm = gparent; \
                continue; \
            } \
            if (RB_RIGHT(parent, field) == elm) { \
                RB_ROTATE_LEFT(head, parent, tmp, field);\
                tmp = parent; \
                parent = elm; \
                elm = tmp; \
            } \
            RB_SET_BLACKRED(parent, gparent, field); \
            RB_ROTATE_RIGHT(head, gparent, tmp, field); \
        } else { \
            tmp = RB_LEFT(gparent, field); \
            if (tmp && RB_COLOR(tmp, field) == RB_RED) { \
                RB_COLOR(tmp, field) = RB_BLACK; \
                RB_SET_BLACKRED(parent, gparent, field);\
                elm = gparent; \
                continue; \
            } \
            if (RB_LEFT(parent, field) == elm) \
{ \
                RB_ROTATE_RIGHT(head, parent, tmp, field);\
                tmp = parent; \
                parent = elm; \
                elm = tmp; \
            } \
            RB_SET_BLACKRED(parent, gparent, field); \
            RB_ROTATE_LEFT(head, gparent, tmp, field); \

```

```

    } \
} \
RB_COLOR(head->rbh_root, field) = RB_BLACK; \
} \
    \
attr void \
name##_RB_REMOVE_COLOR(struct name *head, struct type *parent, struct type *elm) \
{ \
    struct type *tmp; \
    while ((elm == NULL || RB_COLOR(elm, field) == RB_BLACK) && \
        elm != RB_ROOT(head)) { \
        if (RB_LEFT(parent, field) == elm) { \
            tmp = RB_RIGHT(parent, field); \
            if (RB_COLOR(tmp, field) == RB_RED) { \
                RB_SET_BLACKRED(tmp, parent, field); \
                RB_ROTATE_LEFT(head, parent, tmp, field);\
                tmp = RB_RIGHT(parent, field); \
            } \
            if ((RB_LEFT(tmp, field) == NULL || \
                RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) && \
                (RB_RIGHT(tmp, field) == NULL || \
                RB_COLOR(RB_RIGHT(tmp, \
field), field) == RB_BLACK)) {\
                RB_COLOR(tmp, field) = RB_RED; \
                elm = parent; \
                parent = RB_PARENT(elm, field); \
            } else { \
                if (RB_RIGHT(tmp, field) == NULL || \
                    RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK) {\
                    struct type *oleft; \
                    if ((oleft = RB_LEFT(tmp, field)) \
                        != NULL) \
                        RB_COLOR(oleft, field) = RB_BLACK;\
                    RB_COLOR(tmp, field) = RB_RED; \
                    RB_ROTATE_RIGHT(head, tmp, oleft, field);\
                    tmp = RB_RIGHT(parent, field); \
                } \
                RB_COLOR(tmp, field) = RB_COLOR(parent, field);\
                RB_COLOR(parent, field) = RB_BLACK; \
                if (RB_RIGHT(tmp, field)) \
                    RB_COLOR(RB_RIGHT(tmp, field), field) = RB_BLACK;\
                RB_ROTATE_LEFT(head, parent, tmp, field);\
                elm = RB_ROOT(head); \
                break; \
            } \
        } else { \
            tmp = RB_LEFT(parent, field); \
            if (RB_COLOR(tmp, field) == RB_RED) { \

```

```

    RB_SET_BLACKRED(tmp, parent, field); \
    RB_ROTATE_RIGHT(head, parent, tmp, field);\
    tmp
= RB_LEFT(parent, field); \
} \
if ((RB_LEFT(tmp, field) == NULL || \
    RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) &&\
    (RB_RIGHT(tmp, field) == NULL || \
    RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK)) {\
    RB_COLOR(tmp, field) = RB_RED; \
    elm = parent; \
    parent = RB_PARENT(elm, field); \
} else { \
    if (RB_LEFT(tmp, field) == NULL || \
        RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) {\
        struct type *oright; \
        if ((oright = RB_RIGHT(tmp, field)) \
            != NULL) \
            RB_COLOR(oright, field) = RB_BLACK;\
        RB_COLOR(tmp, field) = RB_RED; \
        RB_ROTATE_LEFT(head, tmp, oright, field);\
        tmp = RB_LEFT(parent, field); \
    } \
    RB_COLOR(tmp, field) = RB_COLOR(parent, field);\
    RB_COLOR(parent, field) = RB_BLACK; \
    if (RB_LEFT(tmp, field)) \
        RB_COLOR(RB_LEFT(tmp, field), field) = RB_BLACK;\
    RB_ROTATE_RIGHT(head, parent, tmp, field);\
    elm = RB_ROOT(head); \
    break; \
} \
} \
} \
if
(elm) \
    RB_COLOR(elm, field) = RB_BLACK; \
} \
\
attr struct type * \
name##_RB_REMOVE(struct name *head, struct type *elm) \
{ \
    struct type *child, *parent, *old = elm; \
    int color; \
    if (RB_LEFT(elm, field) == NULL) \
        child = RB_RIGHT(elm, field); \
    else if (RB_RIGHT(elm, field) == NULL) \
        child = RB_LEFT(elm, field); \
    else { \

```

```

struct type *left;  \
elm = RB_RIGHT(elm, field);  \
while ((left = RB_LEFT(elm, field)) != NULL) \
    elm = left;  \
child = RB_RIGHT(elm, field);  \
parent = RB_PARENT(elm, field);  \
color = RB_COLOR(elm, field);  \
if (child)  \
    RB_PARENT(child, field) = parent; \
if (parent) {  \
    if (RB_LEFT(parent, field) == elm) \
        RB_LEFT(parent, field) = child; \
    else  \
        RB_RIGHT(parent, field) = child; \
    RB_AUGMENT(parent);  \
} else  \
    RB_ROOT(head)
= child;  \
if (RB_PARENT(elm, field) == old) \
    parent = elm;  \
(elm)->field = (old)->field;  \
if (RB_PARENT(old, field)) {  \
    if (RB_LEFT(RB_PARENT(old, field), field) == old)\
        RB_LEFT(RB_PARENT(old, field), field) = elm;\
    else  \
        RB_RIGHT(RB_PARENT(old, field), field) = elm;\
    RB_AUGMENT(RB_PARENT(old, field)); \
} else  \
    RB_ROOT(head) = elm;  \
RB_PARENT(RB_LEFT(old, field), field) = elm; \
if (RB_RIGHT(old, field))  \
    RB_PARENT(RB_RIGHT(old, field), field) = elm; \
if (parent) {  \
    left = parent;  \
    do {  \
        RB_AUGMENT(left); \
    } while ((left = RB_PARENT(left, field)) != NULL); \
}  \
goto color;  \
}  \
parent = RB_PARENT(elm, field);  \
color = RB_COLOR(elm, field);  \
if (child)  \
    RB_PARENT(child, field) = parent; \
if (parent) {  \
    if (RB_LEFT(parent, field) == elm) \
        RB_LEFT(parent, field) = child; \
    else  \

```

```

    RB_RIGHT(parent,
field) = child; \
    RB_AUGMENT(parent); \
} else \
    RB_ROOT(head) = child; \
color: \
if (color == RB_BLACK) \
    name##_RB_REMOVE_COLOR(head, parent, child); \
return (old); \
} \
\
/* Inserts a node into the RB tree */ \
attr struct type * \
name##_RB_INSERT(struct name *head, struct type *elm) \
{ \
    struct type *tmp; \
    struct type *parent = NULL; \
    int comp = 0; \
    tmp = RB_ROOT(head); \
    while (tmp) { \
        parent = tmp; \
        comp = (cmp)(elm, parent); \
        if (comp < 0) \
            tmp = RB_LEFT(tmp, field); \
        else if (comp > 0) \
            tmp = RB_RIGHT(tmp, field); \
        else \
            return (tmp); \
    } \
    RB_SET(elm, parent, field); \
    if (parent != NULL) { \
        if (comp < 0) \
            RB_LEFT(parent, field) = elm; \
        else \
            RB_RIGHT(parent, field) = elm; \
        RB_AUGMENT(parent); \
    } else \
        RB_ROOT(head) = elm; \
    name##_RB_INSERT_COLOR(head,
elm); \
    return (NULL); \
} \
\
/* Finds the node with the same key as elm */ \
attr struct type * \
name##_RB_FIND(struct name *head, struct type *elm) \
{ \
    struct type *tmp = RB_ROOT(head); \

```

```

int comp;    \
while (tmp) {    \
    comp = cmp(elm, tmp);    \
    if (comp < 0)    \
        tmp = RB_LEFT(tmp, field);    \
    else if (comp > 0)    \
        tmp = RB_RIGHT(tmp, field);    \
    else    \
        return (tmp);    \
}    \
return (NULL);    \
}    \
    \
/* Finds the first node greater than or equal to the search key */\
attr struct type *    \
name##_RB_NFIND(struct name *head, struct type *elm)    \
{    \
    struct type *tmp = RB_ROOT(head);    \
    struct type *res = NULL;    \
    int comp;    \
    while (tmp) {    \
        comp = cmp(elm, tmp);    \
        if (comp < 0) {    \
            res = tmp;    \
            tmp = RB_LEFT(tmp, field);    \
        }    \
        else if (comp > 0)    \
            tmp =    \
RB_RIGHT(tmp, field);    \
        else    \
            return (tmp);    \
    }    \
    return (res);    \
}    \
    \
/* ARGSUSED */    \
attr struct type *    \
name##_RB_NEXT(struct type *elm)    \
{    \
    if (RB_RIGHT(elm, field)) {    \
        elm = RB_RIGHT(elm, field);    \
        while (RB_LEFT(elm, field))    \
            elm = RB_LEFT(elm, field);    \
    } else {    \
        if (RB_PARENT(elm, field) &&    \
            (elm == RB_LEFT(RB_PARENT(elm, field), field)))    \
            elm = RB_PARENT(elm, field);    \
        else {    \

```



```

while (RB_PARENT(elm, field) && \
      (elm == RB_RIGHT(RB_PARENT(elm, field), field)))\
    elm = RB_PARENT(elm, field); \
elm = RB_PARENT(elm, field); \
} \
} \
return (elm); \
} \
\
/* ARGSUSED */ \
attr struct type * \
name##_RB_PREV(struct type *elm) \
{ \
    if (RB_LEFT(elm, field)) { \
        elm = RB_LEFT(elm, field); \
        while (RB_RIGHT(elm, field)) \
            elm = RB_RIGHT(elm, field); \
    } \
    else { \
        if (RB_PARENT(elm, field) && \
            (elm == RB_RIGHT(RB_PARENT(elm, field), field))) \
            elm = RB_PARENT(elm, field); \
        else { \
            while (RB_PARENT(elm, field) && \
                  (elm == RB_LEFT(RB_PARENT(elm, field), field)))\
                elm = RB_PARENT(elm, field); \
            elm = RB_PARENT(elm, field); \
        } \
    } \
    return (elm); \
} \
\
attr struct type * \
name##_RB_MINMAX(struct name *head, int val) \
{ \
    struct type *tmp = RB_ROOT(head); \
    struct type *parent = NULL; \
    while (tmp) { \
        parent = tmp; \
        if (val < 0) \
            tmp = RB_LEFT(tmp, field); \
        else \
            tmp = RB_RIGHT(tmp, field); \
    } \
    return (parent); \
}

#define RB_NEGINF -1

```

```

#define RB_INF 1

#define RB_INSERT(name, x, y) name##_RB_INSERT(x, y)
#define RB_REMOVE(name, x, y) name##_RB_REMOVE(x, y)
#define RB_FIND(name, x, y) name##_RB_FIND(x, y)
#define RB_NFIND(name, x, y) name##_RB_NFIND(x,
y)
#define RB_NEXT(name, x, y) name##_RB_NEXT(y)
#define RB_PREV(name, x, y) name##_RB_PREV(y)
#define RB_MIN(name, x) name##_RB_MINMAX(x, RB_NEGINF)
#define RB_MAX(name, x) name##_RB_MINMAX(x, RB_INF)

#define RB_FOREACH(x, name, head) \
for ((x) = RB_MIN(name, head); \
(x) != NULL; \
(x) = name##_RB_NEXT(x))

#define RB_FOREACH_FROM(x, name, y) \
for ((x) = (y); \
((x) != NULL) && ((y) = name##_RB_NEXT(x), (x) != NULL); \
(x) = (y))

#define RB_FOREACH_SAFE(x, name, head, y) \
for ((x) = RB_MIN(name, head); \
((x) != NULL) && ((y) = name##_RB_NEXT(x), (x) != NULL); \
(x) = (y))

#define RB_FOREACH_REVERSE(x, name, head) \
for ((x) = RB_MAX(name, head); \
(x) != NULL; \
(x) = name##_RB_PREV(x))

#define RB_FOREACH_REVERSE_FROM(x, name, y) \
for ((x) = (y); \
((x) != NULL) && ((y) = name##_RB_PREV(x), (x) != NULL); \
(x) = (y))

#define RB_FOREACH_REVERSE_SAFE(x, name,
head, y) \
for ((x) = RB_MAX(name, head); \
((x) != NULL) && ((y) = name##_RB_PREV(x), (x) != NULL); \
(x) = (y))

#endif /* _SYS_TREE_H */
pkgname=linux-headers
pkgver=6.14.2 # Follow the latest Linux stable
_kernver=${pkgver%. *}
pkgrel=0

```

```
pkgdesc="Linux system headers"
url="https://kernel.org/"
arch="all" # Headers are architecture specific
license="GPL-2.0-only"
makedepends="perl"
options="!check !dbg !strip !tracedeps !archcheck"
source="https://kernel.org/pub/linux/kernel/v6.x/linux-${_kernver}.tar.xz
revert-broken-uapi.patch
0003-remove-inclusion-of-sysinfo.h-in-kernel.h.patch
```

# 1.147 wget 1.25.0-r1

## 1.147.1 Available under license :

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## 1.152 openssl 10.0\_p1-r9

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*
*/

```

```

#ifndef _BSD_WAITPID_H
#define _BSD_WAITPID_H

```

```

#ifndef HAVE_WAITPID
/* Clean out any potential issues */
#undef WIFEXITED
#undef WIFSTOPPED
#undef WIFSIGNALED

```

```

/* Define required functions to mimic a POSIX look and feel */
#define _W_INT(w) (*(int*)&(w)) /* convert union wait to int */
#define WIFEXITED(w) (!((_W_INT(w)) & 0377))
#define WIFSTOPPED(w) ((_W_INT(w)) & 0100)
#define WIFSIGNALED(w) (!WIFEXITED(w) && !WIFSTOPPED(w))
#define WEXITSTATUS(w) (int)(WIFEXITED(w) ? ((_W_INT(w) >> 8) & 0377) : -1)
#define WTERMSIG(w) (int)(WIFSIGNALED(w) ? (_W_INT(w) & 0177) : -1)
#define WCOREFLAG 0x80
#define WCOREDUMP(w) ((_W_INT(w)) & WCOREFLAG)

```

```

/* Prototype */
pid_t waitpid(int,
int *, int);

```

```

#endif /* !HAVE_WAITPID */
#endif /* _BSD_WAITPID_H */
/* $OpenBSD: poll.h,v 1.11 2003/12/10 23:10:08 millert Exp $ */

```

```

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\*/

/\* OPENBSD ORIGINAL: sys/sys/poll.h \*/

```
#ifndef _COMPAT_POLL_H_
#define _COMPAT_POLL_H_
```

```
#include <sys/types.h>
#ifdef HAVE_POLL_H
# include <poll.h>
#elif HAVE_SYS_POLL_H
# include <sys/poll.h>
#endif
```

```
#ifndef HAVE_STRUCT_POLLFD_FD
typedef struct pollfd {
    int fd;
    short events;
    short revents;
} pollfd_t;
```

```
#ifndef POLLIN
# define POLLIN 0x0001
#endif
#ifndef POLLPRI
# define POLLPRI 0x0002
#endif
#ifndef POLLOUT
# define POLLOUT 0x0004
#endif
```



```

#ifndef POLLERR
# define POLLERR 0x0008
#endif

#ifndef POLLHUP
# define POLLHUP 0x0010
#endif

#ifndef POLLNVAL
# define POLLNVAL 0x0020
#endif

#if 0
/* the following are
   currently not implemented */
#define POLLRDNORM 0x0040
#define POLLNORM POLLRDNORM
#define POLLWRNORM    POLLOUT
#define POLLRDBAND 0x0080
#define POLLWRBAND 0x0100
#endif

#define INFTIM (-1) /* not standard */
#endif /* !HAVE_STRUCT_POLLFD_FD */

#ifndef HAVE_NFDS_T
typedef unsigned int nfds_t;
#endif

#ifndef HAVE_POLL
int poll(struct pollfd *, nfds_t, int);
#endif

#ifndef HAVE_PPOLL
int ppoll(struct pollfd *, nfds_t, const struct timespec *, const sigset_t *);
#endif

#endif /* !_COMPAT_POLL_H_ */

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```

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#include "includes.h"

#if !defined(HAVE_STATVFS) || !defined(HAVE_FSTATVFS)

#include <sys/types.h>

#ifdef HAVE_SYS_MOUNT_H
#include <sys/mount.h>
#endif
#ifdef HAVE_SYS_STATFS_H
#include <sys/statfs.h>
#endif
#ifdef HAVE_SYS_VFS_H
#include <sys/vfs.h>
#endif

#ifdef HAVE_FSBLKCNT_T
typedef unsigned long fsblkcnt_t;
#endif
#ifdef HAVE_FSFILCNT_T
typedef unsigned long fsfilcnt_t;
#endif

#ifdef ST_RDONLY
#define ST_RDONLY 1
#endif
#ifdef ST_NOSUID
#define ST_NOSUID 2
#endif

/* as defined in IEEE Std 1003.1, 2004 Edition */
struct statvfs {
    unsigned long f_bsize; /* File system block size. */
    unsigned long f_frsize; /* Fundamental file system block size. */
    fsblkcnt_t f_blocks; /* Total number of blocks on file system in */
    /* units of f_frsize. */
    fsblkcnt_t f_bfree; /* Total number of free blocks. */
    fsblkcnt_t f_bavail; /* Number of free blocks available to */
    /* non-privileged process. */
    fsfilcnt_t f_files; /* Total number of file serial numbers. */
    fsfilcnt_t f_ffree; /* Total number of free file serial numbers. */
    fsfilcnt_t f_favail; /* Number of file serial numbers available to */
    /* non-privileged process. */

```

```

unsigned long f_fsid; /*
File system ID. */
unsigned long f_flag; /* BBit mask of f_flag values. */
unsigned long f_namemax; /* Maximum filename length. */
};
#endif

#ifndef HAVE_STATVFS
int statvfs(const char *, struct statvfs *);
#endif

#ifndef HAVE_FSTATVFS
int fstatvfs(int, struct statvfs *);
#endif

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 */

#ifndef _BSD_MISC_H
#define _BSD_MISC_H

#include "includes.h"

char *ssh_get_progname(char *);
int seed_from_prngd(unsigned char *, size_t);

#ifndef HAVE_SETSID
#define setsid() setpggrp(0, getpid())
#endif

/* !HAVE_SETSID */

#ifndef HAVE_SETENV
int setenv(const char *, const char *, int);
#endif /* !HAVE_SETENV */

#ifndef HAVE_SETLOGIN

```

```

int setlogin(const char *);
#endif /* !HAVE_SETLOGIN */

#ifndef HAVE_INNETGR
int innetgr(const char *, const char *, const char *, const char *);
#endif /* HAVE_INNETGR */

#if !defined(HAVE_SETEUID) && defined(HAVE_SETREUID)
int seteuid(uid_t);
#endif /* !defined(HAVE_SETEUID) && defined(HAVE_SETREUID) */

#if !defined(HAVE_SETEGID) && defined(HAVE_SETRESGID)
int setegid(uid_t);
#endif /* !defined(HAVE_SETEGID) && defined(HAVE_SETRESGID) */

#if !defined(HAVE_STRERROR) && defined(HAVE_SYS_ERRLIST) && defined(HAVE_SYS_NERR)
const char *strerror(int);
#endif

#if !defined(HAVE_SETLINEBUF)
#define setlinebuf(a) (setvbuf((a), NULL, _IOLBF, 0))
#endif

#ifndef HAVE_UTIMES
#ifndef HAVE_STRUCT_TIMEVAL
struct timeval {
    long tv_sec;
    long tv_usec;
}
#endif /* HAVE_STRUCT_TIMEVAL */

int utimes(const char *, struct timeval *);
#endif /* HAVE_UTIMES */

#ifndef
    AT_FDCWD
#define AT_FDCWD (-2)
#endif

#ifndef HAVE_FCHMODAT
int fchmodat(int, const char *, mode_t, int);
#endif

#ifndef HAVE_FCHOWNAT
int fchownat(int, const char *, uid_t, gid_t, int);
#endif

#ifndef HAVE_TRUNCATE

```

```

int truncate (const char *, off_t);
#endif /* HAVE_TRUNCATE */

#ifndef HAVE_STRUCT_TIMESPEC
struct timespec {
    time_t tv_sec;
    long tv_nsec;
};
#endif /* !HAVE_STRUCT_TIMESPEC */

#if !defined(HAVE_NANOSLEEP) && !defined(HAVE_NSLEEP)
# include <time.h>
int nanosleep(const struct timespec *, struct timespec *);
#endif

#ifndef HAVE_UTIMENSAT
# include <time.h>
/* start with the high bits and work down to minimise risk of overlap */
# ifndef AT_SYMLINK_NOFOLLOW
# define AT_SYMLINK_NOFOLLOW 0x80000000
# endif
int utimensat(int, const char *, const struct timespec[2], int);
#endif /* !HAVE_UTIMENSAT */

#ifndef HAVE_USLEEP
int usleep(unsigned int useconds);
#endif

#ifndef HAVE_TCGETPGRP
pid_t tcgetpgrp(int);
#endif

#ifndef HAVE_TCSENDBREAK
int tcsendbreak(int, int);
#endif

#ifndef
HAVE_UNSETENV
int unsetenv(const char *);
#endif

#ifndef HAVE_ISBLANK
int isblank(int);
#endif

#ifndef HAVE_GETPGID
pid_t getpgid(pid_t);
#endif

```

```

#ifndef HAVE_PSELECT
int pselect(int, fd_set *, fd_set *, fd_set *, const struct timespec *,
    const sigset_t *);
#endif

#ifndef HAVE_ENDGRENT
# define endgrent() do { } while(0)
#endif

#ifndef HAVE_KRB5_GET_ERROR_MESSAGE
# define krb5_get_error_message krb5_get_err_text
#endif

#ifndef HAVE_KRB5_FREE_ERROR_MESSAGE
# define krb5_free_error_message(a,b) do { } while(0)
#endif

#ifndef HAVE_PLEDGE
int pledge(const char *promises, const char *paths[]);
#endif

/* bsd-err.h */
#ifndef HAVE_ERR
void err(int, const char *, ...) __attribute__((format(printf, 2, 3)));
#endif
#ifndef HAVE_ERRX
void errx(int, const char *, ...) __attribute__((format(printf, 2, 3)));
#endif
#ifndef HAVE_WARN
void warn(const char *, ...) __attribute__((format(printf, 1, 2)));
#endif

#ifndef HAVE_LLABS
long long llabs(long long);
#endif

#if defined(HAVE_DECL_BZERO)
&& HAVE_DECL_BZERO == 0
void bzero(void *, size_t);
#endif

#ifndef HAVE_RAISE
int raise(int);
#endif

#ifndef HAVE_GETSID
pid_t getsid(pid_t);

```

```

#endif

#ifndef HAVE_FLOCK
# define LOCK_SH 0x01
# define LOCK_EX 0x02
# define LOCK_NB 0x04
# define LOCK_UN 0x08
int flock(int, int);
#endif

#ifdef FFLUSH_NULL_BUG
# define fflush(x) (_ssh_compat_fflush(x))
#endif

#ifndef HAVE_LOCALTIME_R
struct tm *localtime_r(const time_t *, struct tm *);
#endif

#ifndef HAVE_REALPATH
#define realpath(x, y) (sftp_realpath((x), (y)))
#endif

#endif /* _BSD_MISC_H */
/*
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```

```

*
* This file contains functions for forcing opened file descriptors to
* binary mode on Windows systems.
*/

#ifndef _BSD_CYGWIN_UTIL_H
#define _BSD_CYGWIN_UTIL_H

#ifdef HAVE_CYGWIN

#undef ERROR

/* Avoid including windows headers. */
typedef void *HANDLE;
#define INVALID_HANDLE_VALUE ((HANDLE) -1)
#define DNLEN 16
#define UNLEN 256

/* Cygwin functions for which declarations are only available when including
   windows headers, so we have to define them here explicitly. */
extern HANDLE cygwin_logon_user (const struct passwd *, const char *);
extern void cygwin_set_impersonation_token (const HANDLE);

#include
<sys/cygwin.h>
#include <io.h>

#define CYGWIN_SSH_PRIVSEP_USER (cygwin_ssh_privsep_user())
const char *cygwin_ssh_privsep_user();

int binary_open(const char *, int , ...);
int check_ntsec(const char *);
char **fetch_windows_environment(void);
void free_windows_environment(char **);
int cygwin_ug_match_pattern_list(const char *, const char *);

#ifndef NO_BINARY_OPEN
#define open binary_open
#endif

#endif /* HAVE_CYGWIN */

#endif /* _BSD_CYGWIN_UTIL_H */
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*/

```

```

#ifndef _BSD_SIGNAL_H
#define _BSD_SIGNAL_H

```

```

#include "includes.h"

```

```

#include <signal.h>

```

```

#ifndef _NSIG
# ifdef NSIG
#  define _NSIG NSIG
# else
#  define _NSIG 128
# endif
#endif

```

```

#if !defined(HAVE_STRSIGNAL)
char
*strsignal(int);
#endif

```

```

#endif /* _BSD_SIGNAL_H */
/*

```

```

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\*/

#ifndef \_NEXT\_POSIX\_H

#define \_NEXT\_POSIX\_H

#ifdef HAVE\_NEXT

#include <sys/dir.h>

/\* NGROUPS\_MAX is behind -lposix. Use the BSD version which is NGROUPS \*/

#undef NGROUPS\_MAX

#define NGROUPS\_MAX NGROUPS

/\* NeXT's readdir() is BSD (struct direct) not POSIX (struct dirent) \*/

#define dirent direct

/\* Swap out NeXT's BSD wait() for a more POSIX compliant one \*/

pid\_t posix\_wait(int \*);

#define wait(a) posix\_wait(a)

/\* #ifdef wrapped functions that need defining for clean compiling \*/

pid\_t getppid(void);

void vhangup(void);

int inetgr(const char \*, const char \*, const char \*, const char \*);

/\* TERMCAP \*/

int tcgetattr(int, struct termios \*);

int tcsetattr(int, int,  
const struct termios \*);

int tcsetpgrp(int, pid\_t);

speed\_t cfgetospeed(const struct termios \*);

speed\_t cfgetispeed(const struct termios \*);

int cfsetospeed(struct termios \*, int);

int cfsetispeed(struct termios \*, int);

#endif /\* HAVE\_NEXT \*/

#endif /\* \_NEXT\_POSIX\_H \*/

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 \*/

```
#ifndef HAVE_SETRESGID
int setresgid(gid_t, gid_t, gid_t);
#endif
#ifndef HAVE_SETRESUID
int setresuid(uid_t, uid_t, uid_t);
#endif
```

## 1.153 scapy 2.6.1-r0

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```
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```

```
<signature of Ty Coon>, 1 April 1989
Ty Coon, President of Vice
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```
{
"testfiles": [
  "test/*.uts",
  "test/scapy/layers/*.uts",
  "test/contrib/automotive/*.uts",
  "test/contrib/automotive/obd/*.uts",
```

```

    "test/contrib/automotive/scanner/*.uts",
    "test/contrib/automotive/gm/*.uts",
    "test/contrib/automotive/bmw/*.uts",
    "test/contrib/automotive/xcp/*.uts",
    "test/contrib/automotive/autosar/*.uts",
    "test/contrib/*.uts"
  ],
  "remove_testfiles": [
    "test/linux.uts",
    "test/windows.uts",
    "test/contrib/automotive/ecu_am.uts",
    "test/contrib/automotive/gm/gmlanutils.uts",
    "test/contrib/isotp_packet.uts",
    "test/contrib/isotpscan.uts",
    "test/contrib/isotp_soft_socket.uts"
  ],
  "onlyfailed": true,
  "preexec": {
    "test/contrib/*.uts": "load_contrib(\"%name%\")",
    "test/cert.uts": "load_layer(\"tls\")",
    "test/ssl2.uts": "load_layer(\"tls\")",
    "test/tls*.uts": "load_layer(\"tls\")"
  },
  "kw_ko": [
    "linux",
    "windows",
    "ipv6",
    "vcan_socket",
    "tun",
    "tap"
  ]
}

```

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## 1.155 libverto 0.3.2-r2

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# Maintainer: Francesco Colista <francesco.colista@gmail.com>
pkgname=perl-software-license
_pkgreal=Software-License
pkgver=0.103004
pkgrel=0
pkgdesc="packages that provide templated software licenses"
url="http://search.cpan.org/dist/Software-License/"
arch="noarch"
license="GPL PerlArtistic"
cpandepends="perl-text-template perl-data-section perl-sub-install"
cpanmakedepends=" "
depends="$cpandepends"
makedepends="perl-dev $cpanmakedepends"
subpackages="$pkgname-doc"
source="http://search.cpan.org/CPAN/authors/id/R/RJ/RJBS/_pkgreal-$pkgver.tar.gz"

_builddir="$srcdir/_pkgreal-$pkgver"

prepare() {
    cd "$_builddir"
    export CFLAGS=`perl -MConfig -E 'say $Config{ccflags}'`
    PERL_MM_USE_DEFAULT=1 perl Makefile.PL INSTALLDIRS=vendor
}

build() {
    cd "$_builddir"
    export CFLAGS=`perl -MConfig -E 'say $Config{ccflags}'`
    make && make test
```

```

}

package() {
    cd "$_builddir"
    make
    DESTDIR="$pkgdir" install || return 1
    find "$pkgdir" \( -name perllocal.pod -o -name .packlist \) -delete
}

md5sums="0c5fd53d93818566234578b27d667b35 Software-License-0.103004.tar.gz"
# Maintainer: Natanael Copa <ncopa@alpinelinux.org>
pkgname=libart-lgpl
pkgver=2.3.21
pkgrel=5
pkgdesc="A library for high-performance 2D graphics"
url="http://www.levien.com/libart/"
arch="all"
license="GPL"
depends=
makedepends=
subpackages="$pkgname-dev"
source="https://download.gnome.org/sources/libart_1.2/2.3/libart_1.2-$pkgver.tar.bz2"

_buildddir="$srcdir"/libart_1.2-$pkgver

prepare() {
    cd "$_builddir"
    update_config_sub || return 1
}

build() {
    cd "$_builddir"
    ./configure \
        --build=$CBUILD \
        --host=$CHOST \
        --prefix=/usr \
        || return 1
    make || return 1
}

package() {
    cd "$_builddir"
    make DESTDIR="$pkgdir" install || return 1
}

sha512sums="8a632a6a4da59e5e8c02ec2f5a57e36d182b325b46513765425e5f171ff9ae326af1b133725beba28f7e7
6654309e001aee9bace727b5b4c8589405256a3c020 libart_1.2-2.3.21.tar.bz2"

```

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# Automatically generated by apkgbuild-cpan, template 1

# Contributor: Valery Kartel <valery.kartel@gmail.com>

# Maintainer: Valery Kartel <valery.kartel@gmail.com>

pkgname=perl-bsd-resource

\_pkgreal=BSD-Resource

pkgver=1.2909

pkgrel=2

pkgdesc="Perl extension implements the BSD process resource limit functions"

url="http://search.cpan.org/dist/BSD-Resource/"

arch="all"

license="GPL PerlArtistic"

cpandepends=""

cpanmakedepends=""

depends="\$cpandepends"

makedepends="perl-dev \$cpanmakedepends"

subpackages="\$pkgname-doc"

source="http://search.cpan.org/CPAN/authors/id/J/JH/JHI/\_pkgreal-\$pkgver.tar.gz"

\_builddir="\$srcdir/\_pkgreal-\$pkgver"

prepare() {

cd "\$\_builddir"

export CFLAGS=`perl -MConfig -E 'say \$Config{ccflags}'`

```

PERL_MM_USE_DEFAULT=1 perl Makefile.PL INSTALLDIRS=vendor
}

build() {
    cd "$_builddir"
    export CFLAGS=`perl -MConfig -E 'say $Config{ccflags}'`
    make && make test || return 1
}

package() {
    cd "$_builddir"
    make DESTDIR="$pkgdir" install || return 1
    find "$pkgdir"
    \ ( -name perllocal.pod -o -name .packlist ) -delete
}

md5sums="3c6dd2fa953088aa87e263f40818d012 BSD-Resource-1.2909.tar.gz"
sha256sums="c47d460e2bd00d8d049f6ff4a0f1f61957e289e8de45af5fc79e851e2e855e06 BSD-Resource-1.2909.tar.gz"
sha512sums="5f489eaac5089e82081b7cf51d62638750e443751b49415407354da96b17771819b5e6e85529faa41ddd85743363750157943c7f7700276cce2bd40a429fa430 BSD-Resource-1.2909.tar.gz"
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# Maintainer: Fabian Affolter <fabian@affolter-engineering.ch>

pkgname=py-flake8-copyright

\_pkgname=flake8-copyright

pkgver=0.2.0

pkgrel=1

pkgdesc="Extension for flake8 which checks for copyrights"

url="https://github.com/savoirfairelinux/flake8-copyright"

arch="noarch"

license="MIT"

depends="flake8"

makedepends="python3-dev"

source="https://files.pythonhosted.org/packages/source/\${\_pkgname:0:1}/\${\_pkgname}/\${\_pkgname}-\${pkgver}.tar.gz"

builddir="\$srcdir"/\${\_pkgname}-\${pkgver}

```
build() {  
    cd "$builddir"  
    python3 setup.py build || return 1  
}
```

```
package() {  
    cd "$builddir"  
    python3 setup.py install --prefix=/usr --root="$pkgdir" || return 1  
}
```

md5sums="c6348990c6d74933bf5d5f6a55a14bdf flake8-copyright-0.2.0.tar.gz"

sha256sums="aeef26eb4d5223c9cd5b101e68175fcef6d2b353bf36da688fdde62fccfe2b73 flake8-copyright-0.2.0.tar.gz"

sha512sums="bab1bfaeed3a525ac3c7da12b1f2ec338c204cc69b72d05cd39560e528faff5d586c3b1be9570f4a977a7e2417b586e543bfba12abce256b2023c8c4993eeb90

flake8-copyright-0.2.0.tar.gz"

mini\_sendmail - accept email on behalf of real sendmail

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## 1.159 brotli 1.1.0-r2

### 1.159.1 Available under license :

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## 1.160 llvm 18.1.8-r5

### 1.160.1 Available under license :

; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

; RUN: llc < %s -mtriple=aarch64-- | FileCheck %s

; A shuffle mask with all undef elements is always legal.

```
define <4 x i32> @PR41535(<2 x i32> %p1, <2 x i32> %p2) {
; CHECK-LABEL: PR41535:
; CHECK:      // %bb.0:
; CHECK-NEXT:  ext v0.8b, v0.8b, v1.8b, #4
; CHECK-NEXT:  mov v0.d[1], v0.d[0]
; CHECK-NEXT:  ret
%cat1 = shufflevector <2 x i32> %p1, <2 x i32> undef, <4 x i32> <i32 undef, i32 1, i32 undef, i32 undef>
%cat2 = shufflevector <2 x i32> %p2, <2 x i32> undef, <4 x i32> <i32 0, i32 undef, i32 undef, i32 undef>
```

```

%r = shufflevector <4 x i32> %cat1, <4 x i32> %cat2, <4 x i32> <i32 undef, i32 undef, i32 1, i32 4>
ret <4 x i32> %r
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=amdgc -mcpu=fiji < %s | FileCheck -enable-var-scope --check-prefixes=GCN,GCN-
SAFE,VI,VI-SAFE %s
; RUN: llc -enable-no-signed-zeros-fp-math -mtriple=amdgc -mcpu=fiji < %s | FileCheck -enable-var-scope --
check-prefixes=GCN,GCN-NSZ,VI,VI-NSZ %s

; -----
; rcp tests
; -----

define half @v_fneg_rcp_f16(half %a) #0 {
; GCN-LABEL: v_fneg_rcp_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_rcp_f16_e64 v0, -v0
; GCN-NEXT:  s_setpc_b64 s[30:31]
%rcp = call half @llvm.amdgc.rcp.f16(half %a)
%fneg = fneg half %rcp
ret half %fneg
}

define half @v_fneg_rcp_fneg_f16(half %a) #0 {
; GCN-LABEL: v_fneg_rcp_fneg_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:
    v_rcp_f16_e32 v0, v0
; GCN-NEXT:  s_setpc_b64 s[30:31]
%fneg.a = fneg half %a
%rcp = call half @llvm.amdgc.rcp.f16(half %fneg.a)
%fneg = fneg half %rcp
ret half %fneg
}

define { half, half } @v_fneg_rcp_store_use_fneg_f16(half %a) #0 {
; GCN-LABEL: v_fneg_rcp_store_use_fneg_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_rcp_f16_e32 v2, v0
; GCN-NEXT:  v_xor_b32_e32 v1, 0x8000, v0
; GCN-NEXT:  v_mov_b32_e32 v0, v2
; GCN-NEXT:  s_setpc_b64 s[30:31]
%fneg.a = fneg half %a
%rcp = call half @llvm.amdgc.rcp.f16(half %fneg.a)
%fneg = fneg half %rcp

```

```

%insert.0 = insertvalue { half, half } poison, half %fneg, 0
%insert.1 = insertvalue { half, half } %insert.0, half %fneg.a, 1
ret { half, half } %insert.1
}

define { half, half } @v_fneg_rcp_multi_use_fneg_f16(half %a, half %c) #0 {
; GCN-LABEL: v_fneg_rcp_multi_use_fneg_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:
    v_rcp_f16_e32 v2, v0
; GCN-NEXT:  v_mul_f16_e64 v1, -v0, v1
; GCN-NEXT:  v_mov_b32_e32 v0, v2
; GCN-NEXT:  s_setpc_b64 s[30:31]
    %fneg.a = fneg half %a
    %rcp = call half @llvm.amdgcn.rcp.f16(half %fneg.a)
    %fneg = fneg half %rcp
    %use1 = fmul half %fneg.a, %c
    %insert.0 = insertvalue { half, half } poison, half %fneg, 0
    %insert.1 = insertvalue { half, half } %insert.0, half %use1, 1
    ret { half, half } %insert.1
}

; -----
; sin tests
; -----

define half @v_fneg_amdgcn_sin_f16(half %a) #0 {
; GCN-LABEL: v_fneg_amdgcn_sin_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_sin_f16_e64 v0, -v0
; GCN-NEXT:  s_setpc_b64 s[30:31]
    %sin = call half @llvm.amdgcn.sin.f16(half %a)
    %fneg = fneg half %sin
    ret half %fneg
}

; -----
;
; vintp tests
; -----

define { float, float } @v_fneg_interp_p1_f16(float %a, float %b) #0 {
; GCN-LABEL: v_fneg_interp_p1_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_mul_f32_e64 v1, v0, -v1

```

```

; GCN-NEXT: s_mov_b32 m0, 0
; GCN-NEXT: s_setreg_imm32_b32 hwreg(HW_REG_MODE, 2, 2), 3
; GCN-NEXT: v_interp_p1ll_f16 v0, v1, attr0.x
; GCN-NEXT: v_interp_p1ll_f16 v1, v1, attr0.y
; GCN-NEXT: s_setpc_b64 s[30:31]
%mul = fmul float %a, %b
%fneg = fneg float %mul
%intrap0 = call float @llvm.amdgcn.interp.p1.f16(float %fneg, i32 0, i32 0, i1 false, i32 0)
%intrap1 = call float @llvm.amdgcn.interp.p1.f16(float %fneg, i32 1, i32 0, i1 false, i32 0)
%insert.0 = insertvalue { float, float } poison, float %intrap0, 0
%insert.1 = insertvalue { float, float } %insert.0, float %intrap1, 1
ret { float, float } %insert.1
}

define
{ half, half } @v_fneg_interp_p2_f16(float %a, float %b) #0 {
; GCN-LABEL: v_fneg_interp_p2_f16:
; GCN:      ; %bb.0:
; GCN-NEXT: s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT: v_mul_f32_e64 v1, v0, -v1
; GCN-NEXT: v_mov_b32_e32 v2, 4.0
; GCN-NEXT: s_mov_b32 m0, 0
; GCN-NEXT: s_setreg_imm32_b32 hwreg(HW_REG_MODE, 2, 2), 3
; GCN-NEXT: v_interp_p2_f16 v0, v1, attr0.x, v2
; GCN-NEXT: v_interp_p2_f16 v1, v1, attr0.y, v2
; GCN-NEXT: s_setpc_b64 s[30:31]
%mul = fmul float %a, %b
%fneg = fneg float %mul
%intrap0 = call half @llvm.amdgcn.interp.p2.f16(float 4.0, float %fneg, i32 0, i32 0, i1 false, i32 0)
%intrap1 = call half @llvm.amdgcn.interp.p2.f16(float 4.0, float %fneg, i32 1, i32 0, i1 false, i32 0)
%insert.0 = insertvalue { half, half } poison, half %intrap0, 0
%insert.1 = insertvalue { half, half } %insert.0, half %intrap1, 1
ret { half, half } %insert.1
}

; -----
;
; arithmetic.fence tests
; -----

; FIXME: Legalization/promote is broken
define half @v_fneg_arithmetic_fence_f16(half %a) #0 {
; GCN-LABEL: v_fneg_arithmetic_fence_f16:
; GCN:      ; %bb.0:
; GCN-NEXT: ; ARITH_FENCE
; GCN-NEXT: s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT: v_xor_b32_e32 v0, 0x8000, v0
; GCN-NEXT: s_setpc_b64 s[30:31]

```



```

%fence = call half @llvm.arithmetic.fence.f16(half %a)
%fneg = fneg half %fence
ret half %fneg
}

define half @v_fneg_arithmetic_fence_fmulo_f16(half %a, half %b) #0 {
; GCN-LABEL: v_fneg_arithmetic_fence_fmulo_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_mul_f16_e32 v0, v0, v1
; GCN-NEXT:  ; ARITH_FENCE
; GCN-NEXT:  v_xor_b32_e32 v0, 0x8000, v0
; GCN-NEXT:  s_setpc_b64 s[30:31]
%mul = fmul half %a, %b
%fence = call half @llvm.arithmetic.fence.f16(half %mul)
%fneg = fneg half %fence
ret half
%fneg
}

declare half @llvm.amdgcn.rcp.f16(half) #1
declare half @llvm.amdgcn.sin.f16(half) #1
declare half @llvm.arithmetic.fence.f16(half) #1
declare float @llvm.amdgcn.interp.p1.f16(float, i32, i32, i1, i32) #0
declare half @llvm.amdgcn.interp.p2.f16(float, float, i32, i32, i1, i32) #0

attributes #0 = { nounwind "denormal-fp-math-f32"="preserve-sign,preserve-sign" }
attributes #1 = { nounwind readnone }
attributes #2 = { nounwind "unsafe-fp-math"="true" }
attributes #3 = { nounwind "no-signed-zeros-fp-math"="true" }
attributes #4 = { nounwind "amdgp-ieee"="false" "denormal-fp-math-f32"="preserve-sign,preserve-sign" }
;; NOTE: These prefixes are unused and the list is autogenerated. Do not add tests below this line:
; GCN-NSZ: {{.*}}
; GCN-SAFE: {{.*}}
; VI: {{.*}}
; VI-NSZ: {{.*}}
; VI-SAFE: {{.*}}
; NOTE: Assertions have been autogenerated by utils/update_test_checks.py UTC_ARGS: --function-signature --
check-attributes --check-globals
; RUN: opt -aa-pipeline=basic-aa -passes=attributor -attributor-manifest-internal -attributor-annotate-decl-cs -S <
%s | FileCheck %s --check-prefixes=CHECK,TUNIT
; RUN: opt -aa-pipeline=basic-aa -passes=attributor-cgsc -attributor-manifest-internal -attributor-annotate-decl-cs -
S < %s | FileCheck %s --check-prefixes=CHECK,CGSCC
; Test that we only promote arguments when the caller/callee have compatible
; function attributes.

target triple = "x86_64-unknown-linux-gnu"

```

```

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %arg, ptr
readonly %arg1) #0 {
;
; CHECK: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{^@+}}@callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512
; CHECK-SAME:
(ptr noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[ARG:%.*]], <8 x i64>
[[TMP0:%.*]]) #[[ATTR0:[0-9]+]] {
; CHECK-NEXT: bb:
; CHECK-NEXT: [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT: store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %arg) #0 {
;
; TUNIT: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{^@+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer512
; TUNIT-SAME: (ptr nocapture norecurse writeonly [[ARG:%.*]]) #[[ATTR0]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align
32
; TUNIT-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5:[0-9]+]]
; TUNIT-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; TUNIT-NEXT: call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr
noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6:[0-9]+]]
; TUNIT-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT: ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {{^@+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer512
; CGSCC-SAME: (ptr nocapture

```

```

nofree noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]]) #[[ATTR0]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture nofree noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5:[0-9]+]]
; CGSCC-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT: call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr
noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6:[0-9]+]]
; CGSCC-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void
@llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %arg, ptr
readonly %arg1) #1 {
;
; CHECK: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{^[^@]+}}@callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], <8 x i64> [[TMP0:%.*]]) #[[ATTR1:[0-9]+]] {
; CHECK-NEXT: bb:
; CHECK-NEXT: [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT: store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: [[TMP:%.*]] = load <8 x
i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

```

```

define void @avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %arg) #1 {
;
; TUNIT: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{^@+}}@avx512_legal512_prefer256_call_avx512_legal512_prefer256
; TUNIT-SAME: (ptr nocapture norecurse writeonly [[ARG:%.*]]) #[[ATTR1]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT:  [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT:  [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT:  call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT:  [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; TUNIT-NEXT:
    call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr noalias nocapture
norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64> [[TMP0]]) #[[ATTR6]]
; TUNIT-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT:  ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {{^@+}}@avx512_legal512_prefer256_call_avx512_legal512_prefer256
; CGSCC-SAME: (ptr nocapture norecurse noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR1]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT:  [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT:  [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT:  call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 64
dereferenceable(64)
[[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT:  [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT:  call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr
noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6]]
; CGSCC-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT:  ret void
;
bb:
    %tmp = alloca <8 x i64>, align 32
    %tmp2 = alloca <8 x i64>, align 32
    call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
    call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)
    %tmp4 = load <8 x i64>, ptr %tmp2, align 32
    store <8 x i64> %tmp4, ptr %arg, align 2
    ret void
}

```

```

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr
    %arg, ptr readonly %arg1) #1 {
;
; CHECK: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{^[^@]+}}@callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], <8 x i64> [[TMP0:%.*]]) #[[ATTR1]] {
; CHECK-NEXT: bb:
; CHECK-NEXT: [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT: store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT: ret void
;
bb:
    %tmp = load <8 x i64>, ptr %arg1
    store <8 x i64> %tmp, ptr %arg
    ret void
}

define void @avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr %arg) #0 {
;
; TUNIT: Function Attrs: inlinehint mustprogress norecurse nosync nounwind
willreturn memory(argmem: readwrite) uwtable
; TUNIT-LABEL: define {{^[^@]+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer256
; TUNIT-SAME: (ptr nocapture norecurse writeonly [[ARG:%.*]]) #[[ATTR0]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; TUNIT-NEXT: call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr
noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6]]
; TUNIT-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT:
    ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {{^[^@]+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer256
; CGSCC-SAME: (ptr nocapture norecurse noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR0]] {
; CGSCC-NEXT: bb:

```

```

; CGSCC-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture nofree noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT: call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr
noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6]]
; CGSCC-NEXT:
    [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT: ret void
;
bb:
    %tmp = alloca <8 x i64>, align 32
    %tmp2 = alloca <8 x i64>, align 32
    call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
    call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)
    %tmp4 = load <8 x i64>, ptr %tmp2, align 32
    store <8 x i64> %tmp4, ptr %arg, align 2
    ret void
}

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr %arg, ptr
readonly %arg1) #0 {
;
; CHECK: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{{^@}+}}@callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512
; CHECK-SAME: (ptr noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]],
    <8 x i64> [[TMP0:%.*]]) #[[ATTR0]] {
; CHECK-NEXT: bb:
; CHECK-NEXT: [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT: store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT: ret void
;
bb:
    %tmp = load <8 x i64>, ptr %arg1
    store <8 x i64> %tmp, ptr %arg
    ret void
}

define void @avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr %arg) #1 {
;

```

```

; TUNIT: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{^[^@]+}}@avx512_legal512_prefer256_call_avx512_legal512_prefer512
; TUNIT-SAME: (ptr nocapture norecurse writeonly [[ARG:%.*]]) #[[ATTR1]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT:  [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT:  [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT:  call void @llvm.memset.p0.i64(ptr
noalias nocapture norecurse noundef nonnull writeonly align 32 dereferenceable(64) [[TMP]], i8 noundef 0, i64
noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT:  [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; TUNIT-NEXT:  call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr
noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6]]
; TUNIT-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT:  ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {{^[^@]+}}@avx512_legal512_prefer256_call_avx512_legal512_prefer512
; CGSCC-SAME: (ptr nocapture norecurse noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR1]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT:
[[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT:  [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT:  call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT:  [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT:  call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr
noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6]]
; CGSCC-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT:  ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr
%tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

```

```

; This should not promote
define internal fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %arg, ptr
readonly %arg1) #1 {
;
; CHECK: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{[^@]+}}@callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], ptr noalias nocapture norecurse noundef nonnull readonly align 64 dereferenceable(64) [[ARG1:%.*]])
#[[ATTR1]] {
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1]], align 64
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %arg) #2 {
;
; TUNIT: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{[^@]+}}@avx512_legal256_prefer256_call_avx512_legal512_prefer256
; TUNIT-SAME: (ptr nocapture norecurse writeonly [[ARG:%.*]]) #[[ATTR2:[0-9]+]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT: call fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr
noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], ptr noalias
nocapture norecurse noundef nonnull readonly align 64 dereferenceable(64)
[[TMP]]) #[[ATTR6]]
; TUNIT-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT: ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {{[^@]+}}@avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CGSCC-SAME: (ptr nocapture norecurse noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR2:[0-9]+]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32

```



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; CGSCC-NEXT:  call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT:  call fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr
noalias
nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], ptr noalias nocapture
norecurse noundef nonnull readonly align 64 dereferenceable(64) [[TMP]]) #[[ATTR6]]
; CGSCC-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT:  ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should not promote
define internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %arg, ptr
readonly %arg1) #2 {
;
; CHECK: Function Attrs: inlinehint mustprogress norecurse norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
;
CHECK-LABEL: define {{^[^@]+}}@callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256
; CHECK-SAME: (ptr noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], ptr noalias nocapture norecurse noundef nonnull readonly align 64 dereferenceable(64) [[ARG1:%.*]])
#[[ATTR2:[0-9]+]] {
; CHECK-NEXT: bb:
; CHECK-NEXT:  [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1]], align 64
; CHECK-NEXT:  store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT:  ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %arg) #1 {
;
; TUNIT: Function Attrs: inlinehint mustprogress norecurse norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{^[^@]+}}@avx512_legal512_prefer256_call_avx512_legal256_prefer256
; TUNIT-SAME: (ptr nocapture norecurse writeonly [[ARG:%.*]]) #[[ATTR1]] {

```

```

; TUNIT-NEXT: bb:
; TUNIT-NEXT:
    [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT:  [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT:  call void @llvm.memset.p0.i64(ptr noalias nocapture nofree noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT:  call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr noalias
nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], ptr noalias
nocapture nofree noundef nonnull readonly align 64 dereferenceable(64) [[TMP]]) #[[ATTR6]]
; TUNIT-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT:  ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {[@^@+]}@avx512_legal512_prefer256_call_avx512_legal256_prefer256
;
    CGSCC-SAME: (ptr nocapture nofree noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR1]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT:  [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT:  [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT:  call void @llvm.memset.p0.i64(ptr noalias nocapture nofree noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT:  call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr noalias
nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], ptr noalias
nocapture nofree noundef nonnull readonly align 64 dereferenceable(64) [[TMP]]) #[[ATTR6]]
; CGSCC-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT:  ret void
;
bb:
    %tmp = alloca <8 x i64>, align 32
    %tmp2 = alloca <8 x i64>,
    align 32
    call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
    call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %tmp2, ptr %tmp)
    %tmp4 = load <8 x i64>, ptr %tmp2, align 32
    store <8 x i64> %tmp4, ptr %arg, align 2
    ret void
}

; This should promote
define internal fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %arg, ptr readonly
%arg1) #3 {
;
; CHECK: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable

```

```

; CHECK-LABEL: define {{^[^@]+}}@callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256
; CHECK-SAME: (ptr noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], <8 x i64> [[TMP0:%.*]]) #[[ATTR3:[0-9]+]] {
; CHECK-NEXT: bb:
; CHECK-NEXT: [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT: store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: [[TMP:%.*]]
= load <8 x i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %arg) #4 {
;
; TUNIT: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{^[^@]+}}@avx2_legal256_prefer256_call_avx2_legal512_prefer256
; TUNIT-SAME: (ptr nocapture nofree writeonly [[ARG:%.*]]) #[[ATTR3]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture nofree noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
;
; TUNIT-NEXT: call fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr noalias
nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64> [[TMP0]])
#[[ATTR6]]
; TUNIT-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT: ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {{^[^@]+}}@avx2_legal256_prefer256_call_avx2_legal512_prefer256
; CGSCC-SAME: (ptr nocapture nofree noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR3]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture nofree noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]],

```

```

i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT:  [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT:  call fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr noalias
nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64> [[TMP0]])
#[[ATTR6]]
; CGSCC-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT:  ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr
%arg, ptr readonly %arg1) #4 {
;
; CHECK: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{^[^@]+}}@callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256
; CHECK-SAME: (ptr noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], <8 x i64> [[TMP0:%.*]]) #[[ATTR3]] {
; CHECK-NEXT: bb:
; CHECK-NEXT:  [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT:  store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT:  [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT:  store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT:  ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr %arg) #3 {
;
; TUNIT: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{^[^@]+}}@avx2_legal512_prefer256_call_avx2_legal256_prefer256
; TUNIT-SAME: (ptr nocapture nofree writeonly [[ARG:%.*]]) #[[ATTR3]] {
; TUNIT-NEXT: bb:

```

```

; TUNIT-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture nofree noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; TUNIT-NEXT: call fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr noalias
nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64> [[TMP0]])
#[[ATTR6]]
; TUNIT-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT: ret void
;
; CGSCC: Function
Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem: readwrite) uwtable
; CGSCC-LABEL: define { {^[@]}+} @avx2_legal512_prefer256_call_avx2_legal256_prefer256
; CGSCC-SAME: (ptr nocapture nofree noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR3]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture nofree noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT: call fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr noalias
nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64> [[TMP0]])
#[[ATTR6]]
; CGSCC-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>,
ptr [[TRUETMP2]], align 64
; CGSCC-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; Function Attrs: argmemonly nounwind
declare void @llvm.memset.p0.i64(ptr nocapture writeonly, i8, i64, i1) #5

attributes #0 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-
width"="512" "prefer-vector-width"="512" }
attributes #1 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-
width"="512" "prefer-vector-width"="256" }

```

```

attributes #2 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-
width"="256"
"prefer-vector-width"="256" }
attributes #3 = { inlinehint norecurse nounwind uwtable "target-features"="+avx2" "min-legal-vector-width"="512"
"prefer-vector-width"="256" }
attributes #4 = { inlinehint norecurse nounwind uwtable "target-features"="+avx2" "min-legal-vector-width"="256"
"prefer-vector-width"="256" }
attributes #5 = { argmemonly nounwind }
;
; TUNIT: attributes #[[ATTR0]] = { inlinehint mustprogress nofree norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="512" "target-
features"="+avx512vl" }
; TUNIT: attributes #[[ATTR1]] = { inlinehint mustprogress nofree norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="256" "target-
features"="+avx512vl" }
; TUNIT: attributes #[[ATTR2]] = { inlinehint mustprogress nofree norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="256" "prefer-vector-width"="256"
"target-features"="+avx512vl" }
; TUNIT: attributes #[[ATTR3]] = { inlinehint mustprogress nofree norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="256" "target-
features"="+avx2" }
; TUNIT: attributes #[[ATTR4:[0-9]+]] = { nocallback nofree nounwind willreturn memory(argmem: write) }
; TUNIT: attributes #[[ATTR5]] = { nofree willreturn memory(write) }
; TUNIT: attributes #[[ATTR6]] = { nofree nosync nounwind willreturn }
;
; CGSCC: attributes #[[ATTR0]] = { inlinehint mustprogress nofree norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="512" "target-
features"="+avx512vl" }
; CGSCC: attributes #[[ATTR1]] = { inlinehint mustprogress nofree norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="256" "target-
features"="+avx512vl" }
; CGSCC: attributes #[[ATTR2]]
= { inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem: readwrite) uwtable
"min-legal-vector-width"="256" "prefer-vector-width"="256" "target-features"="+avx512vl" }
; CGSCC: attributes #[[ATTR3]] = { inlinehint mustprogress nofree norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="256" "target-
features"="+avx2" }
; CGSCC: attributes #[[ATTR4:[0-9]+]] = { nocallback nofree nounwind willreturn memory(argmem: write) }
; CGSCC: attributes #[[ATTR5]] = { nofree willreturn memory(write) }
; CGSCC: attributes #[[ATTR6]] = { nofree nounwind willreturn }
;
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64I
; RUN: llc -mtriple=riscv64 -mattr=+zbb -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBB

declare i32 @llvmctlz.i32(i32, i1)

```

```

define signext i32 @ctlz_i32(i32 signext %a) nounwind {
; RV64I-LABEL: ctlz_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT: beqz a0, .LBB0_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 2
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 8
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 16
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT:
    not a0, a0
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 24
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
; RV64I-NEXT: .LBB0_2:
; RV64I-NEXT: li a0, 32
; RV64I-NEXT: ret
;
; RV64ZBB-LABEL: ctlz_i32:

```

```

; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  clzw a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvmctlz.i32(i32 %a, i1 false)
ret i32 %1
}

define signext i32 @log2_i32(i32 signext %a) nounwind {
; RV64I-LABEL: log2_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  beqz a0, .LBB1_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addi a2, a2, 1365
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  lui a1, 209715
; RV64I-NEXT:  addi a1, a1, 819
; RV64I-NEXT:  and a2, a0, a1
; RV64I-NEXT:  srliw a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:
    srliw a1, a0, 4
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srliw a0, a0, 24
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16

```



```

; RV64I-NEXT:  j .LBB1_3
; RV64I-NEXT:  .LBB1_2:
; RV64I-NEXT:  li a0, 32
; RV64I-NEXT:  .LBB1_3: # %cond.end
; RV64I-NEXT:  li a1, 31
; RV64I-NEXT:  subw a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: log2_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  clzw a0, a0
; RV64ZBB-NEXT:  li a1, 31
; RV64ZBB-NEXT:  subw a0, a1, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvmctlz.i32(i32 %a, i1 false)
%2 = sub i32 31, %1
ret i32 %2
}

define signext i32 @log2_ceil_i32(i32 signext %a) nounwind {
; RV64I-LABEL: log2_ceil_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra,
8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:  addiw a0, a0, -1
; RV64I-NEXT:  li s0, 32
; RV64I-NEXT:  li a1, 32
; RV64I-NEXT:  beqz a0, .LBB2_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addi a2, a2, 1365
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  lui a1, 209715

```

```

; RV64I-NEXT:  addi a1, a1, 819
; RV64I-NEXT:  and a2, a0, a1
; RV64I-NEXT:  srliw a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:
    addw a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srliw a1, a0, 24
; RV64I-NEXT:  .LBB2_2: # %cond.end
; RV64I-NEXT:  subw a0, s0, a1
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: log2_ceil_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  addi a0, a0, -1
; RV64ZBB-NEXT:  clzw a0, a0
; RV64ZBB-NEXT:  li a1, 32
; RV64ZBB-NEXT:  subw a0, a1, a0
; RV64ZBB-NEXT:  ret
%1 = sub i32 %a, 1
%2 = call i32 @llvmctlz.i32(i32 %1, i1 false)
%3 = sub i32 32, %2
ret i32 %3
}

define signext i32 @findLastSet_i32(i32 signext %a) nounwind {
; RV64I-LABEL: findLastSet_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
;
    RV64I-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:  mv s0, a0
; RV64I-NEXT:  srliw a0, a0, 1
; RV64I-NEXT:  or a0, s0, a0
; RV64I-NEXT:  srliw a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 4

```

```

; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 8
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 16
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: not a0, a0
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT:
    addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 24
; RV64I-NEXT: xori a0, a0, 31
; RV64I-NEXT: snez a1, s0
; RV64I-NEXT: addiw a1, a1, -1
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64ZBB-LABEL: findLastSet_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT: clzw a1, a0
; RV64ZBB-NEXT: xori a1, a1, 31
; RV64ZBB-NEXT: snez a0, a0
; RV64ZBB-NEXT: addiw a0, a0, -1
; RV64ZBB-NEXT: or a0, a0, a1
; RV64ZBB-NEXT: ret
%1 = call i32 @llvm.ctlz.i32(i32 %a, i1 true)
%2 = xor i32 31, %1
%3 = icmp eq i32 %a, 0
%4 = select i1 %3, i32 -1, i32 %2

```

```
ret i32 %4
}
```

```
define i32 @ctlz_lshr_i32(i32 signext %a) {
; RV64I-LABEL: ctlz_lshr_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT: srliw a0, a0, 1
; RV64I-NEXT: beqz a0, .LBB4_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: addi sp, sp,
-16
; RV64I-NEXT: .cfi_def_cfa_offset 16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: .cfi_offset ra, -8
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 2
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 8
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 16
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: not a0, a0
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0,
a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 24
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
```

```

; RV64I-NEXT:  ret
; RV64I-NEXT:  .LBB4_2:
; RV64I-NEXT:  li a0, 32
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: ctlz_lshr_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  srliw a0, a0, 1
; RV64ZBB-NEXT:  clzw a0, a0
; RV64ZBB-NEXT:  ret
%1 = lshr i32 %a, 1
%2 = call i32 @llvm.ctlz.i32(i32 %1, i1 false)
ret i32 %2
}

declare i64 @llvm.ctlz.i64(i64, i1)

define i64 @ctlz_i64(i64 %a) nounwind {
; RV64I-LABEL: ctlz_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  beqz a0, .LBB5_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  srli a1, a0, 1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 4
; RV64I-NEXT:
    or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 32
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  srli a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addiw a2, a2, 1365
; RV64I-NEXT:  slli a3, a2, 32
; RV64I-NEXT:  add a2, a2, a3
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  sub a0, a0, a1
; RV64I-NEXT:  lui a1, 209715
; RV64I-NEXT:  addiw a1, a1, 819
; RV64I-NEXT:  slli a2, a1, 32

```

```

; RV64I-NEXT:  add a1, a1, a2
; RV64I-NEXT:  and a2, a0, a1
; RV64I-NEXT:  srli a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srli a1, a0, 4
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  slli a2, a1, 32
; RV64I-NEXT:  add a1, a1, a2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:
    addiw a1, a1, 257
; RV64I-NEXT:  slli a2, a1, 32
; RV64I-NEXT:  add a1, a1, a2
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srli a0, a0, 56
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
; RV64I-NEXT: .LBB5_2:
; RV64I-NEXT:  li a0, 64
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: ctlz_i64:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  clz a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i64 @llvm.ctlz.i64(i64 %a, i1 false)
ret i64 %1
}

```

```

declare i32 @llvm.cttz.i32(i32, i1)

```

```

define signext i32 @cttz_i32(i32 signext %a) nounwind {
; RV64I-LABEL: cttz_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  beqz a0, .LBB6_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  negw a1, a0
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 30667
; RV64I-NEXT:  addiw a1, a1, 1329
; RV64I-NEXT:  call __muldi3

```

```

; RV64I-NEXT:  srlw a0, a0, 27
;
RV64I-NEXT:  lui a1, %hi(.LCPI6_0)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI6_0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
; RV64I-NEXT:  .LBB6_2:
; RV64I-NEXT:  li a0, 32
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: cttz_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  ctzw a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 false)
ret i32 %1
}

define signext i32 @cttz_zero_undef_i32(i32 signext %a) nounwind {
; RV64I-LABEL: cttz_zero_undef_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  negw a1, a0
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 30667
; RV64I-NEXT:  addiw a1, a1, 1329
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srlw a0, a0, 27
; RV64I-NEXT:  lui a1, %hi(.LCPI7_0)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI7_0)
; RV64I-NEXT:
    add a0, a1, a0
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: cttz_zero_undef_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  ctzw a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)
ret i32 %1
}

```

```

define signext i32 @findFirstSet_i32(i32 signext %a) nounwind {
; RV64I-LABEL: findFirstSet_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:  mv s0, a0
; RV64I-NEXT:  negw a0, a0
; RV64I-NEXT:  and a0, s0, a0
; RV64I-NEXT:  lui a1, 30667
; RV64I-NEXT:  addiw a1, a1, 1329
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srlw a0, a0, 27
; RV64I-NEXT:  lui a1, %hi(.LCPI8_0)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI8_0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  snez a1, s0
; RV64I-NEXT:
    addi a1, a1, -1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: findFirstSet_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  ctw a1, a0
; RV64ZBB-NEXT:  snez a0, a0
; RV64ZBB-NEXT:  addiw a0, a0, -1
; RV64ZBB-NEXT:  or a0, a0, a1
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)
%2 = icmp eq i32 %a, 0
%3 = select i1 %2, i32 -1, i32 %1
ret i32 %3
}

```

```

define signext i32 @ffs_i32(i32 signext %a) nounwind {
; RV64I-LABEL: ffs_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:  mv s0, a0
; RV64I-NEXT:  negw a0, a0

```



```

; RV64I-NEXT:  and a0, s0, a0
; RV64I-NEXT:  lui a1, 30667
; RV64I-NEXT:  addiw a1, a1, 1329
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:
    srlw a0, a0, 27
; RV64I-NEXT:  lui a1, %hi(.LCPI9_0)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI9_0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  seqz a1, s0
; RV64I-NEXT:  addi a1, a1, -1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: ffs_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  ctzw a1, a0
; RV64ZBB-NEXT:  addi a1, a1, 1
; RV64ZBB-NEXT:  seqz a0, a0
; RV64ZBB-NEXT:  addi a0, a0, -1
; RV64ZBB-NEXT:  and a0, a0, a1
; RV64ZBB-NEXT:  zext.h a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)
%2 = add i32 %1, 1
%3 = icmp eq i32 %a, 0
%4 = select i1 %3, i32 0, i32 %2
ret i32 %4
}

declare i64 @llvm.cttz.i64(i64, i1)

define i64 @cttz_i64(i64
    %a) nounwind {
; RV64I-LABEL: cttz_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  beqz a0, .LBB10_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  neg a1, a0

```

```

; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, %hi(.LCPI10_0)
; RV64I-NEXT: ld a1, %lo(.LCPI10_0)(a1)
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srli a0, a0, 58
; RV64I-NEXT: lui a1, %hi(.LCPI10_1)
; RV64I-NEXT: addi a1, a1, %lo(.LCPI10_1)
; RV64I-NEXT: add a0, a1, a0
; RV64I-NEXT: lbu a0, 0(a0)
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
; RV64I-NEXT: .LBB10_2:
; RV64I-NEXT: li a0, 64
; RV64I-NEXT: ret
;
; RV64ZBB-LABEL: cttz_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  ctz a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i64 @llvm.cttz.i64(i64 %a, i1 false)
ret i64 %1
}

```

```
declare i32 @llvm.ctpop.i32(i32)
```

```

define signext i32 @ctpop_i32(i32
signext %a) nounwind {
; RV64I-LABEL: ctpop_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addi a2, a2, 1365
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  lui a1, 209715
; RV64I-NEXT:  addi a1, a1, 819
; RV64I-NEXT:  and a2, a0, a1
; RV64I-NEXT:  srliw a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  and a0, a0, a1

```

```

; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srlw a0, a0, 24
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: ctpop_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  cpopw
a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvm.ctpop.i32(i32 %a)
ret i32 %1
}

```

```

define signext i32 @ctpop_i32_load(ptr %p) nounwind {
; RV64I-LABEL: ctpop_i32_load:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  srlw a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addi a2, a2, 1365
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  lui a1, 209715
; RV64I-NEXT:  addi a1, a1, 819
; RV64I-NEXT:  and a2, a0, a1
; RV64I-NEXT:  srlw a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srlw a1, a0, 4
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srlw a0, a0, 24
; RV64I-NEXT:  ld ra, 8(sp)
# 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;

```

```

; RV64ZBB-LABEL: ctpop_i32_load:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT: lw a0, 0(a0)
; RV64ZBB-NEXT: cpopw a0, a0
; RV64ZBB-NEXT: ret
%a = load i32, ptr %p
%1 = call i32 @llvm.ctpop.i32(i32 %a)
ret i32 %1
}

```

```
declare i64 @llvm.ctpop.i64(i64)
```

```

define i64 @ctpop_i64(i64 %a) nounwind {
; RV64I-LABEL: ctpop_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: srli a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addiw a2, a2, 1365
; RV64I-NEXT: slli a3, a2, 32
; RV64I-NEXT: add a2, a2, a3
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: sub a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addiw a1, a1, 819
; RV64I-NEXT: slli a2, a1, 32
; RV64I-NEXT: add a1, a1, a2
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srli a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2,
a0
; RV64I-NEXT: srli a1, a0, 4
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: slli a2, a1, 32
; RV64I-NEXT: add a1, a1, a2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: slli a2, a1, 32
; RV64I-NEXT: add a1, a1, a2
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srli a0, a0, 56
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16

```

```

; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: ctpop_i64:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  cpop a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i64 @llvm.ctpop.i64(i64 %a)
ret i64 %1
}

```

```

define signext i32 @sextb_i32(i32 signext %a) nounwind {
; RV64I-LABEL: sextb_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 56
; RV64I-NEXT:  srai a0, a0, 56
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: sextb_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  sext.b a0, a0
; RV64ZBB-NEXT:
    ret
%shl = shl i32 %a, 24
%shr = ashr exact i32 %shl, 24
ret i32 %shr
}

```

```

define i64 @sextb_i64(i64 %a) nounwind {
; RV64I-LABEL: sextb_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 56
; RV64I-NEXT:  srai a0, a0, 56
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: sextb_i64:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  sext.b a0, a0
; RV64ZBB-NEXT:  ret
%shl = shl i64 %a, 56
%shr = ashr exact i64 %shl, 56
ret i64 %shr
}

```

```

define signext i32 @sextb_i32(i32 signext %a) nounwind {
; RV64I-LABEL: sextb_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srai a0, a0, 48

```

```

; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: sixth_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  sext.h a0, a0
; RV64ZBB-NEXT:  ret
%shl = shl i32 %a, 16
%shr = ashr exact i32 %shl, 16
ret i32 %shr
}

define i64 @sixth_i64(i64 %a) nounwind {
; RV64I-LABEL: sixth_i64:
; RV64I:        # %bb.0:
; RV64I-NEXT:   slli a0, a0, 48
; RV64I-NEXT:   srai a0, a0, 48
; RV64I-NEXT:
    ret
;
; RV64ZBB-LABEL: sixth_i64:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  sext.h a0, a0
; RV64ZBB-NEXT:  ret
%shl = shl i64 %a, 48
%shr = ashr exact i64 %shl, 48
ret i64 %shr
}

define signext i32 @min_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: min_i32:
; RV64I:        # %bb.0:
; RV64I-NEXT:   blt a0, a1, .LBB18_2
; RV64I-NEXT:   # %bb.1:
; RV64I-NEXT:   mv a0, a1
; RV64I-NEXT:   .LBB18_2:
; RV64I-NEXT:   ret
;
; RV64ZBB-LABEL: min_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  min a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp slt i32 %a, %b
%cond = select i1 %cmp, i32 %a, i32 %b
ret i32 %cond
}

define i64 @min_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: min_i64:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  blt a0, a1, .LBB19_2
; RV64I-NEXT: # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT: .LBB19_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: min_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  min a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp
slt i64 %a, %b
%cond = select i1 %cmp, i64 %a, i64 %b
ret i64 %cond
}

define signext i32 @max_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: max_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  blt a1, a0, .LBB20_2
; RV64I-NEXT: # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT: .LBB20_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: max_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  max a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp sgt i32 %a, %b
%cond = select i1 %cmp, i32 %a, i32 %b
ret i32 %cond
}

define i64 @max_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: max_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  blt a1, a0, .LBB21_2
; RV64I-NEXT: # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT: .LBB21_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: max_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  max a0, a0, a1
; RV64ZBB-NEXT:  ret

```

```

%cmp = icmp sgt i64 %a, %b
%cond = select i1 %cmp, i64 %a, i64 %b
ret i64 %cond
}

```

```

define signext i32 @minu_i32(i32 signext
%a, i32 signext %b) nounwind {
; RV64I-LABEL: minu_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  bltu a0, a1, .LBB22_2
; RV64I-NEXT: # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT: .LBB22_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: minu_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  minu a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp ult i32 %a, %b
%cond = select i1 %cmp, i32 %a, i32 %b
ret i32 %cond
}

```

```

define i64 @minu_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: minu_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  bltu a0, a1, .LBB23_2
; RV64I-NEXT: # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT: .LBB23_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: minu_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  minu a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp ult i64 %a, %b
%cond = select i1 %cmp, i64 %a, i64 %b
ret i64 %cond
}

```

```

define signext i32 @maxu_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: maxu_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  bltu a1,
a0, .LBB24_2
; RV64I-NEXT: # %bb.1:

```



```

; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  .LBB24_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: maxu_i32:
; RV64ZBB:     # %bb.0:
; RV64ZBB-NEXT:  maxu a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp ugt i32 %a, %b
%cond = select i1 %cmp, i32 %a, i32 %b
ret i32 %cond
}

```

```

define i64 @maxu_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: maxu_i64:
; RV64I:       # %bb.0:
; RV64I-NEXT:  bltu a1, a0, .LBB25_2
; RV64I-NEXT:  # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  .LBB25_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: maxu_i64:
; RV64ZBB:     # %bb.0:
; RV64ZBB-NEXT:  maxu a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp ugt i64 %a, %b
%cond = select i1 %cmp, i64 %a, i64 %b
ret i64 %cond
}

```

```

declare i32 @llvm.abs.i32(i32, i1 immarg)

```

```

define i32 @abs_i32(i32 %x) {
; RV64I-LABEL: abs_i32:
; RV64I:       # %bb.0:
; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL:
abs_i32:
; RV64ZBB:     # %bb.0:
; RV64ZBB-NEXT:  sraiw a1, a0, 31
; RV64ZBB-NEXT:  xor a0, a0, a1
; RV64ZBB-NEXT:  subw a0, a0, a1
; RV64ZBB-NEXT:  ret

```

```

%abs = tail call i32 @llvm.abs.i32(i32 %x, i1 true)
ret i32 %abs
}

```

```

define signext i32 @abs_i32_sext(i32 signext %x) {
; RV64I-LABEL: abs_i32_sext:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: abs_i32_sext:
; RV64ZBB:     # %bb.0:
; RV64ZBB-NEXT:  sraiw a1, a0, 31
; RV64ZBB-NEXT:  xor a0, a0, a1
; RV64ZBB-NEXT:  subw a0, a0, a1
; RV64ZBB-NEXT:  ret
%abs = tail call i32 @llvm.abs.i32(i32 %x, i1 true)
ret i32 %abs
}

```

```

declare i64 @llvm.abs.i64(i64, i1 immarg)

```

```

define i64 @abs_i64(i64 %x) {
; RV64I-LABEL: abs_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srai a1, a0, 63
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  sub a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: abs_i64:
; RV64ZBB:
; RV64ZBB:     # %bb.0:
; RV64ZBB-NEXT:  neg a1, a0
; RV64ZBB-NEXT:  max a0, a0, a1
; RV64ZBB-NEXT:  ret
%abs = tail call i64 @llvm.abs.i64(i64 %x, i1 true)
ret i64 %abs
}

```

```

define i32 @zexth_i32(i32 %a) nounwind {
; RV64I-LABEL: zexth_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  ret

```

```

;
; RV64ZBB-LABEL: zexth_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  slli a0, a0, 48
; RV64ZBB-NEXT:  srli a0, a0, 48
; RV64ZBB-NEXT:  ret
%and = and i32 %a, 65535
ret i32 %and
}

define i64 @zexth_i64(i64 %a) nounwind {
; RV64I-LABEL: zexth_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: zexth_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  zext.h a0, a0
; RV64ZBB-NEXT:  ret
%and = and i64 %a, 65535
ret i64 %and
}

declare i32 @llvm.bswap.i32(i32)

define signext i32 @bswap_i32(i32 signext %a) nounwind {
; RV64I-LABEL: bswap_i32:
;
; RV64I:    # %bb.0:
; RV64I-NEXT:  srliw a1, a0, 8
; RV64I-NEXT:  lui a2, 16
; RV64I-NEXT:  addiw a2, a2, -256
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  srliw a3, a0, 24
; RV64I-NEXT:  or a1, a1, a3
; RV64I-NEXT:  and a2, a0, a2
; RV64I-NEXT:  slliw a2, a2, 8
; RV64I-NEXT:  slliw a0, a0, 24
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: bswap_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  rev8 a0, a0
; RV64ZBB-NEXT:  srai a0, a0, 32

```

```

; RV64ZBB-NEXT:  ret
%1 = tail call i32 @llvm.bswap.i32(i32 %a)
ret i32 %1
}

; Similar to bswap_i32 but the result is not sign extended.
define void @bswap_i32_nosext(i32 signext %a, ptr %x) nounwind {
; RV64I-LABEL: bswap_i32_nosext:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a2, a0, 8
; RV64I-NEXT:  lui a3, 16
; RV64I-NEXT:  addi a3, a3, -256
; RV64I-NEXT:  and a2, a2, a3
; RV64I-NEXT:  srliw a4, a0, 24
; RV64I-NEXT:  or a2, a2, a4
; RV64I-NEXT:
    and a3, a0, a3
; RV64I-NEXT:  slli a3, a3, 8
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:  or a0, a0, a3
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  sw a0, 0(a1)
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: bswap_i32_nosext:
; RV64ZBB:     # %bb.0:
; RV64ZBB-NEXT:  rev8 a0, a0
; RV64ZBB-NEXT:  srli a0, a0, 32
; RV64ZBB-NEXT:  sw a0, 0(a1)
; RV64ZBB-NEXT:  ret
%1 = tail call i32 @llvm.bswap.i32(i32 %a)
store i32 %1, ptr %x
ret void
}

declare i64 @llvm.bswap.i64(i64)

define i64 @bswap_i64(i64 %a) {
; RV64I-LABEL: bswap_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srli a1, a0, 40
; RV64I-NEXT:  lui a2, 16
; RV64I-NEXT:  addiw a2, a2, -256
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  srli a3, a0, 56
; RV64I-NEXT:  or a1, a1, a3
; RV64I-NEXT:  srli a3, a0, 24
; RV64I-NEXT:  lui a4, 4080

```

```

; RV64I-NEXT: and a3, a3, a4
; RV64I-NEXT: srli a5, a0, 8
; RV64I-NEXT: srliw a5, a5, 24
; RV64I-NEXT: slli a5, a5, 24
; RV64I-NEXT: or a3, a5, a3
; RV64I-NEXT:
    or a1, a3, a1
; RV64I-NEXT: and a4, a0, a4
; RV64I-NEXT: slli a4, a4, 24
; RV64I-NEXT: srliw a3, a0, 24
; RV64I-NEXT: slli a3, a3, 32
; RV64I-NEXT: or a3, a4, a3
; RV64I-NEXT: and a2, a0, a2
; RV64I-NEXT: slli a2, a2, 40
; RV64I-NEXT: slli a0, a0, 56
; RV64I-NEXT: or a0, a0, a2
; RV64I-NEXT: or a0, a0, a3
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBB-LABEL: bswap_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT: rev8 a0, a0
; RV64ZBB-NEXT: ret
%1 = call i64 @llvm.bswap.i64(i64 %a)
ret i64 %1
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64I
; RUN: llc -mtriple=riscv64 -mattr=+zbkb -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBKB

```

```

define signext i32 @pack_i32(i32 signext %a, i32 signext %b) nounwind {

```

```

; RV64I-LABEL: pack_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT: slli a0, a0, 48
; RV64I-NEXT: srli a0, a0, 48
; RV64I-NEXT: slliw a1, a1, 16
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBKB-LABEL: pack_i32:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT: packw a0, a0, a1
; RV64ZBKB-NEXT: ret
%shl = and i32 %a, 65535
%shl1 = shl i32 %b, 16

```

```

%or = or i32 %shl1, %shl
ret i32 %or
}

define signext i32 @pack_i32_2(i16 zeroext %a, i16 zeroext %b) nounwind {
; RV64I-LABEL: pack_i32_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slliw
a1, a1, 16
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i32_2:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  packw a0, a0, a1
; RV64ZBKB-NEXT:  ret
%zexta = zext i16 %a to i32
%zextb = zext i16 %b to i32
%shl1 = shl i32 %zextb, 16
%or = or i32 %shl1, %zexta
ret i32 %or
}

; Test case where we don't have a sign_extend_inreg after the or.
define signext i32 @pack_i32_3(i16 zeroext %0, i16 zeroext %1, i32 signext %2) {
; RV64I-LABEL: pack_i32_3:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  addw a0, a0, a2
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i32_3:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  packw a0, a1, a0
; RV64ZBKB-NEXT:  addw a0, a0, a2
; RV64ZBKB-NEXT:  ret
%4 = zext i16 %0 to i32
%5 = shl nuw i32 %4, 16
%6 = zext i16 %1 to i32
%7 = or i32 %5, %6
%8 = add i32 %7, %2
ret i32 %8
}

define i64 @pack_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: pack_i64:
;

```

```

RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i64:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  pack a0, a0, a1
; RV64ZBKB-NEXT:  ret
%shl = and i64 %a, 4294967295
%shl1 = shl i64 %b, 32
%or = or i64 %shl1, %shl
ret i64 %or
}

define i64 @pack_i64_2(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: pack_i64_2:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i64_2:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  pack a0, a0, a1
; RV64ZBKB-NEXT:  ret
%zexta = zext i32 %a to i64
%zextb = zext i32 %b to i64
%shl1 = shl i64 %zextb, 32
%or = or i64 %shl1, %zexta
ret i64 %or
}

define i64 @pack_i64_3(ptr %0, ptr %1) {
; RV64I-LABEL: pack_i64_3:
; RV64I:    #
%bb.0:
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  lwu a1, 0(a1)
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i64_3:

```

```

; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  lw a0, 0(a0)
; RV64ZBKB-NEXT:  lwu a1, 0(a1)
; RV64ZBKB-NEXT:  pack a0, a1, a0
; RV64ZBKB-NEXT:  ret
%3 = load i32, ptr %0, align 4
%4 = zext i32 %3 to i64
%5 = shl i64 %4, 32
%6 = load i32, ptr %1, align 4
%7 = zext i32 %6 to i64
%8 = or i64 %5, %7
ret i64 %8
}

```

```

define signext i32 @packh_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: packh_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  andi a0, a0, 255
; RV64I-NEXT:  slli a1, a1, 56
; RV64I-NEXT:  srli a1, a1, 48
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: packh_i32:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  packh a0, a0, a1
; RV64ZBKB-NEXT:  ret
%and = and i32 %a, 255
%and1 = shl i32 %b, 8
%shl = and i32 %and1, 65280
%or = or
i32 %shl, %and
ret i32 %or
}

```

```

define i32 @packh_i32_2(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: packh_i32_2:
; RV64I:    # %bb.0:
; RV64I-NEXT:  andi a0, a0, 255
; RV64I-NEXT:  andi a1, a1, 255
; RV64I-NEXT:  slliw a1, a1, 8
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: packh_i32_2:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  packh a0, a0, a1
; RV64ZBKB-NEXT:  ret

```



```

%and = and i32 %a, 255
%and1 = and i32 %b, 255
%shl = shl i32 %and1, 8
%or = or i32 %shl, %and
ret i32 %or
}

```

```

define i64 @packh_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: packh_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: andi a0, a0, 255
; RV64I-NEXT: slli a1, a1, 56
; RV64I-NEXT: srli a1, a1, 48
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBKB-LABEL: packh_i64:
; RV64ZBKB:   # %bb.0:
; RV64ZBKB-NEXT: packh a0, a0, a1
; RV64ZBKB-NEXT: ret
%and = and i64 %a, 255
%and1 = shl i64 %b, 8
%shl = and i64 %and1, 65280
%or = or i64 %shl,
%and
ret i64 %or
}

```

```

define i64 @packh_i64_2(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: packh_i64_2:
; RV64I:      # %bb.0:
; RV64I-NEXT: andi a0, a0, 255
; RV64I-NEXT: andi a1, a1, 255
; RV64I-NEXT: slli a1, a1, 8
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBKB-LABEL: packh_i64_2:
; RV64ZBKB:   # %bb.0:
; RV64ZBKB-NEXT: packh a0, a0, a1
; RV64ZBKB-NEXT: ret
%and = and i64 %a, 255
%and1 = and i64 %b, 255
%shl = shl i64 %and1, 8
%or = or i64 %shl, %and
ret i64 %or
}

```

```

define zeroext i16 @packh_i16(i8 zeroext %a, i8 zeroext %b) nounwind {
; RV64I-LABEL: packh_i16:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slliw a1, a1, 8
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: packh_i16:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  packh a0, a0, a1
; RV64ZBKB-NEXT:  ret
%zext = zext i8 %a to i16
%zext1 = zext i8 %b to i16
%shl = shl i16 %zext1, 8
%or = or i16 %shl, %zext
ret i16 %or
}

```

```

define zeroext i16 @packh_i16_2(i8
zeroext %0, i8 zeroext %1, i8 zeroext %2) {
; RV64I-LABEL: packh_i16_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  slli a0, a0, 8
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: packh_i16_2:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  add a0, a1, a0
; RV64ZBKB-NEXT:  packh a0, a2, a0
; RV64ZBKB-NEXT:  ret
%4 = add i8 %1, %0
%5 = zext i8 %4 to i16
%6 = shl i16 %5, 8
%7 = zext i8 %2 to i16
%8 = or i16 %6, %7
ret i16 %8
}

```

```

define i64 @pack_i64_allWUsers(i32 signext %0, i32 signext %1, i32 signext %2) {
; RV64I-LABEL: pack_i64_allWUsers:
; RV64I:      # %bb.0:
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  slli a2, a2, 32

```

```

; RV64I-NEXT: srli a2, a2, 32
; RV64I-NEXT: or a0, a0, a2
; RV64I-NEXT: ret
;
; RV64ZBKB-LABEL: pack_i64_allWUsers:
; RV64ZBKB: # %bb.0:
; RV64ZBKB-NEXT: add a0, a1, a0
; RV64ZBKB-NEXT:
    pack a0, a2, a0
; RV64ZBKB-NEXT: ret
%4 = add i32 %1, %0
%5 = zext i32 %4 to i64
%6 = shl i64 %5, 32
%7 = zext i32 %2 to i64
%8 = or i64 %6, %7
ret i64 %8
}

define signext i32 @pack_i32_allWUsers(i16 zeroext %0, i16 zeroext %1, i16 zeroext %2) {
; RV64I-LABEL: pack_i32_allWUsers:
; RV64I: # %bb.0:
; RV64I-NEXT: add a0, a1, a0
; RV64I-NEXT: slliw a0, a0, 16
; RV64I-NEXT: or a0, a0, a2
; RV64I-NEXT: ret
;
; RV64ZBKB-LABEL: pack_i32_allWUsers:
; RV64ZBKB: # %bb.0:
; RV64ZBKB-NEXT: add a0, a1, a0
; RV64ZBKB-NEXT: packw a0, a2, a0
; RV64ZBKB-NEXT: ret
%4 = add i16 %1, %0
%5 = zext i16 %4 to i32
%6 = shl i32 %5, 16
%7 = zext i16 %2 to i32
%8 = or i32 %6, %7
ret i32 %8
}

define i64 @pack_i64_imm() {
; RV64I-LABEL: pack_i64_imm:
; RV64I: # %bb.0:
; RV64I-NEXT: lui a0, 65793
; RV64I-NEXT: addiw a0, a0, 16
; RV64I-NEXT: slli a1, a0, 32
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: ret
;

```

```

; RV64ZBKB-LABEL:
pack_i64_imm:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  lui a0, 65793
; RV64ZBKB-NEXT:  addi a0, a0, 16
; RV64ZBKB-NEXT:  pack a0, a0, a0
; RV64ZBKB-NEXT:  ret
ret i64 1157442765409226768 ; 0x0101010101010101
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN:  -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64I %s

```

; Check indexed and unindexed, sext, zext and anyext loads

```

define void @lb(ptr %a, ptr %b) nounwind {
; RV64I-LABEL: lb:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lb a2, 1(a0)
; RV64I-NEXT:  lbu zero, 0(a0)
; RV64I-NEXT:  sw a2, 0(a1)
; RV64I-NEXT:  ret
%1 = getelementptr i8, ptr %a, i32 1
%2 = load i8, ptr %1
%3 = sext i8 %2 to i32
; the unused load will produce an anyext for selection
%4 = load volatile i8, ptr %a
store i32 %3, ptr %b
ret void
}

```

```

define void @lbu(ptr %a, ptr %b) nounwind {
; RV64I-LABEL: lbu:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lbu a0, 1(a0)
; RV64I-NEXT:  sw a0, 0(a1)
; RV64I-NEXT:  ret
%1 = getelementptr i8, ptr %a, i32 1
%2 = load i8, ptr %1
%3 = zext i8 %2 to i32
store i32 %3, ptr %b
ret void
}

```

```

define void @lh(ptr
%a, ptr %b) nounwind {
; RV64I-LABEL: lh:
; RV64I:    # %bb.0:

```

```

; RV64I-NEXT:  lh a2, 2(a0)
; RV64I-NEXT:  lh zero, 0(a0)
; RV64I-NEXT:  sw a2, 0(a1)
; RV64I-NEXT:  ret
%1 = getelementptr i16, ptr %a, i32 1
%2 = load i16, ptr %1
%3 = sext i16 %2 to i32
; the unused load will produce an anyext for selection
%4 = load volatile i16, ptr %a
store i32 %3, ptr %b
ret void
}

```

```

define void @lhu(ptr %a, ptr %b) nounwind {
; RV64I-LABEL: lhu:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lhu a0, 2(a0)
; RV64I-NEXT:  sw a0, 0(a1)
; RV64I-NEXT:  ret
%1 = getelementptr i16, ptr %a, i32 1
%2 = load i16, ptr %1
%3 = zext i16 %2 to i32
store i32 %3, ptr %b
ret void
}

```

```

define void @lw(ptr %a, ptr %b) nounwind {
; RV64I-LABEL: lw:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lw a2, 4(a0)
; RV64I-NEXT:  lw zero, 0(a0)
; RV64I-NEXT:  sd a2, 0(a1)
; RV64I-NEXT:  ret
%1 = getelementptr i32, ptr %a, i64 1
%2 = load i32, ptr %1
%3 = sext i32 %2 to i64
; the unused load
will produce an anyext for selection
%4 = load volatile i32, ptr %a
store i64 %3, ptr %b
ret void
}

```

```

define void @lwu(ptr %a, ptr %b) nounwind {
; RV64I-LABEL: lwu:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lwu a0, 4(a0)
; RV64I-NEXT:  sd a0, 0(a1)

```

```

; RV64I-NEXT:  ret
%1 = getelementptr i32, ptr %a, i64 1
%2 = load i32, ptr %1
%3 = zext i32 %2 to i64
store i64 %3, ptr %b
ret void
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -riscv-disable-using-constant-pool-for-large-ints -verify-machineinstrs < %s \
; RUN:  -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=RV64I,RV64I-NOPOOL
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN:  -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=RV64I,RV64I-POOL
; RUN: llc -mtriple=riscv64 -riscv-disable-using-constant-pool-for-large-ints -mattr=+zba \
; RUN:  -riscv-experimental-rv64-legal-i32 -verify-machineinstrs < %s | FileCheck %s -check-prefix=RV64IZBA
; RUN: llc -mtriple=riscv64 -riscv-disable-using-constant-pool-for-large-ints -mattr=+zbb \
; RUN:  -riscv-experimental-rv64-legal-i32 -verify-machineinstrs < %s | FileCheck %s -check-prefix=RV64IZBB
; RUN: llc -mtriple=riscv64 -riscv-disable-using-constant-pool-for-large-ints -mattr=+zbs \
; RUN:  -riscv-experimental-rv64-legal-i32 -verify-machineinstrs < %s | FileCheck
% s -check-prefix=RV64IZBS
; RUN: llc -mtriple=riscv64 -riscv-disable-using-constant-pool-for-large-ints -mattr=+xtheadbb \
; RUN:  -riscv-experimental-rv64-legal-i32 -verify-machineinstrs < %s | FileCheck %s -check-
prefix=RV64IXTHEADBB

```

; Materializing constants

; TODO: It would be preferable if anyext constant returns were sign rather  
; than zero extended. See PR39092. For now, mark returns as explicitly signext  
; (this matches what Clang would generate for equivalent C/C++ anyway).

```

define signext i32 @zero() nounwind {
; RV64I-LABEL: zero:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, 0
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: zero:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: zero:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, 0
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: zero:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, 0

```

```

; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: zero:
; RV64IXTHEADBB:   # %bb.0:
;
RV64IXTHEADBB-NEXT:  li a0, 0
; RV64IXTHEADBB-NEXT:  ret
ret i32 0
}

```

```

define signext i32 @pos_small() nounwind {
; RV64I-LABEL: pos_small:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, 2047
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: pos_small:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 2047
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: pos_small:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, 2047
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: pos_small:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, 2047
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: pos_small:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, 2047
; RV64IXTHEADBB-NEXT:  ret
ret i32 2047
}

```

```

define signext i32 @neg_small() nounwind {
; RV64I-LABEL: neg_small:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, -2048
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: neg_small:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, -2048
; RV64IZBA-NEXT:  ret

```

```

;
; RV64IZBB-LABEL:
neg_small:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, -2048
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: neg_small:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, -2048
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: neg_small:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -2048
; RV64IXTHEADBB-NEXT:  ret
ret i32 -2048
}

define signext i32 @pos_i32() nounwind {
; RV64I-LABEL: pos_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 423811
; RV64I-NEXT:  addiw a0, a0, -1297
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: pos_i32:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 423811
; RV64IZBA-NEXT:  addiw a0, a0, -1297
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: pos_i32:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 423811
; RV64IZBB-NEXT:  addiw a0, a0, -1297
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: pos_i32:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 423811
; RV64IZBS-NEXT:  addiw a0, a0, -1297
; RV64IZBS-NEXT:
ret
;
; RV64IXTHEADBB-LABEL: pos_i32:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 423811

```



```
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1297
; RV64IXTHEADBB-NEXT:  ret
ret i32 1735928559
}
```

```
define signext i32 @neg_i32() nounwind {
; RV64I-LABEL: neg_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 912092
; RV64I-NEXT:  addiw a0, a0, -273
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: neg_i32:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 912092
; RV64IZBA-NEXT:  addiw a0, a0, -273
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: neg_i32:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 912092
; RV64IZBB-NEXT:  addiw a0, a0, -273
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: neg_i32:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 912092
; RV64IZBS-NEXT:  addiw a0, a0, -273
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: neg_i32:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 912092
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -273
;
RV64IXTHEADBB-NEXT:  ret
ret i32 -559038737
}
```

```
define signext i32 @pos_i32_hi20_only() nounwind {
; RV64I-LABEL: pos_i32_hi20_only:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 16
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: pos_i32_hi20_only:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 16
```

```

; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: pos_i32_hi20_only:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 16
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: pos_i32_hi20_only:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 16
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: pos_i32_hi20_only:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 16
; RV64IXTHEADBB-NEXT:  ret
ret i32 65536 ; 0x10000
}

define signext i32 @neg_i32_hi20_only() nounwind {
; RV64I-LABEL: neg_i32_hi20_only:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 1048560
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: neg_i32_hi20_only:
; RV64IZBA:      # %bb.0:
; RV64IZBA-NEXT:  lui a0,
1048560
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: neg_i32_hi20_only:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1048560
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: neg_i32_hi20_only:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 1048560
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: neg_i32_hi20_only:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1048560
; RV64IXTHEADBB-NEXT:  ret
ret i32 -65536 ; -0x10000
}

```

; This can be materialized with ADDI+SLLI, improving compressibility.

```
define signext i32 @imm_left_shifted_addi() nounwind {
; RV64I-LABEL: imm_left_shifted_addi:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 32
; RV64I-NEXT:  addiw a0, a0, -64
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_left_shifted_addi:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 32
; RV64IZBA-NEXT:  addiw a0, a0, -64
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_left_shifted_addi:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 32
;
; RV64IZBB-NEXT:  addiw a0, a0, -64
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_left_shifted_addi:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 32
; RV64IZBS-NEXT:  addiw a0, a0, -64
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_left_shifted_addi:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 32
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -64
; RV64IXTHEADBB-NEXT:  ret
ret i32 131008 ; 0x1FFC0
}
```

; This can be materialized with ADDI+SRLI, improving compressibility.

```
define signext i32 @imm_right_shifted_addi() nounwind {
; RV64I-LABEL: imm_right_shifted_addi:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 524288
; RV64I-NEXT:  addiw a0, a0, -1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_right_shifted_addi:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 524288
```

```

; RV64IZBA-NEXT:  addiw a0, a0, -1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_right_shifted_addi:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 524288
; RV64IZBB-NEXT:
    addiw a0, a0, -1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_right_shifted_addi:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 524288
; RV64IZBS-NEXT:  addiw a0, a0, -1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_right_shifted_addi:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 524288
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1
; RV64IXTHEADBB-NEXT:  ret
ret i32 2147483647 ; 0x7FFFFFFF
}

```

; This can be materialized with LUI+SRLI, improving compressibility.

```

define signext i32 @imm_right_shifted_lui() nounwind {
; RV64I-LABEL: imm_right_shifted_lui:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 56
; RV64I-NEXT:  addiw a0, a0, 580
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_right_shifted_lui:
; RV64IZBA:      # %bb.0:
; RV64IZBA-NEXT:  lui a0, 56
; RV64IZBA-NEXT:  addiw a0, a0, 580
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_right_shifted_lui:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 56
; RV64IZBB-NEXT:
    addiw a0, a0, 580
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_right_shifted_lui:
; RV64IZBS:      # %bb.0:

```

```

; RV64IZBS-NEXT:  lui a0, 56
; RV64IZBS-NEXT:  addiw a0, a0, 580
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_right_shifted_lui:
; RV64IXTHEADBB:   # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 56
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 580
; RV64IXTHEADBB-NEXT:  ret
ret i32 229956 ; 0x38244
}

```

```

define i64 @imm64_1() nounwind {
; RV64I-LABEL: imm64_1:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, 1
; RV64I-NEXT:  slli a0, a0, 31
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_1:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 1
; RV64IZBA-NEXT:  slli a0, a0, 31
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_1:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, 1
; RV64IZBB-NEXT:  slli a0, a0, 31
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_1:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  bseti a0, zero, 31
; RV64IZBS-NEXT:  ret
;
;
RV64IXTHEADBB-LABEL: imm64_1:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, 1
; RV64IXTHEADBB-NEXT:  slli a0, a0, 31
; RV64IXTHEADBB-NEXT:  ret
ret i64 2147483648 ; 0x8000_0000
}

```

```

define i64 @imm64_2() nounwind {
; RV64I-LABEL: imm64_2:
; RV64I:      # %bb.0:

```

```

; RV64I-NEXT:  li a0, -1
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_2:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, -1
; RV64IZBA-NEXT:  srli a0, a0, 32
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_2:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, -1
; RV64IZBB-NEXT:  srli a0, a0, 32
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_2:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, -1
; RV64IZBS-NEXT:  srli a0, a0, 32
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_2:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -1
; RV64IXTHEADBB-NEXT:  srli a0, a0, 32
; RV64IXTHEADBB-NEXT:  ret
ret i64 4294967295 ;
0xFFFF_FFFF
}

```

```

define i64 @imm64_3() nounwind {
; RV64I-LABEL: imm64_3:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a0, 1
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_3:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 1
; RV64IZBA-NEXT:  slli a0, a0, 32
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_3:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, 1
; RV64IZBB-NEXT:  slli a0, a0, 32

```

```

; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_3:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  bseti a0, zero, 32
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_3:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, 1
; RV64IXTHEADBB-NEXT:  slli a0, a0, 32
; RV64IXTHEADBB-NEXT:  ret
ret i64 4294967296 ; 0x1_0000_0000
}

define i64 @imm64_4() nounwind {
; RV64I-LABEL: imm64_4:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, -1
; RV64I-NEXT:  slli a0, a0, 63
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_4:
; RV64IZBA:
;   # %bb.0:
; RV64IZBA-NEXT:  li a0, -1
; RV64IZBA-NEXT:  slli a0, a0, 63
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_4:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  li a0, -1
; RV64IZBB-NEXT:  slli a0, a0, 63
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_4:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  bseti a0, zero, 63
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_4:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -1
; RV64IXTHEADBB-NEXT:  slli a0, a0, 63
; RV64IXTHEADBB-NEXT:  ret
ret i64 9223372036854775808 ; 0x8000_0000_0000_0000
}

```

```

define i64 @imm64_5() nounwind {
; RV64I-LABEL: imm64_5:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, -1
; RV64I-NEXT:  slli a0, a0, 63
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_5:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, -1
; RV64IZBA-NEXT:  slli a0, a0, 63
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_5:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, -1
; RV64IZBB-NEXT:
;               slli a0, a0, 63
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_5:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  bseti a0, zero, 63
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_5:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -1
; RV64IXTHEADBB-NEXT:  slli a0, a0, 63
; RV64IXTHEADBB-NEXT:  ret
ret i64 -9223372036854775808 ; 0x8000_0000_0000_0000
}

```

```

define i64 @imm64_6() nounwind {
; RV64I-LABEL: imm64_6:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 9321
; RV64I-NEXT:  addi a0, a0, -1329
; RV64I-NEXT:  slli a0, a0, 35
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_6:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 9321
; RV64IZBA-NEXT:  addi a0, a0, -1329
; RV64IZBA-NEXT:  slli a0, a0, 35
; RV64IZBA-NEXT:  ret
;

```



```

; RV64IZBB-LABEL: imm64_6:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 9321
; RV64IZBB-NEXT:  addi a0, a0, -1329
; RV64IZBB-NEXT:  slli a0, a0, 35
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_6:
;
RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 9321
; RV64IZBS-NEXT:  addi a0, a0, -1329
; RV64IZBS-NEXT:  slli a0, a0, 35
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_6:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 9321
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1329
; RV64IXTHEADBB-NEXT:  slli a0, a0, 35
; RV64IXTHEADBB-NEXT:  ret
ret i64 1311768464867721216 ; 0x1234_5678_0000_0000
}

```

```

define i64 @imm64_7() nounwind {
; RV64I-LABEL: imm64_7:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a0, 7
; RV64I-NEXT:  slli a0, a0, 36
; RV64I-NEXT:  addi a0, a0, 11
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:  addi a0, a0, 15
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_7:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 7
; RV64IZBA-NEXT:  slli a0, a0, 36
; RV64IZBA-NEXT:  addi a0, a0, 11
; RV64IZBA-NEXT:  slli a0, a0, 24
; RV64IZBA-NEXT:  addi a0, a0, 15
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_7:
; RV64IZBB:    #
%bb.0:
; RV64IZBB-NEXT:  li a0, 7
; RV64IZBB-NEXT:  slli a0, a0, 36

```

```

; RV64IZBB-NEXT:  addi a0, a0, 11
; RV64IZBB-NEXT:  slli a0, a0, 24
; RV64IZBB-NEXT:  addi a0, a0, 15
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_7:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  li a0, 7
; RV64IZBS-NEXT:  slli a0, a0, 36
; RV64IZBS-NEXT:  addi a0, a0, 11
; RV64IZBS-NEXT:  slli a0, a0, 24
; RV64IZBS-NEXT:  addi a0, a0, 15
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_7:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, 7
; RV64IXTHEADBB-NEXT:  slli a0, a0, 36
; RV64IXTHEADBB-NEXT:  addi a0, a0, 11
; RV64IXTHEADBB-NEXT:  slli a0, a0, 24
; RV64IXTHEADBB-NEXT:  addi a0, a0, 15
; RV64IXTHEADBB-NEXT:  ret
ret i64 8070450532432478223 ; 0x7000_0000_0B00_000F
}

```

; TODO: it can be preferable to put constants that are expensive to materialise  
into the constant pool, especially for -Os.

```

define i64 @imm64_8() nounwind {
; RV64-NOPOOL-LABEL: imm64_8:
; RV64-NOPOOL:
    # %bb.0:
; RV64-NOPOOL-NEXT:  lui a0, 583
; RV64-NOPOOL-NEXT:  addiw a0, a0, -1875
; RV64-NOPOOL-NEXT:  slli a0, a0, 14
; RV64-NOPOOL-NEXT:  addi a0, a0, -947
; RV64-NOPOOL-NEXT:  slli a0, a0, 12
; RV64-NOPOOL-NEXT:  addi a0, a0, 1511
; RV64-NOPOOL-NEXT:  slli a0, a0, 13
; RV64-NOPOOL-NEXT:  addi a0, a0, -272
; RV64-NOPOOL-NEXT:  ret
;
; RV64I-POOL-LABEL: imm64_8:
; RV64I-POOL:      # %bb.0:
; RV64I-POOL-NEXT:  lui a0, %hi(.LCPI17_0)
; RV64I-POOL-NEXT:  ld a0, %lo(.LCPI17_0)(a0)
; RV64I-POOL-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_8:

```

```

; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: lui a0, 596523
; RV64IZBA-NEXT: addi a0, a0, 965
; RV64IZBA-NEXT: slli.uw a0, a0, 13
; RV64IZBA-NEXT: addi a0, a0, -1347
; RV64IZBA-NEXT: slli a0, a0, 12
; RV64IZBA-NEXT: addi a0, a0, -529
; RV64IZBA-NEXT: slli a0, a0, 4
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm64_8:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: lui a0, 583
; RV64IZBB-NEXT: addiw
a0, a0, -1875
; RV64IZBB-NEXT: slli a0, a0, 14
; RV64IZBB-NEXT: addi a0, a0, -947
; RV64IZBB-NEXT: slli a0, a0, 12
; RV64IZBB-NEXT: addi a0, a0, 1511
; RV64IZBB-NEXT: slli a0, a0, 13
; RV64IZBB-NEXT: addi a0, a0, -272
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm64_8:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: lui a0, 583
; RV64IZBS-NEXT: addiw a0, a0, -1875
; RV64IZBS-NEXT: slli a0, a0, 14
; RV64IZBS-NEXT: addi a0, a0, -947
; RV64IZBS-NEXT: slli a0, a0, 12
; RV64IZBS-NEXT: addi a0, a0, 1511
; RV64IZBS-NEXT: slli a0, a0, 13
; RV64IZBS-NEXT: addi a0, a0, -272
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm64_8:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 583
; RV64IXTHEADBB-NEXT: addiw a0, a0, -1875
; RV64IXTHEADBB-NEXT: slli a0, a0, 14
; RV64IXTHEADBB-NEXT: addi a0, a0, -947
; RV64IXTHEADBB-NEXT: slli a0, a0, 12
; RV64IXTHEADBB-NEXT: addi a0, a0, 1511
; RV64IXTHEADBB-NEXT: slli a0, a0, 13
; RV64IXTHEADBB-NEXT:
addi a0, a0, -272
; RV64IXTHEADBB-NEXT: ret
ret i64 1311768467463790320 ; 0x1234_5678_9ABC_DEF0

```

```
}
```

```
define i64 @imm64_9() nounwind {  
; RV64I-LABEL: imm64_9:  
; RV64I:    # %bb.0:  
; RV64I-NEXT:  li a0, -1  
; RV64I-NEXT:  ret  
;  
; RV64IZBA-LABEL: imm64_9:  
; RV64IZBA:    # %bb.0:  
; RV64IZBA-NEXT:  li a0, -1  
; RV64IZBA-NEXT:  ret  
;  
; RV64IZBB-LABEL: imm64_9:  
; RV64IZBB:    # %bb.0:  
; RV64IZBB-NEXT:  li a0, -1  
; RV64IZBB-NEXT:  ret  
;  
; RV64IZBS-LABEL: imm64_9:  
; RV64IZBS:    # %bb.0:  
; RV64IZBS-NEXT:  li a0, -1  
; RV64IZBS-NEXT:  ret  
;  
; RV64IXTHEADBB-LABEL: imm64_9:  
; RV64IXTHEADBB:    # %bb.0:  
; RV64IXTHEADBB-NEXT:  li a0, -1  
; RV64IXTHEADBB-NEXT:  ret  
ret i64 -1  
}
```

; Various cases where extraneous ADDIs can be inserted where a (left shifted)  
; LUI suffices.

```
define i64 @imm_left_shifted_lui_1() nounwind {  
; RV64I-LABEL: imm_left_shifted_lui_1:  
; RV64I:    # %bb.0:  
; RV64I-NEXT:  lui a0, 262145  
; RV64I-NEXT:  slli a0, a0, 1  
;  
RV64I-NEXT:  ret  
;  
; RV64IZBA-LABEL: imm_left_shifted_lui_1:  
; RV64IZBA:    # %bb.0:  
; RV64IZBA-NEXT:  lui a0, 262145  
; RV64IZBA-NEXT:  slli a0, a0, 1  
; RV64IZBA-NEXT:  ret  
;  
; RV64IZBB-LABEL: imm_left_shifted_lui_1:
```

```

; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: lui a0, 262145
; RV64IZBB-NEXT: slli a0, a0, 1
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_left_shifted_lui_1:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: lui a0, 262145
; RV64IZBS-NEXT: slli a0, a0, 1
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_left_shifted_lui_1:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 262145
; RV64IXTHEADBB-NEXT: slli a0, a0, 1
; RV64IXTHEADBB-NEXT: ret
ret i64 2147491840 ; 0x8000_2000
}

```

```

define i64 @imm_left_shifted_lui_2() nounwind {
; RV64I-LABEL: imm_left_shifted_lui_2:
; RV64I:    # %bb.0:
; RV64I-NEXT: lui a0, 262145
; RV64I-NEXT: slli a0, a0, 2
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_left_shifted_lui_2:
; RV64IZBA:
; # %bb.0:
; RV64IZBA-NEXT: lui a0, 262145
; RV64IZBA-NEXT: slli a0, a0, 2
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_left_shifted_lui_2:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: lui a0, 262145
; RV64IZBB-NEXT: slli a0, a0, 2
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_left_shifted_lui_2:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: lui a0, 262145
; RV64IZBS-NEXT: slli a0, a0, 2
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_left_shifted_lui_2:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 262145

```

```
; RV64IXTHEADBB-NEXT:  slli a0, a0, 2
; RV64IXTHEADBB-NEXT:  ret
ret i64 4294983680 ; 0x1_0000_4000
}
```

```
define i64 @imm_left_shifted_lui_3() nounwind {
; RV64I-LABEL: imm_left_shifted_lui_3:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 4097
; RV64I-NEXT:  slli a0, a0, 20
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_left_shifted_lui_3:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 4097
; RV64IZBA-NEXT:  slli a0, a0, 20
;
RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_left_shifted_lui_3:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 4097
; RV64IZBB-NEXT:  slli a0, a0, 20
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_left_shifted_lui_3:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 4097
; RV64IZBS-NEXT:  slli a0, a0, 20
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_left_shifted_lui_3:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 4097
; RV64IXTHEADBB-NEXT:  slli a0, a0, 20
; RV64IXTHEADBB-NEXT:  ret
ret i64 17596481011712 ; 0x1001_0000_0000
}
```

; Various cases where extraneous ADDIs can be inserted where a (right shifted)  
; LUI suffices, or where multiple ADDIs can be used instead of a single LUI.

```
define i64 @imm_right_shifted_lui_1() nounwind {
; RV64I-LABEL: imm_right_shifted_lui_1:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 983056
; RV64I-NEXT:  srli a0, a0, 16
; RV64I-NEXT:  ret
```

```

;
; RV64IZBA-LABEL: imm_right_shifted_lui_1:
; RV64IZBA:
    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 983056
; RV64IZBA-NEXT:  srli a0, a0, 16
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_right_shifted_lui_1:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 983056
; RV64IZBB-NEXT:  srli a0, a0, 16
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_right_shifted_lui_1:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 983056
; RV64IZBS-NEXT:  srli a0, a0, 16
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_right_shifted_lui_1:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 983056
; RV64IXTHEADBB-NEXT:  srli a0, a0, 16
; RV64IXTHEADBB-NEXT:  ret
ret i64 281474976706561 ; 0xFFFF_FFFF_F001
}

```

```

define i64 @imm_right_shifted_lui_2() nounwind {
; RV64I-LABEL: imm_right_shifted_lui_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 1044481
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  srli a0, a0, 24
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_right_shifted_lui_2:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:
    lui a0, 1044481
; RV64IZBA-NEXT:  slli a0, a0, 12
; RV64IZBA-NEXT:  srli a0, a0, 24
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_right_shifted_lui_2:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1044481
; RV64IZBB-NEXT:  slli a0, a0, 12

```

```

; RV64IZBB-NEXT: srli a0, a0, 24
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_right_shifted_lui_2:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT: lui a0, 1044481
; RV64IZBS-NEXT: slli a0, a0, 12
; RV64IZBS-NEXT: srli a0, a0, 24
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_right_shifted_lui_2:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 1044481
; RV64IXTHEADBB-NEXT: slli a0, a0, 12
; RV64IXTHEADBB-NEXT: srli a0, a0, 24
; RV64IXTHEADBB-NEXT: ret
ret i64 1099511623681 ; 0xFF_FFFF_F001
}

```

; We can materialize the upper bits with a single (shifted) LUI, but that option  
; can be missed due to the lower bits, which aren't just 1s or just 0s.

```

define i64 @imm_decoupled_lui_addi() nounwind
{
; RV64I-LABEL: imm_decoupled_lui_addi:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a0, 4097
; RV64I-NEXT: slli a0, a0, 20
; RV64I-NEXT: addi a0, a0, -3
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_decoupled_lui_addi:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: lui a0, 4097
; RV64IZBA-NEXT: slli a0, a0, 20
; RV64IZBA-NEXT: addi a0, a0, -3
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_decoupled_lui_addi:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: lui a0, 4097
; RV64IZBB-NEXT: slli a0, a0, 20
; RV64IZBB-NEXT: addi a0, a0, -3
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_decoupled_lui_addi:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: lui a0, 4097

```



```

; RV64IZBS-NEXT:  slli a0, a0, 20
; RV64IZBS-NEXT:  addi a0, a0, -3
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_decoupled_lui_addi:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 4097
; RV64IXTHEADBB-NEXT:  slli a0, a0, 20
; RV64IXTHEADBB-NEXT:  addi a0, a0, -3
; RV64IXTHEADBB-NEXT:
    ret
ret i64 17596481011709 ; 0x1000_FFFF_FFFD
}

```

; This constant can be materialized for RV64 with LUI+SRLI+XORI.

```

define i64 @imm_end_xori_1() nounwind {
; RV64I-LABEL: imm_end_xori_1:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 983040
; RV64I-NEXT:  srli a0, a0, 3
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_end_xori_1:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 983040
; RV64IZBA-NEXT:  srli a0, a0, 3
; RV64IZBA-NEXT:  not a0, a0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_end_xori_1:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 983040
; RV64IZBB-NEXT:  srli a0, a0, 3
; RV64IZBB-NEXT:  not a0, a0
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_end_xori_1:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 983040
; RV64IZBS-NEXT:  srli a0, a0, 3
; RV64IZBS-NEXT:  not a0, a0
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_end_xori_1:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:

```

```

    lui a0, 983040
; RV64IXTHEADBB-NEXT: srli a0, a0, 3
; RV64IXTHEADBB-NEXT: not a0, a0
; RV64IXTHEADBB-NEXT: ret
ret i64 -2305843009180139521 ; 0xE000_0000_01FF_FFFF
}

```

; This constant can be materialized for RV64 with ADDI+SLLI+ADDI+ADDI.

```

define i64 @imm_end_2addi_1() nounwind {
; RV64I-LABEL: imm_end_2addi_1:
; RV64I:    # %bb.0:
; RV64I-NEXT: li a0, -2047
; RV64I-NEXT: slli a0, a0, 39
; RV64I-NEXT: addi a0, a0, -2048
; RV64I-NEXT: addi a0, a0, -1
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_end_2addi_1:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: li a0, -2047
; RV64IZBA-NEXT: slli a0, a0, 39
; RV64IZBA-NEXT: addi a0, a0, -2048
; RV64IZBA-NEXT: addi a0, a0, -1
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_end_2addi_1:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: li a0, -2047
; RV64IZBB-NEXT: slli a0, a0, 39
; RV64IZBB-NEXT: addi a0, a0, -2048
; RV64IZBB-NEXT: addi a0, a0, -1
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_end_2addi_1:
;
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: li a0, -2047
; RV64IZBS-NEXT: slli a0, a0, 39
; RV64IZBS-NEXT: addi a0, a0, -2048
; RV64IZBS-NEXT: addi a0, a0, -1
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_end_2addi_1:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT: li a0, -2047
; RV64IXTHEADBB-NEXT: slli a0, a0, 39
; RV64IXTHEADBB-NEXT: addi a0, a0, -2048

```

```
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1
; RV64IXTHEADBB-NEXT:  ret
ret i64 -1125350151030785 ; 0xFFFC_007F_FFFF_F7FF
}
```

; This constant can be more efficiently materialized for RV64 if we use two registers instead of one.

```
define i64 @imm_2reg_1() nounwind {
; RV64I-LABEL: imm_2reg_1:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 74565
; RV64I-NEXT:  addiw a0, a0, 1656
; RV64I-NEXT:  slli a1, a0, 57
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_2reg_1:
; RV64IZBA:   # %bb.0:
; RV64IZBA-NEXT:  lui a0, 74565
; RV64IZBA-NEXT:  addiw a0, a0, 1656
; RV64IZBA-NEXT:
;               slli a1, a0, 57
; RV64IZBA-NEXT:  add a0, a0, a1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_2reg_1:
; RV64IZBB:   # %bb.0:
; RV64IZBB-NEXT:  lui a0, 74565
; RV64IZBB-NEXT:  addiw a0, a0, 1656
; RV64IZBB-NEXT:  slli a1, a0, 57
; RV64IZBB-NEXT:  add a0, a0, a1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_2reg_1:
; RV64IZBS:   # %bb.0:
; RV64IZBS-NEXT:  lui a0, 74565
; RV64IZBS-NEXT:  addiw a0, a0, 1656
; RV64IZBS-NEXT:  slli a1, a0, 57
; RV64IZBS-NEXT:  add a0, a0, a1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_2reg_1:
; RV64IXTHEADBB:   # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 74565
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 1656
; RV64IXTHEADBB-NEXT:  slli a1, a0, 57
; RV64IXTHEADBB-NEXT:  add a0, a0, a1
```

```
; RV64IXTHEADBB-NEXT:  ret
ret i64 -1152921504301427080 ; 0xF000_0000_1234_5678
}
```

; FIXME: This should use a single ADDI for the immediate.

```
define void @imm_store_i16_neg1(ptr %p) nounwind {
```

```
; RV64I-LABEL: imm_store_i16_neg1:
```

```
;
```

```
RV64I:    # %bb.0:
```

```
; RV64I-NEXT:  li a1, -1
```

```
; RV64I-NEXT:  sh a1, 0(a0)
```

```
; RV64I-NEXT:  ret
```

```
;
```

```
; RV64IZBA-LABEL: imm_store_i16_neg1:
```

```
; RV64IZBA:    # %bb.0:
```

```
; RV64IZBA-NEXT:  li a1, -1
```

```
; RV64IZBA-NEXT:  sh a1, 0(a0)
```

```
; RV64IZBA-NEXT:  ret
```

```
;
```

```
; RV64IZBB-LABEL: imm_store_i16_neg1:
```

```
; RV64IZBB:    # %bb.0:
```

```
; RV64IZBB-NEXT:  li a1, -1
```

```
; RV64IZBB-NEXT:  sh a1, 0(a0)
```

```
; RV64IZBB-NEXT:  ret
```

```
;
```

```
; RV64IZBS-LABEL: imm_store_i16_neg1:
```

```
; RV64IZBS:    # %bb.0:
```

```
; RV64IZBS-NEXT:  li a1, -1
```

```
; RV64IZBS-NEXT:  sh a1, 0(a0)
```

```
; RV64IZBS-NEXT:  ret
```

```
;
```

```
; RV64IXTHEADBB-LABEL: imm_store_i16_neg1:
```

```
; RV64IXTHEADBB:    # %bb.0:
```

```
; RV64IXTHEADBB-NEXT:  li a1, -1
```

```
; RV64IXTHEADBB-NEXT:  sh a1, 0(a0)
```

```
; RV64IXTHEADBB-NEXT:  ret
```

```
store i16 -1, ptr %p
```

```
ret void
```

```
}
```

; FIXME: This should use a single ADDI for the immediate.

```
define void @imm_store_i32_neg1(ptr %p) nounwind {
```

```
; RV64I-LABEL: imm_store_i32_neg1:
```

```
; RV64I:    # %bb.0:
```

```
; RV64I-NEXT:  li a1, -1
```

```
; RV64I-NEXT:
```

```
sw a1, 0(a0)
```

```
; RV64I-NEXT:  ret
```

```

;
; RV64IZBA-LABEL: imm_store_i32_neg1:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: li a1, -1
; RV64IZBA-NEXT: sw a1, 0(a0)
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_store_i32_neg1:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: li a1, -1
; RV64IZBB-NEXT: sw a1, 0(a0)
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_store_i32_neg1:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: li a1, -1
; RV64IZBS-NEXT: sw a1, 0(a0)
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_store_i32_neg1:
; RV64IXTHEADBB: # %bb.0:
; RV64IXTHEADBB-NEXT: li a1, -1
; RV64IXTHEADBB-NEXT: sw a1, 0(a0)
; RV64IXTHEADBB-NEXT: ret
store i32 -1, ptr %p
ret void
}

```

```

define i64 @imm_5372288229() {
; RV64I-LABEL: imm_5372288229:
; RV64I:    # %bb.0:
; RV64I-NEXT: lui a0, 160
; RV64I-NEXT: addiw a0, a0, 437
; RV64I-NEXT: slli a0, a0, 13
; RV64I-NEXT: addi a0, a0, -795
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_5372288229:
; RV64IZBA:
;   # %bb.0:
; RV64IZBA-NEXT: lui a0, 655797
; RV64IZBA-NEXT: slli.uw a0, a0, 1
; RV64IZBA-NEXT: addi a0, a0, -795
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_5372288229:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: lui a0, 160

```

```

; RV64IZBB-NEXT: addiw a0, a0, 437
; RV64IZBB-NEXT: slli a0, a0, 13
; RV64IZBB-NEXT: addi a0, a0, -795
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_5372288229:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: lui a0, 263018
; RV64IZBS-NEXT: addiw a0, a0, -795
; RV64IZBS-NEXT: bseti a0, a0, 32
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_5372288229:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 160
; RV64IXTHEADBB-NEXT: addiw a0, a0, 437
; RV64IXTHEADBB-NEXT: slli a0, a0, 13
; RV64IXTHEADBB-NEXT: addi a0, a0, -795
; RV64IXTHEADBB-NEXT: ret
ret i64 5372288229
}

```

```

define i64 @imm_neg_5372288229() {
; RV64I-LABEL: imm_neg_5372288229:
; RV64I:    # %bb.0:
; RV64I-NEXT: lui a0, 1048416
; RV64I-NEXT:
    addiw a0, a0, -437
; RV64I-NEXT: slli a0, a0, 13
; RV64I-NEXT: addi a0, a0, 795
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_neg_5372288229:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: lui a0, 611378
; RV64IZBA-NEXT: addiw a0, a0, 265
; RV64IZBA-NEXT: sh1add a0, a0, a0
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_neg_5372288229:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: lui a0, 1048416
; RV64IZBB-NEXT: addiw a0, a0, -437
; RV64IZBB-NEXT: slli a0, a0, 13
; RV64IZBB-NEXT: addi a0, a0, 795
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_neg_5372288229:

```

```

; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 785558
; RV64IZBS-NEXT:  addiw a0, a0, 795
; RV64IZBS-NEXT:  bclri a0, a0, 32
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_5372288229:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1048416
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -437
; RV64IXTHEADBB-NEXT:  slli a0, a0, 13
; RV64IXTHEADBB-NEXT:  addi a0, a0,
795
; RV64IXTHEADBB-NEXT:  ret
ret i64 -5372288229
}

```

```

define i64 @imm_8953813715() {
; RV64I-LABEL: imm_8953813715:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 267
; RV64I-NEXT:  addiw a0, a0, -637
; RV64I-NEXT:  slli a0, a0, 13
; RV64I-NEXT:  addi a0, a0, -1325
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_8953813715:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 437198
; RV64IZBA-NEXT:  addiw a0, a0, -265
; RV64IZBA-NEXT:  sh2add a0, a0, a0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_8953813715:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 267
; RV64IZBB-NEXT:  addiw a0, a0, -637
; RV64IZBB-NEXT:  slli a0, a0, 13
; RV64IZBB-NEXT:  addi a0, a0, -1325
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_8953813715:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 88838
; RV64IZBS-NEXT:  addiw a0, a0, -1325
; RV64IZBS-NEXT:  bseti a0, a0, 33
; RV64IZBS-NEXT:  ret
;

```

```

; RV64IXTHEADBB-LABEL: imm_8953813715:
; RV64IXTHEADBB:    # %bb.0:
;
RV64IXTHEADBB-NEXT:  lui a0, 267
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -637
; RV64IXTHEADBB-NEXT:  slli a0, a0, 13
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1325
; RV64IXTHEADBB-NEXT:  ret
ret i64 8953813715
}

define i64 @imm_neg_8953813715() {
; RV64I-LABEL: imm_neg_8953813715:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 1048309
; RV64I-NEXT:  addiw a0, a0, 637
; RV64I-NEXT:  slli a0, a0, 13
; RV64I-NEXT:  addi a0, a0, 1325
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_8953813715:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 611378
; RV64IZBA-NEXT:  addiw a0, a0, 265
; RV64IZBA-NEXT:  sh2add a0, a0, a0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_8953813715:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1048309
; RV64IZBB-NEXT:  addiw a0, a0, 637
; RV64IZBB-NEXT:  slli a0, a0, 13
; RV64IZBB-NEXT:  addi a0, a0, 1325
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_8953813715:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:
    lui a0, 959738
; RV64IZBS-NEXT:  addiw a0, a0, 1325
; RV64IZBS-NEXT:  bclri a0, a0, 33
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_8953813715:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1048309
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 637
; RV64IXTHEADBB-NEXT:  slli a0, a0, 13

```



```

; RV64IXTHEADBB-NEXT:  addi a0, a0, 1325
; RV64IXTHEADBB-NEXT:  ret
ret i64 -8953813715
}

define i64 @imm_16116864687() {
; RV64I-LABEL: imm_16116864687:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 961
; RV64I-NEXT:  addiw a0, a0, -1475
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1711
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_16116864687:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 437198
; RV64IZBA-NEXT:  addiw a0, a0, -265
; RV64IZBA-NEXT:  sh3add a0, a0, a0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_16116864687:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 961
; RV64IZBB-NEXT:  addiw a0, a0, -1475
; RV64IZBB-NEXT:
;     slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1711
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_16116864687:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 961
; RV64IZBS-NEXT:  addiw a0, a0, -1475
; RV64IZBS-NEXT:  slli a0, a0, 12
; RV64IZBS-NEXT:  addi a0, a0, 1711
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_16116864687:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 961
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1475
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1711
; RV64IXTHEADBB-NEXT:  ret
ret i64 16116864687
}

```

```

define i64 @imm_neg_16116864687() {
; RV64I-LABEL: imm_neg_16116864687:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 1047615
; RV64I-NEXT:  addiw a0, a0, 1475
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, -1711
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_16116864687:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 611378
; RV64IZBA-NEXT:
; RV64IZBA-NEXT:  addiw a0, a0, 265
; RV64IZBA-NEXT:  sh3add a0, a0, a0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_16116864687:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1047615
; RV64IZBB-NEXT:  addiw a0, a0, 1475
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, -1711
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_16116864687:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 1047615
; RV64IZBS-NEXT:  addiw a0, a0, 1475
; RV64IZBS-NEXT:  slli a0, a0, 12
; RV64IZBS-NEXT:  addi a0, a0, -1711
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_16116864687:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1047615
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 1475
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1711
; RV64IXTHEADBB-NEXT:  ret
ret i64 -16116864687
}

```

```

define i64 @imm_2344336315() {
; RV64I-LABEL: imm_2344336315:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 143087
; RV64I-NEXT:

```

```

    slli a0, a0, 2
; RV64I-NEXT:  addi a0, a0, -1093
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_2344336315:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 143087
; RV64IZBA-NEXT:  slli a0, a0, 2
; RV64IZBA-NEXT:  addi a0, a0, -1093
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_2344336315:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 143087
; RV64IZBB-NEXT:  slli a0, a0, 2
; RV64IZBB-NEXT:  addi a0, a0, -1093
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_2344336315:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 143087
; RV64IZBS-NEXT:  slli a0, a0, 2
; RV64IZBS-NEXT:  addi a0, a0, -1093
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_2344336315:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 143087
; RV64IXTHEADBB-NEXT:  slli a0, a0, 2
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1093
; RV64IXTHEADBB-NEXT:  ret
ret i64 2344336315 ; 0x8bbbbbbb
}

define i64 @imm_70370820078523() {
; RV64-NOPOOL-LABEL: imm_70370820078523:
;
RV64-NOPOOL:    # %bb.0:
; RV64-NOPOOL-NEXT:  lui a0, 256
; RV64-NOPOOL-NEXT:  addiw a0, a0, 31
; RV64-NOPOOL-NEXT:  slli a0, a0, 12
; RV64-NOPOOL-NEXT:  addi a0, a0, -273
; RV64-NOPOOL-NEXT:  slli a0, a0, 14
; RV64-NOPOOL-NEXT:  addi a0, a0, -1093
; RV64-NOPOOL-NEXT:  ret
;
; RV64I-POOL-LABEL: imm_70370820078523:
; RV64I-POOL:    # %bb.0:

```

```

; RV64I-POOL-NEXT: lui a0, %hi(.LCPI37_0)
; RV64I-POOL-NEXT: ld a0, %lo(.LCPI37_0)(a0)
; RV64I-POOL-NEXT: ret
;
; RV64IZBA-LABEL: imm_70370820078523:
; RV64IZBA: # %bb.0:
; RV64IZBA-NEXT: lui a0, 256
; RV64IZBA-NEXT: addiw a0, a0, 31
; RV64IZBA-NEXT: slli a0, a0, 12
; RV64IZBA-NEXT: addi a0, a0, -273
; RV64IZBA-NEXT: slli a0, a0, 14
; RV64IZBA-NEXT: addi a0, a0, -1093
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_70370820078523:
; RV64IZBB: # %bb.0:
; RV64IZBB-NEXT: lui a0, 256
; RV64IZBB-NEXT: addiw a0, a0, 31
; RV64IZBB-NEXT: slli a0, a0, 12
; RV64IZBB-NEXT: addi a0, a0, -273
;
; RV64IZBB-NEXT: slli a0, a0, 14
; RV64IZBB-NEXT: addi a0, a0, -1093
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_70370820078523:
; RV64IZBS: # %bb.0:
; RV64IZBS-NEXT: lui a0, 506812
; RV64IZBS-NEXT: addiw a0, a0, -1093
; RV64IZBS-NEXT: bseti a0, a0, 46
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_70370820078523:
; RV64IXTHEADBB: # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 256
; RV64IXTHEADBB-NEXT: addiw a0, a0, 31
; RV64IXTHEADBB-NEXT: slli a0, a0, 12
; RV64IXTHEADBB-NEXT: addi a0, a0, -273
; RV64IXTHEADBB-NEXT: slli a0, a0, 14
; RV64IXTHEADBB-NEXT: addi a0, a0, -1093
; RV64IXTHEADBB-NEXT: ret
ret i64 70370820078523 ; 0x40007bbbbbbb
}

define i64 @imm_neg_9223372034778874949() {
; RV64I-LABEL: imm_neg_9223372034778874949:
; RV64I: # %bb.0:
; RV64I-NEXT: lui a0, 506812

```

```

; RV64I-NEXT:    addiw a0, a0, -1093
; RV64I-NEXT:    slli a1, a0, 63
; RV64I-NEXT:    add a0, a0, a1
; RV64I-NEXT:    ret
;
; RV64IZBA-LABEL: imm_neg_9223372034778874949:
;
RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:    lui a0, 506812
; RV64IZBA-NEXT:    addiw a0, a0, -1093
; RV64IZBA-NEXT:    slli a1, a0, 63
; RV64IZBA-NEXT:    add a0, a0, a1
; RV64IZBA-NEXT:    ret
;
; RV64IZBB-LABEL: imm_neg_9223372034778874949:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:    lui a0, 506812
; RV64IZBB-NEXT:    addiw a0, a0, -1093
; RV64IZBB-NEXT:    slli a1, a0, 63
; RV64IZBB-NEXT:    add a0, a0, a1
; RV64IZBB-NEXT:    ret
;
; RV64IZBS-LABEL: imm_neg_9223372034778874949:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:    lui a0, 506812
; RV64IZBS-NEXT:    addiw a0, a0, -1093
; RV64IZBS-NEXT:    bseti a0, a0, 63
; RV64IZBS-NEXT:    ret
;
; RV64IXTHEADBB-LABEL: imm_neg_9223372034778874949:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:    lui a0, 506812
; RV64IXTHEADBB-NEXT:    addiw a0, a0, -1093
; RV64IXTHEADBB-NEXT:    slli a1, a0, 63
; RV64IXTHEADBB-NEXT:    add a0, a0, a1
; RV64IXTHEADBB-NEXT:    ret
ret i64 -9223372034778874949 ; 0x800000007bbbbbbb
}

```

```

define
i64 @imm_neg_9223301666034697285() {
; RV64-NOPOOL-LABEL: imm_neg_9223301666034697285:
; RV64-NOPOOL:    # %bb.0:
; RV64-NOPOOL-NEXT:    lui a0, 917505
; RV64-NOPOOL-NEXT:    slli a0, a0, 8
; RV64-NOPOOL-NEXT:    addi a0, a0, 31
; RV64-NOPOOL-NEXT:    slli a0, a0, 12
; RV64-NOPOOL-NEXT:    addi a0, a0, -273

```

```

; RV64-NOPOOL-NEXT:  slli a0, a0, 14
; RV64-NOPOOL-NEXT:  addi a0, a0, -1093
; RV64-NOPOOL-NEXT:  ret
;
; RV64I-POOL-LABEL: imm_neg_9223301666034697285:
; RV64I-POOL:        # %bb.0:
; RV64I-POOL-NEXT:   lui a0, %hi(.LCPI39_0)
; RV64I-POOL-NEXT:   ld a0, %lo(.LCPI39_0)(a0)
; RV64I-POOL-NEXT:   ret
;
; RV64IZBA-LABEL: imm_neg_9223301666034697285:
; RV64IZBA:         # %bb.0:
; RV64IZBA-NEXT:    lui a0, 917505
; RV64IZBA-NEXT:    slli a0, a0, 8
; RV64IZBA-NEXT:    addi a0, a0, 31
; RV64IZBA-NEXT:    slli a0, a0, 12
; RV64IZBA-NEXT:    addi a0, a0, -273
; RV64IZBA-NEXT:    slli a0, a0, 14
; RV64IZBA-NEXT:    addi a0, a0, -1093
; RV64IZBA-NEXT:    ret
;
; RV64IZBB-LABEL:
imm_neg_9223301666034697285:
; RV64IZBB:         # %bb.0:
; RV64IZBB-NEXT:    lui a0, 917505
; RV64IZBB-NEXT:    slli a0, a0, 8
; RV64IZBB-NEXT:    addi a0, a0, 31
; RV64IZBB-NEXT:    slli a0, a0, 12
; RV64IZBB-NEXT:    addi a0, a0, -273
; RV64IZBB-NEXT:    slli a0, a0, 14
; RV64IZBB-NEXT:    addi a0, a0, -1093
; RV64IZBB-NEXT:    ret
;
; RV64IZBS-LABEL: imm_neg_9223301666034697285:
; RV64IZBS:         # %bb.0:
; RV64IZBS-NEXT:    lui a0, 506812
; RV64IZBS-NEXT:    addiw a0, a0, -1093
; RV64IZBS-NEXT:    bseti a0, a0, 46
; RV64IZBS-NEXT:    bseti a0, a0, 63
; RV64IZBS-NEXT:    ret
;
; RV64IXTHEADBB-LABEL: imm_neg_9223301666034697285:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 917505
; RV64IXTHEADBB-NEXT:  slli a0, a0, 8
; RV64IXTHEADBB-NEXT:  addi a0, a0, 31
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, -273

```

```
; RV64IXTHEADBB-NEXT: slli a0, a0, 14
; RV64IXTHEADBB-NEXT: addi a0, a0, -1093
; RV64IXTHEADBB-NEXT: ret
ret i64 -9223301666034697285 ; 0x800040007bbbbbbb
}
```

```
define i64 @imm_neg_2219066437() {
; RV64I-LABEL: imm_neg_2219066437:
; RV64I:    # %bb.0:
; RV64I-NEXT: lui a0, 913135
; RV64I-NEXT: slli a0, a0, 2
; RV64I-NEXT: addi a0, a0, -1093
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_neg_2219066437:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: lui a0, 913135
; RV64IZBA-NEXT: slli a0, a0, 2
; RV64IZBA-NEXT: addi a0, a0, -1093
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_neg_2219066437:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: lui a0, 913135
; RV64IZBB-NEXT: slli a0, a0, 2
; RV64IZBB-NEXT: addi a0, a0, -1093
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_neg_2219066437:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: lui a0, 913135
; RV64IZBS-NEXT: slli a0, a0, 2
; RV64IZBS-NEXT: addi a0, a0, -1093
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_neg_2219066437:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 913135
; RV64IXTHEADBB-NEXT:
    slli a0, a0, 2
; RV64IXTHEADBB-NEXT: addi a0, a0, -1093
; RV64IXTHEADBB-NEXT: ret
ret i64 -2219066437 ; 0xffffffff7bbbbbbb
}
```

```
define i64 @imm_neg_8798043653189() {
; RV64I-LABEL: imm_neg_8798043653189:
; RV64I:    # %bb.0:
```

```

; RV64I-NEXT:  lui a0, 917475
; RV64I-NEXT:  addiw a0, a0, -273
; RV64I-NEXT:  slli a0, a0, 14
; RV64I-NEXT:  addi a0, a0, -1093
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_8798043653189:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 917475
; RV64IZBA-NEXT:  addiw a0, a0, -273
; RV64IZBA-NEXT:  slli a0, a0, 14
; RV64IZBA-NEXT:  addi a0, a0, -1093
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_8798043653189:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 917475
; RV64IZBB-NEXT:  addiw a0, a0, -273
; RV64IZBB-NEXT:  slli a0, a0, 14
; RV64IZBB-NEXT:  addi a0, a0, -1093
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_8798043653189:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 572348
; RV64IZBS-NEXT:
;               addiw a0, a0, -1093
; RV64IZBS-NEXT:  bclri a0, a0, 43
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_8798043653189:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 917475
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -273
; RV64IXTHEADBB-NEXT:  slli a0, a0, 14
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1093
; RV64IXTHEADBB-NEXT:  ret
;               ret i64 -8798043653189 ; 0xffff7ff8bbbbbbb
}

define i64 @imm_9223372034904144827() {
; RV64I-LABEL: imm_9223372034904144827:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 572348
; RV64I-NEXT:  addiw a0, a0, -1093
; RV64I-NEXT:  slli a1, a0, 63
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret

```



```

;
; RV64IZBA-LABEL: imm_9223372034904144827:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 572348
; RV64IZBA-NEXT:  addiw a0, a0, -1093
; RV64IZBA-NEXT:  slli a1, a0, 63
; RV64IZBA-NEXT:  add a0, a0, a1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_9223372034904144827:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:
    lui a0, 572348
; RV64IZBB-NEXT:  addiw a0, a0, -1093
; RV64IZBB-NEXT:  slli a1, a0, 63
; RV64IZBB-NEXT:  add a0, a0, a1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_9223372034904144827:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 572348
; RV64IZBS-NEXT:  addiw a0, a0, -1093
; RV64IZBS-NEXT:  bclri a0, a0, 63
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_9223372034904144827:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 572348
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1093
; RV64IXTHEADBB-NEXT:  slli a1, a0, 63
; RV64IXTHEADBB-NEXT:  add a0, a0, a1
; RV64IXTHEADBB-NEXT:  ret
ret i64 9223372034904144827 ; 0x7fffffff8bbbbbbb
}

```

```

define i64 @imm_neg_9223354442718100411() {
; RV64-NOPOOL-LABEL: imm_neg_9223354442718100411:
; RV64-NOPOOL:    # %bb.0:
; RV64-NOPOOL-NEXT:  lui a0, 524287
; RV64-NOPOOL-NEXT:  slli a0, a0, 6
; RV64-NOPOOL-NEXT:  addi a0, a0, -29
; RV64-NOPOOL-NEXT:  slli a0, a0, 12
; RV64-NOPOOL-NEXT:
    addi a0, a0, -273
; RV64-NOPOOL-NEXT:  slli a0, a0, 14
; RV64-NOPOOL-NEXT:  addi a0, a0, -1093
; RV64-NOPOOL-NEXT:  ret
;
}

```

```

; RV64I-POOL-LABEL: imm_neg_9223354442718100411:
; RV64I-POOL:      # %bb.0:
; RV64I-POOL-NEXT: lui a0, %hi(.LCPI43_0)
; RV64I-POOL-NEXT: ld a0, %lo(.LCPI43_0)(a0)
; RV64I-POOL-NEXT: ret
;
; RV64IZBA-LABEL: imm_neg_9223354442718100411:
; RV64IZBA:      # %bb.0:
; RV64IZBA-NEXT: lui a0, 524287
; RV64IZBA-NEXT: slli a0, a0, 6
; RV64IZBA-NEXT: addi a0, a0, -29
; RV64IZBA-NEXT: slli a0, a0, 12
; RV64IZBA-NEXT: addi a0, a0, -273
; RV64IZBA-NEXT: slli a0, a0, 14
; RV64IZBA-NEXT: addi a0, a0, -1093
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_neg_9223354442718100411:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT: lui a0, 524287
; RV64IZBB-NEXT: slli a0, a0, 6
; RV64IZBB-NEXT: addi a0, a0, -29
; RV64IZBB-NEXT: slli a0, a0, 12
; RV64IZBB-NEXT: addi a0, a0, -273
; RV64IZBB-NEXT: slli a0, a0, 14
; RV64IZBB-NEXT:
;         addi a0, a0, -1093
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_neg_9223354442718100411:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT: lui a0, 572348
; RV64IZBS-NEXT: addiw a0, a0, -1093
; RV64IZBS-NEXT: bclri a0, a0, 44
; RV64IZBS-NEXT: bclri a0, a0, 63
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_neg_9223354442718100411:
; RV64IXTHEADBB: # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 524287
; RV64IXTHEADBB-NEXT: slli a0, a0, 6
; RV64IXTHEADBB-NEXT: addi a0, a0, -29
; RV64IXTHEADBB-NEXT: slli a0, a0, 12
; RV64IXTHEADBB-NEXT: addi a0, a0, -273
; RV64IXTHEADBB-NEXT: slli a0, a0, 14
; RV64IXTHEADBB-NEXT: addi a0, a0, -1093
; RV64IXTHEADBB-NEXT: ret
ret i64 9223354442718100411 ; 0x7ffefff8bbbbbbb

```

```

}

define i64 @imm_2863311530() {
; RV64I-LABEL: imm_2863311530:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 349525
; RV64I-NEXT:  addiw a0, a0, 1365
; RV64I-NEXT:  slli a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_2863311530:
; RV64IZBA:
;    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 349525
; RV64IZBA-NEXT:  addiw a0, a0, 1365
; RV64IZBA-NEXT:  slli a0, a0, 1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_2863311530:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 349525
; RV64IZBB-NEXT:  addiw a0, a0, 1365
; RV64IZBB-NEXT:  slli a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_2863311530:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 349525
; RV64IZBS-NEXT:  addiw a0, a0, 1365
; RV64IZBS-NEXT:  slli a0, a0, 1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_2863311530:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 349525
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 1365
; RV64IXTHEADBB-NEXT:  slli a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 2863311530 ; #0xaaaaaaaa
}

define i64 @imm_neg_2863311530() {
; RV64I-LABEL: imm_neg_2863311530:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 699051
; RV64I-NEXT:  addiw a0, a0, -1365
; RV64I-NEXT:  slli a0,

```

```

a0, 1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_2863311530:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 699051
; RV64IZBA-NEXT:  addiw a0, a0, -1365
; RV64IZBA-NEXT:  slli a0, a0, 1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_2863311530:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 699051
; RV64IZBB-NEXT:  addiw a0, a0, -1365
; RV64IZBB-NEXT:  slli a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_2863311530:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 699051
; RV64IZBS-NEXT:  addiw a0, a0, -1365
; RV64IZBS-NEXT:  slli a0, a0, 1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_2863311530:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 699051
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1365
; RV64IXTHEADBB-NEXT:  slli a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 -2863311530 ; #0xffffffff55555556
}

```

```

define i64 @imm_2147486378() {
; RV64I-LABEL: imm_2147486378:
; RV64I:    # %bb.0:
; RV64I-NEXT:
    li a0, 1
; RV64I-NEXT:  slli a0, a0, 31
; RV64I-NEXT:  addi a0, a0, 1365
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_2147486378:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 1
; RV64IZBA-NEXT:  slli a0, a0, 31
; RV64IZBA-NEXT:  addi a0, a0, 1365
; RV64IZBA-NEXT:  ret

```

```

;
; RV64IZBB-LABEL: imm_2147486378:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, 1
; RV64IZBB-NEXT:  slli a0, a0, 31
; RV64IZBB-NEXT:  addi a0, a0, 1365
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_2147486378:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, 1365
; RV64IZBS-NEXT:  bseti a0, a0, 31
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_2147486378:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, 1
; RV64IXTHEADBB-NEXT:  slli a0, a0, 31
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1365
; RV64IXTHEADBB-NEXT:  ret
ret i64 2147485013
}

```

```

define i64 @imm_neg_2147485013() {
; RV64I-LABEL: imm_neg_2147485013:
; RV64I:    # %bb.0:
; RV64I-NEXT:
lui a0, 524288
; RV64I-NEXT:  addi a0, a0, -1365
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_2147485013:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 524288
; RV64IZBA-NEXT:  addi a0, a0, -1365
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_2147485013:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 524288
; RV64IZBB-NEXT:  addi a0, a0, -1365
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_2147485013:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 524288
; RV64IZBS-NEXT:  addi a0, a0, -1365
; RV64IZBS-NEXT:  ret

```

```

;
; RV64IXTHEADBB-LABEL: imm_neg_2147485013:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 524288
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1365
; RV64IXTHEADBB-NEXT:  ret
ret i64 -2147485013
}

```

```

define i64 @imm_12900924131259() {
; RV64I-LABEL: imm_12900924131259:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 188
; RV64I-NEXT:  addiw a0, a0, -1093
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:  addi a0,
a0, 1979
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_12900924131259:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768955
; RV64IZBA-NEXT:  slli.uw a0, a0, 12
; RV64IZBA-NEXT:  addi a0, a0, 1979
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_12900924131259:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 188
; RV64IZBB-NEXT:  addiw a0, a0, -1093
; RV64IZBB-NEXT:  slli a0, a0, 24
; RV64IZBB-NEXT:  addi a0, a0, 1979
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_12900924131259:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 188
; RV64IZBS-NEXT:  addiw a0, a0, -1093
; RV64IZBS-NEXT:  slli a0, a0, 24
; RV64IZBS-NEXT:  addi a0, a0, 1979
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_12900924131259:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 188
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1093
; RV64IXTHEADBB-NEXT:  slli a0, a0, 24
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1979

```

```

; RV64IXTHEADBB-NEXT:  ret
ret i64 12900924131259
}

define
i64 @imm_50394234880() {
; RV64I-LABEL: imm_50394234880:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 188
; RV64I-NEXT:  addiw a0, a0, -1093
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_50394234880:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768955
; RV64IZBA-NEXT:  slli.uw a0, a0, 4
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_50394234880:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 188
; RV64IZBB-NEXT:  addiw a0, a0, -1093
; RV64IZBB-NEXT:  slli a0, a0, 16
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_50394234880:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 188
; RV64IZBS-NEXT:  addiw a0, a0, -1093
; RV64IZBS-NEXT:  slli a0, a0, 16
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_50394234880:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 188
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1093
; RV64IXTHEADBB-NEXT:  slli a0, a0, 16
; RV64IXTHEADBB-NEXT:  ret
ret
i64 50394234880
}

define i64 @imm_12900936431479() {
; RV64I-LABEL: imm_12900936431479:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 192239
; RV64I-NEXT:  slli a0, a0, 2

```

```

; RV64I-NEXT:  addi a0, a0, -1093
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1911
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_12900936431479:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768956
; RV64IZBA-NEXT:  addi a0, a0, -1093
; RV64IZBA-NEXT:  slli.uw a0, a0, 12
; RV64IZBA-NEXT:  addi a0, a0, 1911
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_12900936431479:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 192239
; RV64IZBB-NEXT:  slli a0, a0, 2
; RV64IZBB-NEXT:  addi a0, a0, -1093
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1911
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_12900936431479:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 192239
; RV64IZBS-NEXT:  slli a0, a0, 2
; RV64IZBS-NEXT:  addi a0, a0, -1093
; RV64IZBS-NEXT:
;               slli a0, a0, 12
; RV64IZBS-NEXT:  addi a0, a0, 1911
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_12900936431479:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 192239
; RV64IXTHEADBB-NEXT:  slli a0, a0, 2
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1093
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1911
; RV64IXTHEADBB-NEXT:  ret
ret i64 12900936431479
}

define i64 @imm_12900918536874() {
; RV64I-LABEL: imm_12900918536874:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 384477
; RV64I-NEXT:  addiw a0, a0, 1365

```



```

; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1365
; RV64I-NEXT:  slli a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_12900918536874:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768955
; RV64IZBA-NEXT:  addi a0, a0, -1365
; RV64IZBA-NEXT:  slli.uw a0, a0, 12
; RV64IZBA-NEXT:  addi a0, a0, -1366
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_12900918536874:
;
RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 384477
; RV64IZBB-NEXT:  addiw a0, a0, 1365
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1365
; RV64IZBB-NEXT:  slli a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_12900918536874:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 384477
; RV64IZBS-NEXT:  addiw a0, a0, 1365
; RV64IZBS-NEXT:  slli a0, a0, 12
; RV64IZBS-NEXT:  addi a0, a0, 1365
; RV64IZBS-NEXT:  slli a0, a0, 1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_12900918536874:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 384477
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 1365
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1365
; RV64IXTHEADBB-NEXT:  slli a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 12900918536874
}

define i64 @imm_12900925247761() {
; RV64I-LABEL: imm_12900925247761:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 384478
; RV64I-NEXT:  addiw

```

```

a0, a0, -1911
; RV64I-NEXT:  slli a0, a0, 13
; RV64I-NEXT:  addi a0, a0, -2048
; RV64I-NEXT:  addi a0, a0, -1775
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_12900925247761:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768955
; RV64IZBA-NEXT:  addi a0, a0, 273
; RV64IZBA-NEXT:  slli.uw a0, a0, 12
; RV64IZBA-NEXT:  addi a0, a0, 273
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_12900925247761:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 384478
; RV64IZBB-NEXT:  addiw a0, a0, -1911
; RV64IZBB-NEXT:  slli a0, a0, 13
; RV64IZBB-NEXT:  addi a0, a0, -2048
; RV64IZBB-NEXT:  addi a0, a0, -1775
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_12900925247761:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 384478
; RV64IZBS-NEXT:  addiw a0, a0, -1911
; RV64IZBS-NEXT:  slli a0, a0, 13
; RV64IZBS-NEXT:  addi a0, a0, -2048
; RV64IZBS-NEXT:  addi a0, a0, -1775
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_12900925247761:
; RV64IXTHEADBB:
;   # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 384478
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1911
; RV64IXTHEADBB-NEXT:  slli a0, a0, 13
; RV64IXTHEADBB-NEXT:  addi a0, a0, -2048
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1775
; RV64IXTHEADBB-NEXT:  ret
ret i64 12900925247761
}

define i64 @imm_7158272001() {
; RV64I-LABEL: imm_7158272001:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 427

```

```

; RV64I-NEXT:    addiw a0, a0, -1367
; RV64I-NEXT:    slli a0, a0, 12
; RV64I-NEXT:    addi a0, a0, 1
; RV64I-NEXT:    ret
;
; RV64IZBA-LABEL: imm_7158272001:
; RV64IZBA:      # %bb.0:
; RV64IZBA-NEXT:    lui a0, 349525
; RV64IZBA-NEXT:    sh2add a0, a0, a0
; RV64IZBA-NEXT:    addi a0, a0, 1
; RV64IZBA-NEXT:    ret
;
; RV64IZBB-LABEL: imm_7158272001:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:    lui a0, 427
; RV64IZBB-NEXT:    addiw a0, a0, -1367
; RV64IZBB-NEXT:    slli a0, a0, 12
; RV64IZBB-NEXT:    addi a0, a0, 1
; RV64IZBB-NEXT:    ret
;
; RV64IZBS-LABEL: imm_7158272001:
; RV64IZBS:
;   # %bb.0:
; RV64IZBS-NEXT:    lui a0, 427
; RV64IZBS-NEXT:    addiw a0, a0, -1367
; RV64IZBS-NEXT:    slli a0, a0, 12
; RV64IZBS-NEXT:    addi a0, a0, 1
; RV64IZBS-NEXT:    ret
;
; RV64IXTHEADBB-LABEL: imm_7158272001:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:    lui a0, 427
; RV64IXTHEADBB-NEXT:    addiw a0, a0, -1367
; RV64IXTHEADBB-NEXT:    slli a0, a0, 12
; RV64IXTHEADBB-NEXT:    addi a0, a0, 1
; RV64IXTHEADBB-NEXT:    ret
ret i64 7158272001 ; 0x0000_0001_aaaa_9001
}

```

```

define i64 @imm_12884889601() {
; RV64I-LABEL: imm_12884889601:
; RV64I:      # %bb.0:
; RV64I-NEXT:    lui a0, 768
; RV64I-NEXT:    addiw a0, a0, -3
; RV64I-NEXT:    slli a0, a0, 12
; RV64I-NEXT:    addi a0, a0, 1
; RV64I-NEXT:    ret
;

```

```

; RV64IZBA-LABEL: imm_12884889601:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 349525
; RV64IZBA-NEXT:  sh3add a0, a0, a0
; RV64IZBA-NEXT:  addi a0, a0, 1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_12884889601:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:
    lui a0, 768
; RV64IZBB-NEXT:  addiw a0, a0, -3
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_12884889601:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 768
; RV64IZBS-NEXT:  addiw a0, a0, -3
; RV64IZBS-NEXT:  slli a0, a0, 12
; RV64IZBS-NEXT:  addi a0, a0, 1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_12884889601:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 768
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -3
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 12884889601 ; 0x0000_0002_ffff_d001
}

```

```

define i64 @imm_neg_3435982847() {
; RV64I-LABEL: imm_neg_3435982847:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 1048371
; RV64I-NEXT:  addiw a0, a0, 817
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_3435982847:
; RV64IZBA:
    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768955
; RV64IZBA-NEXT:  sh1add a0, a0, a0

```

```

; RV64IZBA-NEXT:  addi a0, a0, 1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_3435982847:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1048371
; RV64IZBB-NEXT:  addiw a0, a0, 817
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_3435982847:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 734001
; RV64IZBS-NEXT:  addiw a0, a0, 1
; RV64IZBS-NEXT:  bclri a0, a0, 31
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_3435982847:
; RV64IXTHEADBB: # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1048371
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 817
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 -3435982847 ; 0xffff_ffff_3333_1001
}

```

```

define i64 @imm_neg_5726842879() {
; RV64I-LABEL: imm_neg_5726842879:
; RV64I:      # %bb.0:
; RV64I-NEXT:
    lui a0, 1048235
; RV64I-NEXT:  addiw a0, a0, -1419
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_5726842879:
; RV64IZBA:   # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768945
; RV64IZBA-NEXT:  sh2add a0, a0, a0
; RV64IZBA-NEXT:  addi a0, a0, 1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_5726842879:
; RV64IZBB:   # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1048235

```

```

; RV64IZBB-NEXT: addiw a0, a0, -1419
; RV64IZBB-NEXT: slli a0, a0, 12
; RV64IZBB-NEXT: addi a0, a0, 1
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_neg_5726842879:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: lui a0, 698997
; RV64IZBS-NEXT: addiw a0, a0, 1
; RV64IZBS-NEXT: bclri a0, a0, 32
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_neg_5726842879:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 1048235
; RV64IXTHEADBB-NEXT: addiw a0, a0, -1419
; RV64IXTHEADBB-NEXT: slli a0, a0, 12
; RV64IXTHEADBB-NEXT:
    addi a0, a0, 1
; RV64IXTHEADBB-NEXT: ret
ret i64 -5726842879 ; 0xffff_fffe_aaa7_5001
}

```

```

define i64 @imm_neg_10307948543() {
; RV64I-LABEL: imm_neg_10307948543:
; RV64I:    # %bb.0:
; RV64I-NEXT: lui a0, 1047962
; RV64I-NEXT: addiw a0, a0, -1645
; RV64I-NEXT: slli a0, a0, 12
; RV64I-NEXT: addi a0, a0, 1
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_neg_10307948543:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: lui a0, 768955
; RV64IZBA-NEXT: sh3add a0, a0, a0
; RV64IZBA-NEXT: addi a0, a0, 1
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_neg_10307948543:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: lui a0, 1047962
; RV64IZBB-NEXT: addiw a0, a0, -1645
; RV64IZBB-NEXT: slli a0, a0, 12
; RV64IZBB-NEXT: addi a0, a0, 1
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_neg_10307948543:

```

```

; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 629139
; RV64IZBS-NEXT:  addiw a0, a0, 1
; RV64IZBS-NEXT:  bclri a0, a0, 33
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL:
imm_neg_10307948543:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1047962
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1645
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 -10307948543 ; 0xffff_fffd_9999_3001
}

```

```

define i64 @li_ropi_1() {
; RV64I-LABEL: li_ropi_1:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a0, -17
; RV64I-NEXT:  slli a0, a0, 43
; RV64I-NEXT:  addi a0, a0, -1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: li_ropi_1:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, -17
; RV64IZBA-NEXT:  slli a0, a0, 43
; RV64IZBA-NEXT:  addi a0, a0, -1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: li_ropi_1:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, -18
; RV64IZBB-NEXT:  ropi a0, a0, 21
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: li_ropi_1:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, -17
; RV64IZBS-NEXT:  slli a0, a0, 43
; RV64IZBS-NEXT:  addi a0, a0,
-1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: li_ropi_1:
; RV64IXTHEADBB:    # %bb.0:

```

```
; RV64IXTHEADBB-NEXT: li a0, -18
; RV64IXTHEADBB-NEXT: th.srri a0, a0, 21
; RV64IXTHEADBB-NEXT: ret
ret i64 -149533581377537
}
```

```
define i64 @li_ropi_2() {
; RV64I-LABEL: li_ropi_2:
; RV64I:    # %bb.0:
; RV64I-NEXT: li a0, -5
; RV64I-NEXT: slli a0, a0, 60
; RV64I-NEXT: addi a0, a0, -6
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: li_ropi_2:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: li a0, -5
; RV64IZBA-NEXT: slli a0, a0, 60
; RV64IZBA-NEXT: addi a0, a0, -6
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: li_ropi_2:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: li a0, -86
; RV64IZBB-NEXT: rori a0, a0, 4
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: li_ropi_2:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: li a0, -5
; RV64IZBS-NEXT: slli a0, a0, 60
; RV64IZBS-NEXT: addi a0, a0, -6
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: li_ropi_2:
; RV64IXTHEADBB:
;   # %bb.0:
; RV64IXTHEADBB-NEXT: li a0, -86
; RV64IXTHEADBB-NEXT: th.srri a0, a0, 4
; RV64IXTHEADBB-NEXT: ret
ret i64 -5764607523034234886
}
```

```
define i64 @li_ropi_3() {
; RV64I-LABEL: li_ropi_3:
; RV64I:    # %bb.0:
; RV64I-NEXT: li a0, -17
; RV64I-NEXT: slli a0, a0, 27
```



```

; RV64I-NEXT:  addi a0, a0, -1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: li_ropi_3:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, -17
; RV64IZBA-NEXT:  slli a0, a0, 27
; RV64IZBA-NEXT:  addi a0, a0, -1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: li_ropi_3:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, -18
; RV64IZBB-NEXT:  ropi a0, a0, 37
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: li_ropi_3:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, -17
; RV64IZBS-NEXT:  slli a0, a0, 27
; RV64IZBS-NEXT:  addi a0, a0, -1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: li_ropi_3:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -18
; RV64IXTHEADBB-NEXT:  th.srri a0,
a0, 37
; RV64IXTHEADBB-NEXT:  ret
ret i64 -2281701377
}

```

; This used to assert when compiled with Zba.

```

define i64 @PR54812() {
; RV64I-LABEL: PR54812:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 1048447
; RV64I-NEXT:  addiw a0, a0, 1407
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: PR54812:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 872917
; RV64IZBA-NEXT:  sh1add a0, a0, a0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: PR54812:

```

```

; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1048447
; RV64IZBB-NEXT:  addiw a0, a0, 1407
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: PR54812:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 1045887
; RV64IZBS-NEXT:  bclri a0, a0, 31
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: PR54812:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1048447
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 1407
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:
    ret
ret i64 -2158497792;
}

```

```

define signext i32 @pos_2048() nounwind {

```

```

; RV64I-LABEL: pos_2048:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a0, 1
; RV64I-NEXT:  slli a0, a0, 11
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: pos_2048:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 1
; RV64IZBA-NEXT:  slli a0, a0, 11
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: pos_2048:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, 1
; RV64IZBB-NEXT:  slli a0, a0, 11
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: pos_2048:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  bseti a0, zero, 11
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: pos_2048:
; RV64IXTHEADBB:    # %bb.0:

```

```
; RV64IXTHEADBB-NEXT: li a0, 1
; RV64IXTHEADBB-NEXT: slli a0, a0, 11
; RV64IXTHEADBB-NEXT: ret
ret i32 2048
}
```

```
define i64 @imm64_same_lo_hi() nounwind {
; RV64I-LABEL: imm64_same_lo_hi:
; RV64I:    # %bb.0:
; RV64I-NEXT: lui a0, 65793
; RV64I-NEXT: addiw a0, a0, 16
; RV64I-NEXT:
    slli a1, a0, 32
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm64_same_lo_hi:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: lui a0, 65793
; RV64IZBA-NEXT: addiw a0, a0, 16
; RV64IZBA-NEXT: slli a1, a0, 32
; RV64IZBA-NEXT: add a0, a0, a1
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm64_same_lo_hi:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: lui a0, 65793
; RV64IZBB-NEXT: addiw a0, a0, 16
; RV64IZBB-NEXT: slli a1, a0, 32
; RV64IZBB-NEXT: add a0, a0, a1
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm64_same_lo_hi:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: lui a0, 65793
; RV64IZBS-NEXT: addiw a0, a0, 16
; RV64IZBS-NEXT: slli a1, a0, 32
; RV64IZBS-NEXT: add a0, a0, a1
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm64_same_lo_hi:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 65793
; RV64IXTHEADBB-NEXT: addiw a0, a0, 16
; RV64IXTHEADBB-NEXT: slli a1, a0, 32
; RV64IXTHEADBB-NEXT: add a0, a0, a1
;
}
```

```

RV64IXTHEADBB-NEXT:  ret
ret i64 1157442765409226768 ; 0x0101010101010101
}

```

; Same as above with optsize. Make sure we use constant pool on RV64

```

define i64 @imm64_same_lo_hi_optsize() nounwind optsize {

```

```

; RV64-NOPOOL-LABEL: imm64_same_lo_hi_optsize:

```

```

; RV64-NOPOOL:      # %bb.0:

```

```

; RV64-NOPOOL-NEXT:  lui a0, 65793

```

```

; RV64-NOPOOL-NEXT:  addiw a0, a0, 16

```

```

; RV64-NOPOOL-NEXT:  slli a1, a0, 32

```

```

; RV64-NOPOOL-NEXT:  add a0, a0, a1

```

```

; RV64-NOPOOL-NEXT:  ret

```

```

;

```

```

; RV64I-POOL-LABEL: imm64_same_lo_hi_optsize:

```

```

; RV64I-POOL:      # %bb.0:

```

```

; RV64I-POOL-NEXT:  lui a0, %hi(.LCPI64_0)

```

```

; RV64I-POOL-NEXT:  ld a0, %lo(.LCPI64_0)(a0)

```

```

; RV64I-POOL-NEXT:  ret

```

```

;

```

```

; RV64IZBA-LABEL: imm64_same_lo_hi_optsize:

```

```

; RV64IZBA:      # %bb.0:

```

```

; RV64IZBA-NEXT:  lui a0, 65793

```

```

; RV64IZBA-NEXT:  addiw a0, a0, 16

```

```

; RV64IZBA-NEXT:  slli a1, a0, 32

```

```

; RV64IZBA-NEXT:  add a0, a0, a1

```

```

; RV64IZBA-NEXT:  ret

```

```

;

```

```

; RV64IZBB-LABEL: imm64_same_lo_hi_optsize:

```

```

; RV64IZBB:      # %bb.0:

```

```

; RV64IZBB-NEXT:  lui
a0, 65793

```

```

; RV64IZBB-NEXT:  addiw a0, a0, 16

```

```

; RV64IZBB-NEXT:  slli a1, a0, 32

```

```

; RV64IZBB-NEXT:  add a0, a0, a1

```

```

; RV64IZBB-NEXT:  ret

```

```

;

```

```

; RV64IZBS-LABEL: imm64_same_lo_hi_optsize:

```

```

; RV64IZBS:      # %bb.0:

```

```

; RV64IZBS-NEXT:  lui a0, 65793

```

```

; RV64IZBS-NEXT:  addiw a0, a0, 16

```

```

; RV64IZBS-NEXT:  slli a1, a0, 32

```

```

; RV64IZBS-NEXT:  add a0, a0, a1

```

```

; RV64IZBS-NEXT:  ret

```

```

;

```

```

; RV64IXTHEADBB-LABEL: imm64_same_lo_hi_optsize:

```

```

; RV64IXTHEADBB:      # %bb.0:

```

```

; RV64IXTHEADBB-NEXT:  lui a0, 65793

```

```
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 16
; RV64IXTHEADBB-NEXT:  slli a1, a0, 32
; RV64IXTHEADBB-NEXT:  add a0, a0, a1
; RV64IXTHEADBB-NEXT:  ret
ret i64 1157442765409226768 ; 0x0101010101010101
}
```

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```
=====
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```

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```
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mcpu=skylake-avx512 -mattr=prefer-256-bit | FileCheck %s
--check-prefixes=CHECK,CHECK-SKX
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mcpu=skylake-avx512 -mattr=prefer-256-bit,avx512vbmi |
FileCheck %s --check-prefixes=CHECK,CHECK-SKX,CHECK-SKX-VBMI
; Make sure CPUs default to prefer-256-bit. avx512vnni isn't interesting as it just adds an isel peephole for
vpmaddwd+vpadd
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mcpu=skylake-avx512 | FileCheck %s --check-
prefixes=CHECK,CHECK-AVX512
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mattr=-avx512vnni -mcpu=cascadelake | FileCheck %s --
check-prefixes=CHECK,CHECK-AVX512
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mattr=-avx512vnni -mcpu=cooperlake | FileCheck %s --
check-prefixes=CHECK,CHECK-AVX512
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mcpu=cannonlake | FileCheck %s --check-
prefixes=CHECK,CHECK-VBMI
;
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mattr=-avx512vnni -mcpu=icelake-client | FileCheck %s --
check-prefixes=CHECK,CHECK-VBMI
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mattr=-avx512vnni -mcpu=icelake-server | FileCheck %s --
check-prefixes=CHECK,CHECK-VBMI
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mattr=-avx512vnni -mcpu=tigerlake | FileCheck %s --check-
prefixes=CHECK,CHECK-VBMI
```

; This file primarily contains tests for specific places in X86ISelLowering.cpp that needed be made aware of the legalizer not allowing 512-bit vectors due to prefer-256-bit even though AVX512 is enabled.

```
define dso_local void @add256(<16 x i32>* %a, <16 x i32>* %b, <16 x i32>* %c) "min-legal-vector-
width"="256" {
; CHECK-LABEL: add256:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vmovdqa (%rdi), %ymm0
; CHECK-NEXT:  vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT:  vpadd 32(%rsi), %ymm1, %ymm1
```





[illegible]

```
define dso_local void @pmaddwd_32_256(<32 x i16>* %APtr, <32 x i16>* %BPtr, <16 x i32>* %CPtr) "min-legal-vector-width"="256" {
; CHECK-LABEL: pmaddwd_32_256:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vmovdqa (%rdi), %ymm0
; CHECK-NEXT:  vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT:  vpmaddwd 32(%rsi), %ymm1, %ymm1
```

```

; CHECK-NEXT: vpmaddwd (%rsi), %ymm0, %ymm0
; CHECK-NEXT: vmovdqa %ymm0, (%rdx)
; CHECK-NEXT: vmovdqa %ymm1, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq

%A = load <32 x i16>, <32 x i16>* %APtr
%B = load <32 x i16>, <32 x i16>* %BPtr
%a = sext <32 x i16> %A to <32 x i32>
%b = sext <32 x i16> %B to <32 x i32>
%m = mul nsw <32 x i32> %a, %b
%odd = shufflevector <32 x i32> %m, <32 x i32> undef, <16 x i32> <i32 0, i32 2, i32 4, i32 6, i32 8, i32 10, i32
12, i32 14, i32 16, i32 18, i32 20, i32 22, i32 24, i32 26, i32 28, i32 30>
%even = shufflevector <32 x i32> %m, <32 x i32> undef, <16 x i32> <i32 1, i32 3, i32 5, i32
7, i32 9, i32 11, i32 13, i32 15, i32 17, i32 19, i32 21, i32 23, i32 25, i32 27, i32 29, i32 31>
%ret = add <16 x i32> %odd, %even
store <16 x i32> %ret, <16 x i32>* %CPtr
ret void
}

define dso_local void @pmaddwd_32_512(<32 x i16>* %APtr, <32 x i16>* %BPtr, <16 x i32>* %CPtr) "min-
legal-vector-width"="512" {
; CHECK-LABEL: pmaddwd_32_512:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa64 (%rdi), %zmm0
; CHECK-NEXT: vpmaddwd (%rsi), %zmm0, %zmm0
; CHECK-NEXT: vmovdqa64 %zmm0, (%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq

%A = load <32 x i16>, <32 x i16>* %APtr
%B = load <32 x i16>, <32 x i16>* %BPtr
%a = sext <32 x i16> %A to <32 x i32>
%b = sext <32 x i16> %B to <32 x i32>
%m = mul nsw <32 x i32> %a, %b
%odd = shufflevector <32 x i32> %m, <32 x i32> undef, <16 x i32> <i32 0, i32 2, i32 4, i32 6, i32 8, i32 10, i32
12, i32 14, i32 16, i32 18, i32 20, i32 22, i32 24, i32 26, i32 28, i32 30>
%even = shufflevector <32 x i32> %m, <32 x i32>
undef, <16 x i32> <i32 1, i32 3, i32 5, i32 7, i32 9, i32 11, i32 13, i32 15, i32 17, i32 19, i32 21, i32 23, i32 25, i32
27, i32 29, i32 31>
%ret = add <16 x i32> %odd, %even
store <16 x i32> %ret, <16 x i32>* %CPtr
ret void
}

define dso_local void @psubus_64i8_max_256(<64 x i8>* %xptr, <64 x i8>* %yptr, <64 x i8>* %zptr) "min-legal-
vector-width"="256" {
; CHECK-LABEL: psubus_64i8_max_256:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0

```

```

; CHECK-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT: vpsubusb 32(%rsi), %ymm1, %ymm1
; CHECK-NEXT: vpsubusb (%rsi), %ymm0, %ymm0
; CHECK-NEXT: vmovdqa %ymm0, (%rdx)
; CHECK-NEXT: vmovdqa %ymm1, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <64 x i8>, <64 x i8>* %xptr
%y = load <64 x i8>, <64 x i8>* %yptr
%cmp = icmp ult <64 x i8> %x, %y
%max = select <64 x i1> %cmp, <64 x i8> %y, <64 x i8> %x
%res = sub <64 x i8> %max, %y
store <64 x i8> %res, <64 x i8>* %zptr
ret void
}

```

```

define
dso_local void @psubus_64i8_max_512(<64 x i8>* %xptr, <64 x i8>* %yptr, <64 x i8>* %zptr) "min-legal-
vector-width"="512" {
; CHECK-LABEL: psubus_64i8_max_512:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa64 (%rdi), %zmm0
; CHECK-NEXT: vpsubusb (%rsi), %zmm0, %zmm0
; CHECK-NEXT: vmovdqa64 %zmm0, (%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <64 x i8>, <64 x i8>* %xptr
%y = load <64 x i8>, <64 x i8>* %yptr
%cmp = icmp ult <64 x i8> %x, %y
%max = select <64 x i1> %cmp, <64 x i8> %y, <64 x i8> %x
%res = sub <64 x i8> %max, %y
store <64 x i8> %res, <64 x i8>* %zptr
ret void
}

```

```

define dso_local i32 @_Z9test_charPcS_i_256(i8* nocapture readonly, i8* nocapture readonly, i32) "min-legal-
vector-width"="256" {
; CHECK-SKX-LABEL: _Z9test_charPcS_i_256:
; CHECK-SKX:      # %bb.0: # %entry
; CHECK-SKX-NEXT: movl %edx, %eax
; CHECK-SKX-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-SKX-NEXT: xorl %ecx, %ecx
; CHECK-SKX-NEXT: vpxor %xmm1, %xmm1, %xmm1
;
CHECK-SKX-NEXT: vpxor %xmm2, %xmm2, %xmm2
; CHECK-SKX-NEXT: .p2align 4, 0x90
; CHECK-SKX-NEXT: .LBB8_1: # %vector.body
; CHECK-SKX-NEXT: # =>This Inner Loop Header: Depth=1

```

```

; CHECK-SKX-NEXT: vpmovsxbw 16(%rdi,%rcx), %ymm3
; CHECK-SKX-NEXT: vpmovsxbw (%rdi,%rcx), %ymm4
; CHECK-SKX-NEXT: vpmovsxbw 16(%rsi,%rcx), %ymm5
; CHECK-SKX-NEXT: vpmaddwd %ymm3, %ymm5, %ymm3
; CHECK-SKX-NEXT: vpadd %ymm2, %ymm3, %ymm2
; CHECK-SKX-NEXT: vpmovsxbw (%rsi,%rcx), %ymm3
; CHECK-SKX-NEXT: vpmaddwd %ymm4, %ymm3, %ymm3
; CHECK-SKX-NEXT: vpadd %ymm1, %ymm3, %ymm1
; CHECK-SKX-NEXT: addq $32, %rcx
; CHECK-SKX-NEXT: cmpq %rcx, %rax
; CHECK-SKX-NEXT: jne .LBB8_1
; CHECK-SKX-NEXT: # %bb.2: # %middle.block
; CHECK-SKX-NEXT: vpadd %ymm0, %ymm1, %ymm1
; CHECK-SKX-NEXT: vpadd %ymm0, %ymm2, %ymm0
; CHECK-SKX-NEXT: vpadd %ymm0, %ymm1, %ymm0
; CHECK-SKX-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-SKX-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT:
    vpsltd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-SKX-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT: vpsrlq $32, %xmm0, %xmm1
; CHECK-SKX-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT: vmovd %xmm0, %eax
; CHECK-SKX-NEXT: vzeroupper
; CHECK-SKX-NEXT: retq
;
; CHECK-AVX512-LABEL: _Z9test_charPcS_i_256:
; CHECK-AVX512:    # %bb.0: # %entry
; CHECK-AVX512-NEXT: movl %edx, %eax
; CHECK-AVX512-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-AVX512-NEXT: xorl %ecx, %ecx
; CHECK-AVX512-NEXT: vpxor %xmm1, %xmm1, %xmm1
; CHECK-AVX512-NEXT: vpxor %xmm2, %xmm2, %xmm2
; CHECK-AVX512-NEXT: .p2align 4, 0x90
; CHECK-AVX512-NEXT: .LBB8_1: # %vector.body
; CHECK-AVX512-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-AVX512-NEXT: vpmovsxbw 16(%rdi,%rcx), %ymm3
; CHECK-AVX512-NEXT: vpmovsxbw (%rdi,%rcx), %ymm4
; CHECK-AVX512-NEXT: vpmovsxbw 16(%rsi,%rcx), %ymm5
; CHECK-AVX512-NEXT: vpmaddwd %ymm3, %ymm5, %ymm3
; CHECK-AVX512-NEXT: vpadd %ymm2, %ymm3,
    %ymm2
; CHECK-AVX512-NEXT: vpmovsxbw (%rsi,%rcx), %ymm3
; CHECK-AVX512-NEXT: vpmaddwd %ymm4, %ymm3, %ymm3
; CHECK-AVX512-NEXT: vpadd %ymm1, %ymm3, %ymm1
; CHECK-AVX512-NEXT: addq $32, %rcx
; CHECK-AVX512-NEXT: cmpq %rcx, %rax
; CHECK-AVX512-NEXT: jne .LBB8_1

```

```

; CHECK-AVX512-NEXT: # %bb.2: # %middle.block
; CHECK-AVX512-NEXT: vpaddd %ymm0, %ymm1, %ymm1
; CHECK-AVX512-NEXT: vpaddd %ymm0, %ymm2, %ymm0
; CHECK-AVX512-NEXT: vpaddd %ymm0, %ymm1, %ymm0
; CHECK-AVX512-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpslufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpsrlq $32, %xmm0, %xmm1
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vmovd %xmm0, %eax
; CHECK-AVX512-NEXT: vzeroupper
; CHECK-AVX512-NEXT: retq
;
; CHECK-VBMI-LABEL: _Z9test_charPcS_i_256:
; CHECK-VBMI: # %bb.0: # %entry
; CHECK-VBMI-NEXT:
    movl %edx, %eax
; CHECK-VBMI-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-VBMI-NEXT: xorl %ecx, %ecx
; CHECK-VBMI-NEXT: vpxor %xmm1, %xmm1, %xmm1
; CHECK-VBMI-NEXT: vpxor %xmm2, %xmm2, %xmm2
; CHECK-VBMI-NEXT: .p2align 4, 0x90
; CHECK-VBMI-NEXT: .LBB8_1: # %vector.body
; CHECK-VBMI-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-VBMI-NEXT: vpmovsxbw 16(%rdi,%rcx), %ymm3
; CHECK-VBMI-NEXT: vpmovsxbw (%rdi,%rcx), %ymm4
; CHECK-VBMI-NEXT: vpmovsxbw 16(%rsi,%rcx), %ymm5
; CHECK-VBMI-NEXT: vpmaddwd %ymm3, %ymm5, %ymm3
; CHECK-VBMI-NEXT: vpaddd %ymm2, %ymm3, %ymm2
; CHECK-VBMI-NEXT: vpmovsxbw (%rsi,%rcx), %ymm3
; CHECK-VBMI-NEXT: vpmaddwd %ymm4, %ymm3, %ymm3
; CHECK-VBMI-NEXT: vpaddd %ymm1, %ymm3, %ymm1
; CHECK-VBMI-NEXT: addq $32, %rcx
; CHECK-VBMI-NEXT: cmpq %rcx, %rax
; CHECK-VBMI-NEXT: jne .LBB8_1
; CHECK-VBMI-NEXT: # %bb.2: # %middle.block
; CHECK-VBMI-NEXT: vpaddd %ymm0, %ymm1, %ymm1
; CHECK-VBMI-NEXT: vpaddd %ymm0, %ymm2,
    %ymm0
; CHECK-VBMI-NEXT: vpaddd %ymm0, %ymm1, %ymm0
; CHECK-VBMI-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vpslufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vpslufd {{.*#+}} xmm1 = xmm0[1,1,1,1]
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vmovd %xmm0, %eax

```

; CHECK-VBMI-NEXT: vzeroupper

; CHECK-VBMI-NEXT: retq

entry:

%3 = zext i32 %2 to i64

br label %vector.body

vector.body:

%index = phi i64 [ %index.next, %vector.body ], [ 0, %entry ]

%vec.phi = phi <32 x i32> [ %11, %vector.body ], [ zeroinitializer, %entry ]

%4 = getelementptr inbounds i8, i8\* %0, i64 %index

%5 = bitcast i8\* %4 to <32 x i8>\*

%wide.load = load <32 x i8>, <32 x i8>\* %5, align 1

%6 = sext <32 x i8> %wide.load to <32 x i32>

%7 = getelementptr inbounds i8, i8\* %1, i64 %index

%8 = bitcast i8\* %7 to <32 x i8>\*

%wide.load14 = load <32 x

i8>, <32 x i8>\* %8, align 1

%9 = sext <32 x i8> %wide.load14 to <32 x i32>

%10 = mul nsw <32 x i32> %9, %6

%11 = add nsw <32 x i32> %10, %vec.phi

%index.next = add i64 %index, 32

%12 = icmp eq i64 %index.next, %3

br i1 %12, label %middle.block, label %vector.body

middle.block:

%rdx.shuf1 = shufflevector <32 x i32> %11, <32 x i32> undef, <32 x i32> <i32 16, i32 17, i32 18, i32 19, i32 20, i32 21, i32 22, i32 23, i32 24, i32 25, i32 26, i32 27, i32 28, i32 29, i32 30, i32 31, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>

%bin.rdx1 = add <32 x i32> %11, %rdx.shuf1

%rdx.shuf = shufflevector <32 x i32> %bin.rdx1, <32 x i32> undef, <32 x i32> <i32 8, i32 9, i32 10, i32 11, i32 12, i32 13, i32 14, i32 15, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>

%bin.rdx = add <32 x i32> %bin.rdx1, %rdx.shuf

%rdx.shuf15 = shufflevector <32 x i32> %bin.rdx, <32 x i32> undef, <32 x i32> <i32 4, i32 5, i32 6, i32 7, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>

%bin.rdx32 = add <32 x i32> %bin.rdx, %rdx.shuf15

%rdx.shuf17 = shufflevector <32 x i32> %bin.rdx32, <32 x i32> undef, <32 x i32> <i32 2, i32 3, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>

%bin.rdx18 = add <32 x i32> %bin.rdx32, %rdx.shuf17

%rdx.shuf19 = shufflevector <32 x i32> %bin.rdx18, <32 x i32> undef, <32 x i32> <i32 1, i32 undef, i32 undef,



```

; CHECK-AVX512-NEXT: .p2align 4, 0x90
; CHECK-AVX512-NEXT: .LBB9_1: # %vector.body
; CHECK-AVX512-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-AVX512-NEXT: vpmovsxbw (%rdi,%rcx), %zmm2
; CHECK-AVX512-NEXT: vpmovsxbw (%rsi,%rcx), %zmm3
; CHECK-AVX512-NEXT: vpmaddwd %zmm2, %zmm3, %zmm2
; CHECK-AVX512-NEXT: vpaddd %zmm1, %zmm2, %zmm1
; CHECK-AVX512-NEXT: addq $32, %rcx
; CHECK-AVX512-NEXT: cmpq %rcx, %rax
; CHECK-AVX512-NEXT: jne .LBB9_1
; CHECK-AVX512-NEXT: # %bb.2: # %middle.block
; CHECK-AVX512-NEXT: vpaddd %zmm0, %zmm1, %zmm0
; CHECK-AVX512-NEXT: vextracti64x4 $1, %zmm0, %ymm1
; CHECK-AVX512-NEXT: vpaddd
%zmm1, %zmm0, %zmm0
; CHECK-AVX512-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpshufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpsrlq $32, %xmm0, %xmm1
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vmovd %xmm0, %eax
; CHECK-AVX512-NEXT: vzeroupper
; CHECK-AVX512-NEXT: retq
;
; CHECK-VBMI-LABEL: _Z9test_charPcS_i_512:
; CHECK-VBMI: # %bb.0: # %entry
; CHECK-VBMI-NEXT: movl %edx, %eax
; CHECK-VBMI-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-VBMI-NEXT: xorl %ecx, %ecx
; CHECK-VBMI-NEXT: vpxor %xmm1, %xmm1, %xmm1
; CHECK-VBMI-NEXT: .p2align 4, 0x90
; CHECK-VBMI-NEXT: .LBB9_1: # %vector.body
; CHECK-VBMI-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-VBMI-NEXT: vpmovsxbw (%rdi,%rcx), %zmm2
; CHECK-VBMI-NEXT: vpmovsxbw (%rsi,%rcx), %zmm3
; CHECK-VBMI-NEXT: vpmaddwd %zmm2, %zmm3, %zmm2
;
CHECK-VBMI-NEXT: vpaddd %zmm1, %zmm2, %zmm1
; CHECK-VBMI-NEXT: addq $32, %rcx
; CHECK-VBMI-NEXT: cmpq %rcx, %rax
; CHECK-VBMI-NEXT: jne .LBB9_1
; CHECK-VBMI-NEXT: # %bb.2: # %middle.block
; CHECK-VBMI-NEXT: vpaddd %zmm0, %zmm1, %zmm0
; CHECK-VBMI-NEXT: vextracti64x4 $1, %zmm0, %ymm1
; CHECK-VBMI-NEXT: vpaddd %zmm1, %zmm0, %zmm0
; CHECK-VBMI-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0

```



```
; CHECK-VBMI-NEXT:  vpsshufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-VBMI-NEXT:  vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT:  vpsshufd {{.*#+}} xmm1 = xmm0[1,1,1,1]
; CHECK-VBMI-NEXT:  vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT:  vmovd %xmm0, %eax
; CHECK-VBMI-NEXT:  vzeroupper
; CHECK-VBMI-NEXT:  retq
```

entry:

```
%3 = zext i32 %2 to i64
```

```
br label %vector.body
```

vector.body:

```
%index = phi i64 [ %index.next, %vector.body ], [ 0, %entry ]
```

```
%vec.phi = phi <32 x i32> [ %11, %vector.body ], [ zeroinitializer, %entry ]
```

```
%4 = getelementptr
```

```
inbounds i8, i8* %0, i64 %index
```

```
%5 = bitcast i8* %4 to <32 x i8>*
```

```
%wide.load = load <32 x i8>, <32 x i8>* %5, align 1
```

```
%6 = sext <32 x i8> %wide.load to <32 x i32>
```

```
%7 = getelementptr inbounds i8, i8* %1, i64 %index
```

```
%8 = bitcast i8* %7 to <32 x i8>*
```

```
%wide.load14 = load <32 x i8>, <32 x i8>* %8, align 1
```

```
%9 = sext <32 x i8> %wide.load14 to <32 x i32>
```

```
%10 = mul nsw <32 x i32> %9, %6
```

```
%11 = add nsw <32 x i32> %10, %vec.phi
```

```
%index.next = add i64 %index, 32
```

```
%12 = icmp eq i64 %index.next, %3
```

```
br i1 %12, label %middle.block, label %vector.body
```

middle.block:

```
%rdx.shuf1 = shufflevector <32 x i32> %11, <32 x i32> undef, <32 x i32> <i32 16, i32 17, i32 18, i32 19, i32 20,
i32 21, i32 22, i32 23, i32 24, i32 25, i32 26, i32 27, i32 28, i32 29, i32 30, i32 31, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef, i32 undef, i32 undef>
```

```
%bin.rdx1 = add <32 x i32> %11, %rdx.shuf1
```

```
%rdx.shuf = shufflevector <32 x i32> %bin.rdx1, <32 x i32> undef, <32 x i32> <i32 8, i32 9, i32 10, i32 11, i32
12, i32 13, i32 14, i32 15, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef, i32 undef, i32 undef>
```

```
%bin.rdx = add <32 x i32> %bin.rdx1, %rdx.shuf
```

```
%rdx.shuf15 = shufflevector <32 x i32> %bin.rdx, <32 x i32> undef, <32 x i32> <i32 4, i32 5, i32 6, i32 7, i32
undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef, i32 undef, i32 undef, i32 undef, i32 undef>
```

```
%bin.rdx32 = add <32 x i32> %bin.rdx, %rdx.shuf15
```

```
%rdx.shuf17 = shufflevector <32 x i32> %bin.rdx32, <32 x i32> undef,
<32 x i32> <i32 2, i32 3, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef>
```

```

i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef>
%bin.rdx18 = add <32 x i32> %bin.rdx32, %rdx.shuf17
%rdx.shuf19 = shufflevector <32 x i32> %bin.rdx18, <32 x i32> undef, <32 x i32> <i32 1, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx20 = add <32 x i32> %bin.rdx18, %rdx.shuf19
%13 = extractelement <32 x i32> %bin.rdx20, i32 0
ret i32 %13
}

```

```

@a = dso_local global [1024 x i8]
zeroinitializer, align 16
@b = dso_local global [1024 x i8] zeroinitializer, align 16

```

```

define dso_local i32 @sad_16i8_256() "min-legal-vector-width"="256" {
; CHECK-SKX-LABEL: sad_16i8_256:
; CHECK-SKX:      # %bb.0: # %entry
; CHECK-SKX-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-SKX-NEXT: movq $-1024, %rax # imm = 0xFC00
; CHECK-SKX-NEXT: vpxor %xmm1, %xmm1, %xmm1
; CHECK-SKX-NEXT: .p2align 4, 0x90
; CHECK-SKX-NEXT: .LBB10_1: # %vector.body
; CHECK-SKX-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-SKX-NEXT: vmovdqu a+1024(%rax), %xmm2
; CHECK-SKX-NEXT: vpsadbw b+1024(%rax), %xmm2, %xmm2
; CHECK-SKX-NEXT: vpaddq %ymm1, %ymm2, %ymm1
; CHECK-SKX-NEXT: addq $4, %rax
; CHECK-SKX-NEXT: jne .LBB10_1
; CHECK-SKX-NEXT: # %bb.2: # %middle.block
; CHECK-SKX-NEXT: vpaddq %ymm0, %ymm1, %ymm0
; CHECK-SKX-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-SKX-NEXT: vpaddq %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT: vpshufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-SKX-NEXT:
; CHECK-SKX-NEXT: vpaddq %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT: vpsrlq $32, %xmm0, %xmm1
; CHECK-SKX-NEXT: vpaddq %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT: vmovd %xmm0, %eax
; CHECK-SKX-NEXT: vzeroupper
; CHECK-SKX-NEXT: retq
;
; CHECK-AVX512-LABEL: sad_16i8_256:
; CHECK-AVX512:      # %bb.0: # %entry
; CHECK-AVX512-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-AVX512-NEXT: movq $-1024, %rax # imm = 0xFC00
; CHECK-AVX512-NEXT: vpxor %xmm1, %xmm1, %xmm1

```

```

; CHECK-AVX512-NEXT: .p2align 4, 0x90
; CHECK-AVX512-NEXT: .LBB10_1: # %vector.body
; CHECK-AVX512-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-AVX512-NEXT: vmovdqu a+1024(%rax), %xmm2
; CHECK-AVX512-NEXT: vpsadbw b+1024(%rax), %xmm2, %xmm2
; CHECK-AVX512-NEXT: vpaddd %ymm1, %ymm2, %ymm1
; CHECK-AVX512-NEXT: addq $4, %rax
; CHECK-AVX512-NEXT: jne .LBB10_1
; CHECK-AVX512-NEXT: # %bb.2: # %middle.block
; CHECK-AVX512-NEXT: vpaddd %ymm0, %ymm1, %ymm0
; CHECK-AVX512-NEXT: vextracti128 $1, %ymm0, %xmm1
;
CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpslufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpsrlq $32, %xmm0, %xmm1
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vmovd %xmm0, %eax
; CHECK-AVX512-NEXT: vzeroupper
; CHECK-AVX512-NEXT: retq
;
; CHECK-VBMI-LABEL: sad_16i8_256:
; CHECK-VBMI: # %bb.0: # %entry
; CHECK-VBMI-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-VBMI-NEXT: movq $-1024, %rax # imm = 0xFC00
; CHECK-VBMI-NEXT: vpxor %xmm1, %xmm1, %xmm1
; CHECK-VBMI-NEXT: .p2align 4, 0x90
; CHECK-VBMI-NEXT: .LBB10_1: # %vector.body
; CHECK-VBMI-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-VBMI-NEXT: vmovdqu a+1024(%rax), %xmm2
; CHECK-VBMI-NEXT: vpsadbw b+1024(%rax), %xmm2, %xmm2
; CHECK-VBMI-NEXT: vpaddd %ymm1, %ymm2, %ymm1
; CHECK-VBMI-NEXT: addq $4, %rax
; CHECK-VBMI-NEXT: jne .LBB10_1
; CHECK-VBMI-NEXT: # %bb.2: # %middle.block
;
CHECK-VBMI-NEXT: vpaddd %ymm0, %ymm1, %ymm0
; CHECK-VBMI-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vpslufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vpslufd {{.*#+}} xmm1 = xmm0[1,1,1,1]
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vmovd %xmm0, %eax
; CHECK-VBMI-NEXT: vzeroupper
; CHECK-VBMI-NEXT: retq
entry:
br label %vector.body

```

vector.body:

```
%index = phi i64 [ 0, %entry ], [ %index.next, %vector.body ]
%vec.phi = phi <16 x i32> [ zeroinitializer, %entry ], [ %10, %vector.body ]
%0 = getelementptr inbounds [1024 x i8], [1024 x i8]* @a, i64 0, i64 %index
%1 = bitcast i8* %0 to <16 x i8>*
%wide.load = load <16 x i8>, <16 x i8>* %1, align 4
%2 = zext <16 x i8> %wide.load to <16 x i32>
%3 = getelementptr inbounds [1024 x i8], [1024 x i8]* @b, i64 0, i64 %index
%4 = bitcast i8* %3 to <16 x i8>*
%wide.load1
= load <16 x i8>, <16 x i8>* %4, align 4
%5 = zext <16 x i8> %wide.load1 to <16 x i32>
%6 = sub nsw <16 x i32> %2, %5
%7 = icmp sgt <16 x i32> %6, <i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1>
%8 = sub nsw <16 x i32> zeroinitializer, %6
%9 = select <16 x i1> %7, <16 x i32> %6, <16 x i32> %8
%10 = add nsw <16 x i32> %9, %vec.phi
%index.next = add i64 %index, 4
%11 = icmp eq i64 %index.next, 1024
br i1 %11, label %middle.block, label %vector.body
```

middle.block:

```
%rdx.shuf = shufflevector <16 x i32> %10, <16 x i32> undef, <16 x i32> <i32 8, i32 9, i32 10, i32 11, i32 12, i32 13, i32 14, i32 15, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx = add <16 x i32> %10, %rdx.shuf
%rdx.shuf2 = shufflevector <16 x i32> %bin.rdx, <16 x i32> undef, <16 x i32> <i32 4, i32 5, i32 6, i32 7, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx2 = add <16 x i32> %bin.rdx, %rdx.shuf2
%rdx.shuf3 = shufflevector <16 x i32> %bin.rdx2, <16 x i32> undef, <16 x i32> <i32 2, i32 3, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx3 = add <16 x i32> %bin.rdx2, %rdx.shuf3
%rdx.shuf4 = shufflevector <16 x i32> %bin.rdx3, <16 x i32> undef, <16 x i32> <i32 1, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx4 = add <16 x i32> %bin.rdx3, %rdx.shuf4
%12 = extractelement <16 x i32> %bin.rdx4, i32 0
ret i32 %12
}
```

```
define dso_local i32 @sad_16i8_512() "min-legal-vector-width"="512" {
; CHECK-SKX-LABEL: sad_16i8_512:
; CHECK-SKX:      # %bb.0: # %entry
; CHECK-SKX-NEXT:  vpxor %xmm0, %xmm0, %xmm0
; CHECK-SKX-NEXT:
```

```

    movq $-1024, %rax # imm = 0xFC00
; CHECK-SKX-NEXT: .p2align 4, 0x90
; CHECK-SKX-NEXT: .LBB11_1: # %vector.body
; CHECK-SKX-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-SKX-NEXT: vmovdqu a+1024(%rax), %xmm1
; CHECK-SKX-NEXT: vpsadbw b+1024(%rax), %xmm1, %xmm1
; CHECK-SKX-NEXT: vpadd %zmm0, %zmm1, %zmm0
; CHECK-SKX-NEXT: addq $4, %rax
; CHECK-SKX-NEXT: jne .LBB11_1
; CHECK-SKX-NEXT: # %bb.2: # %middle.block
; CHECK-SKX-NEXT: vextracti64x4 $1, %zmm0, %ymm1
; CHECK-SKX-NEXT: vpadd %zmm1, %zmm0, %zmm0
; CHECK-SKX-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-SKX-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT: vpslq $32, %xmm0, %xmm1
; CHECK-SKX-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT: vmovd %xmm0, %eax
; CHECK-SKX-NEXT: vzeroupper
; CHECK-SKX-NEXT: retq
;
; CHECK-AVX512-LABEL: sad_16i8_512:
; CHECK-AVX512:
    # %bb.0: # %entry
; CHECK-AVX512-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-AVX512-NEXT: movq $-1024, %rax # imm = 0xFC00
; CHECK-AVX512-NEXT: .p2align 4, 0x90
; CHECK-AVX512-NEXT: .LBB11_1: # %vector.body
; CHECK-AVX512-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-AVX512-NEXT: vmovdqu a+1024(%rax), %xmm1
; CHECK-AVX512-NEXT: vpsadbw b+1024(%rax), %xmm1, %xmm1
; CHECK-AVX512-NEXT: vpadd %zmm0, %zmm1, %zmm0
; CHECK-AVX512-NEXT: addq $4, %rax
; CHECK-AVX512-NEXT: jne .LBB11_1
; CHECK-AVX512-NEXT: # %bb.2: # %middle.block
; CHECK-AVX512-NEXT: vextracti64x4 $1, %zmm0, %ymm1
; CHECK-AVX512-NEXT: vpadd %zmm1, %zmm0, %zmm0
; CHECK-AVX512-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-AVX512-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpslq $32, %xmm0, %xmm1
; CHECK-AVX512-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vmovd %xmm0, %eax
; CHECK-AVX512-NEXT: vzeroupper
; CHECK-AVX512-NEXT: retq

```

```

;
; CHECK-VBMI-LABEL: sad_16i8_512:
; CHECK-VBMI:      # %bb.0: # %entry
; CHECK-VBMI-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-VBMI-NEXT: movq $-1024, %rax # imm = 0xFC00
; CHECK-VBMI-NEXT: .p2align 4, 0x90
; CHECK-VBMI-NEXT: .LBB11_1: # %vector.body
; CHECK-VBMI-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-VBMI-NEXT: vmovdqu a+1024(%rax), %xmm1
; CHECK-VBMI-NEXT: vpsadbw b+1024(%rax), %xmm1, %xmm1
; CHECK-VBMI-NEXT: vpadd %zmm0, %zmm1, %zmm0
; CHECK-VBMI-NEXT: addq $4, %rax
; CHECK-VBMI-NEXT: jne .LBB11_1
; CHECK-VBMI-NEXT: # %bb.2: # %middle.block
; CHECK-VBMI-NEXT: vextracti64x4 $1, %zmm0, %ymm1
; CHECK-VBMI-NEXT: vpadd %zmm1, %zmm0, %zmm0
; CHECK-VBMI-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-VBMI-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vpslufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-VBMI-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT:
    vpslufd {{.*#+}} xmm1 = xmm0[1,1,1,1]
; CHECK-VBMI-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vmovd %xmm0, %eax
; CHECK-VBMI-NEXT: vzeroupper
; CHECK-VBMI-NEXT: retq
entry:
br label %vector.body

vector.body:
%index = phi i64 [ 0, %entry ], [ %index.next, %vector.body ]
%vec.phi = phi <16 x i32> [ zeroinitializer, %entry ], [ %10, %vector.body ]
%0 = getelementptr inbounds [1024 x i8], [1024 x i8]* @a, i64 0, i64 %index
%1 = bitcast i8* %0 to <16 x i8>*
%wide.load = load <16 x i8>, <16 x i8>* %1, align 4
%2 = zext <16 x i8> %wide.load to <16 x i32>
%3 = getelementptr inbounds [1024 x i8], [1024 x i8]* @b, i64 0, i64 %index
%4 = bitcast i8* %3 to <16 x i8>*
%wide.load1 = load <16 x i8>, <16 x i8>* %4, align 4
%5 = zext <16 x i8> %wide.load1 to <16 x i32>
%6 = sub nsw <16 x i32> %2, %5
%7 = icmp sgt <16 x i32> %6, <i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1>
-1, i32 -1, i32 -1, i32
-1, i32 -1>
%8 = sub nsw <16 x i32> zeroinitializer, %6
%9 = select <16 x i1> %7, <16 x i32> %6, <16 x i32> %8
%10 = add nsw <16 x i32> %9, %vec.phi
%index.next = add i64 %index, 4

```

```
%11 = icmp eq i64 %index.next, 1024
br i1 %11, label %middle.block, label %vector.body
```

middle.block:

```
%rdx.shuf = shufflevector <16 x i32> %10, <16 x i32> undef, <16 x i32> <i32 8, i32 9, i32 10, i32 11, i32 12, i32
13, i32 14, i32 15, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx = add <16 x i32> %10, %rdx.shuf
%rdx.shuf2 = shufflevector <16 x i32> %bin.rdx, <16 x i32> undef, <16 x i32> <i32 4, i32 5, i32 6, i32 7, i32
undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef>
%bin.rdx2 = add <16 x i32> %bin.rdx, %rdx.shuf2
%rdx.shuf3 = shufflevector <16 x i32> %bin.rdx2, <16 x i32> undef, <16 x i32> <i32 2, i32 3, i32 undef, i32
undef, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx3 = add <16 x i32> %bin.rdx2, %rdx.shuf3
%rdx.shuf4 = shufflevector <16 x i32> %bin.rdx3, <16 x i32> undef, <16 x i32> <i32 1, i32 undef, i32 undef, i32
undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef>
%bin.rdx4 = add <16 x i32> %bin.rdx3, %rdx.shuf4
%12 = extractelement <16 x i32> %bin.rdx4, i32 0
ret i32 %12
}
```

```
define dso_local void @sbto16f32_256(<16 x i16> %a, <16 x float>* %res) "min-legal-vector-width"="256" {
; CHECK-LABEL: sbto16f32_256:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpmovw2m %ymm0, %k0
; CHECK-NEXT:  kshiftrw $8, %k0, %k1
; CHECK-NEXT:  vpmovm2d %k1, %ymm0
; CHECK-NEXT:  vcvt dq2ps %ymm0, %ymm0
; CHECK-NEXT:  vpmovm2d %k0, %ymm1
; CHECK-NEXT:  vcvt dq2ps %ymm1, %ymm1
; CHECK-NEXT:  vmovaps %ymm1, (%rdi)
; CHECK-NEXT:  vmovaps %ymm0, 32(%rdi)
; CHECK-NEXT:
    vzeroupper
; CHECK-NEXT:  retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = sitofp <16 x i1> %mask to <16 x float>
store <16 x float> %1, <16 x float>* %res
ret void
}
```

```
define dso_local void @sbto16f32_512(<16 x i16> %a, <16 x float>* %res) "min-legal-vector-width"="512" {
; CHECK-LABEL: sbto16f32_512:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpmovw2m %ymm0, %k0
; CHECK-NEXT:  vpmovm2d %k0, %zmm0
```

```

; CHECK-NEXT:   vcvtdq2ps %xmm0, %xmm0
; CHECK-NEXT:   vmovaps %xmm0, (%rdi)
; CHECK-NEXT:   vzeroupper
; CHECK-NEXT:   retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = sitofp <16 x i1> %mask to <16 x float>
store <16 x float> %1, <16 x float>* %res
ret void
}

```

```

define dso_local void @sbto16f64_256(<16 x i16> %a, <16 x double>* %res) "min-legal-vector-width"="256" {
; CHECK-LABEL: sbto16f64_256:
; CHECK:      # %bb.0:
; CHECK-NEXT:   vpmovw2m %ymm0, %k0
; CHECK-NEXT:   kshiftrw $8, %k0, %k1
; CHECK-NEXT:   vpmovm2d %k1, %ymm0
; CHECK-NEXT:
    vcvtdq2pd %xmm0, %ymm1
; CHECK-NEXT:   vextracti128 $1, %ymm0, %xmm0
; CHECK-NEXT:   vcvtdq2pd %xmm0, %ymm0
; CHECK-NEXT:   vpmovm2d %k0, %ymm2
; CHECK-NEXT:   vcvtdq2pd %xmm2, %ymm3
; CHECK-NEXT:   vextracti128 $1, %ymm2, %xmm2
; CHECK-NEXT:   vcvtdq2pd %xmm2, %ymm2
; CHECK-NEXT:   vmovaps %ymm2, 32(%rdi)
; CHECK-NEXT:   vmovaps %ymm3, (%rdi)
; CHECK-NEXT:   vmovaps %ymm0, 96(%rdi)
; CHECK-NEXT:   vmovaps %ymm1, 64(%rdi)
; CHECK-NEXT:   vzeroupper
; CHECK-NEXT:   retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = sitofp <16 x i1> %mask to <16 x double>
store <16 x double> %1, <16 x double>* %res
ret void
}

```

```

define dso_local void @sbto16f64_512(<16 x i16> %a, <16 x double>* %res) "min-legal-vector-width"="512" {
; CHECK-LABEL: sbto16f64_512:
; CHECK:      # %bb.0:
; CHECK-NEXT:   vpmovw2m %ymm0, %k0
; CHECK-NEXT:   vpmovm2d %k0, %zmm0
; CHECK-NEXT:   vcvtdq2pd %ymm0, %zmm1
; CHECK-NEXT:   vextracti64x4 $1, %zmm0, %ymm0
; CHECK-NEXT:   vcvtdq2pd
    %ymm0, %zmm0
; CHECK-NEXT:   vmovaps %zmm0, 64(%rdi)
; CHECK-NEXT:   vmovaps %zmm1, (%rdi)
; CHECK-NEXT:   vzeroupper

```



```

; CHECK-NEXT:    retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = sitofp <16 x i1> %mask to <16 x double>
store <16 x double> %1, <16 x double>* %res
ret void
}

define dso_local void @ubto16f32_256(<16 x i16> %a, <16 x float>* %res) "min-legal-vector-width"="256" {
; CHECK-LABEL: ubto16f32_256:
; CHECK:        # %bb.0:
; CHECK-NEXT:    vpmovw2m %ymm0, %k0
; CHECK-NEXT:    kshiftrw $8, %k0, %k1
; CHECK-NEXT:    vpmovm2d %k1, %ymm0
; CHECK-NEXT:    vpsrld $31, %ymm0, %ymm0
; CHECK-NEXT:    vcvt dq2ps %ymm0, %ymm0
; CHECK-NEXT:    vpmovm2d %k0, %ymm1
; CHECK-NEXT:    vpsrld $31, %ymm1, %ymm1
; CHECK-NEXT:    vcvt dq2ps %ymm1, %ymm1
; CHECK-NEXT:    vmovaps %ymm1, (%rdi)
; CHECK-NEXT:    vmovaps %ymm0, 32(%rdi)
; CHECK-NEXT:    vzeroupper
; CHECK-NEXT:    retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = uitofp <16 x i1> %mask to <16 x float>
store <16 x float> %1, <16 x float>* %res
ret void
}

define dso_local void @ubto16f32_512(<16 x i16> %a, <16 x float>* %res) "min-legal-vector-width"="512" {
; CHECK-LABEL: ubto16f32_512:
; CHECK:        # %bb.0:
; CHECK-NEXT:    vpmovw2m %ymm0, %k0
; CHECK-NEXT:    vpmovm2d %k0, %zmm0
; CHECK-NEXT:    vpsrld $31, %zmm0, %zmm0
; CHECK-NEXT:    vcvt dq2ps %zmm0, %zmm0
; CHECK-NEXT:    vmovaps %zmm0, (%rdi)
; CHECK-NEXT:    vzeroupper
; CHECK-NEXT:    retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = uitofp <16 x i1> %mask to <16 x float>
store <16 x float> %1, <16 x float>* %res
ret void
}

define dso_local void @ubto16f64_256(<16 x i16> %a, <16 x double>* %res) "min-legal-vector-width"="256" {
; CHECK-LABEL: ubto16f64_256:
; CHECK:        # %bb.0:
; CHECK-NEXT:    vpmovw2m %ymm0, %k0

```

```

; CHECK-NEXT: kshiftrw $8, %k0, %k1
; CHECK-NEXT: vpmovm2d %k1, %ymm0
; CHECK-NEXT: vpsrld $31, %ymm0, %ymm0
; CHECK-NEXT: vcvtdq2pd %xmm0, %ymm1
; CHECK-NEXT: vextracti128
$1, %ymm0, %xmm0
; CHECK-NEXT: vcvtdq2pd %xmm0, %ymm0
; CHECK-NEXT: vpmovm2d %k0, %ymm2
; CHECK-NEXT: vpsrld $31, %ymm2, %ymm2
; CHECK-NEXT: vcvtdq2pd %xmm2, %ymm3
; CHECK-NEXT: vextracti128 $1, %ymm2, %xmm2
; CHECK-NEXT: vcvtdq2pd %xmm2, %ymm2
; CHECK-NEXT: vmovaps %ymm2, 32(%rdi)
; CHECK-NEXT: vmovaps %ymm3, (%rdi)
; CHECK-NEXT: vmovaps %ymm0, 96(%rdi)
; CHECK-NEXT: vmovaps %ymm1, 64(%rdi)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = uitofp <16 x i1> %mask to <16 x double>
store <16 x double> %1, <16 x double>* %res
ret void
}

```

```

define dso_local void @ubto16f64_512(<16 x i16> %a, <16 x double>* %res) "min-legal-vector-width"="512" {
; CHECK-LABEL: ubto16f64_512:
; CHECK:      # %bb.0:
; CHECK-NEXT: vpmovw2m %ymm0, %k0
; CHECK-NEXT: vpmovm2d %k0, %zmm0
; CHECK-NEXT: vpsrld $31, %zmm0, %zmm0
; CHECK-NEXT: vcvtdq2pd %ymm0, %zmm1
; CHECK-NEXT: vextracti64x4 $1, %zmm0, %ymm0
; CHECK-NEXT:
    vcvtdq2pd %ymm0, %zmm0
; CHECK-NEXT: vmovaps %zmm0, 64(%rdi)
; CHECK-NEXT: vmovaps %zmm1, (%rdi)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = uitofp <16 x i1> %mask to <16 x double>
store <16 x double> %1, <16 x double>* %res
ret void
}

```

```

define <16 x i16> @test_16f32toub_256(<16 x float>* %ptr, <16 x i16> %passthru) "min-legal-vector-
width"="256" {
; CHECK-LABEL: test_16f32toub_256:
; CHECK:      # %bb.0:

```

```

; CHECK-NEXT: vcvttps2dq (%rdi), %ymm1
; CHECK-NEXT: vpslld $31, %ymm1, %ymm1
; CHECK-NEXT: vpmovd2m %ymm1, %k0
; CHECK-NEXT: vcvttps2dq 32(%rdi), %ymm1
; CHECK-NEXT: vpslld $31, %ymm1, %ymm1
; CHECK-NEXT: vpmovd2m %ymm1, %k1
; CHECK-NEXT: kunpckbw %k0, %k1, %k1
; CHECK-NEXT: vmovdqu16 %ymm0, %ymm0 {%k1} {z}
; CHECK-NEXT: retq
%a = load <16 x float>, <16 x float>* %ptr
%mask = fptoui <16 x float> %a to <16 x i1>
%select = select <16 x i1> %mask, <16 x i16> %passthru,
<16 x i16> zeroinitializer
ret <16 x i16> %select
}

```

```

define <16 x i16> @test_16f32toub_512(<16 x float>* %ptr, <16 x i16> %passthru) "min-legal-vector-
width"="512" {
; CHECK-LABEL: test_16f32toub_512:
; CHECK:      # %bb.0:
; CHECK-NEXT: vcvttps2dq (%rdi), %zmm1
; CHECK-NEXT: vpslld $31, %zmm1, %zmm1
; CHECK-NEXT: vpmovd2m %zmm1, %k1
; CHECK-NEXT: vmovdqu16 %ymm0, %ymm0 {%k1} {z}
; CHECK-NEXT: retq
%a = load <16 x float>, <16 x float>* %ptr
%mask = fptoui <16 x float> %a to <16 x i1>
%select = select <16 x i1> %mask, <16 x i16> %passthru, <16 x i16> zeroinitializer
ret <16 x i16> %select
}

```

```

define <16 x i16> @test_16f32tosb_256(<16 x float>* %ptr, <16 x i16> %passthru) "min-legal-vector-
width"="256" {
; CHECK-LABEL: test_16f32tosb_256:
; CHECK:      # %bb.0:
; CHECK-NEXT: vcvttps2dq (%rdi), %ymm1
; CHECK-NEXT: vpmovd2m %ymm1, %k0
; CHECK-NEXT: vcvttps2dq 32(%rdi), %ymm1
; CHECK-NEXT: vpmovd2m %ymm1, %k1
; CHECK-NEXT: kunpckbw %k0, %k1, %k1
; CHECK-NEXT:
    vmovdqu16 %ymm0, %ymm0 {%k1} {z}
; CHECK-NEXT: retq
%a = load <16 x float>, <16 x float>* %ptr
%mask = fptosi <16 x float> %a to <16 x i1>
%select = select <16 x i1> %mask, <16 x i16> %passthru, <16 x i16> zeroinitializer
ret <16 x i16> %select
}

```

```

define <16 x i16> @test_16f32tosb_512(<16 x float>* %ptr, <16 x i16> %passthru) "min-legal-vector-
width"="512" {
; CHECK-LABEL: test_16f32tosb_512:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vcvttps2dq (%rdi), %zmm1
; CHECK-NEXT:  vpmovd2m %zmm1, %k1
; CHECK-NEXT:  vmovdqu16 %ymm0, %ymm0 {%k1} {z}
; CHECK-NEXT:  retq
%a = load <16 x float>, <16 x float>* %ptr
%mask = fptosi <16 x float> %a to <16 x i1>
%select = select <16 x i1> %mask, <16 x i16> %passthru, <16 x i16> zeroinitializer
ret <16 x i16> %select
}

```

```

define dso_local void @mul256(<64 x i8>* %a, <64 x i8>* %b, <64 x i8>* %c) "min-legal-vector-width"="256" {
; CHECK-SKX-VBMI-LABEL: mul256:
; CHECK-SKX-VBMI:      # %bb.0:
; CHECK-SKX-VBMI-NEXT:  vmovdqa
(%rdi), %ymm0
; CHECK-SKX-VBMI-NEXT:  vmovdqa 32(%rdi), %ymm1
; CHECK-SKX-VBMI-NEXT:  vmovdqa (%rsi), %ymm2
; CHECK-SKX-VBMI-NEXT:  vmovdqa 32(%rsi), %ymm3
; CHECK-SKX-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm4 =
ymm3[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-SKX-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm5 =
ymm1[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-SKX-VBMI-NEXT:  vpmullw %ymm4, %ymm5, %ymm4
; CHECK-SKX-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm3 =
ymm3[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-SKX-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm1 =
ymm1[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-SKX-VBMI-NEXT:  vpmullw %ymm3, %ymm1, %ymm1
; CHECK-SKX-VBMI-NEXT:  vmovdqa {{.*#+}} ymm3 =
[0,2,4,6,8,10,12,14,32,34,36,38,40,42,44,46,16,18,20,22,24,26,28,30,48,50,52,54,56,58,60,62]
;
CHECK-SKX-VBMI-NEXT:  vpermt2b %ymm4, %ymm3, %ymm1
; CHECK-SKX-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm4 =
ymm2[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-SKX-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm5 =
ymm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-SKX-VBMI-NEXT:  vpmullw %ymm4, %ymm5, %ymm4
; CHECK-SKX-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm2 =
ymm2[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-SKX-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm0 =
ymm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-SKX-VBMI-NEXT:  vpmullw %ymm2, %ymm0, %ymm0
; CHECK-SKX-VBMI-NEXT:  vpermt2b %ymm4, %ymm3, %ymm0

```

```

; CHECK-SKX-VBMI-NEXT: vmovdqa %ymm0, (%rdx)
; CHECK-SKX-VBMI-NEXT: vmovdqa %ymm1, 32(%rdx)
; CHECK-SKX-VBMI-NEXT: vzeroupper
; CHECK-SKX-VBMI-NEXT: retq
;
; CHECK-AVX512-LABEL: mul256:
; CHECK-AVX512:
    # %bb.0:
; CHECK-AVX512-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-AVX512-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-AVX512-NEXT: vmovdqa (%rsi), %ymm2
; CHECK-AVX512-NEXT: vmovdqa 32(%rsi), %ymm3
; CHECK-AVX512-NEXT: vpunpckhbw {{.*#+}} ymm4 =
ymm3[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-AVX512-NEXT: vpunpckhbw {{.*#+}} ymm5 =
ymm1[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-AVX512-NEXT: vpmullw %ymm4, %ymm5, %ymm4
; CHECK-AVX512-NEXT: vpbroadcastw {{.*#+}} ymm5 =
[255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255]
; CHECK-AVX512-NEXT: vpand %ymm5, %ymm4, %ymm4
; CHECK-AVX512-NEXT: vpunpcklbw {{.*#+}} ymm3 =
ymm3[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-AVX512-NEXT: vpunpcklbw {{.*#+}} ymm1 =
ymm1[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
;
CHECK-AVX512-NEXT: vpmullw %ymm3, %ymm1, %ymm1
; CHECK-AVX512-NEXT: vpand %ymm5, %ymm1, %ymm1
; CHECK-AVX512-NEXT: vpackuswb %ymm4, %ymm1, %ymm1
; CHECK-AVX512-NEXT: vpunpckhbw {{.*#+}} ymm3 =
ymm2[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-AVX512-NEXT: vpunpckhbw {{.*#+}} ymm4 =
ymm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-AVX512-NEXT: vpmullw %ymm3, %ymm4, %ymm3
; CHECK-AVX512-NEXT: vpand %ymm5, %ymm3, %ymm3
; CHECK-AVX512-NEXT: vpunpcklbw {{.*#+}} ymm2 =
ymm2[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-AVX512-NEXT: vpunpcklbw {{.*#+}} ymm0 =
ymm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-AVX512-NEXT: vpmullw %ymm2, %ymm0, %ymm0
; CHECK-AVX512-NEXT: vpand %ymm5, %ymm0, %ymm0
; CHECK-AVX512-NEXT: vpackuswb %ymm3, %ymm0, %ymm0
; CHECK-AVX512-NEXT:
    vmovdqa %ymm0, (%rdx)
; CHECK-AVX512-NEXT: vmovdqa %ymm1, 32(%rdx)
; CHECK-AVX512-NEXT: vzeroupper
; CHECK-AVX512-NEXT: retq
;
; CHECK-VBMI-LABEL: mul256:

```

```

; CHECK-VBMI:    # %bb.0:
; CHECK-VBMI-NEXT:  vmovdqa (%rdi), %ymm0
; CHECK-VBMI-NEXT:  vmovdqa 32(%rdi), %ymm1
; CHECK-VBMI-NEXT:  vmovdqa (%rsi), %ymm2
; CHECK-VBMI-NEXT:  vmovdqa 32(%rsi), %ymm3
; CHECK-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm4 =
ymm3[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm5 =
ymm1[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-VBMI-NEXT:  vpmullw %ymm4, %ymm5, %ymm4
; CHECK-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm3 =
ymm3[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm1 =
ymm1[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
;
CHECK-VBMI-NEXT:  vpmullw %ymm3, %ymm1, %ymm1
; CHECK-VBMI-NEXT:  vmovdqa {{.*#+}} ymm3 =
[0,2,4,6,8,10,12,14,32,34,36,38,40,42,44,46,16,18,20,22,24,26,28,30,48,50,52,54,56,58,60,62]
; CHECK-VBMI-NEXT:  vpermt2b %ymm4, %ymm3, %ymm1
; CHECK-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm4 =
ymm2[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm5 =
ymm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-VBMI-NEXT:  vpmullw %ymm4, %ymm5, %ymm4
; CHECK-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm2 =
ymm2[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm0 =
ymm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-VBMI-NEXT:  vpmullw %ymm2, %ymm0, %ymm0
; CHECK-VBMI-NEXT:  vpermt2b %ymm4, %ymm3, %ymm0
; CHECK-VBMI-NEXT:  vmovdqa %ymm0, (%rdx)
;
CHECK-VBMI-NEXT:  vmovdqa %ymm1, 32(%rdx)
; CHECK-VBMI-NEXT:  vzeroupper
; CHECK-VBMI-NEXT:  retq
%d = load <64 x i8>, <64 x i8>* %a
%e = load <64 x i8>, <64 x i8>* %b
%f = mul <64 x i8> %d, %e
store <64 x i8> %f, <64 x i8>* %c
ret void
}

```

```

define dso_local void @mul512(<64 x i8>* %a, <64 x i8>* %b, <64 x i8>* %c) "min-legal-vector-width"="512" {

```

```

; CHECK-SKX-VBMI-LABEL: mul512:
; CHECK-SKX-VBMI:    # %bb.0:
; CHECK-SKX-VBMI-NEXT:  vmovdqa64 (%rdi), %zmm0
; CHECK-SKX-VBMI-NEXT:  vmovdqa64 (%rsi), %zmm1
; CHECK-SKX-VBMI-NEXT:  vpunpckhbw {{.*#+}} zmm2 =

```

```

zmm1[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31,40,40,41,41,4
2,42,43,43,44,44,45,45,46,46,47,47,56,56,57,57,58,58,59,59,60,60,61,61,62,62,63,63]
; CHECK-SKX-VBMI-NEXT:  vpunpckhbw {{.*#+}} zmm3 =
zmm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31,40,40,41,41,4
2,42,43,43,44,44,45,45,46,46,47,47,56,56,57,57,58,58,59,59,60,60,61,61,62,62,63,63]
;
CHECK-SKX-VBMI-NEXT:  vmullw %zmm2, %zmm3, %zmm2
; CHECK-SKX-VBMI-NEXT:  vpunpcklbw {{.*#+}} zmm1 =
zmm1[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23,32,32,33,33,34,34,35,35,36,3
6,37,37,38,38,39,39,48,48,49,49,50,50,51,51,52,52,53,53,54,54,55,55]
; CHECK-SKX-VBMI-NEXT:  vpunpcklbw {{.*#+}} zmm0 =
zmm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23,32,32,33,33,34,34,35,35,36,3
6,37,37,38,38,39,39,48,48,49,49,50,50,51,51,52,52,53,53,54,54,55,55]
; CHECK-SKX-VBMI-NEXT:  vmullw %zmm1, %zmm0, %zmm0
; CHECK-SKX-VBMI-NEXT:  vmovdqa64 {{.*#+}} zmm1 =
[0,2,4,6,8,10,12,14,64,66,68,70,72,74,76,78,16,18,20,22,24,26,28,30,80,82,84,86,88,90,92,94,32,34,36,38,40,42,44,
46,96,98,100,102,104,106,108,110,48,50,52,54,56,58,60,62,112,114,116,118,120,122,124,126]
; CHECK-SKX-VBMI-NEXT:  vperm2b %zmm2, %zmm0, %zmm1
; CHECK-SKX-VBMI-NEXT:  vmovdqa64 %zmm1, (%rdx)
; CHECK-SKX-VBMI-NEXT:  vzeroupper
;
CHECK-SKX-VBMI-NEXT:  retq
;
; CHECK-AVX512-LABEL: mul512:
; CHECK-AVX512:  # %bb.0:
; CHECK-AVX512-NEXT:  vmovdqa64 (%rdi), %zmm0
; CHECK-AVX512-NEXT:  vmovdqa64 (%rsi), %zmm1
; CHECK-AVX512-NEXT:  vpunpckhbw {{.*#+}} zmm2 =
zmm1[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31,40,40,41,41,4
2,42,43,43,44,44,45,45,46,46,47,47,56,56,57,57,58,58,59,59,60,60,61,61,62,62,63,63]
; CHECK-AVX512-NEXT:  vpunpckhbw {{.*#+}} zmm3 =
zmm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31,40,40,41,41,4
2,42,43,43,44,44,45,45,46,46,47,47,56,56,57,57,58,58,59,59,60,60,61,61,62,62,63,63]
; CHECK-AVX512-NEXT:  vmullw %zmm2, %zmm3, %zmm2
; CHECK-AVX512-NEXT:  vpbroadcastw {{.*#+}} zmm3 =
[255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,2
55,255,255,255,255]
; CHECK-AVX512-NEXT:  vpandq %zmm3, %zmm2, %zmm2
; CHECK-AVX512-NEXT:  vpunpcklbw
{{.*#+}} zmm1 =
zmm1[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23,32,32,33,33,34,34,35,35,36,3
6,37,37,38,38,39,39,48,48,49,49,50,50,51,51,52,52,53,53,54,54,55,55]
; CHECK-AVX512-NEXT:  vpunpcklbw {{.*#+}} zmm0 =
zmm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23,32,32,33,33,34,34,35,35,36,3
6,37,37,38,38,39,39,48,48,49,49,50,50,51,51,52,52,53,53,54,54,55,55]
; CHECK-AVX512-NEXT:  vmullw %zmm1, %zmm0, %zmm0
; CHECK-AVX512-NEXT:  vpandq %zmm3, %zmm0, %zmm0
; CHECK-AVX512-NEXT:  vpackuswb %zmm2, %zmm0, %zmm0

```

```

; CHECK-AVX512-NEXT: vmovdqa64 %zmm0, (%rdx)
; CHECK-AVX512-NEXT: vzeroupper
; CHECK-AVX512-NEXT: retq
;
; CHECK-VBMI-LABEL: mul512:
; CHECK-VBMI:    # %bb.0:
; CHECK-VBMI-NEXT: vmovdqa64 (%rdi), %zmm0
; CHECK-VBMI-NEXT: vmovdqa64 (%rsi), %zmm1
; CHECK-VBMI-NEXT: vpunpckhbw {{.*#+}} %zmm2 =
zmm1[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31,40,40,41,41,4
2,42,43,43,44,44,45,45,46,46,47,47,56,56,57,57,58,58,59,59,60,60,61,61,62,62,63,63]
;
CHECK-VBMI-NEXT: vpunpckhbw {{.*#+}} %zmm3 =
zmm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31,40,40,41,41,4
2,42,43,43,44,44,45,45,46,46,47,47,56,56,57,57,58,58,59,59,60,60,61,61,62,62,63,63]
; CHECK-VBMI-NEXT: vpmullw %zmm2, %zmm3, %zmm2
; CHECK-VBMI-NEXT: vpunpcklbw {{.*#+}} %zmm1 =
zmm1[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23,32,32,33,33,34,34,35,35,36,3
6,37,37,38,38,39,39,48,48,49,49,50,50,51,51,52,52,53,53,54,54,55,55]
; CHECK-VBMI-NEXT: vpunpcklbw {{.*#+}} %zmm0 =
zmm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23,32,32,33,33,34,34,35,35,36,3
6,37,37,38,38,39,39,48,48,49,49,50,50,51,51,52,52,53,53,54,54,55,55]
; CHECK-VBMI-NEXT: vpmullw %zmm1, %zmm0, %zmm0
; CHECK-VBMI-NEXT: vmovdqa64 {{.*#+}} %zmm1 =
[0,2,4,6,8,10,12,14,64,66,68,70,72,74,76,78,16,18,20,22,24,26,28,30,80,82,84,86,88,90,92,94,32,34,36,38,40,42,44,
46,96,98,100,102,104,106,108,110,48,50,52,54,56,58,60,62,112,114,116,118,120,122,124,126]
;
CHECK-VBMI-NEXT: vpermi2b %zmm2, %zmm0, %zmm1
; CHECK-VBMI-NEXT: vmovdqa64 %zmm1, (%rdx)
; CHECK-VBMI-NEXT: vzeroupper
; CHECK-VBMI-NEXT: retq
%d = load <64 x i8>, <64 x i8>* %a
%e = load <64 x i8>, <64 x i8>* %b
%f = mul <64 x i8> %d, %e
store <64 x i8> %f, <64 x i8>* %c
ret void
}

```

; This threw an assertion at one point.

```
define <4 x i32> @mload_v4i32(<4 x i32> %trigger, <4 x i32>* %addr, <4 x i32> %dst) "min-legal-vector-
width"="256" {
```

```

; CHECK-LABEL: mload_v4i32:
; CHECK:    # %bb.0:
; CHECK-NEXT: vptestnmd %xmm0, %xmm0, %k1
; CHECK-NEXT: vpbblendmd (%rdi), %xmm1, %xmm0 {%k1}
; CHECK-NEXT: retq
%mask = icmp eq <4 x i32> %trigger, zeroinitializer
%res = call <4 x i32> @llvm.masked.load.v4i32.p0v4i32(<4 x i32>* %addr, i32 4, <4 x i1> %mask, <4 x i32>

```



```

%dst)
ret <4 x i32> %res
}
declare <4 x i32>
@llvm.masked.load.v4i32.p0v4i32(<4 x i32>*, i32, <4 x i1>, <4 x i32>)

define <16 x i32> @trunc_v16i64_v16i32(<16 x i64>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v16i64_v16i32:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT: vmovdqa 64(%rdi), %ymm2
; CHECK-NEXT: vmovdqa 96(%rdi), %ymm3
; CHECK-NEXT: vpmovqd %ymm0, %xmm0
; CHECK-NEXT: vpmovqd %ymm1, %xmm1
; CHECK-NEXT: vinserti128 $1, %xmm1, %ymm0, %ymm0
; CHECK-NEXT: vpmovqd %ymm2, %xmm1
; CHECK-NEXT: vpmovqd %ymm3, %xmm2
; CHECK-NEXT: vinserti128 $1, %xmm2, %ymm1, %ymm1
; CHECK-NEXT: retq
%a = load <16 x i64>, <16 x i64>* %x
%b = trunc <16 x i64> %a to <16 x i32>
ret <16 x i32> %b
}

define <16 x i8> @trunc_v16i64_v16i8(<16 x i64>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v16i64_v16i8:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rdi),
%ymm1
; CHECK-NEXT: vmovdqa 64(%rdi), %ymm2
; CHECK-NEXT: vmovdqa 96(%rdi), %ymm3
; CHECK-NEXT: vpmovqb %ymm3, %xmm3
; CHECK-NEXT: vpmovqb %ymm2, %xmm2
; CHECK-NEXT: vpunpckldq {{.*#+}} xmm2 = xmm2[0],xmm3[0],xmm2[1],xmm3[1]
; CHECK-NEXT: vpmovqb %ymm1, %xmm1
; CHECK-NEXT: vpmovqb %ymm0, %xmm0
; CHECK-NEXT: vpunpckldq {{.*#+}} xmm0 = xmm0[0],xmm1[0],xmm0[1],xmm1[1]
; CHECK-NEXT: vpunpckldq {{.*#+}} xmm0 = xmm0[0],xmm2[0]
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = load <16 x i64>, <16 x i64>* %x
%b = trunc <16 x i64> %a to <16 x i8>
ret <16 x i8> %b
}

define <16 x i8> @trunc_v16i32_v16i8(<16 x i32>* %x) nounwind "min-legal-vector-width"="256" {

```

```

; CHECK-LABEL: trunc_v16i32_v16i8:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT: vpmovdb %ymm1, %xmm1
; CHECK-NEXT: vpmovdb %ymm0, %xmm0
; CHECK-NEXT: vpunpcklqdq {{.*#+}} xmm0 = xmm0[0],xmm1[0]
; CHECK-NEXT: vzeroupper
;
CHECK-NEXT:  retq
%a = load <16 x i32>, <16 x i32>* %x
%b = trunc <16 x i32> %a to <16 x i8>
ret <16 x i8> %b
}

define <8 x i8> @trunc_v8i64_v8i8(<8 x i64>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v8i64_v8i8:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT: vpmovqb %ymm1, %xmm1
; CHECK-NEXT: vpmovqb %ymm0, %xmm0
; CHECK-NEXT: vpunpckldq {{.*#+}} xmm0 = xmm0[0],xmm1[0],xmm0[1],xmm1[1]
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = load <8 x i64>, <8 x i64>* %x
%b = trunc <8 x i64> %a to <8 x i8>
ret <8 x i8> %b
}

define <8 x i16> @trunc_v8i64_v8i16(<8 x i64>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v8i64_v8i16:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT: vpmovqw %ymm1, %xmm1
; CHECK-NEXT: vpmovqw %ymm0, %xmm0
; CHECK-NEXT: vpunpcklqdq {{.*#+}} xmm0
= xmm0[0],xmm1[0]
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = load <8 x i64>, <8 x i64>* %x
%b = trunc <8 x i64> %a to <8 x i16>
ret <8 x i16> %b
}

define <8 x i32> @trunc_v8i64_v8i32_zeroes(<8 x i64>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v8i64_v8i32_zeroes:

```

```

; CHECK:      # %bb.0:
; CHECK-NEXT:  vpsrlq $48, 32(%rdi), %ymm0
; CHECK-NEXT:  vpsrlq $48, (%rdi), %ymm1
; CHECK-NEXT:  vpackusdw %ymm0, %ymm1, %ymm0
; CHECK-NEXT:  vpermq {{.*#+}} ymm0 = ymm0[0,2,1,3]
; CHECK-NEXT:  retq
%a = load <8 x i64>, <8 x i64>* %x
%b = lshr <8 x i64> %a, <i64 48, i64 48, i64 48, i64 48, i64 48, i64 48, i64 48, i64 48>
%c = trunc <8 x i64> %b to <8 x i32>
ret <8 x i32> %c
}

define <16 x i16> @trunc_v16i32_v16i16_zeroes(<16 x i32>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v16i32_v16i16_zeroes:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vmovdqa (%rdi), %ymm1
; CHECK-NEXT:  vmovdqa {{.*#+}} ymm0 = [1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31]
;
; CHECK-NEXT:  vpermi2w 32(%rdi), %ymm1, %ymm0
; CHECK-NEXT:  retq
%a = load <16 x i32>, <16 x i32>* %x
%b = lshr <16 x i32> %a, <i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16>
%c = trunc <16 x i32> %b to <16 x i16>
ret <16 x i16> %c
}

define <32 x i8> @trunc_v32i16_v32i8_zeroes(<32 x i16>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-SKX-VBMI-LABEL: trunc_v32i16_v32i8_zeroes:
; CHECK-SKX-VBMI:      # %bb.0:
; CHECK-SKX-VBMI-NEXT:  vmovdqa (%rdi), %ymm1
; CHECK-SKX-VBMI-NEXT:  vmovdqa {{.*#+}} ymm0 =
[1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39,41,43,45,47,49,51,53,55,57,59,61,63]
; CHECK-SKX-VBMI-NEXT:  vpermi2b 32(%rdi), %ymm1, %ymm0
; CHECK-SKX-VBMI-NEXT:  retq
;
; CHECK-AVX512-LABEL: trunc_v32i16_v32i8_zeroes:
; CHECK-AVX512:      # %bb.0:
; CHECK-AVX512-NEXT:  vpsrlw $8, 32(%rdi), %ymm0
; CHECK-AVX512-NEXT:  vpsrlw $8, (%rdi),
%ymm1
; CHECK-AVX512-NEXT:  vpackuswb %ymm0, %ymm1, %ymm0
; CHECK-AVX512-NEXT:  vpermq {{.*#+}} ymm0 = ymm0[0,2,1,3]
; CHECK-AVX512-NEXT:  retq
;
; CHECK-VBMI-LABEL: trunc_v32i16_v32i8_zeroes:
; CHECK-VBMI:      # %bb.0:
; CHECK-VBMI-NEXT:  vmovdqa (%rdi), %ymm1

```



```

; CHECK-SKX-VBMI-NEXT:    retq
;
; CHECK-AVX512-LABEL: trunc_v32i16_v32i8_sign:
; CHECK-AVX512:    # %bb.0:
; CHECK-AVX512-NEXT:    vpsrlw $8, 32(%rdi), %ymm0
; CHECK-AVX512-NEXT:    vpsrlw $8, (%rdi), %ymm1
; CHECK-AVX512-NEXT:    vpackuswb %ymm0, %ymm1, %ymm0
; CHECK-AVX512-NEXT:    vpermq {{.*#+}} ymm0 = ymm0[0,2,1,3]
; CHECK-AVX512-NEXT:    retq
;
; CHECK-VBMI-LABEL: trunc_v32i16_v32i8_sign:
; CHECK-VBMI:    # %bb.0:
; CHECK-VBMI-NEXT:    vmovdqa (%rdi), %ymm1
; CHECK-VBMI-NEXT:    vmovdqa {{.*#+}} ymm0 =
[1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39,41,43,45,47,49,51,53,55,57,59,61,63]
;
CHECK-VBMI-NEXT:    vpermi2b 32(%rdi), %ymm1, %ymm0
; CHECK-VBMI-NEXT:    retq

%a = load <32 x i16>, <32 x i16>* %x
%b = ashr <32 x i16> %a, <i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8>
%c = trunc <32 x i16> %b to <32 x i8>
ret <32 x i8> %c
}

```

```
define dso_local void @zext_v16i8_v16i64(<16 x i8> %x, <16 x i64>* %y) nounwind "min-legal-vector-
width"="256" {
; CHECK-LABEL: zext_v16i8_v16i64:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpmovzxbw {{.*#+}} ymm1 =
xmm0[0],zero,xmm0[1],zero,xmm0[2],zero,xmm0[3],zero,xmm0[4],zero,xmm0[5],zero,xmm0[6],zero,xmm0[7],zer
o,xmm0[8],zero,xmm0[9],zero,xmm0[10],zero,xmm0[11],zero,xmm0[12],zero,xmm0[13],zero,xmm0[14],zero,xm
m0[15],zero
; CHECK-NEXT:  vpslufd {{.*#+}} xmm2 = xmm1[2,3,2,3]
; CHECK-NEXT:
    vpmovzxbw {{.*#+}} ymm2 =
xmm2[0],zero,zero,zero,xmm2[1],zero,zero,zero,xmm2[2],zero,zero,zero,xmm2[3],zero,zero,zero
; CHECK-NEXT:  vextracti128 $1, %ymm1, %xmm1
; CHECK-NEXT:  vpslufd {{.*#+}} xmm3 = xmm1[2,3,2,3]
; CHECK-NEXT:  vpmovzxbw {{.*#+}} ymm3 =
xmm3[0],zero,zero,zero,xmm3[1],zero,zero,zero,xmm3[2],zero,zero,zero,xmm3[3],zero,zero,zero
; CHECK-NEXT:  vpmovzxbw {{.*#+}} ymm1 =
xmm1[0],zero,zero,zero,xmm1[1],zero,zero,zero,xmm1[2],zero,zero,zero,xmm1[3],zero,zero,zero
; CHECK-NEXT:  vpmovzxbq {{.*#+}} ymm0 =
xmm0[0],zero,zero,zero,zero,zero,zero,zero,xmm0[1],zero,zero,zero,zero,zero,zero,zero,xmm0[2],zero,zero,zero,zer
o,zero,zero,zero,zero,zero,zero,zero,zero,zero,zero,zero,zero,zero,zero
; CHECK-NEXT:  vmovdqa %ymm0, (%rdi)
; CHECK-NEXT:  vmovdqa %ymm1, 64(%rdi)
```

```

; CHECK-NEXT: vmovdqa %ymm3, 96(%rdi)
; CHECK-NEXT: vmovdqa %ymm2, 32(%rdi)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = zext <16 x i8> %x to <16 x i64>
store <16 x i64> %a, <16 x i64>*
%y
ret void
}

```

```

define dso_local void @sext_v16i8_v16i64(<16 x i8> %x, <16 x i64>* %y) nounwind "min-legal-vector-
width"="256" {

```

```

; CHECK-LABEL: sext_v16i8_v16i64:
; CHECK:      # %bb.0:
; CHECK-NEXT: vpmovsxbw %xmm0, %ymm1
; CHECK-NEXT: vpshufd {{.*#+}} xmm2 = xmm1[2,3,2,3]
; CHECK-NEXT: vpmovsxdq %xmm2, %ymm2
; CHECK-NEXT: vextracti128 $1, %ymm1, %xmm1
; CHECK-NEXT: vpshufd {{.*#+}} xmm3 = xmm1[2,3,2,3]
; CHECK-NEXT: vpmovsxdq %xmm3, %ymm3
; CHECK-NEXT: vpmovsxdq %xmm1, %ymm1
; CHECK-NEXT: vpmovsxbq %xmm0, %ymm0
; CHECK-NEXT: vmovdqa %ymm0, (%rdi)
; CHECK-NEXT: vmovdqa %ymm1, 64(%rdi)
; CHECK-NEXT: vmovdqa %ymm3, 96(%rdi)
; CHECK-NEXT: vmovdqa %ymm2, 32(%rdi)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = sext <16 x i8> %x to <16 x i64>
store <16 x i64> %a, <16 x i64>* %y
ret void
}

```

```

define dso_local void @vselect_split_v8i16_setcc(<8 x i16> %s, <8 x i16> %t, <8 x i64>* %p, <8 x i64>* %q, <8
x i64>* %r) "min-legal-vector-width"="256"
{

```

```

; CHECK-LABEL: vselect_split_v8i16_setcc:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rsi), %ymm2
; CHECK-NEXT: vmovdqa 32(%rsi), %ymm3
; CHECK-NEXT: vpcmpeqw %xmm1, %xmm0, %k1
; CHECK-NEXT: kshiftrb $4, %k1, %k2
; CHECK-NEXT: vmovdqa64 32(%rdi), %ymm3 {%k2}
; CHECK-NEXT: vmovdqa64 (%rdi), %ymm2 {%k1}
; CHECK-NEXT: vmovdqa %ymm2, (%rdx)
; CHECK-NEXT: vmovdqa %ymm3, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq

```

```

%x = load <8 x i64>, <8 x i64>* %p
%y = load <8 x i64>, <8 x i64>* %q
%a = icmp eq <8 x i16> %s, %t
%b = select <8 x i1> %a, <8 x i64> %x, <8 x i64> %y
store <8 x i64> %b, <8 x i64>* %r
ret void
}

```

```

define dso_local void @vselect_split_v8i32_setcc(<8 x i32> %s, <8 x i32> %t, <8 x i64>* %p, <8 x i64>* %q, <8
x i64>* %r) "min-legal-vector-width"="256" {
; CHECK-LABEL: vselect_split_v8i32_setcc:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rsi), %ymm2
; CHECK-NEXT: vmovdqa 32(%rsi), %ymm3
; CHECK-NEXT: vpcmpeqd %ymm1,
%ymm0, %k1
; CHECK-NEXT: kshiftrb $4, %k1, %k2
; CHECK-NEXT: vmovdqa64 32(%rdi), %ymm3 {%k2}
; CHECK-NEXT: vmovdqa64 (%rdi), %ymm2 {%k1}
; CHECK-NEXT: vmovdqa %ymm2, (%rdx)
; CHECK-NEXT: vmovdqa %ymm3, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <8 x i64>, <8 x i64>* %p
%y = load <8 x i64>, <8 x i64>* %q
%a = icmp eq <8 x i32> %s, %t
%b = select <8 x i1> %a, <8 x i64> %x, <8 x i64> %y
store <8 x i64> %b, <8 x i64>* %r
ret void
}

```

```

define dso_local void @vselect_split_v16i8_setcc(<16 x i8> %s, <16 x i8> %t, <16 x i32>* %p, <16 x i32>* %q,
<16 x i32>* %r) "min-legal-vector-width"="256" {
; CHECK-LABEL: vselect_split_v16i8_setcc:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rsi), %ymm2
; CHECK-NEXT: vmovdqa 32(%rsi), %ymm3
; CHECK-NEXT: vpcmpeqb %xmm1, %xmm0, %k1
; CHECK-NEXT: kshiftrw $8, %k1, %k2
; CHECK-NEXT: vmovdqa32 32(%rdi), %ymm3 {%k2}
; CHECK-NEXT: vmovdqa32 (%rdi), %ymm2 {%k1}
; CHECK-NEXT: vmovdqa %ymm2,
(%rdx)
; CHECK-NEXT: vmovdqa %ymm3, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <16 x i32>, <16 x i32>* %p
%y = load <16 x i32>, <16 x i32>* %q

```

```

%a = icmp eq <16 x i8> %s, %t
%b = select <16 x i1> %a, <16 x i32> %x, <16 x i32> %y
store <16 x i32> %b, <16 x i32>* %r
ret void
}

```

```

define dso_local void @vselect_split_v16i16_setcc(<16 x i16> %s, <16 x i16> %t, <16 x i32>* %p, <16 x i32>*
%q, <16 x i32>* %r) "min-legal-vector-width"="256" {
; CHECK-LABEL: vselect_split_v16i16_setcc:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rsi), %ymm2
; CHECK-NEXT: vmovdqa 32(%rsi), %ymm3
; CHECK-NEXT: vpcmpeqw %ymm1, %ymm0, %k1
; CHECK-NEXT: kshiftrw $8, %k1, %k2
; CHECK-NEXT: vmovdqa32 32(%rdi), %ymm3 {%k2}
; CHECK-NEXT: vmovdqa32 (%rdi), %ymm2 {%k1}
; CHECK-NEXT: vmovdqa %ymm2, (%rdx)
; CHECK-NEXT: vmovdqa %ymm3, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <16 x i32>, <16 x i32>* %p
%y = load <16 x i32>,
<16 x i32>* %q
%a = icmp eq <16 x i16> %s, %t
%b = select <16 x i1> %a, <16 x i32> %x, <16 x i32> %y
store <16 x i32> %b, <16 x i32>* %r
ret void
}

```

```

define <16 x i8> @trunc_packus_v16i32_v16i8(<16 x i32>* %p) "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_packus_v16i32_v16i8:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vpackusdw 32(%rdi), %ymm0, %ymm0
; CHECK-NEXT: vpermq {{.*#+}} ymm0 = ymm0[0,2,1,3]
; CHECK-NEXT: vpmovuswb %ymm0, %xmm0
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = load <16 x i32>, <16 x i32>* %p
%b = icmp slt <16 x i32> %a, <i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255>
%c = select <16 x i1> %b, <16 x i32> %a, <16 x i32> <i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255>
%d = icmp sgt <16 x i32> %c, zeroinitializer
%e = select <16 x i1> %d, <16 x i32> %c, <16 x i32> zeroinitializer
%f = trunc <16 x i32> %e to <16 x i8>
ret <16 x i8> %f
}

```



```

define dso_local void @trunc_packus_v16i32_v16i8_store(<16 x i32>* %p, <16 x i8>* %q) "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_packus_v16i32_v16i8_store:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vpackusdw 32(%rdi), %ymm0, %ymm0
; CHECK-NEXT: vpermq {{.*#+}} ymm0 = ymm0[0,2,1,3]
; CHECK-NEXT: vpmovuswb %ymm0, (%rsi)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
    %a = load <16 x i32>, <16 x i32>* %p
    %b = icmp slt <16 x i32> %a, <i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255>
    %c = select <16 x i1> %b, <16 x i32> %a, <16 x i32> <i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255>
    %d = icmp sgt <16
x i32> %c, zeroinitializer
    %e = select <16 x i1> %d, <16 x i32> %c, <16 x i32> zeroinitializer
    %f = trunc <16 x i32> %e to <16 x i8>
    store <16 x i8> %f, <16 x i8>* %q
    ret void
}

```

```

define <64 x i1> @v64i1_argument_return(<64 x i1> %x) "min-legal-vector-width"="256" {
; CHECK-LABEL: v64i1_argument_return:
; CHECK:      # %bb.0:
; CHECK-NEXT: retq
    ret <64 x i1> %x
}

```

```

define dso_local void @v64i1_shuffle(<64 x i8>* %x, <64 x i8>* %y) "min-legal-vector-width"="256" {
; CHECK-LABEL: v64i1_shuffle:
; CHECK:      # %bb.0: # %entry
; CHECK-NEXT: vmovdqa (%rdi), %ymm1
; CHECK-NEXT: vmovdqa 32(%rdi), %ymm0
; CHECK-NEXT: vptestnmb %ymm1, %ymm1, %k0
; CHECK-NEXT: kshiftrd $1, %k0, %k1
; CHECK-NEXT: kshiftrlq $63, %k0, %k2
; CHECK-NEXT: kshiftrq $62, %k2, %k2
; CHECK-NEXT: kshiftrlq $63, %k1, %k1
; CHECK-NEXT: kshiftrq $63, %k1, %k1
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-5, %rax
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1,
    %k1
; CHECK-NEXT: kshiftrd $3, %k0, %k2

```

```

; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $61, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-9, %rax
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $2, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $60, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-17, %rax
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $5, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $59, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-33, %rax
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $4, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $58, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-65, %rax
; CHECK-NEXT: kmovq %rax, %k2
;
CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $7, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $57, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-129, %rax
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $6, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $56, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-257, %rax # imm = 0xFEFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $9, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $55, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-513, %rax # imm = 0xFDFD
; CHECK-NEXT: kmovq %rax, %k2

```

```

; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $8, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $54, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
;
CHECK-NEXT:  movq $-1025, %rax # imm = 0xFBFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $11, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $53, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-2049, %rax # imm = 0xF7FF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $10, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $52, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-4097, %rax # imm = 0xEFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $13, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $51, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-8193, %rax # imm = 0xDFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $12, %k0, %k2
; CHECK-NEXT:
    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $50, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-16385, %rax # imm = 0xBFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $15, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $49, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-32769, %rax # imm = 0xFFFF7FFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $14, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $48, %k2, %k2

```

```

; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-65537, %rax # imm = 0xFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $17, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $47, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-131073, %rax # imm = 0xFFFFDFFFF
;
CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $16, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $46, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-262145, %rax # imm = 0xFFFFBFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $19, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $45, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-524289, %rax # imm = 0xFFFF7FFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $18, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $44, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-1048577, %rax # imm = 0xFFEFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $21, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT:
kshiftrq $43, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-2097153, %rax # imm = 0xFFDFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $20, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $42, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-4194305, %rax # imm = 0xFFBFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1

```

```

; CHECK-NEXT: kshiftrd $23, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $41, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-8388609, %rax # imm = 0xFF7FFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $22, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $40, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-16777217, %rax # imm = 0xFEFFFFFF
; CHECK-NEXT: kmovq
%rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $25, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $39, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-33554433, %rax # imm = 0xFDFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $24, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $38, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-67108865, %rax # imm = 0xFBFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $27, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $37, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-134217729, %rax # imm = 0xF7FFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $26, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq
$36, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-268435457, %rax # imm = 0xEFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $29, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $35, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1

```

```

; CHECK-NEXT:  movq $-536870913, %rax # imm = 0xDFFFFFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $28, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $34, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-1073741825, %rax # imm = 0xBFFFFFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $31, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $33, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movabsq $-2147483649, %rax # imm = 0xFFFFFFFF7FFFFFFF
; CHECK-NEXT:
    kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k2
; CHECK-NEXT:  vptestnmb %ymm0, %ymm0, %k1
; CHECK-NEXT:  kshiftrd $30, %k0, %k0
; CHECK-NEXT:  kshiftrlq $63, %k0, %k0
; CHECK-NEXT:  kshiftrq $32, %k0, %k0
; CHECK-NEXT:  korq %k0, %k2, %k0
; CHECK-NEXT:  movabsq $-4294967297, %rax # imm = 0xFFFFFFFFFFFFFFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k0, %k0
; CHECK-NEXT:  kshiftrd $1, %k1, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $31, %k2, %k2
; CHECK-NEXT:  korq %k2, %k0, %k0
; CHECK-NEXT:  movabsq $-8589934593, %rax # imm = 0xFFFFFFFFDFFFFFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k0, %k0
; CHECK-NEXT:  kshiftrlq $63, %k1, %k2
; CHECK-NEXT:  kshiftrq $30, %k2, %k2
; CHECK-NEXT:  korq %k2, %k0, %k0
; CHECK-NEXT:  movabsq $-17179869185, %rax # imm = 0xFFFFFFFFBFFFFFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k0, %k0
; CHECK-NEXT:  kshiftrd $3, %k1, %k2
; CHECK-NEXT:
    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $29, %k2, %k2
; CHECK-NEXT:  korq %k2, %k0, %k0
; CHECK-NEXT:  movabsq $-34359738369, %rax # imm = 0xFFFFFFFF7FFFFFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k0, %k0
; CHECK-NEXT:  kshiftrd $2, %k1, %k2

```

```

; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $28, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-68719476737, %rax # imm = 0xFFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $5, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $27, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-137438953473, %rax # imm = 0xFFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $4, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $26, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
;
CHECK-NEXT: movabsq $-274877906945, %rax # imm = 0xFFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $7, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $25, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-549755813889, %rax # imm = 0xFFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $6, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $24, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-1099511627777, %rax # imm = 0xFFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $9, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $23, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-2199023255553, %rax # imm = 0xFFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
;
CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $8, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $22, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-4398046511105, %rax # imm = 0xFFFFFFFFFFFFFFFF

```

```

; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k0, %k0
; CHECK-NEXT:    kshiftrd $11, %k1, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $21, %k2, %k2
; CHECK-NEXT:    korq %k2, %k0, %k0
; CHECK-NEXT:    movabsq $-8796093022209, %rax # imm = 0xFFFFF7FFFFFFFFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k0, %k0
; CHECK-NEXT:    kshiftrd $10, %k1, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $20, %k2, %k2
; CHECK-NEXT:    korq %k2, %k0, %k0
; CHECK-NEXT:    movabsq $-17592186044417, %rax # imm = 0xFFFFEFFFFFFFFFFFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k0, %k0
; CHECK-NEXT:    kshiftrd $13, %k1, %k2
; CHECK-NEXT:    kshiftrlq
$63, %k2, %k2
; CHECK-NEXT:    kshiftrq $19, %k2, %k2
; CHECK-NEXT:    korq %k2, %k0, %k0
; CHECK-NEXT:    movabsq $-35184372088833, %rax # imm = 0xFFFFDFFFFFFFFFFFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k0, %k0
; CHECK-NEXT:    kshiftrd $12, %k1, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $18, %k2, %k2
; CHECK-NEXT:    korq %k2, %k0, %k0
; CHECK-NEXT:    movabsq $-70368744177665, %rax # imm = 0xFFFFBFFFFFFFFFFFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k0, %k0
; CHECK-NEXT:    kshiftrd $15, %k1, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $17, %k2, %k2
; CHECK-NEXT:    korq %k2, %k0, %k0
; CHECK-NEXT:    movabsq $-140737488355329, %rax # imm = 0xFFFF7FFFFFFFFFFFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k0, %k0
; CHECK-NEXT:    kshiftrd $14, %k1, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $16, %k2, %k2
; CHECK-NEXT:    korq %k2, %k0, %k0
; CHECK-NEXT:
    movabsq $-281474976710657, %rax # imm = 0xFFFEFFFFFFFFFFFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k0, %k0
; CHECK-NEXT:    kshiftrd $17, %k1, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2

```



```

; CHECK-NEXT: kshiftrq $15, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-562949953421313, %rax # imm = 0xFFFFDFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $16, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $14, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-1125899906842625, %rax # imm = 0xFFFBFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $19, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $13, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-2251799813685249, %rax # imm = 0xFFF7FFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq
%rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $18, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $12, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-4503599627370497, %rax # imm = 0xFFEFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $21, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $11, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-9007199254740993, %rax # imm = 0xFFDFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $20, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $10, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-18014398509481985, %rax # imm = 0xFFBFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $23, %k1, %k2
;
CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $9, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-36028797018963969, %rax # imm = 0xFF7FFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2

```

```

; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $22, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $8, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-72057594037927937, %rax # imm = 0xFEFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $25, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $7, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-144115188075855873, %rax # imm = 0xFDFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $24, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $6, %k2, %k2
; CHECK-NEXT:
    korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-288230376151711745, %rax # imm = 0xFBFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $27, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $5, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-576460752303423489, %rax # imm = 0xF7FFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $26, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $4, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-1152921504606846977, %rax # imm = 0xEEFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $29, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $3, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-2305843009213693953, %rax # imm =
0xDFFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $28, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $2, %k2, %k2

```

```

; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-4611686018427387905, %rax # imm = 0xBFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $31, %k1, %k2
; CHECK-NEXT: kshiftrlq $62, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $30, %k1, %k1
; CHECK-NEXT: kshiftrlq $1, %k0, %k0
; CHECK-NEXT: kshiftrq $1, %k0, %k0
; CHECK-NEXT: kshiftrlq $63, %k1, %k1
; CHECK-NEXT: korq %k1, %k0, %k1
; CHECK-NEXT: vmovdqu8 %ymm1, (%rsi) {%k1}
; CHECK-NEXT: kshiftrq $32, %k1, %k1
; CHECK-NEXT: vmovdqu8 %ymm0, 32(%rsi) {%k1}
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq

entry:
%a = load <64 x i8>, <64 x i8>* %x
%b = icmp eq <64 x i8> %a, zeroinitializer
%shuf = shufflevector
<64 x i1> %b, <64 x i1> undef, <64 x i32> <i32 1, i32 0, i32 3, i32 2, i32 5, i32 4, i32 7, i32 6, i32 9, i32 8, i32 11,
i32 10, i32 13, i32 12, i32 15, i32 14, i32 17, i32 16, i32 19, i32 18, i32 21, i32 20, i32 23, i32 22, i32 25, i32 24, i32
27, i32 26, i32 29, i32 28, i32 31, i32 30, i32 33, i32 32, i32 35, i32 34, i32 37, i32 36, i32 39, i32 38, i32 41, i32 40,
i32 43, i32 42, i32 45, i32 44, i32 47, i32 46, i32 49, i32 48, i32 51, i32 50, i32 53, i32 52, i32 55, i32 54, i32 57, i32
56, i32 59, i32 58, i32 61, i32 60, i32 63, i32 62>
call void @llvm.masked.store.v64i8.p0v64i8(<64 x i8> %a, <64 x i8>* %y, i32 1, <64 x i1> %shuf)
ret void
}

declare void @llvm.masked.store.v64i8.p0v64i8(<64 x i8>, <64 x i8>*, i32, <64 x i1>)

@mem64_dst = dso_local global i64 0, align 8
@mem64_src = dso_local global i64 0, align 8
define dso_local i32 @v64i1_inline_asm() "min-legal-vector-width"="256" {
; CHECK-LABEL: v64i1_inline_asm:
; CHECK:      # %bb.0:
; CHECK-NEXT: kmovq mem64_src(%rip),
%k0
; CHECK-NEXT: #APP
; CHECK-NEXT: #NO_APP
; CHECK-NEXT: kmovq %k0, mem64_dst(%rip)
; CHECK-NEXT: movl -{[0-9]+}}(%rsp), %eax
; CHECK-NEXT: retq
%1 = alloca i32, align 4
%2 = load i64, i64* @mem64_src, align 8
%3 = call i64 @asm "", "=k,k,~{dirflag},~{fpsr},~{flags}"(i64 %2)
store i64 %3, i64* @mem64_dst, align 8
%4 = load i32, i32* %1, align 4

```

```
ret i32 %4
}
```

```
define dso_local void @cmp_v8i64_sext(<8 x i64>* %xptr, <8 x i64>* %yptr, <8 x i64>* %zptr) "min-legal-
vector-width"="256" {
; CHECK-LABEL: cmp_v8i64_sext:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rsi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rsi), %ymm1
; CHECK-NEXT: vpcmpgtq 32(%rdi), %ymm1, %ymm1
; CHECK-NEXT: vpcmpgtq (%rdi), %ymm0, %ymm0
; CHECK-NEXT: vmovdqa %ymm0, (%rdx)
; CHECK-NEXT: vmovdqa %ymm1, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <8 x i64>, <8 x i64>* %xptr
%y = load <8 x i64>, <8 x i64>* %yptr
%cmp = icmp slt <8 x i64> %x, %y
%ext
= sext <8 x i1> %cmp to <8 x i64>
store <8 x i64> %ext, <8 x i64>* %zptr
ret void
}
```

```
define dso_local void @cmp_v8i64_zext(<8 x i64>* %xptr, <8 x i64>* %yptr, <8 x i64>* %zptr) "min-legal-
vector-width"="256" {
; CHECK-LABEL: cmp_v8i64_zext:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rsi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rsi), %ymm1
; CHECK-NEXT: vpcmpgtq 32(%rdi), %ymm1, %ymm1
; CHECK-NEXT: vpcmpgtq (%rdi), %ymm0, %ymm0
; CHECK-NEXT: vpsrlq $63, %ymm1, %ymm1
; CHECK-NEXT: vpsrlq $63, %ymm0, %ymm0
; CHECK-NEXT: vmovdqa %ymm0, (%rdx)
; CHECK-NEXT: vmovdqa %ymm1, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <8 x i64>, <8 x i64>* %xptr
%y = load <8 x i64>, <8 x i64>* %yptr
%cmp = icmp slt <8 x i64> %x, %y
%ext = zext <8 x i1> %cmp to <8 x i64>
store <8 x i64> %ext, <8 x i64>* %zptr
ret void
}
```

```
define <16 x i8> @var_rotate_v16i8(<16 x i8> %a, <16 x i8> %b) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: var_rotate_v16i8:
```

```
;
CHECK:    # %bb.0:
; CHECK-NEXT:  vpandd {{\.?LCPI[0-9]+_[0-9]+}}(%rip){1to4}, %xmm1, %xmm1
; CHECK-NEXT:  vpxor %xmm2, %xmm2, %xmm2
; CHECK-NEXT:  vpunpckhbw {{.*#+}} xmm2 =
xmm1[8],xmm2[8],xmm1[9],xmm2[9],xmm1[10],xmm2[10],xmm1[11],xmm2[11],xmm1[12],xmm2[12],xmm1[13],
xmm2[13],xmm1[14],xmm2[14],xmm1[15],xmm2[15]
; CHECK-NEXT:  vpunpckhbw {{.*#+}} xmm3 = xmm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15]
; CHECK-NEXT:  vpsllvw %xmm2, %xmm3, %xmm2
; CHECK-NEXT:  vpsrlw $8, %xmm2, %xmm2
; CHECK-NEXT:  vpunpcklbw {{.*#+}} xmm0 = xmm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7]
; CHECK-NEXT:  vpmovzxbw {{.*#+}} xmm1 =
xmm1[0],zero,xmm1[1],zero,xmm1[2],zero,xmm1[3],zero,xmm1[4],zero,xmm1[5],zero,xmm1[6],zero,xmm1[7],zer
o
; CHECK-NEXT:  vpsllvw %xmm1, %xmm0, %xmm0
; CHECK-NEXT:  vpsrlw $8, %xmm0, %xmm0
; CHECK-NEXT:  vpackuswb %xmm2, %xmm0, %xmm0
; CHECK-NEXT:  retq
%b8 = sub <16 x i8> <i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8>, %b
i8 8, i8 8, i8 8>, %b
%shl = shl <16 x i8> %a, %b
%lshr = lshr <16 x i8> %a, %b8
%or = or <16 x i8> %shl, %lshr
ret <16 x i8> %or
}
```

```
define <32 x i8> @var_rotate_v32i8(<32 x i8> %a, <32 x i8> %b) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: var_rotate_v32i8:
; CHECK:    # %bb.0:
; CHECK-NEXT:  vpandd {{\.?LCPI[0-9]+_[0-9]+}}(%rip){1to8}, %ymm1, %ymm1
; CHECK-NEXT:  vpxor %xmm2, %xmm2, %xmm2
; CHECK-NEXT:  vpunpckhbw {{.*#+}} ymm3 =
ymm1[8],ymm2[8],ymm1[9],ymm2[9],ymm1[10],ymm2[10],ymm1[11],ymm2[11],ymm1[12],ymm2[12],ymm1[13],
ymm2[13],ymm1[14],ymm2[14],ymm1[15],ymm2[15],ymm1[24],ymm2[24],ymm1[25],ymm2[25],ymm1[26],ymm
m2[26],ymm1[27],ymm2[27],ymm1[28],ymm2[28],ymm1[29],ymm2[29],ymm1[30],ymm2[30],ymm1[31],ymm2[
31]
; CHECK-NEXT:  vpunpckhbw {{.*#+}} ymm4 =
ymm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-NEXT:  vpsllvw %ymm3, %ymm4, %ymm3
; CHECK-NEXT:  vpsrlw $8, %ymm3, %ymm3
; CHECK-NEXT:  vpunpcklbw
{{.*#+}} ymm1 =
ymm1[0],ymm2[0],ymm1[1],ymm2[1],ymm1[2],ymm2[2],ymm1[3],ymm2[3],ymm1[4],ymm2[4],ymm1[5],ymm2[
5],ymm1[6],ymm2[6],ymm1[7],ymm2[7],ymm1[16],ymm2[16],ymm1[17],ymm2[17],ymm1[18],ymm2[18],ymm1[
19],ymm2[19],ymm1[20],ymm2[20],ymm1[21],ymm2[21],ymm1[22],ymm2[22],ymm1[23],ymm2[23]
; CHECK-NEXT:  vpunpcklbw {{.*#+}} ymm0 =
ymm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-NEXT:  vpsllvw %ymm1, %ymm0, %ymm0
```

```

; CHECK-NEXT: vpsrlw $8, %ymm0, %ymm0
; CHECK-NEXT: vpackuswb %ymm3, %ymm0, %ymm0
; CHECK-NEXT: retq
%b8 = sub <32 x i8> <i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8>, %b
%shl = shl <32 x i8> %a, %b
%lshr = lshr <32 x i8> %a, %b8
%or = or <32 x i8> %shl, %lshr
ret <32 x i8> %or
}

```

```

define <32 x i8> @splatvar_rotate_v32i8(<32 x i8> %a, <32 x i8> %b) nounwind "min-legal-vector-width"="256"
{
; CHECK-LABEL: splatvar_rotate_v32i8:
; CHECK:      # %bb.0:
; CHECK-NEXT: vpunpckhbw {{.*#+}} ymm2 =
ymm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-NEXT: vpand {{\.?LCPI[0-9]+_[0-9]+}}(%rip), %xmm1, %xmm1
; CHECK-NEXT: vpsllw %xmm1, %ymm2, %ymm2
; CHECK-NEXT: vpsrlw $8, %ymm2, %ymm2
; CHECK-NEXT: vpunpcklbw {{.*#+}} ymm0 =
ymm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-NEXT: vpsllw %xmm1, %ymm0, %ymm0
; CHECK-NEXT: vpsrlw $8, %ymm0, %ymm0
; CHECK-NEXT: vpackuswb %ymm2, %ymm0, %ymm0
; CHECK-NEXT: retq
%$splat = shufflevector <32 x i8> %b, <32 x i8> undef, <32 x i32> zeroinitializer
%$splat8 = sub <32 x i8> <i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8>, %$splat
%shl = shl <32 x i8>
%a, %$splat
%lshr = lshr <32 x i8> %a, %$splat8
%or = or <32 x i8> %shl, %lshr
ret <32 x i8> %or
}

```

```

define <32 x i8> @constant_rotate_v32i8(<32 x i8> %a) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: constant_rotate_v32i8:
; CHECK:      # %bb.0:
; CHECK-NEXT: vpunpckhbw {{.*#+}} ymm1 =
ymm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-NEXT: vpsllvw {{\.?LCPI[0-9]+_[0-9]+}}(%rip), %ymm1, %ymm1
; CHECK-NEXT: vpsrlw $8, %ymm1, %ymm1
; CHECK-NEXT: vpunpcklbw {{.*#+}} ymm0 =
ymm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-NEXT: vpsllvw {{\.?LCPI[0-9]+_[0-9]+}}(%rip), %ymm0, %ymm0
; CHECK-NEXT: vpsrlw $8, %ymm0, %ymm0
; CHECK-NEXT: vpackuswb %ymm1, %ymm0, %ymm0

```

```
; CHECK-NEXT:    retq
%shl = shl <32 x i8> %a, <i8 0, i8 1, i8 2, i8 3, i8 4, i8 5, i8 6, i8 7, i8 8, i8 7, i8 6, i8 5, i8 4, i8 3, i8 2, i8 1, i8 0, i8 1, i8 2, i8 3, i8 4, i8 5, i8 6, i8 7, i8 8, i8 7, i8 6, i8 5, i8 4, i8 3, i8 2, i8 1>
%lshr = lshr <32 x i8> %a, <i8 8, i8 7, i8 6, i8 5, i8 4, i8 3, i8 2, i8 1, i8 0, i8 1, i8 2, i8 3, i8 4, i8 5, i8 6, i8 7, i8 8, i8 7, i8 6, i8 5, i8 4, i8 3, i8 2, i8 1, i8 0, i8 1, i8 2, i8 3, i8 4, i8 5, i8 6, i8 7>
%or = or <32 x i8> %shl, %lshr
ret <32 x i8> %or
}
```

```
define <32 x i8> @splatconstant_rotate_v32i8(<32 x i8> %a) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: splatconstant_rotate_v32i8:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpsllw $4, %ymm0, %ymm1
; CHECK-NEXT:  vpsrlw $4, %ymm0, %ymm0
; CHECK-NEXT:  vpternlogd $216, {{\.?LCPI[0-9]+\_[0-9]+\}}(%rip){1to8}, %ymm1, %ymm0
; CHECK-NEXT:  retq
%shl = shl <32 x i8> %a, <i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4>
%lshr = lshr <32 x i8> %a, <i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4>
%or = or <32 x i8> %shl, %lshr
ret <32 x i8> %or
}
```

```
define <32 x i8> @splatconstant_rotate_mask_v32i8(<32 x i8> %a) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: splatconstant_rotate_mask_v32i8:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpsllw $4, %ymm0, %ymm1
; CHECK-NEXT:  vpsrlw $4, %ymm0, %ymm0
; CHECK-NEXT:  vpternlogd $216, {{\.?LCPI[0-9]+\_[0-9]+\}}(%rip){1to8}, %ymm1, %ymm0
; CHECK-NEXT:  vpandd {{\.?LCPI[0-9]+\_[0-9]+\}}(%rip){1to8}, %ymm0, %ymm0
; CHECK-NEXT:  retq
%shl = shl <32 x i8> %a, <i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4>
%lshr = lshr <32 x i8> %a, <i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4>
%rmask = and <32 x i8> %lshr, <i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55, i8 55>
%lmask = and <32 x i8> %shl, <i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33, i8 33>
%or = or <32 x i8> %lmask, %rmask
ret <32 x i8> %or
}
```

```
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64I
; RUN: llc -mtriple=riscv64 -mattr=+zbs -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64ZBS
```

```
define signext i32 @bclr_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: bclr_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclr_i32:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  andi a1, a1, 31
; RV64ZBS-NEXT:  bclr a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%and = and i32 %b, 31
%shl = shl nuw i32 1, %and
%neg = xor i32 %shl, -1
%and1 = and i32 %neg, %a
ret i32 %and1
}
```

```
define signext i32 @bclr_i32_no_mask(i32 signext %a,
i32 signext %b) nounwind {
; RV64I-LABEL: bclr_i32_no_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclr_i32_no_mask:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bclr a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%shl = shl i32 1, %b
%neg = xor i32 %shl, -1
%and1 = and i32 %neg, %a
ret i32 %and1
}
```



```

define signext i32 @bclr_i32_load(ptr %p, i32 signext %b) nounwind {
; RV64I-LABEL: bclr_i32_load:
; RV64I:      # %bb.0:
; RV64I-NEXT: lw a0, 0(a0)
; RV64I-NEXT: li a2, 1
; RV64I-NEXT: sllw a1, a2, a1
; RV64I-NEXT: not a1, a1
; RV64I-NEXT: and a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bclr_i32_load:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: lw a0, 0(a0)
; RV64ZBS-NEXT: bclr a0, a0, a1
; RV64ZBS-NEXT: sext.w a0, a0
; RV64ZBS-NEXT: ret
%a = load i32, ptr %p
%shl = shl i32 1, %b
%neg
= xor i32 %shl, -1
%and1 = and i32 %neg, %a
ret i32 %and1
}

```

```

define i64 @bclr_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: bclr_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a2, 1
; RV64I-NEXT: sll a1, a2, a1
; RV64I-NEXT: not a1, a1
; RV64I-NEXT: and a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bclr_i64:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bclr a0, a0, a1
; RV64ZBS-NEXT: ret
%and = and i64 %b, 63
%shl = shl nuw i64 1, %and
%neg = xor i64 %shl, -1
%and1 = and i64 %neg, %a
ret i64 %and1
}

```

```

define i64 @bclr_i64_no_mask(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: bclr_i64_no_mask:
; RV64I:      # %bb.0:

```

```

; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sll a1, a2, a1
; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclr_i64_no_mask:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bclr a0, a0, a1
; RV64ZBS-NEXT:  ret
%shl = shl i64 1, %b
%neg = xor i64 %shl, -1
%and1 = and i64 %neg, %a
ret i64
%and1
}

```

```

define signext i32 @bset_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: bset_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bset_i32:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  andi a1, a1, 31
; RV64ZBS-NEXT:  bset a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%and = and i32 %b, 31
%shl = shl nuw i32 1, %and
%or = or i32 %shl, %a
ret i32 %or
}

```

```

define signext i32 @bset_i32_no_mask(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: bset_i32_no_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bset_i32_no_mask:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bset a0, a0, a1

```

```

; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%shl = shl i32 1, %b
%or = or i32 %shl, %a
ret i32 %or
}

define signext i32
@bset_i32_load(ptr %p, i32 signext %b) nounwind {
; RV64I-LABEL: bset_i32_load:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bset_i32_load:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  lw a0, 0(a0)
; RV64ZBS-NEXT:  bset a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%a = load i32, ptr %p
%shl = shl i32 1, %b
%or = or i32 %shl, %a
ret i32 %or
}

```

; We can use bsetw for  $1 \ll x$  by setting the first source to zero.

```

define signext i32 @bset_i32_zero(i32 signext %a) nounwind {
; RV64I-LABEL: bset_i32_zero:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  sllw a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bset_i32_zero:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bset a0, zero, a0
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%shl = shl i32 1, %a
ret i32 %shl
}

```

```

define i64 @bset_i64(i64 %a,

```

```

i64 %b) nounwind {
; RV64I-LABEL: bset_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a2, 1
; RV64I-NEXT: sll a1, a2, a1
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bset_i64:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bset a0, a0, a1
; RV64ZBS-NEXT: ret
%conv = and i64 %b, 63
%shl = shl nuw i64 1, %conv
%or = or i64 %shl, %a
ret i64 %or
}

```

```

define i64 @bset_i64_no_mask(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: bset_i64_no_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a2, 1
; RV64I-NEXT: sll a1, a2, a1
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bset_i64_no_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bset a0, a0, a1
; RV64ZBS-NEXT: ret
%shl = shl i64 1, %b
%or = or i64 %shl, %a
ret i64 %or
}

```

; We can use bsetw for  $1 \ll x$  by setting the first source to zero.

```

define signext i64 @bset_i64_zero(i64 signext %a) nounwind {
; RV64I-LABEL: bset_i64_zero:
; RV64I:      # %bb.0:
; RV64I-NEXT: li
a1, 1
; RV64I-NEXT: sll a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bset_i64_zero:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bset a0, zero, a0
; RV64ZBS-NEXT: ret

```

```

%shl = shl i64 1, %a
ret i64 %shl
}

define signext i32 @binv_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: binv_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  xor a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binv_i32:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  andi a1, a1, 31
; RV64ZBS-NEXT:  binv a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%and = and i32 %b, 31
%shl = shl nuw i32 1, %and
%xor = xor i32 %shl, %a
ret i32 %xor
}

define signext i32 @binv_i32_no_mask(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: binv_i32_no_mask:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  xor a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binv_i32_no_mask:
;
RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  binv a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%shl = shl i32 1, %b
%xor = xor i32 %shl, %a
ret i32 %xor
}

define signext i32 @binv_i32_load(ptr %p, i32 signext %b) nounwind {
; RV64I-LABEL: binv_i32_load:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  li a2, 1

```

```

; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  xor a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binv_i32_load:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  lw a0, 0(a0)
; RV64ZBS-NEXT:  binv a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%a = load i32, ptr %p
%shl = shl i32 1, %b
%xor = xor i32 %shl, %a
ret i32 %xor
}

```

```

define i64 @binv_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: binv_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sll a1, a2, a1
; RV64I-NEXT:  xor a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binv_i64:
; RV64ZBS:      # %bb.0:
;
RV64ZBS-NEXT:  binv a0, a0, a1
; RV64ZBS-NEXT:  ret
%conv = and i64 %b, 63
%shl = shl nuw i64 1, %conv
%xor = xor i64 %shl, %a
ret i64 %xor
}

```

```

define i64 @binv_i64_no_mask(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: binv_i64_no_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sll a1, a2, a1
; RV64I-NEXT:  xor a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binv_i64_no_mask:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  binv a0, a0, a1
; RV64ZBS-NEXT:  ret
%shl = shl nuw i64 1, %b

```

```

%xor = xor i64 %shl, %a
ret i64 %xor
}

```

```

define signext i32 @bext_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: bext_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a0, a0, a1
; RV64I-NEXT:  andi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bext_i32:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  andi a1, a1, 31
; RV64ZBS-NEXT:  bext a0, a0, a1
; RV64ZBS-NEXT:  ret
%and = and i32 %b, 31
%shr = lshr i32 %a, %and
%and1 = and i32
%shr, 1
ret i32 %and1
}

```

```

define signext i32 @bext_i32_no_mask(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: bext_i32_no_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a0, a0, a1
; RV64I-NEXT:  andi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bext_i32_no_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bext a0, a0, a1
; RV64ZBS-NEXT:  ret
%shr = lshr i32 %a, %b
%and1 = and i32 %shr, 1
ret i32 %and1
}

```

; This gets previous converted to (i1 (truncate (srl X, Y))). Make sure we are  
; able to use bext.

```

define void @bext_i32_trunc(i32 signext %0, i32 signext %1) {
; RV64I-LABEL: bext_i32_trunc:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a0, a0, a1
; RV64I-NEXT:  andi a0, a0, 1
; RV64I-NEXT:  beqz a0, .LBB19_2
; RV64I-NEXT:  # %bb.1:

```

```

; RV64I-NEXT:  ret
; RV64I-NEXT:  .LBB19_2:
; RV64I-NEXT:  tail bar
;
; RV64ZBS-LABEL: bext_i32_trunc:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bext a0, a0, a1
; RV64ZBS-NEXT:  beqz a0, .LBB19_2
; RV64ZBS-NEXT:
; RV64ZBS-NEXT:  # %bb.1:
; RV64ZBS-NEXT:  ret
; RV64ZBS-NEXT:  .LBB19_2:
; RV64ZBS-NEXT:  tail bar
%3 = shl i32 1, %1
%4 = and i32 %3, %0
%5 = icmp eq i32 %4, 0
br i1 %5, label %6, label %7

6:                                ; preds = %2
tail call void @bar()
br label %7

7:                                ; preds = %6, %2
ret void
}

declare void @bar()

define i64 @bext_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: bext_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srl a0, a0, a1
; RV64I-NEXT:  andi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bext_i64:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bext a0, a0, a1
; RV64ZBS-NEXT:  ret
%conv = and i64 %b, 63
%shr = lshr i64 %a, %conv
%and1 = and i64 %shr, 1
ret i64 %and1
}

define i64 @bext_i64_no_mask(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: bext_i64_no_mask:
; RV64I:      # %bb.0:

```



```

; RV64I-NEXT:  srl a0, a0, a1
; RV64I-NEXT:  andi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL:
bext_i64_no_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bext a0, a0, a1
; RV64ZBS-NEXT:  ret
%shr = lshr i64 %a, %b
%and1 = and i64 %shr, 1
ret i64 %and1
}

```

```

define signext i32 @bexti_i32(i32 signext %a) nounwind {
; RV64I-LABEL: bexti_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 58
; RV64I-NEXT:  srli a0, a0, 63
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bexti_i32:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bexti a0, a0, 5
; RV64ZBS-NEXT:  ret
%shr = lshr i32 %a, 5
%and = and i32 %shr, 1
ret i32 %and
}

```

```

define i64 @bexti_i64(i64 %a) nounwind {
; RV64I-LABEL: bexti_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 58
; RV64I-NEXT:  srli a0, a0, 63
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bexti_i64:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bexti a0, a0, 5
; RV64ZBS-NEXT:  ret
%shr = lshr i64 %a, 5
%and = and i64 %shr, 1
ret i64 %and
}

```

```

define signext i32 @bexti_i32_cmp(i32 signext %a) nounwind {
; CHECK-LABEL: bexti_i32_cmp:

```

```

;
CHECK:    # %bb.0:
; CHECK-NEXT:  andi a0, a0, 32
; CHECK-NEXT:  snez a0, a0
; CHECK-NEXT:  ret
%and = and i32 %a, 32
%cmp = icmp ne i32 %and, 0
%zext = zext i1 %cmp to i32
ret i32 %zext
}

define i64 @bexti_i64_cmp(i64 %a) nounwind {
; RV64I-LABEL: bexti_i64_cmp:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 58
; RV64I-NEXT:  srli a0, a0, 63
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bexti_i64_cmp:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bexti a0, a0, 5
; RV64ZBS-NEXT:  ret
%and = and i64 %a, 32
%cmp = icmp ne i64 %and, 0
%zext = zext i1 %cmp to i64
ret i64 %zext
}

define signext i32 @bclri_i32_10(i32 signext %a) nounwind {
; CHECK-LABEL: bclri_i32_10:
; CHECK:    # %bb.0:
; CHECK-NEXT:  andi a0, a0, -1025
; CHECK-NEXT:  ret
%and = and i32 %a, -1025
ret i32 %and
}

define signext i32 @bclri_i32_11(i32 signext %a) nounwind {
; RV64I-LABEL: bclri_i32_11:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 1048575
; RV64I-NEXT:  addiw a1,
a1, 2047
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i32_11:
; RV64ZBS:    # %bb.0:

```

```

; RV64ZBS-NEXT:  bclri a0, a0, 11
; RV64ZBS-NEXT:  ret
%and = and i32 %a, -2049
ret i32 %and
}

define signext i32 @bclri_i32_30(i32 signext %a) nounwind {
; RV64I-LABEL: bclri_i32_30:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 786432
; RV64I-NEXT:  addiw a1, a1, -1
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i32_30:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 30
; RV64ZBS-NEXT:  ret
%and = and i32 %a, -1073741825
ret i32 %and
}

define signext i32 @bclri_i32_31(i32 signext %a) nounwind {
; RV64I-LABEL: bclri_i32_31:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 33
; RV64I-NEXT:  srli a0, a0, 33
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i32_31:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 31
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%and = and i32 %a,
-2147483649
ret i32 %and
}

define i64 @bclri_i64_10(i64 %a) nounwind {
; CHECK-LABEL: bclri_i64_10:
; CHECK:      # %bb.0:
; CHECK-NEXT:  andi a0, a0, -1025
; CHECK-NEXT:  ret
%and = and i64 %a, -1025
ret i64 %and
}

```

```

define i64 @bclri_i64_11(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_11:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 1048575
; RV64I-NEXT:  addiw a1, a1, 2047
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i64_11:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 11
; RV64ZBS-NEXT:  ret
%and = and i64 %a, -2049
ret i64 %and
}

```

```

define i64 @bclri_i64_30(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_30:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 786432
; RV64I-NEXT:  addiw a1, a1, -1
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i64_30:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 30
; RV64ZBS-NEXT:  ret
%and = and i64 %a, -1073741825
ret i64 %and
}

```

```

define
i64 @bclri_i64_31(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_31:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 524288
; RV64I-NEXT:  addi a1, a1, -1
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i64_31:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 31
; RV64ZBS-NEXT:  ret
%and = and i64 %a, -2147483649
ret i64 %and
}

```

```

define i64 @bclri_i64_62(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_62:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a1, -1
; RV64I-NEXT: slli a1, a1, 62
; RV64I-NEXT: addi a1, a1, -1
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bclri_i64_62:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bclri a0, a0, 62
; RV64ZBS-NEXT: ret
%and = and i64 %a, -4611686018427387905
ret i64 %and
}

```

```

define i64 @bclri_i64_63(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_63:
; RV64I:      # %bb.0:
; RV64I-NEXT: slli a0, a0, 1
; RV64I-NEXT: srli a0, a0, 1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL:
bclri_i64_63:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bclri a0, a0, 63
; RV64ZBS-NEXT: ret
%and = and i64 %a, -9223372036854775809
ret i64 %and
}

```

```

define i64 @bclri_i64_large0(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_large0:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a1, 1044480
; RV64I-NEXT: addiw a1, a1, -256
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bclri_i64_large0:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: andi a0, a0, -256
; RV64ZBS-NEXT: bclri a0, a0, 24
; RV64ZBS-NEXT: ret
%and = and i64 %a, -16777472

```

```

ret i64 %and
}

define i64 @bclri_i64_large1(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_large1:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a1, 1044464
; RV64I-NEXT: addiw a1, a1, -1
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bclri_i64_large1:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bclri a0, a0, 16
; RV64ZBS-NEXT: bclri a0, a0, 24
; RV64ZBS-NEXT: ret
%and = and i64 %a,
-16842753
ret i64 %and
}

define signext i32 @bseti_i32_10(i32 signext %a) nounwind {
; CHECK-LABEL: bseti_i32_10:
; CHECK:      # %bb.0:
; CHECK-NEXT: ori a0, a0, 1024
; CHECK-NEXT: ret
%or = or i32 %a, 1024
ret i32 %or
}

define signext i32 @bseti_i32_11(i32 signext %a) nounwind {
; RV64I-LABEL: bseti_i32_11:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a1, 1
; RV64I-NEXT: slliw a1, a1, 11
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bseti_i32_11:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bseti a0, a0, 11
; RV64ZBS-NEXT: ret
%or = or i32 %a, 2048
ret i32 %or
}

define signext i32 @bseti_i32_30(i32 signext %a) nounwind {
; RV64I-LABEL: bseti_i32_30:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 262144
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i32_30:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 30
; RV64ZBS-NEXT:  ret
%or = or i32 %a, 1073741824
ret i32 %or
}

```

```

define signext i32
@bseti_i32_31(i32 signext %a) nounwind {
; RV64I-LABEL: bseti_i32_31:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 524288
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i32_31:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 31
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%or = or i32 %a, 2147483648
ret i32 %or
}

```

```

define i64 @bseti_i64_10(i64 %a) nounwind {
; CHECK-LABEL: bseti_i64_10:
; CHECK:    # %bb.0:
; CHECK-NEXT:  ori a0, a0, 1024
; CHECK-NEXT:  ret
%or = or i64 %a, 1024
ret i64 %or
}

```

```

define i64 @bseti_i64_11(i64 %a) nounwind {
; RV64I-LABEL: bseti_i64_11:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  slli a1, a1, 11
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i64_11:

```

```

; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 11
; RV64ZBS-NEXT:  ret
%or = or i64 %a, 2048
ret i64 %or
}

define i64 @bseti_i64_30(i64 %a) nounwind {
; RV64I-LABEL: bseti_i64_30:
;
RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 262144
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i64_30:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 30
; RV64ZBS-NEXT:  ret
%or = or i64 %a, 1073741824
ret i64 %or
}

define i64 @bseti_i64_31(i64 %a) nounwind {
; RV64I-LABEL: bseti_i64_31:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  slli a1, a1, 31
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i64_31:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 31
; RV64ZBS-NEXT:  ret
%or = or i64 %a, 2147483648
ret i64 %or
}

define i64 @bseti_i64_62(i64 %a) nounwind {
; RV64I-LABEL: bseti_i64_62:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  slli a1, a1, 62
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i64_62:

```



```

; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 62
; RV64ZBS-NEXT:  ret
%or = or i64 %a,
4611686018427387904
ret i64 %or
}

define i64 @bseti_i64_63(i64 %a) nounwind {
; RV64I-LABEL: bseti_i64_63:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  slli a1, a1, 63
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i64_63:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 63
; RV64ZBS-NEXT:  ret
%or = or i64 %a, 9223372036854775808
ret i64 %or
}

define signext i32 @binvi_i32_10(i32 signext %a) nounwind {
; CHECK-LABEL: binvi_i32_10:
; CHECK:    # %bb.0:
; CHECK-NEXT:  xori a0, a0, 1024
; CHECK-NEXT:  ret
%xor = xor i32 %a, 1024
ret i32 %xor
}

define signext i32 @binvi_i32_11(i32 signext %a) nounwind {
; RV64I-LABEL: binvi_i32_11:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  slliw a1, a1, 11
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binvi_i32_11:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  binvi a0, a0, 11
; RV64ZBS-NEXT:  ret
%xor = xor i32 %a,
2048
ret i32 %xor
}

```

```

}

define signext i32 @binvi_i32_30(i32 signext %a) nounwind {
; RV64I-LABEL: binvi_i32_30:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a1, 262144
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: binvi_i32_30:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: binvi a0, a0, 30
; RV64ZBS-NEXT: ret
%xor = xor i32 %a, 1073741824
ret i32 %xor
}

```

```

define signext i32 @binvi_i32_31(i32 signext %a) nounwind {
; RV64I-LABEL: binvi_i32_31:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a1, 524288
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: binvi_i32_31:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: binvi a0, a0, 31
; RV64ZBS-NEXT: sext.w a0, a0
; RV64ZBS-NEXT: ret
%xor = xor i32 %a, 2147483648
ret i32 %xor
}

```

```

define i64 @binvi_i64_10(i64 %a) nounwind {
; CHECK-LABEL: binvi_i64_10:
; CHECK:      # %bb.0:
; CHECK-NEXT: xori a0, a0, 1024
; CHECK-NEXT: ret
%xor = xor i64 %a, 1024
ret i64 %xor
}

```

```

define i64 @binvi_i64_11(i64
%a) nounwind {
; RV64I-LABEL: binvi_i64_11:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a1, 1
; RV64I-NEXT: slli a1, a1, 11

```

```

; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binvi_i64_11:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  binvi a0, a0, 11
; RV64ZBS-NEXT:  ret
%xor = xor i64 %a, 2048
ret i64 %xor
}

define i64 @binvi_i64_30(i64 %a) nounwind {
; RV64I-LABEL: binvi_i64_30:
; RV64I:        # %bb.0:
; RV64I-NEXT:   lui a1, 262144
; RV64I-NEXT:   xor a0, a0, a1
; RV64I-NEXT:   ret
;
; RV64ZBS-LABEL: binvi_i64_30:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  binvi a0, a0, 30
; RV64ZBS-NEXT:  ret
%xor = xor i64 %a, 1073741824
ret i64 %xor
}

define i64 @binvi_i64_31(i64 %a) nounwind {
; RV64I-LABEL: binvi_i64_31:
; RV64I:        # %bb.0:
; RV64I-NEXT:   li a1, 1
; RV64I-NEXT:   slli a1, a1, 31
; RV64I-NEXT:   xor a0, a0, a1
; RV64I-NEXT:   ret
;
; RV64ZBS-LABEL: binvi_i64_31:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  binvi
a0, a0, 31
; RV64ZBS-NEXT:  ret
%xor = xor i64 %a, 2147483648
ret i64 %xor
}

define i64 @binvi_i64_62(i64 %a) nounwind {
; RV64I-LABEL: binvi_i64_62:
; RV64I:        # %bb.0:
; RV64I-NEXT:   li a1, 1
; RV64I-NEXT:   slli a1, a1, 62

```

```

; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binvi_i64_62:
; RV64ZBS:     # %bb.0:
; RV64ZBS-NEXT:  binvi a0, a0, 62
; RV64ZBS-NEXT:  ret
%xor = xor i64 %a, 4611686018427387904
ret i64 %xor
}

define i64 @binvi_i64_63(i64 %a) nounwind {
; RV64I-LABEL: binvi_i64_63:
; RV64I:       # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  slli a1, a1, 63
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binvi_i64_63:
; RV64ZBS:     # %bb.0:
; RV64ZBS-NEXT:  binvi a0, a0, 63
; RV64ZBS-NEXT:  ret
%xor = xor i64 %a, 9223372036854775808
ret i64 %xor
}

define i64 @xor_i64_large(i64 %a) nounwind {
; RV64I-LABEL: xor_i64_large:
; RV64I:       # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  slli
a1, a1, 32
; RV64I-NEXT:  addi a1, a1, 1
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: xor_i64_large:
; RV64ZBS:     # %bb.0:
; RV64ZBS-NEXT:  binvi a0, a0, 0
; RV64ZBS-NEXT:  binvi a0, a0, 32
; RV64ZBS-NEXT:  ret
%xor = xor i64 %a, 4294967297
ret i64 %xor
}

define i64 @xor_i64_4099(i64 %a) nounwind {
; RV64I-LABEL: xor_i64_4099:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 1
; RV64I-NEXT:  addiw a1, a1, 3
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: xor_i64_4099:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  xori a0, a0, 3
; RV64ZBS-NEXT:  binvi a0, a0, 12
; RV64ZBS-NEXT:  ret
%xor = xor i64 %a, 4099
ret i64 %xor
}

```

```

define i64 @xor_i64_96(i64 %a) nounwind {
; CHECK-LABEL: xor_i64_96:
; CHECK:      # %bb.0:
; CHECK-NEXT:  xori a0, a0, 96
; CHECK-NEXT:  ret
%xor = xor i64 %a, 96
ret i64 %xor
}

```

```

define i64 @or_i64_large(i64 %a) nounwind {
; RV64I-LABEL: or_i64_large:
; RV64I:      # %bb.0:
; RV64I-NEXT:
    li a1, 1
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  addi a1, a1, 1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: or_i64_large:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 0
; RV64ZBS-NEXT:  bseti a0, a0, 32
; RV64ZBS-NEXT:  ret
%or = or i64 %a, 4294967297
ret i64 %or
}

```

```

define i64 @xor_i64_66901(i64 %a) nounwind {
; RV64I-LABEL: xor_i64_66901:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 16
; RV64I-NEXT:  addiw a1, a1, 1365

```

```

; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: xor_i64_66901:
; RV64ZBS:     # %bb.0:
; RV64ZBS-NEXT: xori a0, a0, 1365
; RV64ZBS-NEXT: binvi a0, a0, 16
; RV64ZBS-NEXT: ret
%xor = xor i64 %a, 66901
ret i64 %xor
}

define i64 @or_i64_4099(i64 %a) nounwind {
; RV64I-LABEL: or_i64_4099:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a1, 1
; RV64I-NEXT: addiw a1, a1, 3
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: or_i64_4099:
; RV64ZBS:
;   # %bb.0:
; RV64ZBS-NEXT: ori a0, a0, 3
; RV64ZBS-NEXT: bseti a0, a0, 12
; RV64ZBS-NEXT: ret
%or = or i64 %a, 4099
ret i64 %or
}

define i64 @or_i64_96(i64 %a) nounwind {
; CHECK-LABEL: or_i64_96:
; CHECK:      # %bb.0:
; CHECK-NEXT: ori a0, a0, 96
; CHECK-NEXT: ret
%or = or i64 %a, 96
ret i64 %or
}

define i64 @or_i64_66901(i64 %a) nounwind {
; RV64I-LABEL: or_i64_66901:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a1, 16
; RV64I-NEXT: addiw a1, a1, 1365
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: or_i64_66901:

```

```

; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  ori a0, a0, 1365
; RV64ZBS-NEXT:  bseti a0, a0, 16
; RV64ZBS-NEXT:  ret
%or = or i64 %a, 66901
ret i64 %or
}

define signext i32 @bset_trailing_ones_i32_mask(i32 signext %a) nounwind {
; RV64I-LABEL: bset_trailing_ones_i32_mask:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  sllw a0, a1, a0
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
;
RV64ZBS-LABEL: bset_trailing_ones_i32_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  andi a0, a0, 31
; RV64ZBS-NEXT:  bset a0, zero, a0
; RV64ZBS-NEXT:  addiw a0, a0, -1
; RV64ZBS-NEXT:  ret
%and = and i32 %a, 31
%shift = shl nsw i32 -1, %and
%not = xor i32 %shift, -1
ret i32 %not
}

define signext i32 @bset_trailing_ones_i32_no_mask(i32 signext %a) nounwind {
; RV64I-LABEL: bset_trailing_ones_i32_no_mask:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  sllw a0, a1, a0
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
RV64ZBS-LABEL: bset_trailing_ones_i32_no_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bset a0, zero, a0
; RV64ZBS-NEXT:  addiw a0, a0, -1
; RV64ZBS-NEXT:  ret
%shift = shl nsw i32 -1, %a
%not = xor i32 %shift, -1
ret i32 %not
}

define signext i64 @bset_trailing_ones_i64_mask(i64 signext %a) nounwind {

```

```

; RV64I-LABEL: bset_trailing_ones_i64_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a1, -1
; RV64I-NEXT: sll
a0, a1, a0
; RV64I-NEXT: not a0, a0
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bset_trailing_ones_i64_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bset a0, zero, a0
; RV64ZBS-NEXT: addi a0, a0, -1
; RV64ZBS-NEXT: ret
%and = and i64 %a, 63
%shift = shl nsw i64 -1, %and
%not = xor i64 %shift, -1
ret i64 %not
}

define signext i64 @bset_trailing_ones_i64_no_mask(i64 signext %a) nounwind {
; RV64I-LABEL: bset_trailing_ones_i64_no_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a1, -1
; RV64I-NEXT: sll a0, a1, a0
; RV64I-NEXT: not a0, a0
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bset_trailing_ones_i64_no_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bset a0, zero, a0
; RV64ZBS-NEXT: addi a0, a0, -1
; RV64ZBS-NEXT: ret
%shift = shl nsw i64 -1, %a
%not = xor i64 %shift, -1
ret i64 %not
}

```

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clang-tidy High-Integrity C++ Files

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```
; RUN: opt -passes=consthoist -S -o - %s | FileCheck %s
target datalayout = "e-m:e-p:32:32-i64:64-v128:64:128-a:0:32-n32-S64"
target triple = "thumbv6m-none--musleabi"
```

```
; Check that for i8 type, the maximum legal offset is 31.
; Also check that an constant used as value to be stored rather than
; pointer in a store instruction is hoisted.
; CHECK: foo_i8
; CHECK-DAG: %[[C1:const[0-9]?]] = bitcast i32 805874720 to i32
; CHECK-DAG: %[[C2:const[0-9]?]] = bitcast i32 805874688 to i32
; CHECK-DAG: %[[C3:const[0-9]?]] = bitcast i32 805873720 to i32
; CHECK-DAG: %[[C4:const[0-9]?]] = bitcast i32 805873688 to i32
; CHECK: %0 = inttoptr i32 %[[C2]] to ptr
; CHECK-NEXT: %1 = load volatile i8, ptr %0
; CHECK-NEXT: %[[M1:const_mat[0-9]?]] = add i32 %[[C2]], 4
; CHECK-NEXT: %2 = inttoptr i32 %[[M1]] to ptr
; CHECK-NEXT: %3 = load volatile i8, ptr %2
; CHECK-NEXT: %[[M2:const_mat[0-9]?]] = add i32 %[[C2]], 31
; CHECK-NEXT: %4 = inttoptr i32 %[[M2]] to ptr
; CHECK-NEXT: %5 = load volatile
i8, ptr %4
; CHECK-NEXT: %6 = inttoptr i32 %[[C1]] to ptr
; CHECK-NEXT: %7 = load volatile i8, ptr %6
; CHECK-NEXT: %[[M3:const_mat[0-9]?]] = add i32 %[[C1]], 7
```

```

; CHECK-NEXT: %8 = inttoptr i32 %[[M3]] to ptr
; CHECK-NEXT: %9 = load volatile i8, ptr %8
; CHECK-NEXT: %10 = inttoptr i32 %[[C4]] to ptr
; CHECK-NEXT: store i8 %9, ptr %10
; CHECK-NEXT: %[[M4:const_mat[0-9]?]] = add i32 %[[C4]], 31
; CHECK-NEXT: %11 = inttoptr i32 %[[M4]] to ptr
; CHECK-NEXT: store i8 %7, ptr %11
; CHECK-NEXT: %12 = inttoptr i32 %[[C3]] to ptr
; CHECK-NEXT: store i8 %5, ptr %12
; CHECK-NEXT: %[[M5:const_mat[0-9]?]] = add i32 %[[C3]], 7
; CHECK-NEXT: %13 = inttoptr i32 %[[M5]] to ptr
; CHECK-NEXT: store i8 %3, ptr %13
; CHECK-NEXT: %[[M6:const_mat[0-9]?]] = add i32 %[[C1]], 80
; CHECK-NEXT: %14 = inttoptr i32 %[[M6]] to ptr
; CHECK-NEXT: store ptr %14, ptr @goo

```

@goo = global ptr undef

```

define void @foo_i8() {
entry:
  %0 = load volatile i8, ptr inttoptr (i32 805874688 to ptr)
  %1 = load volatile
i8, ptr inttoptr (i32 805874692 to ptr)
  %2 = load volatile i8, ptr inttoptr (i32 805874719 to ptr)
  %3 = load volatile i8, ptr inttoptr (i32 805874720 to ptr)
  %4 = load volatile i8, ptr inttoptr (i32 805874727 to ptr)
  store i8 %4, ptr inttoptr(i32 805873688 to ptr)
  store i8 %3, ptr inttoptr(i32 805873719 to ptr)
  store i8 %2, ptr inttoptr(i32 805873720 to ptr)
  store i8 %1, ptr inttoptr(i32 805873727 to ptr)
  store ptr inttoptr(i32 805874800 to ptr), ptr @goo
  ret void
}

```

```

; Check that for i16 type, the maximum legal offset is 62.
; CHECK: foo_i16
; CHECK-DAG: %[[C1:const[0-9]?]] = bitcast i32 805874752 to i32
; CHECK-DAG: %[[C2:const[0-9]?]] = bitcast i32 805874688 to i32
; CHECK: %0 = inttoptr i32 %[[C2]] to ptr
; CHECK-NEXT: %1 = load volatile i16, ptr %0, align 2
; CHECK-NEXT: %[[M1:const_mat[0-9]?]] = add i32 %[[C2]], 4
; CHECK-NEXT: %2 = inttoptr i32 %[[M1]] to ptr
; CHECK-NEXT: %3 = load volatile i16, ptr %2, align 2
; CHECK-NEXT: %[[M2:const_mat[0-9]?]] = add
i32 %[[C2]], 32
; CHECK-NEXT: %4 = inttoptr i32 %[[M2]] to ptr
; CHECK-NEXT: %5 = load volatile i16, ptr %4, align 2
; CHECK-NEXT: %[[M3:const_mat[0-9]?]] = add i32 %[[C2]], 62

```

```
; CHECK-NEXT: %6 = inttoptr i32 %[[M3]] to ptr
; CHECK-NEXT: %7 = load volatile i16, ptr %6, align 2
; CHECK-NEXT: %8 = inttoptr i32 %[[C1]] to ptr
; CHECK-NEXT: %9 = load volatile i16, ptr %8, align 2
; CHECK-NEXT: %[[M4:const_mat[0-9]?]] = add i32 %[[C1]], 22
; CHECK-NEXT: %10 = inttoptr i32 %[[M4]] to ptr
; CHECK-NEXT: %11 = load volatile i16, ptr %10, align 2
```

```
define void @foo_i16() {
```

```
entry:
```

```
%0 = load volatile i16, ptr inttoptr (i32 805874688 to ptr), align 2
%1 = load volatile i16, ptr inttoptr (i32 805874692 to ptr), align 2
%2 = load volatile i16, ptr inttoptr (i32 805874720 to ptr), align 2
%3 = load volatile i16, ptr inttoptr (i32 805874750 to ptr), align 2
%4 = load volatile i16, ptr inttoptr (i32 805874752 to ptr), align 2
%5 = load volatile i16, ptr inttoptr (i32 805874774 to ptr), align
2
ret void
}
```

```
; Check that for i32 type, the maximum legal offset is 124.
```

```
; CHECK: foo_i32
```

```
; CHECK-DAG: %[[C1:const[0-9]?]] = bitcast i32 805874816 to i32
```

```
; CHECK-DAG: %[[C2:const[0-9]?]] = bitcast i32 805874688 to i32
```

```
; CHECK: %0 = inttoptr i32 %[[C2]] to ptr
```

```
; CHECK-NEXT: %1 = load volatile i32, ptr %0, align 4
```

```
; CHECK-NEXT: %[[M1:const_mat[0-9]?]] = add i32 %[[C2]], 4
```

```
; CHECK-NEXT: %2 = inttoptr i32 %[[M1]] to ptr
```

```
; CHECK-NEXT: %3 = load volatile i32, ptr %2, align 4
```

```
; CHECK-NEXT: %[[M2:const_mat[0-9]?]] = add i32 %[[C2]], 124
```

```
; CHECK-NEXT: %4 = inttoptr i32 %[[M2]] to ptr
```

```
; CHECK-NEXT: %5 = load volatile i32, ptr %4, align 4
```

```
; CHECK-NEXT: %6 = inttoptr i32 %[[C1]] to ptr
```

```
; CHECK-NEXT: %7 = load volatile i32, ptr %6, align 4
```

```
; CHECK-NEXT: %[[M3:const_mat[0-9]?]] = add i32 %[[C1]], 8
```

```
; CHECK-NEXT: %8 = inttoptr i32 %[[M3]] to ptr
```

```
; CHECK-NEXT: %9 = load volatile i32, ptr %8, align 4
```

```
; CHECK-NEXT: %[[M4:const_mat[0-9]?]] = add i32 %[[C1]], 12
```

```
; CHECK-NEXT: %10 = inttoptr
```

```
i32 %[[M4]] to ptr
```

```
; CHECK-NEXT: %11 = load volatile i32, ptr %10, align 4
```

```
define void @foo_i32() {
```

```
entry:
```

```
%0 = load volatile i32, ptr inttoptr (i32 805874688 to ptr), align 4
```

```
%1 = load volatile i32, ptr inttoptr (i32 805874692 to ptr), align 4
```

```
%2 = load volatile i32, ptr inttoptr (i32 805874812 to ptr), align 4
```

```
%3 = load volatile i32, ptr inttoptr (i32 805874816 to ptr), align 4
```

```

%4 = load volatile i32, ptr inttoptr (i32 805874824 to ptr), align 4
%5 = load volatile i32, ptr inttoptr (i32 805874828 to ptr), align 4
ret void
}
; RUN: llc -march=hexagon < %s
; REQUIRES: asserts

; The two loads based on %struct.0, loading two different data types
; cause LSR to assume type "void" for the memory type. This would then
; cause an assert in isLegalAddressingMode. Make sure we no longer crash.

```

```
target triple = "hexagon"
```

```

%struct.0 = type { ptr, i8, %union.anon.0 }
%union.anon.0 = type { ptr }

```

```

define hidden fastcc void @fred() unnamed_addr #0 {
entry:
br i1 undef, label %while.end, label %while.body.lr.ph

```

```

while.body.lr.ph:                ; preds = %entry
br label %while.body

```

```

while.body:                      ; preds = %exit.2, %while.body.lr.ph
%lsr.iv = phi ptr [ %cgep22, %exit.2 ], [ undef, %while.body.lr.ph ]
switch i32 undef, label %exit [
  i32 1, label %sw.bb.i
  i32 2, label %sw.bb3.i
]

```

```

sw.bb.i:                        ; preds = %while.body
unreachable

```

```

sw.bb3.i:                      ; preds = %while.body
unreachable

```

```

exit:                            ; preds = %while.body
switch i32 undef, label %exit.2 [
  i32 1, label %sw.bb.i17
  i32 2, label %sw.bb3.i20
]

```

```

sw.bb.i17:                     ; preds = %exit
%0 = load i32, ptr %lsr.iv, align 4
unreachable

```

```

sw.bb3.i20:                   ; preds = %exit

```



%1 = load ptr, ptr %lsr.iv, align 4

unreachable

```
exit.2:                                ; preds = %exit
%cgcp22 = getelementptr %struct.0, ptr %lsr.iv, i32 1
br label %while.body
```

```
while.end:                            ; preds = %entry
ret void
}
```

attributes #0 = { nounwind optsize "target-cpu"="hexagonv55" }

; NOTE: Assertions have been autogenerated by utils/update\_test\_checks.py UTC\_ARGS: --include-generated-funcs

; RUN: opt -S -passes=verify,iroutliner -ir-outlining-no-cost < %s | FileCheck %s

; FIXME: Disabled run-line after running into some turbulence with debuginfo-iterators

; run: opt -S -passes=verify,iroutliner -ir-outlining-no-cost < %s --try-experimental-debuginfo-iterators | FileCheck %s

; This test checks that debug info is recognized as able to be extracted along  
; with the other instructions, but is not included in the consolidated function.

```
define void @function1() !dbg !6 {
entry:
  %a = alloca i32, align 4, !dbg !17
  call void @llvm.dbg.value(metadata ptr %a, metadata !9, metadata !DIExpression()), !dbg !17
  %b = alloca i32, align 4, !dbg !18
  call void @llvm.dbg.value(metadata ptr %b, metadata !11, metadata !DIExpression()), !dbg !18
  %c = alloca i32, align 4, !dbg !19
  call void @llvm.dbg.value(metadata ptr %c, metadata !12, metadata !DIExpression()), !dbg !19

  store i32 2, ptr %a, align 4, !dbg !20
  store i32 3, ptr %b, align 4, !dbg !21
  store i32 4, ptr %c, align 4, !dbg !22
  %al = load i32, ptr %a, align 4, !dbg !23
  call void @llvm.dbg.value(metadata i32 %al, metadata !13, metadata !DIExpression()), !dbg !23
  %bl = load i32, ptr %b, align 4, !dbg !24
  call void @llvm.dbg.value(metadata i32 %bl, metadata !15, metadata !DIExpression()), !dbg !24
  %cl = load i32, ptr %c, align 4, !dbg !25
  call void @llvm.dbg.value(metadata i32 %cl, metadata !16, metadata !DIExpression()), !dbg !25
  ret void, !dbg !26
}
```

```
define void @function2() !dbg !27 {
entry:
  %a = alloca i32, align 4, !dbg !35
  call void @llvm.dbg.value(metadata ptr %a, metadata !29, metadata !DIExpression()), !dbg !35
  %b = alloca i32, align 4, !dbg !36
```

```

call void @llvm.dbg.value(metadata ptr %b, metadata !30, metadata !DIExpression()), !dbg !36
%c = alloca i32, align 4, !dbg !37
call void @llvm.dbg.value(metadata ptr %c, metadata !31, metadata !DIExpression()), !dbg
!37
store i32 2, ptr %a, align 4, !dbg !38
store i32 3, ptr %b, align 4, !dbg !39
store i32 4, ptr %c, align 4, !dbg !40
%a1 = load i32, ptr %a, align 4, !dbg !41
call void @llvm.dbg.value(metadata i32 %a1, metadata !32, metadata !DIExpression()), !dbg !41
%b1 = load i32, ptr %b, align 4, !dbg !42
call void @llvm.dbg.value(metadata i32 %b1, metadata !33, metadata !DIExpression()), !dbg !42
%c1 = load i32, ptr %c, align 4, !dbg !43
call void @llvm.dbg.value(metadata i32 %c1, metadata !34, metadata !DIExpression()), !dbg !43
ret void, !dbg !44
}

```

```

; Function Attrs: nounwind readnone speculatable willreturn
declare void @llvm.dbg.value(metadata, metadata, metadata) #0

```

```

attributes #0 = { nounwind readnone speculatable willreturn }

```

```

!llvm.dbg.cu = !{!0}
!llvm.debugify = !{!3, !4}
!llvm.module.flags = !{!5}

```

```

!0 = distinct !DICompileUnit(language: DW_LANG_C, file: !1, producer: "debugify", isOptimized: true,
runtimeVersion: 0, emissionKind: FullDebug, enums: !2)
!1 = !DIFile(filename:
"legal-debug.ll", directory: "")
!2 = !{}
!3 = !{i32 20}
!4 = !{i32 12}
!5 = !{i32 2, !"Debug Info Version", i32 3}
!6 = distinct !DISubprogram(name: "function1", linkageName: "function1", scope: null, file: !1, line: 1, type: !7,
scopeLine: 1, spFlags: DISPFlagDefinition | DISPFlagOptimized, unit: !0, retainedNodes: !8)
!7 = !DISubroutineType(types: !2)
!8 = !{!9, !11, !12, !13, !15, !16}
!9 = !DILocalVariable(name: "1", scope: !6, file: !1, line: 1, type: !10)
!10 = !DIBasicType(name: "ty64", size: 64, encoding: DW_ATE_unsigned)
!11 = !DILocalVariable(name: "2", scope: !6, file: !1, line: 2, type: !10)
!12 = !DILocalVariable(name: "3", scope: !6, file: !1, line: 3, type: !10)
!13 = !DILocalVariable(name: "4", scope: !6, file: !1, line: 7, type: !14)
!14 = !DIBasicType(name: "ty32", size: 32, encoding: DW_ATE_unsigned)
!15 = !DILocalVariable(name: "5", scope: !6, file: !1, line: 8, type: !14)
!16 = !DILocalVariable(name: "6", scope: !6, file: !1, line: 9, type: !14)
!17

```

```

= !DILocation(line: 1, column: 1, scope: !6)
!18 = !DILocation(line: 2, column: 1, scope: !6)
!19 = !DILocation(line: 3, column: 1, scope: !6)
!20 = !DILocation(line: 4, column: 1, scope: !6)
!21 = !DILocation(line: 5, column: 1, scope: !6)
!22 = !DILocation(line: 6, column: 1, scope: !6)
!23 = !DILocation(line: 7, column: 1, scope: !6)
!24 = !DILocation(line: 8, column: 1, scope: !6)
!25 = !DILocation(line: 9, column: 1, scope: !6)
!26 = !DILocation(line: 10, column: 1, scope: !6)
!27 = distinct !DISubprogram(name: "function2", linkageName: "function2", scope: null, file: !1, line: 11, type: !7,
scopeLine: 11, spFlags: DISPFlagDefinition | DISPFlagOptimized, unit: !0, retainedNodes: !28)
!28 = !{!29, !30, !31, !32, !33, !34}
!29 = !DILocalVariable(name: "7", scope: !27, file: !1, line: 11, type: !10)
!30 = !DILocalVariable(name: "8", scope: !27, file: !1, line: 12, type: !10)
!31 = !DILocalVariable(name: "9", scope: !27, file: !1, line: 13, type: !10)
!32 = !DILocalVariable(name: "10",
scope: !27, file: !1, line: 17, type: !14)
!33 = !DILocalVariable(name: "11", scope: !27, file: !1, line: 18, type: !14)
!34 = !DILocalVariable(name: "12", scope: !27, file: !1, line: 19, type: !14)
!35 = !DILocation(line: 11, column: 1, scope: !27)
!36 = !DILocation(line: 12, column: 1, scope: !27)
!37 = !DILocation(line: 13, column: 1, scope: !27)
!38 = !DILocation(line: 14, column: 1, scope: !27)
!39 = !DILocation(line: 15, column: 1, scope: !27)
!40 = !DILocation(line: 16, column: 1, scope: !27)
!41 = !DILocation(line: 17, column: 1, scope: !27)
!42 = !DILocation(line: 18, column: 1, scope: !27)
!43 = !DILocation(line: 19, column: 1, scope: !27)
!44 = !DILocation(line: 20, column: 1, scope: !27)
; CHECK-LABEL: @function1(
; CHECK-NEXT: entry:
; CHECK-NEXT: [[A:%.*]] = alloca i32, align 4, !dbg [[DBG17:![0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[A]], metadata [[META9:![0-9]+]], metadata
!DIExpression()), !dbg [[DBG17]]
; CHECK-NEXT: [[B:%.*]] = alloca
i32, align 4, !dbg [[DBG18:![0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[B]], metadata [[META11:![0-9]+]], metadata
!DIExpression()), !dbg [[DBG18]]
; CHECK-NEXT: [[C:%.*]] = alloca i32, align 4, !dbg [[DBG19:![0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[C]], metadata [[META12:![0-9]+]], metadata
!DIExpression()), !dbg [[DBG19]]
; CHECK-NEXT: call void @outlined_ir_func_0(ptr [[A]], ptr [[B]], ptr [[C]]), !dbg [[DBG20:![0-9]+]]
; CHECK-NEXT: ret void, !dbg [[DBG21:![0-9]+]]
;
;
; CHECK-LABEL: @function2(
; CHECK-NEXT: entry:

```

```

; CHECK-NEXT: [[A:%.*]] = alloca i32, align 4, !dbg [[DBG30:[0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[A]], metadata [[META24:[0-9]+]], metadata
!DIExpression()), !dbg [[DBG30]]
; CHECK-NEXT: [[B:%.*]] = alloca i32, align 4, !dbg [[DBG31:[0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[B]], metadata [[META25:[0-9]+]], metadata
!DIExpression()), !dbg [[DBG31]]
;
CHECK-NEXT: [[C:%.*]] = alloca i32, align 4, !dbg [[DBG32:[0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[C]], metadata [[META26:[0-9]+]], metadata
!DIExpression()), !dbg [[DBG32]]
; CHECK-NEXT: call void @outlined_ir_func_0(ptr [[A]], ptr [[B]], ptr [[C]]), !dbg [[DBG33:[0-9]+]]
; CHECK-NEXT: ret void, !dbg [[DBG34:[0-9]+]]
;
;
; CHECK: @outlined_ir_func_0(ptr [[TMP0:%.*]], ptr [[TMP1:%.*]], ptr [[TMP2:%.*]])
; CHECK: entry_to_outline:
; CHECK-NEXT: store i32 2, ptr [[TMP0]], align 4
; CHECK-NEXT: store i32 3, ptr [[TMP1]], align 4
; CHECK-NEXT: store i32 4, ptr [[TMP2]], align 4
; CHECK-NEXT: [[AL:%.*]] = load i32, ptr [[TMP0]], align 4
; CHECK-NEXT: [[BL:%.*]] = load i32, ptr [[TMP1]], align 4
; CHECK-NEXT: [[CL:%.*]] = load i32, ptr [[TMP2]], align 4
; CHECK-NEXT: br label [[ENTRY_AFTER_OUTLINE_EXITSTUB:%.*]]
;
; RUN: opt < %s -passes=argpromotion -S | FileCheck %s

; CHECK-LABEL: define i32 @foo() #0 {
; CHECK-NEXT:    %.val = load <32 x half>, ptr undef, align 4
; CHECK-NEXT:    call void @bar(<32 x half> %.val)
; CHECK-NEXT:    ret i32 0
; CHECK-NEXT: }

; CHECK-LABEL: define internal void @bar(<32 x half> %.0.val) #0 {
; CHECK-NEXT:    ret void
; CHECK-NEXT: }

; CHECK: attributes #0 = { uwtable "min-legal-vector-width"="512" }

define i32 @foo() #0 {
    call void @bar(ptr undef)
    ret i32 0
}

define internal void @bar(ptr) #0 {
    %2 = load <32 x half>, ptr %0, align 4
    ret void
}

```

attributes #0 = { uwtable "min-legal-vector-width"="0" }

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```
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -mattr=+m -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64I
; RUN: llc -mtriple=riscv64 -mattr=+m,+zba -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-
prefixes=CHECK,RV64ZBA,RV64ZBANOZBB
; RUN: llc -mtriple=riscv64 -mattr=+m,+zba,+zbb -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64ZBA,RV64ZBAZBB
```

```
define i64 @slliuv(i64 %a) nounwind {
; RV64I-LABEL: slliuv:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 31
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: slliuv:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 1
; RV64ZBA-NEXT:  ret
%conv1 = shl i64 %a, 1
%shl = and i64 %conv1, 8589934590
ret i64 %shl
}
```

```
define i128 @slliuv_2(i32 signext %0, ptr %1) {
; RV64I-LABEL:
```

```

slliuw_2:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 28
; RV64I-NEXT:  add a1, a1, a0
; RV64I-NEXT:  ld a0, 0(a1)
; RV64I-NEXT:  ld a1, 8(a1)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: slliuw_2:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 4
; RV64ZBA-NEXT:  add a1, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a1)
; RV64ZBA-NEXT:  ld a1, 8(a1)
; RV64ZBA-NEXT:  ret
%3 = zext i32 %0 to i64
%4 = getelementptr inbounds i128, ptr %1, i64 %3
%5 = load i128, ptr %4
ret i128 %5
}

```

```

define i128 @slliuw_3(i32 signext %0, ptr %1) {
; RV64I-LABEL: slliuw_3:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 28
; RV64I-NEXT:  add a1, a1, a0
; RV64I-NEXT:  ld a0, 0(a1)
; RV64I-NEXT:  ld a1, 8(a1)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: slliuw_3:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  addi a0, a0, 1
; RV64ZBA-NEXT:  slli.uw a0, a0, 4
; RV64ZBA-NEXT:
    add a1, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a1)
; RV64ZBA-NEXT:  ld a1, 8(a1)
; RV64ZBA-NEXT:  ret
%add = add i32 %0, 1
%3 = zext i32 %add to i64
%4 = getelementptr inbounds i128, ptr %1, i64 %3
%5 = load i128, ptr %4
ret i128 %5
}

```

```

define i64 @adduw(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: adduw:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 32
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: adduw:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  add.uw a0, a1, a0
; RV64ZBA-NEXT:  ret
%and = and i64 %b, 4294967295
%add = add i64 %and, %a
ret i64 %add
}

define signext i8 @adduw_2(i32 signext %0, ptr %1) {
; RV64I-LABEL: adduw_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lb a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: adduw_2:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  add.uw a0, a0, a1
; RV64ZBA-NEXT:
    lb a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = zext i32 %0 to i64
%4 = getelementptr inbounds i8, ptr %1, i64 %3
%5 = load i8, ptr %4
ret i8 %5
}

define signext i8 @adduw_3(i32 signext %0, ptr %1) {
; RV64I-LABEL: adduw_3:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lb a0, 0(a0)
; RV64I-NEXT:  ret

```

```

;
; RV64ZBA-LABEL: adduw_3:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  addi a0, a0, 1
; RV64ZBA-NEXT:  add.uw a0, a0, a1
; RV64ZBA-NEXT:  lb a0, 0(a0)
; RV64ZBA-NEXT:  ret
%add = add i32 %0, 1
%3 = zext i32 %add to i64
%4 = getelementptr inbounds i8, ptr %1, i64 %3
%5 = load i8, ptr %4
ret i8 %5
}

```

```

define i64 @zextw_i64(i64 %a) nounwind {
; RV64I-LABEL: zextw_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: zextw_i64:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:
    zext.w a0, a0
; RV64ZBA-NEXT:  ret
%and = and i64 %a, 4294967295
ret i64 %and
}

```

; This makes sure targetShrinkDemandedConstant changes the and immediate to  
; allow zext.w or slli+srli.

```

define i64 @zextw_demandedbits_i64(i64 %0) {
; RV64I-LABEL: zextw_demandedbits_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  ori a0, a0, 1
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: zextw_demandedbits_i64:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  ori a0, a0, 1
; RV64ZBA-NEXT:  zext.w a0, a0
; RV64ZBA-NEXT:  ret
%2 = and i64 %0, 4294967294
%3 = or i64 %2, 1
ret i64 %3
}

```

```
}
```

```
define signext i16 @sh1add(i64 %0, ptr %1) {  
; RV64I-LABEL: sh1add:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: slli a0, a0, 1  
; RV64I-NEXT: add a0, a1, a0  
; RV64I-NEXT: lh a0, 0(a0)  
; RV64I-NEXT: ret  
;  
; RV64ZBA-LABEL: sh1add:  
; RV64ZBA:      # %bb.0:  
; RV64ZBA-NEXT: sh1add a0, a0, a1  
; RV64ZBA-NEXT: lh a0, 0(a0)  
; RV64ZBA-NEXT:  
    ret  
%3 = getelementptr inbounds i16, ptr %1, i64 %0  
%4 = load i16, ptr %3  
ret i16 %4  
}
```

```
define signext i32 @sh2add(i64 %0, ptr %1) {  
; RV64I-LABEL: sh2add:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: slli a0, a0, 2  
; RV64I-NEXT: add a0, a1, a0  
; RV64I-NEXT: lw a0, 0(a0)  
; RV64I-NEXT: ret  
;  
; RV64ZBA-LABEL: sh2add:  
; RV64ZBA:      # %bb.0:  
; RV64ZBA-NEXT: sh2add a0, a0, a1  
; RV64ZBA-NEXT: lw a0, 0(a0)  
; RV64ZBA-NEXT: ret  
%3 = getelementptr inbounds i32, ptr %1, i64 %0  
%4 = load i32, ptr %3  
ret i32 %4  
}
```

```
define i64 @sh3add(i64 %0, ptr %1) {  
; RV64I-LABEL: sh3add:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: slli a0, a0, 3  
; RV64I-NEXT: add a0, a1, a0  
; RV64I-NEXT: ld a0, 0(a0)  
; RV64I-NEXT: ret  
;  
; RV64ZBA-LABEL: sh3add:
```

```
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a1
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = getelementptr inbounds i64, ptr %1, i64 %0
%4 = load i64, ptr %3
ret i64 %4
}
```

```
define signext i16 @sh1adduw(i32
signext %0, ptr %1) {
; RV64I-LABEL: sh1adduw:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 31
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lh a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh1adduw:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh1add.uw a0, a0, a1
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = zext i32 %0 to i64
%4 = getelementptr inbounds i16, ptr %1, i64 %3
%5 = load i16, ptr %4
ret i16 %5
}
```

```
define i64 @sh1adduw_2(i64 %0, i64 %1) {
; RV64I-LABEL: sh1adduw_2:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 31
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh1adduw_2:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh1add.uw a0, a0, a1
; RV64ZBA-NEXT:  ret
%3 = shl i64 %0, 1
%4 = and i64 %3, 8589934590
%5 = add i64 %4, %1
ret i64 %5
}
```



```

define signext i32 @sh2adduw(i32 signext %0, ptr %1) {
; RV64I-LABEL: sh2adduw:
; RV64I:
    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 30
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh2adduw:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh2add.uw a0, a0, a1
; RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = zext i32 %0 to i64
%4 = getelementptr inbounds i32, ptr %1, i64 %3
%5 = load i32, ptr %4
ret i32 %5
}

```

```

define i64 @sh2adduw_2(i64 %0, i64 %1) {
; RV64I-LABEL: sh2adduw_2:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 30
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh2adduw_2:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh2add.uw a0, a0, a1
; RV64ZBA-NEXT:  ret
%3 = shl i64 %0, 2
%4 = and i64 %3, 17179869180
%5 = add i64 %4, %1
ret i64 %5
}

```

```

define i64 @sh3adduw(i32 signext %0, ptr %1) {
; RV64I-LABEL: sh3adduw:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:
    srli a0, a0, 29
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret

```

```

;
; RV64ZBA-LABEL: sh3adduw:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add.uw a0, a0, a1
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = zext i32 %0 to i64
%4 = getelementptr inbounds i64, ptr %1, i64 %3
%5 = load i64, ptr %4
ret i64 %5
}

```

```

define i64 @sh3adduw_2(i64 %0, i64 %1) {
; RV64I-LABEL: sh3adduw_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 29
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh3adduw_2:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add.uw a0, a0, a1
; RV64ZBA-NEXT:  ret
%3 = shl i64 %0, 3
%4 = and i64 %3, 34359738360
%5 = add i64 %4, %1
ret i64 %5
}

```

; Type legalization inserts a sext\_inreg after the first add. That add will be  
; selected as sh2add which does not sign extend. SimplifyDandedBits is unable  
; to remove the sext\_inreg because it has multiple uses.

The ashr will use the

; sext\_inreg to become sraiw. This leaves the sext\_inreg only used by the shl.

; If the shl is selected as sllw, we don't need the sext\_inreg.

```
define i64 @sh2add_extra_sext(i32 %x, i32 %y, i32 %z) {
```

```

; RV64I-LABEL: sh2add_extra_sext:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  sllw a1, a2, a0
; RV64I-NEXT:  sraiw a0, a0, 2
; RV64I-NEXT:  mul a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh2add_extra_sext:
; RV64ZBA:      # %bb.0:

```

```

; RV64ZBA-NEXT:  sh2add a0, a0, a1
; RV64ZBA-NEXT:  sllw a1, a2, a0
; RV64ZBA-NEXT:  sraiw a0, a0, 2
; RV64ZBA-NEXT:  mul a0, a1, a0
; RV64ZBA-NEXT:  ret
%a = shl i32 %x, 2
%b = add i32 %a, %y
%c = shl i32 %z, %b
%d = ashr i32 %b, 2
%e = sext i32 %c to i64
%f = sext i32 %d to i64
%g = mul i64 %e, %f
ret i64 %g
}

```

```

define i64 @addmul6(i64 %a, i64 %b) {
; RV64I-LABEL: addmul6:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 6
; RV64I-NEXT:  mul
a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul6:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  sh1add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 6
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @addmul10(i64 %a, i64 %b) {
; RV64I-LABEL: addmul10:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 10
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul10:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add a0, a0, a0
; RV64ZBA-NEXT:  sh1add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 10

```

```

%d = add i64 %c, %b
ret i64 %d
}

define i64 @addmul12(i64 %a, i64 %b) {
; RV64I-LABEL: addmul12:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 12
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul12:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  sh2add
a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 12
%d = add i64 %c, %b
ret i64 %d
}

define i64 @addmul18(i64 %a, i64 %b) {
; RV64I-LABEL: addmul18:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 18
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul18:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  sh1add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 18
%d = add i64 %c, %b
ret i64 %d
}

define i64 @addmul20(i64 %a, i64 %b) {
; RV64I-LABEL: addmul20:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 20
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret

```

```

;
; RV64ZBA-LABEL: addmul20:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh2add a0, a0, a0
; RV64ZBA-NEXT:  sh2add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 20
%d = add i64 %c, %b
ret i64 %d
}

define i64 @addmul24(i64 %a, i64 %b) {
; RV64I-LABEL: addmul24:
; RV64I:
;   # %bb.0:
; RV64I-NEXT:  li a2, 24
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul24:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  sh3add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 24
%d = add i64 %c, %b
ret i64 %d
}

define i64 @addmul36(i64 %a, i64 %b) {
; RV64I-LABEL: addmul36:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 36
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul36:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  sh2add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 36
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @addmul40(i64 %a, i64 %b) {
; RV64I-LABEL: addmul40:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 40
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul40:
; RV64ZBA:    # %bb.0:
;
; RV64ZBA-NEXT: sh2add a0, a0, a0
; RV64ZBA-NEXT: sh3add a0, a0, a1
; RV64ZBA-NEXT: ret
%c = mul i64 %a, 40
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @addmul72(i64 %a, i64 %b) {
; RV64I-LABEL: addmul72:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 72
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul72:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT: sh3add a0, a0, a0
; RV64ZBA-NEXT: sh3add a0, a0, a1
; RV64ZBA-NEXT: ret
%c = mul i64 %a, 72
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @mul96(i64 %a) {
; RV64I-LABEL: mul96:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 96
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul96:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT: sh1add a0, a0, a0
; RV64ZBA-NEXT: slli a0, a0, 5

```

```

; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 96
ret i64 %c
}

define i64 @mul160(i64 %a) {
; RV64I-LABEL: mul160:
; RV64I:      # %bb.0:
; RV64I-NEXT:
    li a1, 160
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul160:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh2add a0, a0, a0
; RV64ZBA-NEXT:  slli a0, a0, 5
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 160
ret i64 %c
}

define i64 @mul288(i64 %a) {
; RV64I-LABEL: mul288:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 288
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul288:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  slli a0, a0, 5
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 288
ret i64 %c
}

define i64 @zext_mul96(i32 signext %a) {
; RV64I-LABEL: zext_mul96:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 3
; RV64I-NEXT:  slli a1, a1, 37
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  mulhu a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: zext_mul96:

```

```

; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 5
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  ret
%b = zext
i32 %a to i64
%c = mul i64 %b, 96
ret i64 %c
}

define i64 @zext_mul160(i32 signext %a) {
; RV64I-LABEL: zext_mul160:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  slli a1, a1, 37
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  mulhu a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: zext_mul160:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 5
; RV64ZBA-NEXT:  sh2add a0, a0, a0
; RV64ZBA-NEXT:  ret
%b = zext i32 %a to i64
%c = mul i64 %b, 160
ret i64 %c
}

define i64 @zext_mul288(i32 signext %a) {
; RV64I-LABEL: zext_mul288:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 9
; RV64I-NEXT:  slli a1, a1, 37
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  mulhu a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: zext_mul288:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 5
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  ret
%b = zext i32 %a to i64
%c = mul i64 %b, 288
ret i64 %c
}

```



```

; We can't use slli.uw becaues
the shift amount is more than 31.
; FIXME: The zext.w is unneeded.
define i64 @zext_mul12884901888(i32 signext %a) {
; RV64I-LABEL: zext_mul12884901888:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  li a1, 3
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: zext_mul12884901888:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  andi a0, a0, -1
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  slli a0, a0, 32
; RV64ZBA-NEXT:  ret
%b = zext i32 %a to i64
%c = mul i64 %b, 12884901888
ret i64 %c
}

; We can't use slli.uw becaues the shift amount is more than 31.
; FIXME: The zext.w is unneeded.
define i64 @zext_mul21474836480(i32 signext %a) {
; RV64I-LABEL: zext_mul21474836480:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:
ret
;
; RV64ZBA-LABEL: zext_mul21474836480:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  andi a0, a0, -1
; RV64ZBA-NEXT:  sh2add a0, a0, a0
; RV64ZBA-NEXT:  slli a0, a0, 32
; RV64ZBA-NEXT:  ret
%b = zext i32 %a to i64
%c = mul i64 %b, 21474836480
ret i64 %c
}

```

; We can't use slli.uw because the shift amount is more than 31.

; FIXME: The zext.w is unneeded.

define i64 @zext\_mul38654705664(i32 signext %a) {

; RV64I-LABEL: zext\_mul38654705664:

; RV64I: # %bb.0:

; RV64I-NEXT: slli a0, a0, 32

; RV64I-NEXT: srli a0, a0, 32

; RV64I-NEXT: li a1, 9

; RV64I-NEXT: slli a1, a1, 32

; RV64I-NEXT: mul a0, a0, a1

; RV64I-NEXT: ret

;

; RV64ZBA-LABEL: zext\_mul38654705664:

; RV64ZBA: # %bb.0:

; RV64ZBA-NEXT: andi a0, a0, -1

; RV64ZBA-NEXT: sh3add a0, a0, a0

; RV64ZBA-NEXT: slli a0, a0, 32

; RV64ZBA-NEXT: ret

%b = zext i32 %a to i64

%c = mul i64 %b, 38654705664

ret i64 %c

}

define i64 @sh1add\_imm(i64 %0) {

; CHECK-LABEL: sh1add\_imm:

;

CHECK: # %bb.0:

; CHECK-NEXT: slli a0, a0, 1

; CHECK-NEXT: addi a0, a0, 5

; CHECK-NEXT: ret

%a = shl i64 %0, 1

%b = add i64 %a, 5

ret i64 %b

}

define i64 @sh2add\_imm(i64 %0) {

; CHECK-LABEL: sh2add\_imm:

; CHECK: # %bb.0:

; CHECK-NEXT: slli a0, a0, 2

; CHECK-NEXT: addi a0, a0, -6

; CHECK-NEXT: ret

%a = shl i64 %0, 2

%b = add i64 %a, -6

ret i64 %b

}

define i64 @sh3add\_imm(i64 %0) {

; CHECK-LABEL: sh3add\_imm:

```

; CHECK:    # %bb.0:
; CHECK-NEXT:  slli a0, a0, 3
; CHECK-NEXT:  addi a0, a0, 7
; CHECK-NEXT:  ret
%a = shl i64 %0, 3
%b = add i64 %a, 7
ret i64 %b
}

define i64 @sh1adduw_imm(i32 signext %0) {
; RV64I-LABEL: sh1adduw_imm:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 31
; RV64I-NEXT:  addi a0, a0, 11
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh1adduw_imm:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 1
; RV64ZBA-NEXT:  addi a0, a0, 11
; RV64ZBA-NEXT:  ret
%a =
zext i32 %0 to i64
%b = shl i64 %a, 1
%c = add i64 %b, 11
ret i64 %c
}

define i64 @sh2adduw_imm(i32 signext %0) {
; RV64I-LABEL: sh2adduw_imm:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 30
; RV64I-NEXT:  addi a0, a0, -12
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh2adduw_imm:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 2
; RV64ZBA-NEXT:  addi a0, a0, -12
; RV64ZBA-NEXT:  ret
%a = zext i32 %0 to i64
%b = shl i64 %a, 2
%c = add i64 %b, -12
ret i64 %c
}

```

```

define i64 @sh3adduw_imm(i32 signext %0) {
; RV64I-LABEL: sh3adduw_imm:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 29
; RV64I-NEXT:  addi a0, a0, 13
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh3adduw_imm:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 3
; RV64ZBA-NEXT:  addi a0, a0, 13
; RV64ZBA-NEXT:  ret
%a = zext i32 %0 to i64
%b = shl i64 %a, 3
%c = add i64 %b, 13
ret i64 %c
}

```

```

define i64
@adduw_imm(i32 signext %0) nounwind {
; RV64I-LABEL: adduw_imm:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  addi a0, a0, 5
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: adduw_imm:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  zext.w a0, a0
; RV64ZBA-NEXT:  addi a0, a0, 5
; RV64ZBA-NEXT:  ret
%a = zext i32 %0 to i64
%b = add i64 %a, 5
ret i64 %b
}

```

```

define i64 @mul258(i64 %a) {
; CHECK-LABEL: mul258:
; CHECK:      # %bb.0:
; CHECK-NEXT:  li a1, 258
; CHECK-NEXT:  mul a0, a0, a1
; CHECK-NEXT:  ret
%c = mul i64 %a, 258
ret i64 %c
}

```

```

define i64 @mul260(i64 %a) {
; CHECK-LABEL: mul260:
; CHECK:      # %bb.0:
; CHECK-NEXT:  li a1, 260
; CHECK-NEXT:  mul a0, a0, a1
; CHECK-NEXT:  ret
    %c = mul i64 %a, 260
    ret i64 %c
}

```

```

define i64 @mul264(i64 %a) {
; CHECK-LABEL: mul264:
; CHECK:      # %bb.0:
; CHECK-NEXT:  li a1, 264
; CHECK-NEXT:  mul a0, a0, a1
; CHECK-NEXT:  ret
    %c = mul i64 %a, 264
    ret i64
    %c
}

```

```

define i64 @imm_zextw() nounwind {
; RV64I-LABEL: imm_zextw:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, 1
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  addi a0, a0, -2
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: imm_zextw:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  li a0, -2
; RV64ZBA-NEXT:  zext.w a0, a0
; RV64ZBA-NEXT:  ret
    ret i64 4294967294 ; -2 in 32 bits.
}

```

```

define i64 @mul11(i64 %a) {
; RV64I-LABEL: mul11:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 11
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul11:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh2add a1, a0, a0
; RV64ZBA-NEXT:  sh1add a0, a1, a0

```

```

; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 11
ret i64 %c
}

define i64 @mul19(i64 %a) {
; RV64I-LABEL: mul19:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 19
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul19:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add a1, a0, a0
; RV64ZBA-NEXT:  sh1add a0,
a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 19
ret i64 %c
}

```

```

define i64 @mul13(i64 %a) {
; RV64I-LABEL: mul13:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 13
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul13:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh1add a1, a0, a0
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 13
ret i64 %c
}

```

```

define i64 @mul21(i64 %a) {
; RV64I-LABEL: mul21:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 21
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul21:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add a1, a0, a0

```

```
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 21
ret i64 %c
}
```

```
define i64 @mul37(i64 %a) {
; RV64I-LABEL: mul37:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 37
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul37:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add a1, a0, a0
; RV64ZBA-NEXT:
    sh2add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 37
ret i64 %c
}
```

```
define i64 @mul25(i64 %a) {
; RV64I-LABEL: mul25:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 25
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul25:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh1add a1, a0, a0
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 25
ret i64 %c
}
```

```
define i64 @mul41(i64 %a) {
; RV64I-LABEL: mul41:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 41
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul41:
; RV64ZBA:      # %bb.0:
```

```

; RV64ZBA-NEXT:  sh2add a1, a0, a0
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 41
ret i64 %c
}

```

```

define i64 @mul73(i64 %a) {
; RV64I-LABEL: mul73:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 73
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul73:
; RV64ZBA:     # %bb.0:
; RV64ZBA-NEXT:  sh3add
a1, a0, a0
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 73
ret i64 %c
}

```

```

define i64 @mul27(i64 %a) {
; RV64I-LABEL: mul27:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 27
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul27:
; RV64ZBA:     # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 27
ret i64 %c
}

```

```

define i64 @mul45(i64 %a) {
; RV64I-LABEL: mul45:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 45
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul45:

```



```

; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  sh2add a0, a0, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 45
ret i64 %c
}

```

```

define i64 @mul81(i64 %a) {
; RV64I-LABEL: mul81:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 81
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul81:
; RV64ZBA:    # %bb.0:
;
RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 81
ret i64 %c
}

```

```

define i64 @mul4098(i64 %a) {
; RV64I-LABEL: mul4098:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a1, a0, 1
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul4098:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  slli a1, a0, 12
; RV64ZBA-NEXT:  sh1add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 4098
ret i64 %c
}

```

```

define i64 @mul4100(i64 %a) {
; RV64I-LABEL: mul4100:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a1, a0, 2
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  add a0, a0, a1

```

```

; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul4100:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli a1, a0, 12
; RV64ZBA-NEXT:  sh2add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 4100
ret i64 %c
}

```

```

define i64 @mul4104(i64 %a) {
; RV64I-LABEL: mul4104:
; RV64I:        # %bb.0:
; RV64I-NEXT:
    slli a1, a0, 3
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul4104:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli a1, a0, 12
; RV64ZBA-NEXT:  sh3add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 4104
ret i64 %c
}

```

```

define signext i32 @mulw192(i32 signext %a) {
; CHECK-LABEL: mulw192:
; CHECK:        # %bb.0:
; CHECK-NEXT:   li a1, 192
; CHECK-NEXT:   mulw a0, a0, a1
; CHECK-NEXT:   ret
%c = mul i32 %a, 192
ret i32 %c
}

```

```

define signext i32 @mulw320(i32 signext %a) {
; CHECK-LABEL: mulw320:
; CHECK:        # %bb.0:
; CHECK-NEXT:   li a1, 320
; CHECK-NEXT:   mulw a0, a0, a1
; CHECK-NEXT:   ret
%c = mul i32 %a, 320
ret i32 %c
}

```

```

define signext i32 @mulw576(i32 signext %a) {
; CHECK-LABEL: mulw576:
; CHECK:      # %bb.0:
; CHECK-NEXT:  li a1, 576
; CHECK-NEXT:  mulw a0, a0, a1
; CHECK-NEXT:  ret
%c = mul i32 %a, 576
ret i32 %c
}

```

```

define i64 @add4104(i64 %a) {
; RV64I-LABEL: add4104:
; RV64I:
    # %bb.0:
; RV64I-NEXT:  lui a1, 1
; RV64I-NEXT:  addiw a1, a1, 8
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: add4104:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  li a1, 1026
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = add i64 %a, 4104
ret i64 %c
}

```

```

define i64 @add8208(i64 %a) {
; RV64I-LABEL: add8208:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 2
; RV64I-NEXT:  addiw a1, a1, 16
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: add8208:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  li a1, 1026
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = add i64 %a, 8208
ret i64 %c
}

```

; Make sure we prefer LUI for the 8192 instead of using sh3add.

```

define signext i32 @add8192_i32(i32 signext %a) {

```

```

; CHECK-LABEL: add8192_i32:
; CHECK:      # %bb.0:
; CHECK-NEXT:  lui a1, 2
; CHECK-NEXT:  addw a0, a0, a1
; CHECK-NEXT:  ret
%c = add i32 %a, 8192
ret i32 %c
}

```

```

; Make sure we prefer LUI
for the 8192 instead of using sh3add.
define i64 @add8192(i64 %a) {
; CHECK-LABEL: add8192:
; CHECK:      # %bb.0:
; CHECK-NEXT:  lui a1, 2
; CHECK-NEXT:  add a0, a0, a1
; CHECK-NEXT:  ret
%c = add i64 %a, 8192
ret i64 %c
}

```

```

define signext i32 @addshl32_5_6(i32 signext %a, i32 signext %b) {
; RV64I-LABEL: addshl32_5_6:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 5
; RV64I-NEXT:  slli a1, a1, 6
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addshl32_5_6:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh1add a0, a1, a0
; RV64ZBA-NEXT:  slliw a0, a0, 5
; RV64ZBA-NEXT:  ret
%c = shl i32 %a, 5
%d = shl i32 %b, 6
%e = add i32 %c, %d
ret i32 %e
}

```

```

define i64 @addshl64_5_6(i64 %a, i64 %b) {
; RV64I-LABEL: addshl64_5_6:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 5
; RV64I-NEXT:  slli a1, a1, 6
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;

```

```

; RV64ZBA-LABEL: addshl64_5_6:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:
    sh1add a0, a1, a0
; RV64ZBA-NEXT:  slli a0, a0, 5
; RV64ZBA-NEXT:  ret
    %c = shl i64 %a, 5
    %d = shl i64 %b, 6
    %e = add i64 %c, %d
    ret i64 %e
}

```

```

define signext i32 @addshl32_5_7(i32 signext %a, i32 signext %b) {
; RV64I-LABEL: addshl32_5_7:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 5
; RV64I-NEXT:  slli a1, a1, 7
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addshl32_5_7:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  slliw a0, a0, 5
; RV64ZBA-NEXT:  ret
    %c = shl i32 %a, 5
    %d = shl i32 %b, 7
    %e = add i32 %c, %d
    ret i32 %e
}

```

```

define i64 @addshl64_5_7(i64 %a, i64 %b) {
; RV64I-LABEL: addshl64_5_7:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 5
; RV64I-NEXT:  slli a1, a1, 7
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addshl64_5_7:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  slli a0, a0, 5
; RV64ZBA-NEXT:  ret
    %c
    = shl i64 %a, 5
    %d = shl i64 %b, 7
    %e = add i64 %c, %d

```

```

ret i64 %e
}

define signext i32 @addshl32_5_8(i32 signext %a, i32 signext %b) {
; RV64I-LABEL: addshl32_5_8:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 5
; RV64I-NEXT:  slli a1, a1, 8
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addshl32_5_8:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  slliw a0, a0, 5
; RV64ZBA-NEXT:  ret
%c = shl i32 %a, 5
%d = shl i32 %b, 8
%e = add i32 %c, %d
ret i32 %e
}

define i64 @addshl64_5_8(i64 %a, i64 %b) {
; RV64I-LABEL: addshl64_5_8:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 5
; RV64I-NEXT:  slli a1, a1, 8
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addshl64_5_8:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  slli a0, a0, 5
; RV64ZBA-NEXT:  ret
%c = shl i64 %a, 5
%d = shl i64 %b, 8
%e = add i64 %c, %d
ret i64 %e
}

; Make
sure we use sext.h+slli+srli for Zba+Zbb.
; FIXME: The RV64I and Zba only cases can be done with only 3 shifts.
define zeroext i32 @sext_ashr_zext_i8(i8 %a) nounwind {
; RV64I-LABEL: sext_ashr_zext_i8:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 24

```

```

; RV64I-NEXT:  sraiw a0, a0, 31
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  ret
;
; RV64ZBANOBZBB-LABEL: sext_ashr_zext_i8:
; RV64ZBANOBZBB:    # %bb.0:
; RV64ZBANOBZBB-NEXT:  slli a0, a0, 24
; RV64ZBANOBZBB-NEXT:  sraiw a0, a0, 31
; RV64ZBANOBZBB-NEXT:  zext.w a0, a0
; RV64ZBANOBZBB-NEXT:  ret
;
; RV64ZBAZBB-LABEL: sext_ashr_zext_i8:
; RV64ZBAZBB:    # %bb.0:
; RV64ZBAZBB-NEXT:  sext.b a0, a0
; RV64ZBAZBB-NEXT:  sraiw a0, a0, 9
; RV64ZBAZBB-NEXT:  zext.w a0, a0
; RV64ZBAZBB-NEXT:  ret
%ext = sext i8 %a to i32
%1 = ashr i32 %ext, 9
ret i32 %1
}

; Make sure we use sext.h+slli+srli for Zba+Zbb.
; FIXME: The RV64I and Zba only cases can be done with only 3 shifts.
define
zeroext i32 @sext_ashr_zext_i16(i16 %a) nounwind {
; RV64I-LABEL: sext_ashr_zext_i16:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a0, a0, 25
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  ret
;
; RV64ZBANOBZBB-LABEL: sext_ashr_zext_i16:
; RV64ZBANOBZBB:    # %bb.0:
; RV64ZBANOBZBB-NEXT:  slli a0, a0, 16
; RV64ZBANOBZBB-NEXT:  sraiw a0, a0, 25
; RV64ZBANOBZBB-NEXT:  zext.w a0, a0
; RV64ZBANOBZBB-NEXT:  ret
;
; RV64ZBAZBB-LABEL: sext_ashr_zext_i16:
; RV64ZBAZBB:    # %bb.0:
; RV64ZBAZBB-NEXT:  slli a0, a0, 48
; RV64ZBAZBB-NEXT:  srai a0, a0, 57
; RV64ZBAZBB-NEXT:  zext.w a0, a0
; RV64ZBAZBB-NEXT:  ret

```

```

%ext = sext i16 %a to i32
%1 = ashr i32 %ext, 9
ret i32 %1
}

```

; This the IR you get from InstCombine if take the difference of 2 pointers and  
; cast is to unsigned before using as an index.

```

define signext i16 @sh1adduw_ptrdiff(i64 %diff, ptr %baseptr) {
; RV64I-LABEL: sh1adduw_ptrdiff:
; RV64I:
;   # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  slli a2, a2, 33
; RV64I-NEXT:  addi a2, a2, -2
; RV64I-NEXT:  and a0, a0, a2
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lh a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh1adduw_ptrdiff:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  srli a0, a0, 1
; RV64ZBA-NEXT:  sh1add.uw a0, a0, a1
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:  ret
%ptrdiff = lshr exact i64 %diff, 1
%cast = and i64 %ptrdiff, 4294967295
%ptr = getelementptr inbounds i16, ptr %baseptr, i64 %cast
%res = load i16, ptr %ptr
ret i16 %res
}

```

```

define signext i32 @sh2adduw_ptrdiff(i64 %diff, ptr %baseptr) {
; RV64I-LABEL: sh2adduw_ptrdiff:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  slli a2, a2, 34
; RV64I-NEXT:  addi a2, a2, -4
; RV64I-NEXT:  and a0, a0, a2
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh2adduw_ptrdiff:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:
;   srli a0, a0, 2
; RV64ZBA-NEXT:  sh2add.uw a0, a0, a1

```



```

; RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%ptrdiff = lshr exact i64 %diff, 2
%cast = and i64 %ptrdiff, 4294967295
%ptr = getelementptr inbounds i32, ptr %baseptr, i64 %cast
%res = load i32, ptr %ptr
ret i32 %res
}

```

```

define i64 @sh3adduw_ptrdiff(i64 %diff, ptr %baseptr) {
; RV64I-LABEL: sh3adduw_ptrdiff:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  slli a2, a2, 35
; RV64I-NEXT:  addi a2, a2, -8
; RV64I-NEXT:  and a0, a0, a2
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh3adduw_ptrdiff:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srli a0, a0, 3
; RV64ZBA-NEXT:  sh3add.uw a0, a0, a1
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%ptrdiff = lshr exact i64 %diff, 3
%cast = and i64 %ptrdiff, 4294967295
%ptr = getelementptr inbounds i64, ptr %baseptr, i64 %cast
%res = load i64, ptr %ptr
ret i64 %res
}

```

```

define signext
i16 @srliw_1_sh1add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srliw_1_sh1add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a1, 1
; RV64I-NEXT:  slli a1, a1, 1
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lh a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srliw_1_sh1add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srliw a1, a1, 1
; RV64ZBA-NEXT:  sh1add a0, a1, a0
; RV64ZBA-NEXT:  lh a0, 0(a0)

```

```

; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 1
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i16, ptr %0, i64 %4
%6 = load i16, ptr %5, align 2
ret i16 %6
}

define i128 @sliuw_ptrdiff(i64 %diff, ptr %baseptr) {
; RV64I-LABEL: sliuw_ptrdiff:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  slli a2, a2, 36
; RV64I-NEXT:  addi a2, a2, -16
; RV64I-NEXT:  and a0, a0, a2
; RV64I-NEXT:  add a1, a1, a0
; RV64I-NEXT:  ld a0, 0(a1)
; RV64I-NEXT:  ld a1, 8(a1)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sliuw_ptrdiff:
; RV64ZBA:      # %bb.0:
;
RV64ZBA-NEXT:  srli a0, a0, 4
; RV64ZBA-NEXT:  slli.uw a0, a0, 4
; RV64ZBA-NEXT:  add a1, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a1)
; RV64ZBA-NEXT:  ld a1, 8(a1)
; RV64ZBA-NEXT:  ret
%ptrdiff = lshr exact i64 %diff, 4
%cast = and i64 %ptrdiff, 4294967295
%ptr = getelementptr inbounds i128, ptr %baseptr, i64 %cast
%res = load i128, ptr %ptr
ret i128 %res
}

define signext i32 @srliw_2_sh2add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srliw_2_sh2add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a1, 2
; RV64I-NEXT:  slli a1, a1, 2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srliw_2_sh2add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srliw a1, a1, 2

```

```

; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 2
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i32, ptr %0, i64 %4
%6 = load i32, ptr %5, align 4
ret i32 %6
}

```

```

define i64 @srliw_3_sh3add(ptr
%0, i32 signext %1) {
; RV64I-LABEL: srliw_3_sh3add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a1, 3
; RV64I-NEXT:  slli a1, a1, 3
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srliw_3_sh3add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srliw a1, a1, 3
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 3
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i64, ptr %0, i64 %4
%6 = load i64, ptr %5, align 8
ret i64 %6
}

```

```

define signext i32 @srliw_1_sh2add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srliw_1_sh2add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a1, 1
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 30
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srliw_1_sh2add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srliw a1, a1, 1
; RV64ZBA-NEXT:  sh2add a0, a1, a0
;

```

```

RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 1
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i32, ptr %0, i64 %4
%6 = load i32, ptr %5, align 4
ret i32 %6
}

define i64 @srliw_1_sh3add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srliw_1_sh3add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a1, 1
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 29
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srliw_1_sh3add:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  srliw a1, a1, 1
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 1
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i64, ptr %0, i64 %4
%6 = load i64, ptr %5, align 8
ret i64 %6
}

define i64 @srliw_2_sh3add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srliw_2_sh3add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a1, 2
; RV64I-NEXT:  slli a1, a1, 32
;
; RV64I-NEXT:  srli a1, a1, 29
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srliw_2_sh3add:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  srliw a1, a1, 2
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a0)

```

```

; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 2
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i64, ptr %0, i64 %4
%6 = load i64, ptr %5, align 8
ret i64 %6
}

```

```

define signext i16 @srliw_2_sh1add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srliw_2_sh1add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a1, 2
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 31
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lh a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srliw_2_sh1add:
; RV64ZBA:     # %bb.0:
; RV64ZBA-NEXT:  srliw a1, a1, 2
; RV64ZBA-NEXT:  sh1add a0, a1, a0
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 2
%4 = zext i32 %3 to i64
%5 = getelementptr
inbounds i16, ptr %0, i64 %4
%6 = load i16, ptr %5, align 2
ret i16 %6
}

```

```

define signext i32 @srliw_3_sh2add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srliw_3_sh2add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a1, 3
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 30
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srliw_3_sh2add:
; RV64ZBA:     # %bb.0:
; RV64ZBA-NEXT:  srliw a1, a1, 3
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  lw a0, 0(a0)

```

```

; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 3
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i32, ptr %0, i64 %4
%6 = load i32, ptr %5, align 4
ret i32 %6
}

define i64 @srliw_4_sh3add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srliw_4_sh3add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a1, 4
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 29
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:
    ret
;
; RV64ZBA-LABEL: srliw_4_sh3add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srliw a1, a1, 4
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 4
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i64, ptr %0, i64 %4
%6 = load i64, ptr %5, align 8
ret i64 %6
}

define signext i32 @srli_1_sh2add(ptr %0, i64 %1) {
; RV64I-LABEL: srli_1_sh2add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a1, a1, 1
; RV64I-NEXT:  andi a1, a1, -4
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srli_1_sh2add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srli a1, a1, 1
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i64 %1, 1

```

```

%4 = getelementptr inbounds i32, ptr %0, i64 %3
%5 = load i32, ptr %4, align 4
ret i32 %5
}

```

```

define i64 @srli_2_sh3add(ptr %0, i64 %1) {
; RV64I-LABEL: srli_2_sh3add:
; RV64I:      # %bb.0:
;
; RV64I-NEXT:  slli a1, a1, 1
; RV64I-NEXT:  andi a1, a1, -8
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srli_2_sh3add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srli a1, a1, 2
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i64 %1, 2
%4 = getelementptr inbounds i64, ptr %0, i64 %3
%5 = load i64, ptr %4, align 8
ret i64 %5
}

```

```

define signext i16 @srli_2_sh1add(ptr %0, i64 %1) {
; RV64I-LABEL: srli_2_sh1add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srli a1, a1, 1
; RV64I-NEXT:  andi a1, a1, -2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lh a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srli_2_sh1add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srli a1, a1, 2
; RV64ZBA-NEXT:  sh1add a0, a1, a0
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i64 %1, 2
%4 = getelementptr inbounds i16, ptr %0, i64 %3
%5 = load i16, ptr %4, align
2
ret i16 %5
}

```

```

define signext i32 @srli_3_sh2add(ptr %0, i64 %1) {
; RV64I-LABEL: srli_3_sh2add:
; RV64I:      # %bb.0:
; RV64I-NEXT: srli a1, a1, 1
; RV64I-NEXT: andi a1, a1, -4
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: lw a0, 0(a0)
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: srli_3_sh2add:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT: srli a1, a1, 3
; RV64ZBA-NEXT: sh2add a0, a1, a0
; RV64ZBA-NEXT: lw a0, 0(a0)
; RV64ZBA-NEXT: ret
%3 = lshr i64 %1, 3
%4 = getelementptr inbounds i32, ptr %0, i64 %3
%5 = load i32, ptr %4, align 4
ret i32 %5
}

```

```

define i64 @srli_4_sh3add(ptr %0, i64 %1) {
; RV64I-LABEL: srli_4_sh3add:
; RV64I:      # %bb.0:
; RV64I-NEXT: srli a1, a1, 1
; RV64I-NEXT: andi a1, a1, -8
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: ld a0, 0(a0)
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: srli_4_sh3add:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT: srli a1, a1, 4
; RV64ZBA-NEXT: sh3add a0, a1, a0
; RV64ZBA-NEXT: ld a0, 0(a0)
; RV64ZBA-NEXT:
ret
%3 = lshr i64 %1, 4
%4 = getelementptr inbounds i64, ptr %0, i64 %3
%5 = load i64, ptr %4, align 8
ret i64 %5
}

```

```

define signext i16 @shl_2_sh1add(ptr %0, i32 signext %1) {
; RV64I-LABEL: shl_2_sh1add:
; RV64I:      # %bb.0:
; RV64I-NEXT: slli a1, a1, 2

```



```

; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 31
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lh a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: shl_2_sh1add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli a1, a1, 2
; RV64ZBA-NEXT:  zext.w a1, a1
; RV64ZBA-NEXT:  sh1add a0, a1, a0
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = shl i32 %1, 2
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i16, ptr %0, i64 %4
%6 = load i16, ptr %5, align 2
ret i16 %6
}

define signext i32 @shl_16_sh2add(ptr %0, i32 signext %1) {
; RV64I-LABEL: shl_16_sh2add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a1, a1, 16
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 30
;
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: shl_16_sh2add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli a1, a1, 16
; RV64ZBA-NEXT:  zext.w a1, a1
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = shl i32 %1, 16
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i32, ptr %0, i64 %4
%6 = load i32, ptr %5, align 4
ret i32 %6
}

define i64 @shl_31_sh3add(ptr %0, i32 signext %1) {
; RV64I-LABEL: shl_31_sh3add:
; RV64I:      # %bb.0:

```

```

; RV64I-NEXT:  slli a1, a1, 31
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 29
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: shl_31_sh3add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli a1, a1, 31
; RV64ZBA-NEXT:  zext.w a1, a1
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = shl i32 %1, 31
%4 = zext i32 %3
to i64
%5 = getelementptr inbounds i64, ptr %0, i64 %4
%6 = load i64, ptr %5, align 8
ret i64 %6
}

```

```

define i64 @pack_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: pack_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: pack_i64:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli a1, a1, 32
; RV64ZBA-NEXT:  add.uw a0, a0, a1
; RV64ZBA-NEXT:  ret
%shl = and i64 %a, 4294967295
%shl1 = shl i64 %b, 32
%or = or i64 %shl1, %shl
ret i64 %or
}

```

```

define i64 @pack_i64_2(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: pack_i64_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32

```

```

; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: pack_i64_2:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli a1, a1, 32
; RV64ZBA-NEXT:  add.uw a0, a0,
a1
; RV64ZBA-NEXT:  ret
%zexta = zext i32 %a to i64
%zextb = zext i32 %b to i64
%shl1 = shl i64 %zextb, 32
%or = or i64 %shl1, %zexta
ret i64 %or
}

define i64 @pack_i64_3(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: pack_i64_3:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  addi a1, a1, 1
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: pack_i64_3:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  addi a0, a0, 1
; RV64ZBA-NEXT:  addi a1, a1, 1
; RV64ZBA-NEXT:  slli a1, a1, 32
; RV64ZBA-NEXT:  add.uw a0, a0, a1
; RV64ZBA-NEXT:  ret
%adda = add i32 %a, 1
%addb = add i32 %b, 1
%zexta = zext i32 %adda to i64
%zextb = zext i32 %addb to i64
%shl1 = shl i64 %zextb, 32
%or = or i64 %shl1, %zexta
ret i64 %or
}

```

=====

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```
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -mattr=+zbb -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBB
```

```
declare i32 @llvm.riscv.orc.b.i32(i32)
```

```
define signext i32 @orc32(i32 signext %a) nounwind {
; RV64ZBB-LABEL: orc32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  orc.b a0, a0
; RV64ZBB-NEXT:  sext.w a0, a0
; RV64ZBB-NEXT:  ret
  %tmp = call i32 @llvm.riscv.orc.b.i32(i32 %a)
  ret i32 %tmp
}
```

```
define zeroext i32 @orc32_zext(i32 zeroext %a) nounwind {
; RV64ZBB-LABEL: orc32_zext:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  orc.b a0, a0
; RV64ZBB-NEXT:  ret
  %tmp = call i32 @llvm.riscv.orc.b.i32(i32 %a)
  ret i32 %tmp
}
```

; Second and+or is redundant with the first, make sure we remove them.

```
define signext i32 @orc32_knownbits(i32 signext %a) nounwind {
; RV64ZBB-LABEL: orc32_knownbits:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  lui a1, 1044480
; RV64ZBB-NEXT:
  and a0, a0, a1
; RV64ZBB-NEXT:  lui a1, 2048
; RV64ZBB-NEXT:  addi a1, a1, 1
; RV64ZBB-NEXT:  or a0, a0, a1
; RV64ZBB-NEXT:  orc.b a0, a0
; RV64ZBB-NEXT:  sext.w a0, a0
; RV64ZBB-NEXT:  ret
  %tmp = and i32 %a, 4278190080 ; 0xFF000000
  %tmp2 = or i32 %tmp, 8388609 ; 0x800001
  %tmp3 = call i32 @llvm.riscv.orc.b.i32(i32 %tmp2)
  %tmp4 = and i32 %tmp3, 4278190080 ; 0xFF000000
  %tmp5 = or i32 %tmp4, 16711935 ; 0xFF00FF
  ret i32 %tmp5
}
```

```
declare i64 @llvm.riscv.orc.b.i64(i64)
```

```

define i64 @orcb64(i64 %a) nounwind {
; RV64ZBB-LABEL: orcb64:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  orc.b a0, a0
; RV64ZBB-NEXT:  ret
%tmp = call i64 @llvm.riscv.orc.b.i64(i64 %a)
ret i64 %tmp
}

```

; Second and+or is redundant with the first, make sure we remove them.

```

define i64 @orcb64_knownbits(i64 %a) nounwind {
; RV64ZBB-LABEL: orcb64_knownbits:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  lui a1, 65535
; RV64ZBB-NEXT:  slli a1, a1, 12
; RV64ZBB-NEXT:  and a0, a0, a1
;
; RV64ZBB-NEXT:  lui a1, 256
; RV64ZBB-NEXT:  addiw a1, a1, 8
; RV64ZBB-NEXT:  slli a2, a1, 42
; RV64ZBB-NEXT:  add a1, a1, a2
; RV64ZBB-NEXT:  or a0, a0, a1
; RV64ZBB-NEXT:  orc.b a0, a0
; RV64ZBB-NEXT:  ret
%tmp = and i64 %a, 1099494850560 ; 0x000000ffff000000
%tmp2 = or i64 %tmp, 4611721202800525320 ; 0x4000200000100008
%tmp3 = call i64 @llvm.riscv.orc.b.i64(i64 %tmp2)
%tmp4 = and i64 %tmp3, 1099494850560 ; 0x000000ffff000000
%tmp5 = or i64 %tmp4, 18374966855153418495 ; 0xff00ff0000ff00ff
ret i64 %tmp5
}

```

; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

; RUN: llc -mtriple=riscv64 -mattr=+zbc -verify-machineinstrs < %s \

; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBC

```

declare i64 @llvm.riscv.clmulr.i64(i64 %a, i64 %b)

```

```

define i64 @clmul64r(i64 %a, i64 %b) nounwind {
; RV64ZBC-LABEL: clmul64r:
; RV64ZBC:      # %bb.0:
; RV64ZBC-NEXT:  clmulr a0, a0, a1
; RV64ZBC-NEXT:  ret
%tmp = call i64 @llvm.riscv.clmulr.i64(i64 %a, i64 %b)
ret i64 %tmp
}

```

```

declare i32 @llvm.riscv.clmulr.i32(i32 %a, i32 %b)

```

```

define signext i32 @clmul32r(i32 signext %a, i32 signext %b) nounwind {
; RV64ZBC-LABEL: clmul32r:
; RV64ZBC:      # %bb.0:
; RV64ZBC-NEXT:  slli a1, a1, 32
; RV64ZBC-NEXT:  slli a0, a0, 32
; RV64ZBC-NEXT:  clmulr a0, a0, a1
; RV64ZBC-NEXT:  srai a0, a0, 32
; RV64ZBC-NEXT:  ret
    %tmp = call i32 @llvm.riscv.clmulr.i32(i32 %a, i32 %b)
    ret i32 %tmp
}

; FIXME: We could avoid the slli instructions by using clmul+srli+sext.w
; since
; the inputs are zero extended.
define signext i32 @clmul32r_zext(i32 zeroext %a, i32 zeroext %b) nounwind {
; RV64ZBC-LABEL: clmul32r_zext:
; RV64ZBC:      # %bb.0:
; RV64ZBC-NEXT:  slli a1, a1, 32
; RV64ZBC-NEXT:  slli a0, a0, 32
; RV64ZBC-NEXT:  clmulr a0, a0, a1
; RV64ZBC-NEXT:  srai a0, a0, 32
; RV64ZBC-NEXT:  ret
    %tmp = call i32 @llvm.riscv.clmulr.i32(i32 %a, i32 %b)
    ret i32 %tmp
}

; RUN: opt %s -passes=inline -S | FileCheck %s

define internal void @innerSmall() "min-legal-vector-width"="128" {
    ret void
}

define internal void @innerLarge() "min-legal-vector-width"="512" {
    ret void
}

define internal void @innerNoAttribute() {
    ret void
}

; We should not add an attribute during inlining. No attribute means unknown.
; Inlining doesn't change the fact that we don't know anything about this
; function.
define void @outerNoAttribute() {
    call void @innerLarge()
    ret void
}

```

```

define void @outerConflictingAttributeSmall() "min-legal-vector-width"="128" {
  call void @innerLarge()
  ret void
}

define void @outerConflictingAttributeLarge() "min-legal-vector-width"="512" {
  call void @innerSmall()
  ret void
}

; We should remove the attribute after inlining since the callee's
; vector width requirements are unknown.
define void @outerAttribute() "min-legal-vector-width"="128" {
  call void @innerNoAttribute()
  ret void
}

; CHECK: define void @outerNoAttribute()
; {
; CHECK: define void @outerConflictingAttributeSmall() #0
; CHECK: define void @outerConflictingAttributeLarge() #0
; CHECK: define void @outerAttribute() {
; CHECK: attributes #0 = { "min-legal-vector-width"="512" }
; RUN: opt -mtriple=aarch64-linux-gnu -mattr=+sve -passes=sanitize-masked-mem-intrin -S < %s | FileCheck %s

; Testing that masked scatters operating on scalable vectors that are
; packed in SVE registers are not scalarized.

; CHECK-LABEL: @masked_scatter_nxv4i32(
; CHECK: call void @llvm.masked.scatter.nxv4i32
define void @masked_scatter_nxv4i32(<vscale x 4 x i32> %data, <vscale x 4 x ptr> %ptrs, <vscale x 4 x i1>
%mask) {
  call void @llvm.masked.scatter.nxv4i32(<vscale x 4 x i32> %data, <vscale x 4 x ptr> %ptrs, i32 0, <vscale x 4 x
i1> %mask)
  ret void
}

; Testing that masked scatters operating on scalable vectors of FP
; data that is packed in SVE registers are not scalarized.

; CHECK-LABEL: @masked_scatter_nxv2f64(
; CHECK: call void @llvm.masked.scatter.nxv2f64
define void @masked_scatter_nxv2f64(<vscale x 2 x double> %data, <vscale x 2 x ptr> %ptrs, <vscale x 2 x i1>
%mask) {
  call void @llvm.masked.scatter.nxv2f64(<vscale x 2 x double> %data, <vscale x 2 x ptr> %ptrs,
i32 0, <vscale x 2 x i1> %mask)
  ret void
}

```

; Testing that masked scatters operating on scalable vectors of FP  
; data that is unpacked in SVE registers are not scalarized.

```
; CHECK-LABEL: @masked_scatter_nxv2f16(  
; CHECK: call void @llvm.masked.scatter.nxv2f16  
define void @masked_scatter_nxv2f16(<vscale x 2 x half> %data, <vscale x 2 x ptr> %ptrs, <vscale x 2 x i1>  
%masks) {  
    call void @llvm.masked.scatter.nxv2f16(<vscale x 2 x half> %data, <vscale x 2 x ptr> %ptrs, i32 0, <vscale x 2 x  
i1> %masks)  
    ret void  
}
```

; Testing that masked scatters operating on 64-bit fixed vectors are  
; scalarized because NEON doesn't have support for masked scatter  
; instructions.

```
; CHECK-LABEL: @masked_scatter_v2f32(  
; CHECK-NOT: @llvm.masked.scatter.v2f32(  
define void @masked_scatter_v2f32(<2 x float> %data, <2 x ptr> %ptrs, <2 x i1> %masks) {  
    call void @llvm.masked.scatter.v2f32(<2 x float> %data, <2 x ptr> %ptrs, i32 0, <2 x i1> %masks)  
    ret void  
}
```

; Testing that masked scatters operating on 128-bit  
fixed vectors are  
; scalarized because NEON doesn't have support for masked scatter  
; instructions and because we are not targeting fixed width SVE.

```
; CHECK-LABEL: @masked_scatter_v4i32(  
; CHECK-NOT: @llvm.masked.scatter.v4i32(  
define void @masked_scatter_v4i32(<4 x i32> %data, <4 x ptr> %ptrs, <4 x i1> %masks) {  
    call void @llvm.masked.scatter.v4i32(<4 x i32> %data, <4 x ptr> %ptrs, i32 0, <4 x i1> %masks)  
    ret void  
}
```

```
declare void @llvm.masked.scatter.nxv4i32(<vscale x 4 x i32> %data, <vscale x 4 x ptr> %ptrs, i32 %align,  
<vscale x 4 x i1> %masks)  
declare void @llvm.masked.scatter.nxv2f64(<vscale x 2 x double> %data, <vscale x 2 x ptr> %ptrs, i32 %align,  
<vscale x 2 x i1> %masks)  
declare void @llvm.masked.scatter.nxv2f16(<vscale x 2 x half> %data, <vscale x 2 x ptr> %ptrs, i32 %align,  
<vscale x 2 x i1> %masks)  
declare void @llvm.masked.scatter.v2f32(<2 x float> %data, <2 x ptr> %ptrs, i32 %align, <2 x i1> %masks)  
declare void @llvm.masked.scatter.v4i32(<4 x i32> %data, <4 x  
ptr> %ptrs, i32 %align, <4 x i1> %masks)  
//===-- ObjectContainerBSDArchive.h -----*- C++ -*-====//  
//  
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```

```

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//
//===-----
//
#endif
LLDB_SOURCE_PLUGINS_OBJECTCONTAINER_BSD_ARCHIVE_OBJECTCONTAINERBSDARCHIVE_H
#define
LLDB_SOURCE_PLUGINS_OBJECTCONTAINER_BSD_ARCHIVE_OBJECTCONTAINERBSDARCHIVE_H

#include "lldb/Core/UniqueCStringMap.h"
#include "lldb/Symbol/ObjectContainer.h"
#include "lldb/Utility/ArchSpec.h"
#include "lldb/Utility/ConstString.h"
#include "lldb/Utility/FileSpec.h"

#include "llvm/Object/Archive.h"
#include "llvm/Support/Chrono.h"
#include "llvm/Support/Path.h"

#include <map>
#include <memory>
#include <mutex>

enum class ArchiveType { Invalid, Archive, ThinArchive };

class ObjectContainerBSDArchive : public lldb_private::ObjectContainer
{
public:
    ObjectContainerBSDArchive(const lldb::ModuleSP &module_sp,
                             lldb::DataBufferSP &data_sp,
                             lldb::offset_t data_offset,
                             const lldb_private::FileSpec *file,
                             lldb::offset_t offset, lldb::offset_t length,
                             ArchiveType archive_type);

    ~ObjectContainerBSDArchive() override;

    // Static Functions
    static void Initialize();

    static void Terminate();

    static llvm::StringRef GetPluginNameStatic() { return "bsd-archive"; }

    static llvm::StringRef GetPluginDescriptionStatic() {
        return "BSD Archive object container reader.";
    }
}

```



```

static lldb_private::ObjectContainer *
CreateInstance(const lldb::ModuleSP &module_sp, lldb::DataBufferSP &data_sp,
               lldb::offset_t data_offset, const lldb_private::FileSpec *file,
               lldb::offset_t offset, lldb::offset_t length);

static size_t GetModuleSpecifications(const
lldb_private::FileSpec &file,
                                     lldb::DataBufferSP &data_sp,
                                     lldb::offset_t data_offset,
                                     lldb::offset_t file_offset,
                                     lldb::offset_t length,
                                     lldb_private::ModuleSpecList &specs);

static ArchiveType MagicBytesMatch(const lldb_private::DataExtractor &data);

// Member Functions
bool ParseHeader() override;

size_t GetNumObjects() const override {
    if (m_archive_sp)
        return m_archive_sp->GetNumObjects();
    return 0;
}

lldb::ObjectFileSP GetObjectFile(const lldb_private::FileSpec *file) override;

// PluginInterface protocol
llvm::StringRef GetPluginName() override { return GetPluginNameStatic(); }

protected:
struct Object {
    Object();

    void Clear();

    lldb::offset_t ExtractFromThin(const lldb_private::DataExtractor &data,
                                   lldb::offset_t offset,
                                   llvm::StringRef stringTable);

    lldb::offset_t Extract(const lldb_private::DataExtractor &data,
                           lldb::offset_t offset);
    /// Object name in the archive.
    lldb_private::ConstString ar_name;

    /// Object modification time in the archive.
    uint32_t modification_time = 0;

```

```

/// Object size in bytes in the archive.
uint32_t size = 0;

/// File offset in bytes from the beginning of the file of the object data.
lldb::offset_t file_offset = 0;

/// Length of the object data.
lldb::offset_t file_size = 0;

void Dump() const;
};

class Archive {
public:
    typedef std::shared_ptr<Archive> shared_ptr;
    typedef std::multimap<lldb_private::FileSpec, shared_ptr> Map;

    Archive(const lldb_private::ArchSpec &arch,
            const llvm::sys::TimePoint<> &mod_time, lldb::offset_t file_offset,
            lldb_private::DataExtractor &data, ArchiveType archive_type);

    ~Archive();

    static Map &GetArchiveCache();

    static std::recursive_mutex &GetArchiveCacheMutex();

    static Archive::shared_ptr FindCachedArchive(
        const lldb_private::FileSpec &file, const lldb_private::ArchSpec &arch,
        const llvm::sys::TimePoint<> &mod_time, lldb::offset_t file_offset);

    static Archive::shared_ptr ParseAndCacheArchiveForFile(
        const lldb_private::FileSpec &file, const lldb_private::ArchSpec &arch,
        const llvm::sys::TimePoint<> &mod_time, lldb::offset_t file_offset,
        lldb_private::DataExtractor &data, ArchiveType archive_type);

    size_t GetNumObjects() const { return m_objects.size(); }

    const Object *GetObjectAtIndex(size_t idx) {
        if (idx < m_objects.size())
            return &m_objects[idx];
        return nullptr;
    }

    size_t ParseObjects();

    Object *FindObject(lldb_private::ConstString object_name,

```

```

        const llvm::sys::TimePoint<> &object_mod_time);

lldb::offset_t
GetFileOffset() const { return m_file_offset; }

const llvm::sys::TimePoint<> &GetModificationTime() {
    return m_modification_time;
}

const lldb_private::ArchSpec &GetArchitecture() const { return m_arch; }

void SetArchitecture(const lldb_private::ArchSpec &arch) { m_arch = arch; }

bool HasNoExternalReferences() const;

lldb_private::DataExtractor &GetData() { return m_data; }

ArchiveType GetArchiveType() { return m_archive_type; }

protected:
    typedef lldb_private::UniqueCStringMap<uint32_t> ObjectNameToIndexMap;
    // Member Variables
    lldb_private::ArchSpec m_arch;
    llvm::sys::TimePoint<> m_modification_time;
    lldb::offset_t m_file_offset;
    std::vector<Object> m_objects;
    ObjectNameToIndexMap m_object_name_to_index_map;
    lldb_private::DataExtractor m_data; ///< The data for this object container
                                         ///

```

! 2.19.6.2 copyprivate Clause

! If the list item is a polymorphic variable with the allocatable attribute,

! the behavior is unspecified.

subroutine firstprivate()

class(\*), allocatable, save :: x

!PORTABILITY: If a polymorphic variable with allocatable attribute 'x' is in FIRSTPRIVATE clause, the behavior is unspecified

!\$omp parallel firstprivate(x)

call sub()

!\$omp end parallel

end

subroutine lastprivate()

class(\*), allocatable, save :: x

!PORTABILITY: If a polymorphic variable with allocatable attribute 'x' is in LASTPRIVATE clause, the behavior is unspecified

!\$omp do lastprivate(x)

do i = 1, 10

call sub()

enddo

!\$omp end do

end

subroutine copyin()

class(\*), allocatable, save :: x

!\$omp threadprivate(x)

!PORTABILITY: If a polymorphic variable with allocatable attribute 'x' is in COPYIN clause, the behavior is unspecified

!\$omp parallel copyin(x)

call sub()

!\$omp end parallel

end

subroutine copyprivate()

class(\*), allocatable, save :: x

!\$omp threadprivate(x)

!\$omp single

call sub()

!PORTABILITY: If a polymorphic variable with allocatable attribute 'x' is in COPYPRIVATE clause, the behavior is unspecified

!\$omp end single copyprivate(x)

end

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```
static_library("BSD-Archive") {
  output_name = "lldbPluginObjectContainerBSDArchive"
  configs += [ "../llvm/utils/gn/build:lldb_code" ]
  deps = [
    "../lldb/source/Core",
    "../lldb/source/Host",
    "../lldb/source/Symbol",
```

```

    "//llvm/lib/Support",
]
sources = [ "ObjectContainerBSDArchive.cpp" ]
}
; RUN: opt -mtriple=aarch64-linux-gnu -mattr=+sve -passes=sccp,masked-gather-intrin -S < %s | FileCheck %s

; Testing that masked gathers operating on scalable vectors that are
; packed in SVE registers are not scalarized.

; CHECK-LABEL: @masked_gather_nxv4i32(
; CHECK: call <vscale x 4 x i32> @llvm.masked.gather.nxv4i32
define <vscale x 4 x i32> @masked_gather_nxv4i32(<vscale x 4 x ptr> %ld, <vscale x 4 x i1> %masks, <vscale x 4
x i32> %passthru) {
    %res = call <vscale x 4 x i32> @llvm.masked.gather.nxv4i32(<vscale x 4 x ptr> %ld, i32 0, <vscale x 4 x i1>
%masks, <vscale x 4 x i32> %passthru)
    ret <vscale x 4 x i32> %res
}

; Testing that masked gathers operating on scalable vectors of FP data
; that is packed in SVE registers are not scalarized.

; CHECK-LABEL: @masked_gather_nxv2f64(
; CHECK: call <vscale x 2 x double> @llvm.masked.gather.nxv2f64
define <vscale x 2 x double> @masked_gather_nxv2f64(<vscale x 2 x ptr> %ld, <vscale x 2 x i1> %masks, <vscale
x 2 x double> %passthru)
{
    %res = call <vscale x 2 x double> @llvm.masked.gather.nxv2f64(<vscale x 2 x ptr> %ld, i32 0, <vscale x 2 x i1>
%masks, <vscale x 2 x double> %passthru)
    ret <vscale x 2 x double> %res
}

; Testing that masked gathers operating on scalable vectors of FP data
; that is unpacked in SVE registers are not scalarized.

; CHECK-LABEL: @masked_gather_nxv2f16(
; CHECK: call <vscale x 2 x half> @llvm.masked.gather.nxv2f16
define <vscale x 2 x half> @masked_gather_nxv2f16(<vscale x 2 x ptr> %ld, <vscale x 2 x i1> %masks, <vscale x
2 x half> %passthru) {
    %res = call <vscale x 2 x half> @llvm.masked.gather.nxv2f16(<vscale x 2 x ptr> %ld, i32 0, <vscale x 2 x i1>
%masks, <vscale x 2 x half> %passthru)
    ret <vscale x 2 x half> %res
}

; Testing that masked gathers operating on 64-bit fixed vectors are
; scalarized because NEON doesn't have support for masked gather
; instructions.

; CHECK-LABEL: @masked_gather_v2f32(

```

```
; CHECK-NOT: @llvm.masked.gather.v2f32(
define <2 x float> @masked_gather_v2f32(<2
x ptr> %ld, <2 x i1> %masks, <2 x float> %passthru) {
%res = call <2 x float> @llvm.masked.gather.v2f32(<2 x ptr> %ld, i32 0, <2 x i1> %masks, <2 x float> %passthru)
ret <2 x float> %res
}
```

; Testing that masked gathers operating on 128-bit fixed vectors are  
; scalarized because NEON doesn't have support for masked gather  
; instructions and because we are not targeting fixed width SVE.

```
; CHECK-LABEL: @masked_gather_v4i32(
; CHECK-NOT: @llvm.masked.gather.v4i32(
define <4 x i32> @masked_gather_v4i32(<4 x ptr> %ld, <4 x i1> %masks, <4 x i32> %passthru) {
%res = call <4 x i32> @llvm.masked.gather.v4i32(<4 x ptr> %ld, i32 0, <4 x i1> %masks, <4 x i32> %passthru)
ret <4 x i32> %res
}
```

```
declare <vscale x 4 x i32> @llvm.masked.gather.nxv4i32(<vscale x 4 x ptr> %ptrs, i32 %align, <vscale x 4 x i1>
%masks, <vscale x 4 x i32> %passthru)
declare <vscale x 2 x double> @llvm.masked.gather.nxv2f64(<vscale x 2 x ptr> %ptrs, i32 %align, <vscale x 2 x
i1> %masks, <vscale x 2 x double>
%passthru)
declare <vscale x 2 x half> @llvm.masked.gather.nxv2f16(<vscale x 2 x ptr> %ptrs, i32 %align, <vscale x 2 x i1>
%masks, <vscale x 2 x half> %passthru)
declare <2 x float> @llvm.masked.gather.v2f32(<2 x ptr> %ptrs, i32 %align, <2 x i1> %masks, <2 x float>
%passthru)
declare <4 x i32> @llvm.masked.gather.v4i32(<4 x ptr> %ptrs, i32 %align, <4 x i1> %masks, <4 x i32> %passthru)
# RUN: llc -O0 -mtriple=m68k -start-after=prologuepilg -verify-machineinstrs %s -o - | FileCheck %s
```

name: is-pcrel-register-operand-legal

body: |

bb.0.entry:

```
; CHECK: move.l (0,%pc,%a0), (%a1)
```

```
; CHECK: move.l (%a0), (0,%pc,%a1)
```

```
MOV32jk $a1, 0, $a0, implicit-def $ccr
```

```
MOV32kj 0, $a1, $a0, implicit-def $ccr
```

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; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

; RUN: llc < %s -mtriple=x86\_64-linux-android -mattr=+mmx -enable-legalize-types-checking | FileCheck %s

;

; D31946

; Check that we dont end up with the ""LLVM ERROR: Cannot select" error.

; Additionally ensure that the output code actually put fp128 values in SSE registers.

declare fp128 @llvm.fabs.f128(fp128)

declare fp128 @llvm.copysign.f128(fp128, fp128)

define fp128 @TestSelect(fp128 %a, fp128 %b) {

; CHECK-LABEL: TestSelect:

; CHECK: # %bb.0:

; CHECK-NEXT: pushq %rbx

; CHECK-NEXT: .cfi\_def\_cfa\_offset 16

; CHECK-NEXT: subq \$32, %rsp

; CHECK-NEXT: .cfi\_def\_cfa\_offset 48

; CHECK-NEXT: .cfi\_offset %rbx, -16

; CHECK-NEXT: movaps %xmm1, {[[-0-9]+]}(%r{[sb]})p) # 16-byte Spill

; CHECK-NEXT: movaps %xmm0, (%rsp) # 16-byte Spill

; CHECK-NEXT: callq \_\_gttf2@PLT

; CHECK-NEXT: movl %eax, %ebx

; CHECK-NEXT: movaps (%rsp), %xmm0 # 16-byte Reload

; CHECK-NEXT: movaps {[[-0-9]+]}(%r{[sb]})p),

%xmm1 # 16-byte Reload

; CHECK-NEXT: callq \_\_subtf3@PLT

; CHECK-NEXT: testl %ebx, %ebx

; CHECK-NEXT: jg .LBB0\_2

; CHECK-NEXT: # %bb.1:

; CHECK-NEXT: xorps %xmm0, %xmm0

; CHECK-NEXT: .LBB0\_2:

; CHECK-NEXT: addq \$32, %rsp

; CHECK-NEXT: .cfi\_def\_cfa\_offset 16

; CHECK-NEXT: popq %rbx

; CHECK-NEXT: .cfi\_def\_cfa\_offset 8

; CHECK-NEXT: retq

%cmp = fcmp ogt fp128 %a, %b

%sub = fsub fp128 %a, %b

%res = select i1 %cmp, fp128 %sub, fp128 0xL00000000000000000000000000000000

ret fp128 %res

}

define fp128 @TestFabs(fp128 %a) {

; CHECK-LABEL: TestFabs:

```
; CHECK:      # %bb.0:
; CHECK-NEXT:  andps {{\.?LCPI[0-9]+_[0-9]+}}(%rip), %xmm0
; CHECK-NEXT:  retq
%res = call fp128 @llvm.fabs.f128(fp128 %a)
ret fp128 %res
}
```

```
define fp128 @TestCopysign(fp128 %a, fp128 %b) {
; CHECK-LABEL: TestCopysign:
; CHECK:      # %bb.0:
; CHECK-NEXT:  andps {{\.?LCPI[0-9]+_[0-9]+}}(%rip), %xmm1
; CHECK-NEXT:  andps {{\.?LCPI[0-9]+_[0-9]+}}(%rip), %xmm0
; CHECK-NEXT:
    orps %xmm1, %xmm0
; CHECK-NEXT:  retq
%res = call fp128 @llvm.copysign.f128(fp128 %a, fp128 %b)
ret fp128 %res
}
```

```
define fp128 @TestFneg(fp128 %a) {
; CHECK-LABEL: TestFneg:
; CHECK:      # %bb.0:
; CHECK-NEXT:  pushq %rax
; CHECK-NEXT:  .cfi_def_cfa_offset 16
; CHECK-NEXT:  movaps %xmm0, %xmm1
; CHECK-NEXT:  callq __multf3@PLT
; CHECK-NEXT:  xorps {{\.?LCPI[0-9]+_[0-9]+}}(%rip), %xmm0
; CHECK-NEXT:  popq %rax
; CHECK-NEXT:  .cfi_def_cfa_offset 8
; CHECK-NEXT:  retq
%mul = fmul fp128 %a, %a
%res = fsub fp128 0xL00000000000000008000000000000000, %mul
ret fp128 %res
}
```

---

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---

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; RUN: llc -mtriple=riscv64 -mattr=+zbbk -verify-machineinstrs < %s \

; RUN: | FileCheck %s -check-prefix=RV64ZBKB

declare i64 @llvm.riscv.brev8.i64(i64)

```
define i64 @brev8(i64 %a) nounwind {
; RV64ZBKB-LABEL: brev8:
; RV64ZBKB:      # %bb.0:
; RV64ZBKB-NEXT:  brev8 a0, a0
; RV64ZBKB-NEXT:  ret
%val = call i64 @llvm.riscv.brev8.i64(i64 %a)
ret i64 %val
}
```

```

; Test that rev8 is recognized as preserving zero extension.
define zeroext i16 @brev8_knownbits(i16 zeroext %a) nounwind {
; RV64ZBKB-LABEL: brev8_knownbits:
; RV64ZBKB:      # %bb.0:
; RV64ZBKB-NEXT:  brev8 a0, a0
; RV64ZBKB-NEXT:  ret
%zext = zext i16 %a to i64
%val = call i64 @llvm.riscv.brev8.i64(i64 %zext)
%trunc = trunc i64 %val to i16
ret i16 %trunc
}

declare i64 @llvm.bswap.i64(i64)

define i64 @rev8_i64(i64 %a) {
; RV64ZBKB-LABEL: rev8_i64:
; RV64ZBKB:      # %bb.0:
; RV64ZBKB-NEXT:  rev8 a0, a0
; RV64ZBKB-NEXT:  ret
%1 = call i64 @llvm.bswap.i64(i64 %a)
ret i64 %1
}

declare i32 @llvm.riscv.brev8.i32(i32)

define signext i32 @brev8_i32(i32 signext %a) nounwind {
; RV64ZBKB-LABEL: brev8_i32:
; RV64ZBKB:      # %bb.0:
; RV64ZBKB-NEXT:  brev8 a0, a0
; RV64ZBKB-NEXT:  sext.w a0, a0
; RV64ZBKB-NEXT:  ret
%val = call i32 @llvm.riscv.brev8.i32(i32 %a)
ret i32 %val
}

; Test that rev8 is recognized as preserving zero extension.
define zeroext i16 @brev8_i32_knownbits(i16 zeroext %a) nounwind {
; RV64ZBKB-LABEL: brev8_i32_knownbits:
; RV64ZBKB:      # %bb.0:
; RV64ZBKB-NEXT:  brev8 a0, a0
; RV64ZBKB-NEXT:  ret
%zext = zext i16 %a to i32
%val = call i32 @llvm.riscv.brev8.i32(i32 %zext)
%trunc = trunc i32 %val to i16
ret i16 %trunc
}

```

```
declare i32 @llvm.bswap.i32(i32)
```

```
define signext i32 @rev8_i32(i32 signext %a) {  
; RV64ZBKB-LABEL: rev8_i32:  
; RV64ZBKB:      # %bb.0:  
; RV64ZBKB-NEXT: rev8 a0, a0  
; RV64ZBKB-NEXT: srai a0, a0, 32  
; RV64ZBKB-NEXT: ret  
%1 = call i32 @llvm.bswap.i32(i32  
%a)  
ret i32 %1  
}
```

; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

; RUN: llc -mtriple=amdgcn -mcpu=fiji < %s | FileCheck -check-prefixes=VI %s

; FIXME: This one should fold to rcp

```
define half @select_fneg_posk_src_rcp_f16(i32 %c, half %x, half %y) {  
; VI-LABEL: select_fneg_posk_src_rcp_f16:  
; VI:      ; %bb.0:  
; VI-NEXT: s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)  
; VI-NEXT: v_rcp_f16_e64 v1, -v1  
; VI-NEXT: v_mov_b32_e32 v2, 0x4000  
; VI-NEXT: v_cmp_eq_u32_e32 vcc, 0, v0  
; VI-NEXT: v_cndmask_b32_e32 v0, v2, v1, vcc  
; VI-NEXT: s_setpc_b64 s[30:31]  
%cmp = icmp eq i32 %c, 0  
%rcp = call half @llvm.amdgcn.rcp.f16(half %x)  
%fneg = fneg half %rcp  
%select = select i1 %cmp, half %fneg, half 2.0  
ret half %select  
}
```

```
declare half @llvm.amdgcn.rcp.f16(half) #0
```

attributes #0 = { nocallback noreturn nosync nounwind speculatable willreturn memory(none) }

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; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \

; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64I

; RUN: llc -mtriple=riscv64 -mattr=+zbb -verify-machineinstrs < %s \

; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64ZBB-ZBKB,RV64ZBB

; RUN: llc -mtriple=riscv64 -mattr=+zbbk -verify-machineinstrs < %s \

; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64ZBB-ZBKB,RV64ZBKB

```
define signext i32 @andn_i32(i32 signext %a, i32 signext %b) nounwind {  
; RV64I-LABEL: andn_i32:  
; RV64I:      # %bb.0:
```

```

; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: andn_i32:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  andn a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
%neg = xor i32 %b, -1
%and = and i32 %neg, %a
ret i32 %and
}

define i64 @andn_i64(i64 %a, i64
%b) nounwind {
; RV64I-LABEL: andn_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: andn_i64:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  andn a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
%neg = xor i64 %b, -1
%and = and i64 %neg, %a
ret i64 %and
}

define signext i32 @orn_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: orn_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: orn_i32:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  orn a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
%neg = xor i32 %b, -1
%or = or i32 %neg, %a
ret i32 %or
}

define i64 @orn_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: orn_i64:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: orn_i64:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:
    orn a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
    %neg = xor i64 %b, -1
    %or = or i64 %neg, %a
    ret i64 %or
}

define signext i32 @xnor_i32(i32 signext %a, i32 signext %b) nounwind {
; CHECK-LABEL: xnor_i32:
; CHECK:    # %bb.0:
; CHECK-NEXT:  xor a0, a0, a1
; CHECK-NEXT:  not a0, a0
; CHECK-NEXT:  ret
    %neg = xor i32 %a, -1
    %xor = xor i32 %neg, %b
    ret i32 %xor
}

define i64 @xnor_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: xnor_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: xnor_i64:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  xnor a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
    %neg = xor i64 %a, -1
    %xor = xor i64 %neg, %b
    ret i64 %xor
}

declare i32 @llvm.fshl.i32(i32, i32, i32)

define signext i32 @rol_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: rol_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  andi a2, a1, -1

```

```

; RV64I-NEXT:  sllw a1, a0, a1
; RV64I-NEXT:
    negw a2, a2
; RV64I-NEXT:  srlw a0, a0, a2
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rol_i32:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  rolw a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshl.i32(i32 %a, i32 %a, i32 %b)
ret i32 %1
}

; Similar to rol_i32, but doesn't sign extend the result.
define void @rol_i32_nosext(i32 signext %a, i32 signext %b, ptr %x) nounwind {
; RV64I-LABEL: rol_i32_nosext:
; RV64I:    # %bb.0:
; RV64I-NEXT:  andi a3, a1, -1
; RV64I-NEXT:  sllw a1, a0, a1
; RV64I-NEXT:  negw a3, a3
; RV64I-NEXT:  srlw a0, a0, a3
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  sw a0, 0(a2)
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rol_i32_nosext:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  rolw a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  sw a0, 0(a2)
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshl.i32(i32 %a, i32 %a, i32 %b)
store i32 %1, ptr %x
ret void
}

define signext
i32 @rol_i32_neg_constant_rhs(i32 signext %a) nounwind {
; RV64I-LABEL: rol_i32_neg_constant_rhs:
; RV64I:    # %bb.0:
; RV64I-NEXT:  andi a1, a0, -1
; RV64I-NEXT:  li a2, -2
; RV64I-NEXT:  sllw a0, a2, a0
; RV64I-NEXT:  negw a1, a1
; RV64I-NEXT:  srlw a1, a2, a1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret

```



```

;
; RV64ZBB-ZBKB-LABEL: rol_i32_neg_constant_rhs:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  li a1, -2
; RV64ZBB-ZBKB-NEXT:  rolw a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshl.i32(i32 -2, i32 -2, i32 %a)
ret i32 %1
}

```

```

declare i64 @llvm.fshl.i64(i64, i64, i64)

```

```

define i64 @rol_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: rol_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  sll a2, a0, a1
; RV64I-NEXT:  negw a1, a1
; RV64I-NEXT:  srl a0, a0, a1
; RV64I-NEXT:  or a0, a2, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rol_i64:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  rol a0, a0, a1
; RV64ZBB-ZBKB-NEXT:
ret
%or = tail call i64 @llvm.fshl.i64(i64 %a, i64 %a, i64 %b)
ret i64 %or
}

```

```

declare i32 @llvm.fshr.i32(i32, i32, i32)

```

```

define signext i32 @ror_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: ror_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  andi a2, a1, -1
; RV64I-NEXT:  srlw a1, a0, a1
; RV64I-NEXT:  negw a2, a2
; RV64I-NEXT:  sllw a0, a0, a2
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: ror_i32:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  rorw a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshr.i32(i32 %a, i32 %a, i32 %b)
ret i32 %1

```

```
}
```

```
; Similar to ror_i32, but doesn't sign extend the result.
```

```
define void @ror_i32_nosext(i32 signext %a, i32 signext %b, ptr %x) nounwind {
```

```
; RV64I-LABEL: ror_i32_nosext:
```

```
; RV64I:      # %bb.0:
```

```
; RV64I-NEXT:  andi a3, a1, -1
```

```
; RV64I-NEXT:  srlw a1, a0, a1
```

```
; RV64I-NEXT:  negw a3, a3
```

```
; RV64I-NEXT:  sllw a0, a0, a3
```

```
; RV64I-NEXT:  or a0, a1, a0
```

```
; RV64I-NEXT:
```

```
    sw a0, 0(a2)
```

```
; RV64I-NEXT:  ret
```

```
;
```

```
; RV64ZBB-ZBKB-LABEL: ror_i32_nosext:
```

```
; RV64ZBB-ZBKB:      # %bb.0:
```

```
; RV64ZBB-ZBKB-NEXT:  rorw a0, a0, a1
```

```
; RV64ZBB-ZBKB-NEXT:  sw a0, 0(a2)
```

```
; RV64ZBB-ZBKB-NEXT:  ret
```

```
%1 = tail call i32 @llvm.fshr.i32(i32 %a, i32 %a, i32 %b)
```

```
store i32 %1, ptr %x
```

```
ret void
```

```
}
```

```
define signext i32 @ror_i32_neg_constant_rhs(i32 signext %a) nounwind {
```

```
; RV64I-LABEL: ror_i32_neg_constant_rhs:
```

```
; RV64I:      # %bb.0:
```

```
; RV64I-NEXT:  andi a1, a0, -1
```

```
; RV64I-NEXT:  li a2, -2
```

```
; RV64I-NEXT:  srlw a0, a2, a0
```

```
; RV64I-NEXT:  negw a1, a1
```

```
; RV64I-NEXT:  sllw a1, a2, a1
```

```
; RV64I-NEXT:  or a0, a0, a1
```

```
; RV64I-NEXT:  ret
```

```
;
```

```
; RV64ZBB-ZBKB-LABEL: ror_i32_neg_constant_rhs:
```

```
; RV64ZBB-ZBKB:      # %bb.0:
```

```
; RV64ZBB-ZBKB-NEXT:  li a1, -2
```

```
; RV64ZBB-ZBKB-NEXT:  rorw a0, a1, a0
```

```
; RV64ZBB-ZBKB-NEXT:  ret
```

```
%1 = tail call i32 @llvm.fshr.i32(i32 -2, i32 -2, i32 %a)
```

```
ret i32 %1
```

```
}
```

```
declare i64 @llvm.fshr.i64(i64, i64, i64)
```

```
define i64 @ror_i64(i64 %a, i64 %b) nounwind {
```

```

;
RV64I-LABEL: ror_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  srl a2, a0, a1
; RV64I-NEXT:  negw a1, a1
; RV64I-NEXT:  sll a0, a0, a1
; RV64I-NEXT:  or a0, a2, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: ror_i64:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  ror a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
%or = tail call i64 @llvm.fshr.i64(i64 %a, i64 %a, i64 %b)
ret i64 %or
}

define signext i32 @rori_i32_fshl(i32 signext %a) nounwind {
; RV64I-LABEL: rori_i32_fshl:
; RV64I:    # %bb.0:
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  slliw a0, a0, 31
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i32_fshl:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  roriw a0, a0, 1
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshl.i32(i32 %a, i32 %a, i32 31)
ret i32 %1
}

; Similar to rori_i32_fshl, but doesn't sign extend the result.
define void @rori_i32_fshl_nosext(i32 signext %a, ptr %x) nounwind {
; RV64I-LABEL: rori_i32_fshl_nosext:
;
RV64I:    # %bb.0:
; RV64I-NEXT:  srliw a2, a0, 1
; RV64I-NEXT:  slli a0, a0, 31
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  sw a0, 0(a1)
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i32_fshl_nosext:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  roriw a0, a0, 1
; RV64ZBB-ZBKB-NEXT:  sw a0, 0(a1)

```

```

; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshl.i32(i32 %a, i32 %a, i32 31)
store i32 %1, ptr %x
ret void
}

define signext i32 @rori_i32_fshr(i32 signext %a) nounwind {
; RV64I-LABEL: rori_i32_fshr:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slliw a1, a0, 1
; RV64I-NEXT:  srliw a0, a0, 31
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i32_fshr:
; RV64ZBB-ZBKB:  # %bb.0:
; RV64ZBB-ZBKB-NEXT:  roriw a0, a0, 31
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshr.i32(i32 %a, i32 %a, i32 31)
ret i32 %1
}

```

; Similar to rori\_i32\_fshr, but doesn't sign extend the result.

```

define void @rori_i32_fshr_nosext(i32
signext %a, ptr %x) nounwind {
; RV64I-LABEL: rori_i32_fshr_nosext:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a2, a0, 1
; RV64I-NEXT:  srliw a0, a0, 31
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  sw a0, 0(a1)
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i32_fshr_nosext:
; RV64ZBB-ZBKB:  # %bb.0:
; RV64ZBB-ZBKB-NEXT:  roriw a0, a0, 31
; RV64ZBB-ZBKB-NEXT:  sw a0, 0(a1)
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshr.i32(i32 %a, i32 %a, i32 31)
store i32 %1, ptr %x
ret void
}

```

; This test is similar to the type legalized version of the fshl/fshr tests, but

; instead of having the same input to both shifts it has different inputs. Make

; sure we don't match it as a roriw.

```

define signext i32 @not_rori_i32(i32 signext %x, i32 signext %y) nounwind {
; CHECK-LABEL: not_rori_i32:

```

```

; CHECK:    # %bb.0:
; CHECK-NEXT:  slliw a0, a0, 31
; CHECK-NEXT:  srliw a1, a1, 1
; CHECK-NEXT:  or a0, a0, a1
; CHECK-NEXT:  ret
%a = shl
i32 %x, 31
%b = lshr i32 %y, 1
%c = or i32 %a, %b
ret i32 %c
}

```

; This is similar to the type legalized roriw pattern, but the and mask is more  
; than 32 bits so the lshr doesn't shift zeroes into the lower 32 bits. Make  
; sure we don't match it to roriw.

```

define i64 @roriw_bug(i64 %x) nounwind {
; CHECK-LABEL: roriw_bug:
; CHECK:    # %bb.0:
; CHECK-NEXT:  slli a1, a0, 31
; CHECK-NEXT:  andi a2, a0, -2
; CHECK-NEXT:  srli a0, a0, 1
; CHECK-NEXT:  or a0, a1, a0
; CHECK-NEXT:  sext.w a0, a0
; CHECK-NEXT:  xor a0, a2, a0
; CHECK-NEXT:  ret
%a = shl i64 %x, 31
%b = and i64 %x, 18446744073709551614
%c = lshr i64 %b, 1
%d = or i64 %a, %c
%e = shl i64 %d, 32
%f = ashr i64 %e, 32
%g = xor i64 %b, %f ; to increase the use count on %b to disable SimplifyDandedBits.
ret i64 %g
}

```

```

define i64 @rori_i64_fshl(i64 %a) nounwind {
; RV64I-LABEL: rori_i64_fshl:
; RV64I:    # %bb.0:
; RV64I-NEXT:  srli a1, a0, 1
; RV64I-NEXT:  slli a0, a0, 63
; RV64I-NEXT:
;   or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i64_fshl:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  rori a0, a0, 1
; RV64ZBB-ZBKB-NEXT:  ret

```

```

%1 = tail call i64 @llvm.fshl.i64(i64 %a, i64 %a, i64 63)
ret i64 %1
}

```

```

define i64 @rori_i64_fshr(i64 %a) nounwind {
; RV64I-LABEL: rori_i64_fshr:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a1, a0, 1
; RV64I-NEXT:  srli a0, a0, 63
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i64_fshr:
; RV64ZBB-ZBKB:  # %bb.0:
; RV64ZBB-ZBKB-NEXT:  rori a0, a0, 63
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i64 @llvm.fshr.i64(i64 %a, i64 %a, i64 63)
ret i64 %1
}

```

```

define signext i32 @not_shl_one_i32(i32 signext %x) {
; RV64I-LABEL: not_shl_one_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  sllw a0, a1, a0
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: not_shl_one_i32:
; RV64ZBB-ZBKB:  # %bb.0:
; RV64ZBB-ZBKB-NEXT:  li a1,
-2
; RV64ZBB-ZBKB-NEXT:  rolw a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  ret
%1 = shl i32 1, %x
%2 = xor i32 %1, -1
ret i32 %2
}

```

```

define i64 @not_shl_one_i64(i64 %x) {
; RV64I-LABEL: not_shl_one_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  sll a0, a1, a0
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: not_shl_one_i64:

```

```
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  li a1, -2
; RV64ZBB-ZBKB-NEXT:  rol a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  ret
%1 = shl i64 1, %x
%2 = xor i64 %1, -1
ret i64 %2
}
```

```
define i8 @srli_i8(i8 %a) nounwind {
; CHECK-LABEL: srli_i8:
; CHECK:      # %bb.0:
; CHECK-NEXT:  slli a0, a0, 56
; CHECK-NEXT:  srli a0, a0, 62
; CHECK-NEXT:  ret
%1 = lshr i8 %a, 6
ret i8 %1
}
```

; We could use sext.b+srai, but slli+srai offers more opportunities for  
; compressed instructions.

```
define i8 @srai_i8(i8 %a) nounwind {
; RV64I-LABEL: srai_i8:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:
    sraiw a0, a0, 29
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: srai_i8:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  slli a0, a0, 56
; RV64ZBB-NEXT:  srai a0, a0, 61
; RV64ZBB-NEXT:  ret
;
; RV64ZBKB-LABEL: srai_i8:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  slli a0, a0, 24
; RV64ZBKB-NEXT:  sraiw a0, a0, 29
; RV64ZBKB-NEXT:  ret
%1 = ashr i8 %a, 5
ret i8 %1
}
```

; We could use zext.h+srli, but slli+srli offers more opportunities for  
; compressed instructions.

```
define i16 @srli_i16(i16 %a) nounwind {
; CHECK-LABEL: srli_i16:
```

```
; CHECK:    # %bb.0:
; CHECK-NEXT:  slli a0, a0, 48
; CHECK-NEXT:  srli a0, a0, 54
; CHECK-NEXT:  ret
%1 = lshr i16 %a, 6
ret i16 %1
}
```

; We could use sext.h+srai, but slli+srai offers more opportunities for  
; compressed instructions.

```
define i16 @srai_i16(i16 %a) nounwind {
; RV64I-LABEL: srai_i16:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a0, a0, 25
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: srai_i16:
;
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  slli a0, a0, 48
; RV64ZBB-NEXT:  srai a0, a0, 57
; RV64ZBB-NEXT:  ret
;
; RV64ZBKB-LABEL: srai_i16:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  slli a0, a0, 16
; RV64ZBKB-NEXT:  sraiw a0, a0, 25
; RV64ZBKB-NEXT:  ret
%1 = ashr i16 %a, 9
ret i16 %1
}
```

```
define i1 @andn_seqz_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: andn_seqz_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  seqz a0, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: andn_seqz_i32:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  andn a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  seqz a0, a0
; RV64ZBB-ZBKB-NEXT:  ret
%and = and i32 %a, %b
%cmpeq = icmp eq i32 %and, %b
```



```

ret i1 %cmpeq
}

define i1 @andn_seqz_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: andn_seqz_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: seqz a0, a0
; RV64I-NEXT:
    ret
;
; RV64ZBB-ZBKB-LABEL: andn_seqz_i64:
; RV64ZBB-ZBKB:      # %bb.0:
; RV64ZBB-ZBKB-NEXT: andn a0, a1, a0
; RV64ZBB-ZBKB-NEXT: seqz a0, a0
; RV64ZBB-ZBKB-NEXT: ret
    %and = and i64 %a, %b
    %cmpeq = icmp eq i64 %and, %b
    ret i1 %cmpeq
}

define i1 @andn_snez_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: andn_snez_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: snez a0, a0
; RV64I-NEXT: ret
;
; RV64ZBB-ZBKB-LABEL: andn_snez_i32:
; RV64ZBB-ZBKB:      # %bb.0:
; RV64ZBB-ZBKB-NEXT: andn a0, a1, a0
; RV64ZBB-ZBKB-NEXT: snez a0, a0
; RV64ZBB-ZBKB-NEXT: ret
    %and = and i32 %a, %b
    %cmpeq = icmp ne i32 %and, %b
    ret i1 %cmpeq
}

define i1 @andn_snez_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: andn_snez_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: snez a0, a0
; RV64I-NEXT: ret
;

```

```

; RV64ZBB-ZBKB-LABEL: andn_snez_i64:
;
RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  andn a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  snez a0, a0
; RV64ZBB-ZBKB-NEXT:  ret
%and = and i64 %a, %b
%cmpeq = icmp ne i64 %and, %b
ret i1 %cmpeq
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64I %s
; RUN: llc -mtriple=riscv64 -mattr=+m -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64IM %s

```

```

define i32 @urem(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: urem:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 32
; RV64I-NEXT:  call __umoddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: urem:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  remuw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = urem i32 %a, %b
ret i32 %1
}

```

```

define i32 @urem_constant_lhs(i32 %a) nounwind {
;
RV64I-LABEL: urem_constant_lhs:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a1, a0, 32
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  call __umoddi3

```

```

; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: urem_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  remuw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = urem i32 10, %a
ret i32 %1
}

```

```

define i32 @srem(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: srem:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  sext.w a1, a1
; RV64I-NEXT:  call __moddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:
    remw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = srem i32 %a, %b
ret i32 %1
}

```

```

define i32 @srem_pow2(i32 %a) nounwind {
; RV64I-LABEL: srem_pow2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  srliw a1, a1, 29
; RV64I-NEXT:  add a1, a0, a1
; RV64I-NEXT:  andi a1, a1, -8
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem_pow2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  sraiw a1, a0, 31
; RV64IM-NEXT:  srliw a1, a1, 29

```

```

; RV64IM-NEXT:  add a1, a0, a1
; RV64IM-NEXT:  andi a1, a1, -8
; RV64IM-NEXT:  subw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = srem i32 %a, 8
ret i32 %1
}

```

```

define i32 @srem_pow2_2(i32 %a) nounwind {
; RV64I-LABEL: srem_pow2_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  srlw a1, a1, 16
; RV64I-NEXT:  add a1, a0, a1
; RV64I-NEXT:  lui a2, 1048560
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem_pow2_2:
; RV64IM:
;   # %bb.0:
; RV64IM-NEXT:  sraiw a1, a0, 31
; RV64IM-NEXT:  srlw a1, a1, 16
; RV64IM-NEXT:  add a1, a0, a1
; RV64IM-NEXT:  lui a2, 1048560
; RV64IM-NEXT:  and a1, a1, a2
; RV64IM-NEXT:  subw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = srem i32 %a, 65536
ret i32 %1
}

```

```

define i32 @srem_constant_lhs(i32 %a) nounwind {
; RV64I-LABEL: srem_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sext.w a1, a0
; RV64I-NEXT:  li a0, -10
; RV64I-NEXT:  call __moddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, -10

```

```

; RV64IM-NEXT:  remw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = srem i32 -10, %a
ret i32 %1
}

define i64 @urem64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: urem64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  tail __umoddi3
;
; RV64IM-LABEL:
urem64:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  remu a0, a0, a1
; RV64IM-NEXT:  ret
%1 = urem i64 %a, %b
ret i64 %1
}

define i64 @urem64_constant_lhs(i64 %a) nounwind {
; RV64I-LABEL: urem64_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  mv a1, a0
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  tail __umoddi3
;
; RV64IM-LABEL: urem64_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  remu a0, a1, a0
; RV64IM-NEXT:  ret
%1 = urem i64 10, %a
ret i64 %1
}

define i64 @srem64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: srem64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  tail __moddi3
;
; RV64IM-LABEL: srem64:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  rem a0, a0, a1
; RV64IM-NEXT:  ret
%1 = srem i64 %a, %b
ret i64 %1
}

```

```

define i64 @srem64_constant_lhs(i64 %a) nounwind {
; RV64I-LABEL: srem64_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  mv a1, a0
; RV64I-NEXT:  li a0, -10
; RV64I-NEXT:  tail __moddi3
;
; RV64IM-LABEL: srem64_constant_lhs:
;
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, -10
; RV64IM-NEXT:  rem a0, a1, a0
; RV64IM-NEXT:  ret
; %1 = srem i64 -10, %a
; ret i64 %1
}

```

```

define i8 @urem8(i8 %a, i8 %b) nounwind {
; RV64I-LABEL: urem8:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  andi a0, a0, 255
; RV64I-NEXT:  andi a1, a1, 255
; RV64I-NEXT:  call __umoddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: urem8:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  andi a1, a1, 255
; RV64IM-NEXT:  andi a0, a0, 255
; RV64IM-NEXT:  remuw a0, a0, a1
; RV64IM-NEXT:  ret
; %1 = urem i8 %a, %b
; ret i8 %1
}

```

```

define i8 @urem8_constant_lhs(i8 %a) nounwind {
; RV64I-LABEL: urem8_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  andi a1, a0, 255
; RV64I-NEXT:

```

```

    li a0, 10
; RV64I-NEXT:  call __umoddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: urem8_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  andi a0, a0, 255
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  remuw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = urem i8 10, %a
ret i8 %1
}

```

```

define i8 @srem8(i8 %a, i8 %b) nounwind {
; RV64I-LABEL: srem8:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a1, a1, 24
; RV64I-NEXT:  sraiw a1, a1, 24
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:  sraiw a0, a0, 24
; RV64I-NEXT:  call __moddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem8:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a1, a1, 24
; RV64IM-NEXT:  sraiw a1, a1, 24
; RV64IM-NEXT:  slli a0, a0, 24
; RV64IM-NEXT:  sraiw
a0, a0, 24
; RV64IM-NEXT:  remw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = srem i8 %a, %b
ret i8 %1
}

```

```

define i8 @srem8_constant_lhs(i8 %a) nounwind {
; RV64I-LABEL: srem8_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16

```

```

; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: slli a0, a0, 24
; RV64I-NEXT: sraiw a1, a0, 24
; RV64I-NEXT: li a0, -10
; RV64I-NEXT: call __moddi3
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64IM-LABEL: srem8_constant_lhs:
; RV64IM: # %bb.0:
; RV64IM-NEXT: slli a0, a0, 24
; RV64IM-NEXT: sraiw a0, a0, 24
; RV64IM-NEXT: li a1, -10
; RV64IM-NEXT: remw a0, a1, a0
; RV64IM-NEXT: ret
%1 = srem i8 -10, %a
ret i8 %1
}

```

```

define i16 @urem16(i16 %a, i16 %b) nounwind {
; RV64I-LABEL: urem16:
; RV64I: # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: lui a2, 16
; RV64I-NEXT:
addiw a2, a2, -1
; RV64I-NEXT: and a0, a0, a2
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: call __umoddi3
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64IM-LABEL: urem16:
; RV64IM: # %bb.0:
; RV64IM-NEXT: lui a2, 16
; RV64IM-NEXT: addi a2, a2, -1
; RV64IM-NEXT: and a1, a1, a2
; RV64IM-NEXT: and a0, a0, a2
; RV64IM-NEXT: remuw a0, a0, a1
; RV64IM-NEXT: ret
%1 = urem i16 %a, %b
ret i16 %1
}

```



```

define i16 @urem16_constant_lhs(i16 %a) nounwind {
; RV64I-LABEL: urem16_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a1, a0, 48
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  call __umoddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: urem16_constant_lhs:
; RV64IM:      # %bb.0:
;
; RV64IM-NEXT:  slli a0, a0, 48
; RV64IM-NEXT:  srli a0, a0, 48
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  remuw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = urem i16 10, %a
ret i16 %1
}

```

```

define i16 @srem16(i16 %a, i16 %b) nounwind {
; RV64I-LABEL: srem16:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a1, a1, 16
; RV64I-NEXT:  sraiw a1, a1, 16
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a0, a0, 16
; RV64I-NEXT:  call __moddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem16:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a1, a1, 16
; RV64IM-NEXT:  sraiw a1, a1, 16
; RV64IM-NEXT:  slli a0, a0, 16
; RV64IM-NEXT:  sraiw a0, a0, 16
; RV64IM-NEXT:  remw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = srem i16 %a, %b

```

```

ret i16 %1
}

define i16 @srem16_constant_lhs(i16 %a) nounwind {
; RV64I-LABEL: srem16_constant_lhs:
;
RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a1, a0, 16
; RV64I-NEXT:  li a0, -10
; RV64I-NEXT:  call __moddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem16_constant_lhs:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 16
; RV64IM-NEXT:  sraiw a0, a0, 16
; RV64IM-NEXT:  li a1, -10
; RV64IM-NEXT:  remw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = srem i16 -10, %a
ret i16 %1
}

; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=aarch64-apple-ios %s -o - | FileCheck %s

```

```

define <16 x double> @test_sitofp_fixed(<16 x i32> %in) {
; CHECK-LABEL: test_sitofp_fixed:
; CHECK:      ; %bb.0:
; CHECK-NEXT:  sshll2.2d v4, v0, #0
; CHECK-NEXT:  sshll.2d v0, v0, #0
; CHECK-NEXT:  sshll2.2d v5, v1, #0
; CHECK-NEXT:  sshll.2d v6, v1, #0
; CHECK-NEXT:  sshll.2d v7, v2, #0
; CHECK-NEXT:  sshll2.2d v16, v2, #0
; CHECK-NEXT:  sshll2.2d v17, v3, #0
; CHECK-NEXT:  sshll.2d v18, v3, #0
; CHECK-NEXT:  scvtf.2d v1, v4, #6
; CHECK-NEXT:  scvtf.2d v0, v0, #6
; CHECK-NEXT:  scvtf.2d v3, v5, #6
; CHECK-NEXT:  scvtf.2d v2, v6, #6
; CHECK-NEXT:  scvtf.2d v4, v7, #6
; CHECK-NEXT:  scvtf.2d v5, v16, #6
; CHECK-NEXT:  scvtf.2d v7, v17, #6

```

```
; CHECK-NEXT:   scvtf.2d v6, v18, #6
; CHECK-NEXT:   ret

%flt = sitofp <16 x i32> %in to <16 x double>
%res = fdiv <16 x double> %flt, <double 64.0, double 64.0, double 64.0,
double 64.0, double 64.0, double 64.0, double 64.0, double 64.0, double
64.0, double 64.0, double 64.0, double 64.0, double 64.0>
ret <16 x double> %res
}
```

; This one is small enough to satisfy isSimple, but still illegally large.

```
define <4 x double> @test_sitofp_fixed_shortish(<4 x i64> %in) {
```

```
; CHECK-LABEL: test_sitofp_fixed_shortish:
```

```
; CHECK:       ; %bb.0:
```

```
; CHECK-NEXT:   scvtf.2d v0, v0, #6
```

```
; CHECK-NEXT:   scvtf.2d v1, v1, #6
```

```
; CHECK-NEXT:   ret
```

```
%flt = sitofp <4 x i64> %in to <4 x double>
```

```
%res = fdiv <4 x double> %flt, <double 64.0, double 64.0, double 64.0, double 64.0>
```

```
ret <4 x double> %res
```

```
}
```

; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

```
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
```

```
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64I
```

; These tests are each targeted at a particular RISC-V ALU instruction. Most

; other files in this folder exercise LLVM IR instructions that don't directly

; match a RISC-V instruction.

; Register-immediate instructions.

```
define i32 @addi(i32 %a) nounwind {
```

```
; RV64I-LABEL: addi:
```

```
; RV64I:       # %bb.0:
```

```
; RV64I-NEXT:   addiw a0, a0, 1
```

```
; RV64I-NEXT:   ret
```

```
%1 = add i32 %a, 1
```

```
ret i32 %1
```

```
}
```

```
define i32 @slti(i32 %a) nounwind {
```

```
; RV64I-LABEL: slti:
```

```
; RV64I:       # %bb.0:
```

```
; RV64I-NEXT:   sext.w a0, a0
```

```
; RV64I-NEXT:   slti a0, a0, 2
```

```
; RV64I-NEXT:   ret
```

```

%1 = icmp slt i32 %a, 2
%2 = zext i1 %1 to i32
ret i32 %2
}

```

```

define i32 @sltiu(i32 %a) nounwind {
; RV64I-LABEL: sltiu:
; RV64I:      # %bb.0:
; RV64I-NEXT: sext.w a0, a0
; RV64I-NEXT: sltiu a0, a0, 3
; RV64I-NEXT:
    ret
%1 = icmp ult i32 %a, 3
%2 = zext i1 %1 to i32
ret i32 %2
}

```

```

define i32 @xori(i32 %a) nounwind {
; RV64I-LABEL: xori:
; RV64I:      # %bb.0:
; RV64I-NEXT: xori a0, a0, 4
; RV64I-NEXT: ret
%1 = xor i32 %a, 4
ret i32 %1
}

```

```

define i32 @ori(i32 %a) nounwind {
; RV64I-LABEL: ori:
; RV64I:      # %bb.0:
; RV64I-NEXT: ori a0, a0, 5
; RV64I-NEXT: ret
%1 = or i32 %a, 5
ret i32 %1
}

```

```

define i32 @andi(i32 %a) nounwind {
; RV64I-LABEL: andi:
; RV64I:      # %bb.0:
; RV64I-NEXT: andi a0, a0, 6
; RV64I-NEXT: ret
%1 = and i32 %a, 6
ret i32 %1
}

```

```

define i32 @slli(i32 %a) nounwind {
; RV64I-LABEL: slli:
; RV64I:      # %bb.0:
; RV64I-NEXT: slliw a0, a0, 7

```

```
; RV64I-NEXT:  ret
%1 = shl i32 %a, 7
ret i32 %1
}
```

```
define i32 @srli(i32 %a) nounwind {
; RV64I-LABEL: srli:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a0, a0, 8
; RV64I-NEXT:  ret
%1 = lshr i32 %a, 8
ret i32 %1
}
```

```
define i32 @srai(i32 %a) nounwind {
; RV64I-LABEL: srai:
; RV64I:
# %bb.0:
; RV64I-NEXT:  sraiw a0, a0, 9
; RV64I-NEXT:  ret
%1 = ashr i32 %a, 9
ret i32 %1
}
```

```
; Register-register instructions
```

```
define i32 @add(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  ret
%1 = add i32 %a, %b
ret i32 %1
}
```

```
define i32 @sub(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: sub:
; RV64I:      # %bb.0:
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  ret
%1 = sub i32 %a, %b
ret i32 %1
}
```

```
define i32 @sub_negative_constant_lhs(i32 %a) nounwind {
; RV64I-LABEL: sub_negative_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, -2
```

```
; RV64I-NEXT:  subw a0, a1, a0
; RV64I-NEXT:  ret
%1 = sub i32 -2, %a
ret i32 %1
}
```

```
define i32 @sll(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: sll:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sllw a0, a0, a1
; RV64I-NEXT:  ret
%1 = shl i32 %a, %b
ret i32 %1
}
```

; Make sure we don't emit instructions to zero extend the shift amount to i64.

```
define
i32 @sll_shamt_zext(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: sll_shamt_zext:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a1, a1, 1
; RV64I-NEXT:  sllw a0, a0, a1
; RV64I-NEXT:  ret
%shamt = add i32 %b, 1
%1 = shl i32 %a, %shamt
ret i32 %1
}
```

```
define i32 @sll_negative_constant_lhs(i32 %a) nounwind {
; RV64I-LABEL: sll_negative_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  sllw a0, a1, a0
; RV64I-NEXT:  ret
%1 = shl i32 -1, %a
ret i32 %1
}
```

```
define i32 @slt(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: slt:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sext.w a1, a1
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  slt a0, a0, a1
; RV64I-NEXT:  ret
%1 = icmp slt i32 %a, %b
%2 = zext i1 %1 to i32
ret i32 %2
}
```

```
}
```

```
define i32 @sltu(i32 %a, i32 %b) nounwind {  
;  
; RV64I-LABEL: sltu:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: sext.w a1, a1  
; RV64I-NEXT: sext.w a0, a0  
; RV64I-NEXT: sltu a0, a0, a1  
; RV64I-NEXT: ret  
%1 = icmp ult i32 %a,  
%b  
%2 = zext i1 %1 to i32  
ret i32 %2  
}
```

```
define i32 @xor(i32 %a, i32 %b) nounwind {  
;  
; RV64I-LABEL: xor:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: xor a0, a0, a1  
; RV64I-NEXT: ret  
%1 = xor i32 %a, %b  
ret i32 %1  
}
```

```
define i32 @srl(i32 %a, i32 %b) nounwind {  
;  
; RV64I-LABEL: srl:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: srlw a0, a0, a1  
; RV64I-NEXT: ret  
%1 = lshr i32 %a, %b  
ret i32 %1  
}
```

; Make sure we don't emit instructions to zero extend the shift amount to i64.

```
define i32 @srl_shamt_zext(i32 %a, i32 %b) nounwind {  
; RV64I-LABEL: srl_shamt_zext:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: addi a1, a1, 1  
; RV64I-NEXT: srlw a0, a0, a1  
; RV64I-NEXT: ret  
%shamt = add i32 %b, 1  
%1 = lshr i32 %a, %shamt  
ret i32 %1  
}
```

```

define i32 @srl_negative_constant_lhs(i32 %a) nounwind {
;
; RV64I-LABEL: srl_negative_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  srlw a0, a1, a0
; RV64I-NEXT:  ret
%1 = lshr i32 -1, %a
ret i32 %1
}

define
i32 @sra(i32 %a, i32 %b) nounwind {
;
; RV64I-LABEL: sra:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sraw a0, a0, a1
; RV64I-NEXT:  ret
%1 = ashr i32 %a, %b
ret i32 %1
}

; Make sure we don't emit instructions to zero extend the shift amount to i64.
define i32 @sra_shamt_zext(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: sra_shamt_zext:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a1, a1, 1
; RV64I-NEXT:  sraw a0, a0, a1
; RV64I-NEXT:  ret
%shamt = add i32 %b, 1
%1 = ashr i32 %a, %shamt
ret i32 %1
}

define i32 @sra_negative_constant_lhs(i32 %a) nounwind {
;
; RV64I-LABEL: sra_negative_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 524288
; RV64I-NEXT:  sraw a0, a1, a0
; RV64I-NEXT:  ret
%1 = ashr i32 2147483648, %a
ret i32 %1
}

define i32 @or(i32 %a, i32 %b) nounwind {
;
; RV64I-LABEL: or:

```



```

; RV64I:    # %bb.0:
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
%1 = or i32 %a, %b
ret i32 %1
}

define i32 @and(i32 %a, i32 %b) nounwind {
;
; RV64I-LABEL:
and:
; RV64I:    # %bb.0:
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
%1 = and i32 %a, %b
ret i32 %1
}
; NOTE: Assertions have been autogenerated by utils/update_test_checks.py UTC_ARGS: --include-generated-funcs
; RUN: opt -S -passes=verify,iroutliner -ir-outlining-no-cost < %s | FileCheck %s

; This test checks that we do outline indirect calls when it is not specified
; that we should not.

declare void @f1(ptr, ptr);
declare void @f2(ptr, ptr);

define void @function1(ptr %func) {
entry:
%a = alloca i32, align 4
%b = alloca i32, align 4
%c = alloca i32, align 4
store i32 2, ptr %a, align 4
store i32 3, ptr %b, align 4
store i32 4, ptr %c, align 4
call void %func()
%al = load i32, ptr %a
%bl = load i32, ptr %b
%cl = load i32, ptr %c
ret void
}

define void @function2(ptr %func) {
entry:
%a = alloca i32, align 4
%b = alloca i32, align 4
%c = alloca i32, align 4
store i32 2, ptr %a, align 4

```

```

store i32 3, ptr %b, align 4
store i32 4, ptr %c, align 4
call void %func()
%al = load i32, ptr %a
%bl = load i32, ptr %b
%cl = load i32, ptr %c
ret void
}
;
CHECK-LABEL: @function1(
; CHECK-NEXT: entry:
; CHECK-NEXT: [[A:%.*]] = alloca i32, align 4
; CHECK-NEXT: [[B:%.*]] = alloca i32, align 4
; CHECK-NEXT: [[C:%.*]] = alloca i32, align 4
; CHECK-NEXT: call void @outlined_ir_func_0(ptr [[A]], ptr [[B]], ptr [[C]], ptr [[FUNC:%.*]])
; CHECK-NEXT: ret void
;
;
; CHECK-LABEL: @function2(
; CHECK-NEXT: entry:
; CHECK-NEXT: [[A:%.*]] = alloca i32, align 4
; CHECK-NEXT: [[B:%.*]] = alloca i32, align 4
; CHECK-NEXT: [[C:%.*]] = alloca i32, align 4
; CHECK-NEXT: call void @outlined_ir_func_0(ptr [[A]], ptr [[B]], ptr [[C]], ptr [[FUNC:%.*]])
; CHECK-NEXT: ret void
;
;
; CHECK-LABEL: define internal void @outlined_ir_func_0(
; CHECK-NEXT: newFuncRoot:
; CHECK-NEXT: br label [[ENTRY_TO_OUTLINE:%.*]]
; CHECK: entry_to_outline:
; CHECK-NEXT: store i32 2, ptr [[TMP0:%.*]], align 4
; CHECK-NEXT: store i32 3, ptr [[TMP1:%.*]], align 4
; CHECK-NEXT: store i32 4, ptr [[TMP2:%.*]], align 4
; CHECK-NEXT:
call void [[TMP3:%.*]]()
; CHECK-NEXT: [[AL:%.*]] = load i32, ptr [[TMP0]], align 4
; CHECK-NEXT: [[BL:%.*]] = load i32, ptr [[TMP1]], align 4
; CHECK-NEXT: [[CL:%.*]] = load i32, ptr [[TMP2]], align 4
; CHECK-NEXT: br label [[ENTRY_AFTER_OUTLINE_EXITSTUB:%.*]]
; CHECK: entry_after_outline.exitStub:
; CHECK-NEXT: ret void
;
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64I
; RUN: llc -mtriple=riscv64 -mattr=+xtheadbb -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64XTHEADBB

```

```

declare i32 @llvm.ctlz.i32(i32, i1)

define signext i32 @ctlz_i32(i32 signext %a) nounwind {
; RV64I-LABEL: ctlz_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT: beqz a0, .LBB0_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 2
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 8
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 16
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT:
    not a0, a0
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 24
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
; RV64I-NEXT: .LBB0_2:
; RV64I-NEXT: li a0, 32
; RV64I-NEXT: ret

```

```

;
; RV64XTHEADBB-LABEL: ctlz_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  th.extu a0, a0, 31, 0
; RV64XTHEADBB-NEXT:  th.ff1 a0,
a0
; RV64XTHEADBB-NEXT:  addi a0, a0, -32
; RV64XTHEADBB-NEXT:  ret
%1 = call i32 @llvm.ctlz.i32(i32 %a, i1 false)
ret i32 %1
}

```

```

define signext i32 @log2_i32(i32 signext %a) nounwind {
; RV64I-LABEL: log2_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  beqz a0, .LBB1_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addi a2, a2, 1365
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  lui a1, 209715
; RV64I-NEXT:  addi a1, a1, 819
; RV64I-NEXT:
and a2, a0, a1
; RV64I-NEXT:  srliw a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112

```

```

; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 24
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: j .LBB1_3
; RV64I-NEXT: .LBB1_2:
; RV64I-NEXT: li a0, 32
; RV64I-NEXT: .LBB1_3: # %cond.end
; RV64I-NEXT: li a1, 31
; RV64I-NEXT: subw a0, a1, a0
; RV64I-NEXT: ret
;
; RV64XTHEADBB-LABEL: log2_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT: th.extu a0, a0, 31, 0
; RV64XTHEADBB-NEXT: th.ff1 a0, a0
; RV64XTHEADBB-NEXT: addi a0, a0, -32
; RV64XTHEADBB-NEXT: li a1, 31
; RV64XTHEADBB-NEXT: subw a0, a1, a0
; RV64XTHEADBB-NEXT: ret
%1 = call i32 @llvm.ctlz.i32(i32
%a, i1 false)
%2 = sub i32 31, %1
ret i32 %2
}

define signext i32 @log2_ceil_i32(i32 signext %a) nounwind {
; RV64I-LABEL: log2_ceil_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT: addiw a0, a0, -1
; RV64I-NEXT: li s0, 32
; RV64I-NEXT: li a1, 32
; RV64I-NEXT: beqz a0, .LBB2_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 2
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 8
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 16
; RV64I-NEXT: or a0, a0, a1

```

```

; RV64I-NEXT: not a0, a0
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT:
    lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a1, a0, 24
; RV64I-NEXT: .LBB2_2: # %cond.end
; RV64I-NEXT: subw a0, s0, a1
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64XTHEADBB-LABEL: log2_ceil_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT: addi a0, a0, -1
; RV64XTHEADBB-NEXT: slli a0, a0, 32
; RV64XTHEADBB-NEXT: srli a0, a0, 32
; RV64XTHEADBB-NEXT: th.ff1 a0, a0
; RV64XTHEADBB-NEXT: addi a0, a0, -32
; RV64XTHEADBB-NEXT:
    li a1, 32
; RV64XTHEADBB-NEXT: subw a0, a1, a0
; RV64XTHEADBB-NEXT: ret
%1 = sub i32 %a, 1
%2 = call i32 @llvm.ctlz.i32(i32 %1, i1 false)
%3 = sub i32 32, %2
ret i32 %3
}

define signext i32 @findLastSet_i32(i32 signext %a) nounwind {
; RV64I-LABEL: findLastSet_i32:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:  mv s0, a0
; RV64I-NEXT:  srlw a0, a0, 1
; RV64I-NEXT:  or a0, s0, a0
; RV64I-NEXT:  srlw a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srlw a1, a0, 4
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srlw a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srlw a1, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  srlw a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addi a2, a2, 1365
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:
    lui a1, 209715
; RV64I-NEXT:  addi a1, a1, 819
; RV64I-NEXT:  and a2, a0, a1
; RV64I-NEXT:  srlw a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srlw a1, a0, 4
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srlw a0, a0, 24
; RV64I-NEXT:  xori a0, a0, 31
; RV64I-NEXT:  snez a1, s0
; RV64I-NEXT:  addiw a1, a1, -1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: findLastSet_i32:
; RV64XTHEADBB:    # %bb.0:

```

```

; RV64XTHEADBB-NEXT: th.extu a1, a0, 31, 0
; RV64XTHEADBB-NEXT: th.ff1 a1, a1
; RV64XTHEADBB-NEXT: addiw a1, a1, -32
; RV64XTHEADBB-NEXT: xori a1, a1,
31
; RV64XTHEADBB-NEXT: snez a0, a0
; RV64XTHEADBB-NEXT: addiw a0, a0, -1
; RV64XTHEADBB-NEXT: or a0, a0, a1
; RV64XTHEADBB-NEXT: ret
%1 = call i32 @llvm.ctlz.i32(i32 %a, i1 true)
%2 = xor i32 31, %1
%3 = icmp eq i32 %a, 0
%4 = select i1 %3, i32 -1, i32 %2
ret i32 %4
}

```

```

define i32 @ctlz_lshr_i32(i32 signext %a) {
; RV64I-LABEL: ctlz_lshr_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT: srliw a0, a0, 1
; RV64I-NEXT: beqz a0, .LBB4_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: .cfi_def_cfa_offset 16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: .cfi_offset ra, -8
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 2
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 8
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 16
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: not
a0, a0
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1

```



```

; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srliw a0, a0, 24
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
; RV64I-NEXT:  .LBB4_2:
; RV64I-NEXT:  li a0, 32
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: ctlz_lshr_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  srliw a0, a0, 1
; RV64XTHEADBB-NEXT:  th.ff1 a0, a0
; RV64XTHEADBB-NEXT:
    addi a0, a0, -32
; RV64XTHEADBB-NEXT:  ret
%1 = lshr i32 %a, 1
%2 = call i32 @llvm.ctlz.i32(i32 %1, i1 false)
ret i32 %2
}

```

```
declare i64 @llvm.ctlz.i64(i64, i1)
```

```

define i64 @ctlz_i64(i64 %a) nounwind {
; RV64I-LABEL: ctlz_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  beqz a0, .LBB5_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  srli a1, a0, 1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 4
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 16
; RV64I-NEXT:  or a0, a0, a1

```

```

; RV64I-NEXT: srli a1, a0, 32
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: not a0, a0
; RV64I-NEXT: srli a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addiw a2, a2, 1365
; RV64I-NEXT: slli a3, a2, 32
; RV64I-NEXT: add a2, a2,
a3
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: sub a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addiw a1, a1, 819
; RV64I-NEXT: slli a2, a1, 32
; RV64I-NEXT: add a1, a1, a2
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srli a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srli a1, a0, 4
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: slli a2, a1, 32
; RV64I-NEXT: add a1, a1, a2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: slli a2, a1, 32
; RV64I-NEXT: add a1, a1, a2
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srli a0, a0, 56
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
; RV64I-NEXT: .LBB5_2:
; RV64I-NEXT: li a0, 64
; RV64I-NEXT: ret
;
; RV64XTHEADBB-LABEL: ctlz_i64:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:
    th.ff1 a0, a0
; RV64XTHEADBB-NEXT: ret
%1 = call i64 @llvm.ctlz.i64(i64 %a, i1 false)
ret i64 %1
}

```

```
declare i32 @llvm.cttz.i32(i32, i1)
```

```
define signext i32 @cttz_i32(i32 signext %a) nounwind {
; RV64I-LABEL: cttz_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT: beqz a0, .LBB6_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: negw a1, a0
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 30667
; RV64I-NEXT: addiw a1, a1, 1329
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 27
; RV64I-NEXT: lui a1, %hi(.LCPI6_0)
; RV64I-NEXT: addi a1, a1, %lo(.LCPI6_0)
; RV64I-NEXT: add a0, a1, a0
; RV64I-NEXT: lbu a0, 0(a0)
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
; RV64I-NEXT: .LBB6_2:
; RV64I-NEXT: li a0, 32
; RV64I-NEXT: ret
;
; RV64XTHEADBB-LABEL: cttz_i32:
; RV64XTHEADBB:      #
; RV64XTHEADBB:      %bb.0:
; RV64XTHEADBB-NEXT: beqz a0, .LBB6_2
; RV64XTHEADBB-NEXT: # %bb.1: # %cond.false
; RV64XTHEADBB-NEXT: addi sp, sp, -16
; RV64XTHEADBB-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT: negw a1, a0
; RV64XTHEADBB-NEXT: and a0, a0, a1
; RV64XTHEADBB-NEXT: lui a1, 30667
; RV64XTHEADBB-NEXT: addiw a1, a1, 1329
; RV64XTHEADBB-NEXT: call __muldi3
; RV64XTHEADBB-NEXT: srliw a0, a0, 27
; RV64XTHEADBB-NEXT: lui a1, %hi(.LCPI6_0)
; RV64XTHEADBB-NEXT: addi a1, a1, %lo(.LCPI6_0)
; RV64XTHEADBB-NEXT: add a0, a1, a0
; RV64XTHEADBB-NEXT: lbu a0, 0(a0)
; RV64XTHEADBB-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT: addi sp, sp, 16
; RV64XTHEADBB-NEXT: ret
; RV64XTHEADBB-NEXT: .LBB6_2:
; RV64XTHEADBB-NEXT: li a0, 32
```

```

; RV64XTHEADBB-NEXT:  ret
; RV64ZBB-LABEL: cttz_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  ctw a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 false)
ret i32 %1
}

define
  signext i32 @cttz_zero_undef_i32(i32 signext %a) nounwind {
; RV64I-LABEL: cttz_zero_undef_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  negw a1, a0
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 30667
; RV64I-NEXT:  addiw a1, a1, 1329
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srliw a0, a0, 27
; RV64I-NEXT:  lui a1, %hi(.LCPI7_0)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI7_0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: cttz_zero_undef_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  addi sp, sp, -16
; RV64XTHEADBB-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT:  negw a1, a0
; RV64XTHEADBB-NEXT:  and a0, a0, a1
; RV64XTHEADBB-NEXT:  lui a1, 30667
; RV64XTHEADBB-NEXT:  addiw a1, a1, 1329
; RV64XTHEADBB-NEXT:
  call __muldi3
; RV64XTHEADBB-NEXT:  srliw a0, a0, 27
; RV64XTHEADBB-NEXT:  lui a1, %hi(.LCPI7_0)
; RV64XTHEADBB-NEXT:  addi a1, a1, %lo(.LCPI7_0)
; RV64XTHEADBB-NEXT:  add a0, a1, a0
; RV64XTHEADBB-NEXT:  lbu a0, 0(a0)
; RV64XTHEADBB-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT:  addi sp, sp, 16
; RV64XTHEADBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)

```

```
ret i32 %1
}
```

```
define signext i32 @findFirstSet_i32(i32 signext %a) nounwind {
; RV64I-LABEL: findFirstSet_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT: mv s0, a0
; RV64I-NEXT: negw a0, a0
; RV64I-NEXT: and a0, s0, a0
; RV64I-NEXT: lui a1, 30667
; RV64I-NEXT: addiw a1, a1, 1329
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srlw a0, a0, 27
; RV64I-NEXT: lui a1, %hi(.LCPI8_0)
; RV64I-NEXT: addi a1, a1, %lo(.LCPI8_0)
; RV64I-NEXT:
    add a0, a1, a0
; RV64I-NEXT: lbu a0, 0(a0)
; RV64I-NEXT: snez a1, s0
; RV64I-NEXT: addi a1, a1, -1
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64XTHEADBB-LABEL: findFirstSet_i32:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT: addi sp, sp, -16
; RV64XTHEADBB-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT: sd s0, 0(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT: mv s0, a0
; RV64XTHEADBB-NEXT: negw a0, a0
; RV64XTHEADBB-NEXT: and a0, s0, a0
; RV64XTHEADBB-NEXT: lui a1, 30667
; RV64XTHEADBB-NEXT: addiw a1, a1, 1329
; RV64XTHEADBB-NEXT: call __muldi3
; RV64XTHEADBB-NEXT: srlw a0, a0, 27
; RV64XTHEADBB-NEXT: lui a1, %hi(.LCPI8_0)
; RV64XTHEADBB-NEXT: addi a1, a1, %lo(.LCPI8_0)
; RV64XTHEADBB-NEXT: add a0, a1, a0
; RV64XTHEADBB-NEXT: lbu a0, 0(a0)
; RV64XTHEADBB-NEXT:
    snez a1, s0
; RV64XTHEADBB-NEXT: addi a1, a1, -1
```

```

; RV64XTHEADBB-NEXT:  or a0, a1, a0
; RV64XTHEADBB-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT:  ld s0, 0(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT:  addi sp, sp, 16
; RV64XTHEADBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)
%2 = icmp eq i32 %a, 0
%3 = select i1 %2, i32 -1, i32 %1
ret i32 %3
}

```

```

define signext i32 @ffs_i32(i32 signext %a) nounwind {

```

```

; RV64I-LABEL: ffs_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:  mv s0, a0
; RV64I-NEXT:  negw a0, a0
; RV64I-NEXT:  and a0, s0, a0
; RV64I-NEXT:  lui a1, 30667
; RV64I-NEXT:  addiw a1, a1, 1329
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srlw a0, a0, 27
; RV64I-NEXT:  lui a1, %hi(.LCPI9_0)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI9_0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:
    lbu a0, 0(a0)
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  seqz a1, s0
; RV64I-NEXT:  addi a1, a1, -1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: ffs_i32:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:  addi sp, sp, -16
; RV64XTHEADBB-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT:  mv s0, a0
; RV64XTHEADBB-NEXT:  negw a0, a0
; RV64XTHEADBB-NEXT:  and a0, s0, a0

```

```

; RV64XTHEADBB-NEXT: lui a1, 30667
; RV64XTHEADBB-NEXT: addiw a1, a1, 1329
; RV64XTHEADBB-NEXT: call __muldi3
; RV64XTHEADBB-NEXT: srliw a0, a0, 27
; RV64XTHEADBB-NEXT: lui a1, %hi(.LCPI9_0)
; RV64XTHEADBB-NEXT: addi a1, a1, %lo(.LCPI9_0)
; RV64XTHEADBB-NEXT: add a0, a1, a0
;
RV64XTHEADBB-NEXT: lbu a0, 0(a0)
; RV64XTHEADBB-NEXT: addi a0, a0, 1
; RV64XTHEADBB-NEXT: seqz a1, s0
; RV64XTHEADBB-NEXT: addi a1, a1, -1
; RV64XTHEADBB-NEXT: and a0, a1, a0
; RV64XTHEADBB-NEXT: slli a0, a0, 32
; RV64XTHEADBB-NEXT: srli a0, a0, 32
; RV64XTHEADBB-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT: ld s0, 0(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT: addi sp, sp, 16
; RV64XTHEADBB-NEXT: ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)
%2 = add i32 %1, 1
%3 = icmp eq i32 %a, 0
%4 = select i1 %3, i32 0, i32 %2
ret i32 %4
}

```

```
declare i64 @llvm.cttz.i64(i64, i1)
```

```

define i64 @cttz_i64(i64 %a) nounwind {
; RV64I-LABEL: cttz_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT: beqz a0, .LBB10_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: neg a1, a0
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, %hi(.LCPI10_0)
; RV64I-NEXT:
    ld a1, %lo(.LCPI10_0)(a1)
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srli a0, a0, 58
; RV64I-NEXT: lui a1, %hi(.LCPI10_1)
; RV64I-NEXT: addi a1, a1, %lo(.LCPI10_1)
; RV64I-NEXT: add a0, a1, a0
; RV64I-NEXT: lbu a0, 0(a0)
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16

```

```

; RV64I-NEXT:  ret
; RV64I-NEXT:  .LBB10_2:
; RV64I-NEXT:  li a0, 64
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: cttz_i64:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:  beqz a0, .LBB10_2
; RV64XTHEADBB-NEXT:  # %bb.1: # %cond.false
; RV64XTHEADBB-NEXT:  addi a1, a0, -1
; RV64XTHEADBB-NEXT:  not a0, a0
; RV64XTHEADBB-NEXT:  and a0, a0, a1
; RV64XTHEADBB-NEXT:  th.ff1 a0, a0
; RV64XTHEADBB-NEXT:  li a1, 64
; RV64XTHEADBB-NEXT:  sub a0, a1, a0
; RV64XTHEADBB-NEXT:  ret
; RV64XTHEADBB-NEXT: .LBB10_2:
; RV64XTHEADBB-NEXT:  li a0, 64
; RV64XTHEADBB-NEXT:  ret
%1 = call i64 @llvm.cttz.i64(i64 %a, i1 false)
ret i64 %1
}

```

```

define signext
i32 @sextb_i32(i32 signext %a) nounwind {
; RV64I-LABEL: sextb_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 56
; RV64I-NEXT:  srai a0, a0, 56
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: sextb_i32:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:  th.ext a0, a0, 7, 0
; RV64XTHEADBB-NEXT:  ret
%shl = shl i32 %a, 24
%shr = ashr exact i32 %shl, 24
ret i32 %shr
}

```

```

define i64 @sextb_i64(i64 %a) nounwind {
; RV64I-LABEL: sextb_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 56
; RV64I-NEXT:  srai a0, a0, 56
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: sextb_i64:

```



```

; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  th.ext a0, a0, 7, 0
; RV64XTHEADBB-NEXT:  ret
%shl = shl i64 %a, 56
%shr = ashr exact i64 %shl, 56
ret i64 %shr
}

define signext i32 @sexth_i32(i32 signext %a) nounwind {
; RV64I-LABEL: sexth_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srai a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL:
sexth_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  th.ext a0, a0, 15, 0
; RV64XTHEADBB-NEXT:  ret
%shl = shl i32 %a, 16
%shr = ashr exact i32 %shl, 16
ret i32 %shr
}

define signext i32 @no_sexth_i32(i32 signext %a) nounwind {
; RV64I-LABEL: no_sexth_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 17
; RV64I-NEXT:  sraiw a0, a0, 16
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: no_sexth_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  slli a0, a0, 17
; RV64XTHEADBB-NEXT:  sraiw a0, a0, 16
; RV64XTHEADBB-NEXT:  ret
%shl = shl i32 %a, 17
%shr = ashr exact i32 %shl, 16
ret i32 %shr
}

define i64 @sexth_i64(i64 %a) nounwind {
; RV64I-LABEL: sexth_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srai a0, a0, 48
; RV64I-NEXT:  ret

```

```

;
; RV64XTHEADBB-LABEL: sexth_i64:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  th.ext a0, a0, 15, 0
; RV64XTHEADBB-NEXT:  ret
%shl = shl i64 %a, 48
%shr = ashr
exact i64 %shl, 48
ret i64 %shr
}

define i64 @no_sexth_i64(i64 %a) nounwind {
; RV64I-LABEL: no_sexth_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 49
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: no_sexth_i64:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  slli a0, a0, 49
; RV64XTHEADBB-NEXT:  srli a0, a0, 48
; RV64XTHEADBB-NEXT:  ret
%shl = shl i64 %a, 49
%shr = ashr exact i64 %shl, 48
ret i64 %shr
}

define i32 @zexth_i32(i32 %a) nounwind {
; RV64I-LABEL: zexth_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: zexth_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  th.extu a0, a0, 15, 0
; RV64XTHEADBB-NEXT:  ret
%and = and i32 %a, 65535
ret i32 %and
}

define i64 @zexth_i64(i64 %a) nounwind {
; RV64I-LABEL: zexth_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48

```

```

; RV64I-NEXT:
    ret
;
; RV64XTHEADBB-LABEL: zexth_i64:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  th.extu a0, a0, 15, 0
; RV64XTHEADBB-NEXT:  ret
    %and = and i64 %a, 65535
    ret i64 %and
}

```

```

define i64 @zext_bf_i64(i64 %a) nounwind {
; RV64I-LABEL: zext_bf_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 47
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: zext_bf_i64:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  th.extu a0, a0, 16, 1
; RV64XTHEADBB-NEXT:  ret
    %1 = lshr i64 %a, 1
    %and = and i64 %1, 65535
    ret i64 %and
}

```

```

define i64 @zext_i64_srliw(i64 %a) nounwind {
; RV64I-LABEL: zext_i64_srliw:
; RV64I:    # %bb.0:
; RV64I-NEXT:  srliw a0, a0, 16
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: zext_i64_srliw:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  srliw a0, a0, 16
; RV64XTHEADBB-NEXT:  ret
    %1 = lshr i64 %a, 16
    %and = and i64 %1, 65535
    ret i64 %and
}

```

```

declare i32 @llvm.bswap.i32(i32)

```

```

define signext
i32 @bswap_i32(i32 signext %a) nounwind {
; RV64I-LABEL: bswap_i32:
; RV64I:    # %bb.0:

```

```

; RV64I-NEXT:  srlw a1, a0, 8
; RV64I-NEXT:  lui a2, 16
; RV64I-NEXT:  addiw a2, a2, -256
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  srlw a3, a0, 24
; RV64I-NEXT:  or a1, a1, a3
; RV64I-NEXT:  and a2, a0, a2
; RV64I-NEXT:  sllw a2, a2, 8
; RV64I-NEXT:  sllw a0, a0, 24
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: bswap_i32:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:  th.rev w a0, a0
; RV64XTHEADBB-NEXT:  ret
%1 = tail call i32 @llvm.bswap.i32(i32 %a)
ret i32 %1
}

```

; Similar to bswap\_i32 but the result is not sign extended.

```
define void @bswap_i32_nosext(i32 signext %a, ptr %x) nounwind {
```

```

; RV64I-LABEL: bswap_i32_nosext:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a2, a0, 8
; RV64I-NEXT:  lui a3, 16
; RV64I-NEXT:  addi a3, a3, -256
; RV64I-NEXT:  and a2, a2, a3
; RV64I-NEXT:  srlw
a4, a0, 24
; RV64I-NEXT:  or a2, a2, a4
; RV64I-NEXT:  and a3, a0, a3
; RV64I-NEXT:  slli a3, a3, 8
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:  or a0, a0, a3
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  sw a0, 0(a1)
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: bswap_i32_nosext:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:  th.rev w a0, a0
; RV64XTHEADBB-NEXT:  sw a0, 0(a1)
; RV64XTHEADBB-NEXT:  ret
%1 = tail call i32 @llvm.bswap.i32(i32 %a)
store i32 %1, ptr %x
ret void

```

```
}
```

```
declare i64 @llvm.bswap.i64(i64)
```

```
define i64 @bswap_i64(i64 %a) {
```

```
; RV64I-LABEL: bswap_i64:
```

```
; RV64I:      # %bb.0:
```

```
; RV64I-NEXT: srli a1, a0, 40
```

```
; RV64I-NEXT: lui a2, 16
```

```
; RV64I-NEXT: addiw a2, a2, -256
```

```
; RV64I-NEXT: and a1, a1, a2
```

```
; RV64I-NEXT: srli a3, a0, 56
```

```
; RV64I-NEXT: or a1, a1, a3
```

```
; RV64I-NEXT: srli a3, a0, 24
```

```
; RV64I-NEXT: lui a4, 4080
```

```
; RV64I-NEXT: and a3, a3, a4
```

```
; RV64I-NEXT: srli a5, a0, 8
```

```
; RV64I-NEXT: srliw a5, a5, 24
```

```
; RV64I-NEXT: slli
```

```
a5, a5, 24
```

```
; RV64I-NEXT: or a3, a5, a3
```

```
; RV64I-NEXT: or a1, a3, a1
```

```
; RV64I-NEXT: and a4, a0, a4
```

```
; RV64I-NEXT: slli a4, a4, 24
```

```
; RV64I-NEXT: srliw a3, a0, 24
```

```
; RV64I-NEXT: slli a3, a3, 32
```

```
; RV64I-NEXT: or a3, a4, a3
```

```
; RV64I-NEXT: and a2, a0, a2
```

```
; RV64I-NEXT: slli a2, a2, 40
```

```
; RV64I-NEXT: slli a0, a0, 56
```

```
; RV64I-NEXT: or a0, a0, a2
```

```
; RV64I-NEXT: or a0, a0, a3
```

```
; RV64I-NEXT: or a0, a0, a1
```

```
; RV64I-NEXT: ret
```

```
;
```

```
; RV64XTHEADBB-LABEL: bswap_i64:
```

```
; RV64XTHEADBB:      # %bb.0:
```

```
; RV64XTHEADBB-NEXT: th.rev a0, a0
```

```
; RV64XTHEADBB-NEXT: ret
```

```
%1 = call i64 @llvm.bswap.i64(i64 %a)
```

```
ret i64 %1
```

```
}
```

```
; RUN: llc < %s -mtriple=s390x-linux-gnu -mcpu=zEC12 -verify-machineinstrs | FileCheck %s
```

```
;
```

```
; Test that early if conversion produces LOCR with operands of the right
```

```
; register classes.
```

```
define void @autogen_SD4739(ptr) {
```

; CHECK-NOT: Expected a GR32Bit register, but got a GRX32Bit register

BB:

%L34 = load i8, ptr %0

%Cmp56 = icmp sgt i8 undef, %L34

br label %CF246

CF246: ; preds = %CF246, %BB

%S1163 = select i1 %Cmp56, i8 %L34, i8 undef

br i1 undef, label %CF246, label %CF248

CF248: ; preds = %CF248, %CF246

store i8 %S1163, ptr %0

br label %CF248

}

; RUN: llc -march=hexagon -hexagon-hvx-widen=32 < %s | FileCheck %s

; Truncating a type-to-be-widenened to a legal type (v8i8).

; Check that this compiles successfully.

; CHECK-LABEL: f0:

; CHECK: dealloc\_return

target datalayout = "e-m:e-p:32:32:32-a:0-n16:32-i64:64:64-i32:32:32-i16:16:16-i1:8:8-f32:32:32-f64:64:64-v32:32:32-v64:64:64-v512:512:512-v1024:1024:1024-v2048:2048:2048"

target triple = "hexagon"

define dlllexport void @f0(ptr %a0) local\_unnamed\_addr #0 {

b0:

%v0 = load i8, ptr undef, align 1

%v1 = zext i8 %v0 to i16

%v2 = add i16 0, %v1

%v3 = icmp sgt i16 %v2, 1

%v4 = select i1 %v3, i16 %v2, i16 1

%v5 = udiv i16 -32768, %v4

%v6 = zext i16 %v5 to i32

%v7 = insertelement <8 x i32> undef, i32 %v6, i32 0

%v8 = shufflevector <8 x i32> %v7, <8 x i32> undef, <8 x i32> zeroinitializer

%v9 = load <8 x i16>, ptr undef, align 2

%v10 = sext <8 x i16> %v9 to <8 x i32>

%v11 = mul nsw <8 x i32> %v8, %v10

%v12 = add nsw <8 x i32> %v11, <i32 16384, i32 16384, i32 16384, i32 16384, i32 16384, i32 16384, i32 16384, i32 16384>

%v13 = lshr <8 x i32> %v12, <i32 15, i32 15, i32 15, i32 15, i32 15, i32 15, i32 15, i32 15>

%v14 = trunc <8 x i32> %v13 to <8 x i8>

%v15 = getelementptr inbounds i8, ptr %a0, i32 undef

store <8 x i8> %v14, ptr %v15, align 1

ret void

}

```
attributes #0 = { "target-features"="+hvx,+hvx-length128b" }  
; RUN: llc -O3 -mtriple=powerpc-unknown-linux-gnu -mcpu=e500 -mattr=spe < %s | FileCheck %s
```

```
; PowerPC SPE is a rare in-tree target that has the FP_TO_SINT node marked  
; as Legal.
```

```
; Verify that fptosi(42.1) isn't simplified when the rounding mode is  
; unknown.  
; Verify that no gross errors happen.  
; CHECK-LABEL: @f20  
; COMMON: cfdctsiz  
define i32 @f20(double %a) strictfp {  
entry:  
  %result = call i32 @llvm.experimental.constrained.fptosi.i32.f64(double 42.1,  
                                metadata !"fpexcept.strict")  
                                strictfp  
  ret i32 %result  
}
```

```
@llvm.fp.env = thread_local global i8 zeroinitializer, section "llvm.metadata"  
declare i32 @llvm.experimental.constrained.fptosi.i32.f64(double, metadata)  
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```

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```
; NOTE: Assertions have been autogenerated by utils/update_analyze_test_checks.py  
; RUN: opt < %s -passes="print<cost-model>" 2>&1 -disable-output -mtriple=x86_64-apple-macosx10.8.0 -  
mattr=+avx2 | FileCheck %s --check-prefixes=VEC256,AVX  
; RUN: opt < %s -passes="print<cost-model>" 2>&1 -disable-output -mtriple=x86_64-apple-macosx10.8.0 -  
mattr=+avx512vl,+prefer-256-bit | FileCheck %s --check-prefixes=VEC256,AVX512VL256
```

```

; RUN: opt < %s -passes="print<cost-model>" 2>&1 -disable-output -mtriple=x86_64-apple-macosx10.8.0 -
mattr=+avx512vl,-prefer-256-bit | FileCheck %s --check-prefixes=AVX512VL512
; RUN: opt < %s -passes="print<cost-model>" 2>&1 -disable-output -mtriple=x86_64-apple-macosx10.8.0 -
mattr=+avx512vl,+avx512bw,+avx512dq,+prefer-256-bit | FileCheck %s --check-prefixes=VEC256,SKX256
; RUN: opt < %s -passes="print<cost-model>" 2>&1 -disable-output -mtriple=x86_64-apple-macosx10.8.0 -
mattr=+avx512vl,+avx512bw,+avx512dq,-prefer-256-bit | FileCheck %s --check-prefixes=SKX512

define
void @zext256() "min-legal-vector-width"="256" {
; AVX-LABEL: 'zext256'
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %A = zext <8 x i16> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %B = zext <8 x i32> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %C = zext <16 x i8> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %D = zext <16 x i16> undef to <16 x
i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %E = zext <32 x i8> undef to <32 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL256-LABEL: 'zext256'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %A = zext <8 x i16> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %B = zext <8 x i32> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost
Model: Found an estimated cost of 2 for instruction: %C = zext <16 x i8> undef to <16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %D = zext <16 x i16> undef to
<16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = zext <32 x i8> undef to
<32 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL512-LABEL: 'zext256'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = zext <8 x i32> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16 x i16> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction:
%E = zext <32 x i8> undef to <32 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX256-LABEL: 'zext256'
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %A = zext <8 x i16> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %B = zext <8 x i32> undef to <8 x

```



```

i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %C = zext <16 x i8> undef to <16 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %D = zext <16 x i16> undef to <16 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = zext <32 x i8> undef to <32 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX512-LABEL: 'zext256'
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to <8 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated
cost of 1 for instruction: %B = zext <8 x i32> undef to <8 x i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to <16 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16 x i16> undef to <16 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = zext <32 x i8> undef to <32 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
%A = zext <8 x i16> undef to <8 x i64>
%B = zext <8 x i32> undef to <8 x i64>
%C = zext <16 x i8> undef to <16 x i32>
%D = zext <16 x i16> undef to <16 x i32>
%E = zext <32 x i8> undef to <32 x i16>
ret void
}

```

```

define void @zext512() "min-legal-vector-width"="512" {
; AVX-LABEL: 'zext512'
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %A = zext <8 x i16> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %B = zext <8 x i32>
undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %C = zext <16 x i8> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %D = zext <16 x i16> undef to <16 x
i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %E = zext <32 x i8> undef to <32 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL256-LABEL: 'zext512'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = zext <8 x i32> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to
<16 x i32>

```

```

; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16 x i16> undef to
<16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost
of 3 for instruction: %E = zext <32 x i8> undef to <32 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL512-LABEL: 'zext512'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = zext <8 x i32> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16 x i16> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = zext <32 x i8> undef to
<32 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX256-LABEL: 'zext512'
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to <8
x i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = zext <8 x i32> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to <16 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16 x i16> undef to <16 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = zext <32 x i8> undef to <32 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX512-LABEL: 'zext512'
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to <8 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = zext <8 x i32> undef to <8 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to <16 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16
x i16> undef to <16 x i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = zext <32 x i8> undef to <32 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
%A = zext <8 x i16> undef to <8 x i64>
%B = zext <8 x i32> undef to <8 x i64>
%C = zext <16 x i8> undef to <16 x i32>

```

```

%D = zext <16 x i16> undef to <16 x i32>
%E = zext <32 x i8> undef to <32 x i16>
ret void
}

define void @sext256() "min-legal-vector-width"="256" {
; AVX-LABEL: 'sext256'
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %A = sext <8 x i8> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %B = sext <8 x i16> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %C = sext <8 x i32> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %D = sext <16 x i8> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found
an estimated cost of 3 for instruction: %E = sext <16 x i16> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %F = sext <32 x i8> undef to <32 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL256-LABEL: 'sext256'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %A = sext <8 x i8> undef to <8
x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %B = sext <8 x i16> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %C = sext <8 x i32> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %D = sext <16 x i8> undef to
<16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = sext <16 x i16> undef to
<16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %F = sext <32 x i8> undef
to <32 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL512-LABEL: 'sext256'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8
x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = sext <16 x i16> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %F = sext <32 x i8> undef to
<32 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX256-LABEL: 'sext256'
; SKX256-NEXT: Cost Model: Found an

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estimated cost of 2 for instruction: %A = sext <8 x i8> undef to <8 x i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %B = sext <8 x i16> undef to <8 x i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %C = sext <8 x i32> undef to <8 x i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %D = sext <16 x i8> undef to <16 x i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = sext <16 x i16> undef to <16 x i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %F = sext <32 x i8> undef to <32 x i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX512-LABEL: 'sext256'
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8 x i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to <8 x i64>
; SKX512-NEXT: Cost
Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to <8 x i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to <16 x i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = sext <16 x i16> undef to <16 x i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %F = sext <32 x i8> undef to <32 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
%A = sext <8 x i8> undef to <8 x i64>
%B = sext <8 x i16> undef to <8 x i64>
%C = sext <8 x i32> undef to <8 x i64>
%D = sext <16 x i8> undef to <16 x i32>
%E = sext <16 x i16> undef to <16 x i32>
%F = sext <32 x i8> undef to <32 x i16>
ret void
}

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define void @sext512() "min-legal-vector-width"="512" {
; AVX-LABEL: 'sext512'
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %A = sext <8 x i8> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found
an estimated cost of 4 for instruction: %B = sext <8 x i16> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %C = sext <8 x i32> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %D = sext <16 x i8> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = sext <16 x i16> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %F = sext <32 x i8> undef to <32 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL256-LABEL: 'sext512'

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; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8
x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to
<8 x i64>
; AVX512VL256-NEXT:
Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to <16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = sext <16 x i16> undef to
<16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %F = sext <32 x i8> undef to
<32 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL512-LABEL: 'sext512'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8
x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost
of 1 for instruction: %E = sext <16 x i16> undef to <16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %F = sext <32 x i8> undef to
<32 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX256-LABEL: 'sext512'
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8 x i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to <16 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = sext <16 x i16> undef to <16 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %F = sext <32 x i8> undef to <32 x
i16>
; SKX256-NEXT: Cost
Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX512-LABEL: 'sext512'
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8 x i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to <8 x
i64>

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; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to <8 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to <16 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = sext <16 x i16> undef to <16 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %F = sext <32 x i8> undef to <32 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
%A = sext <8 x i8> undef to <8 x i64>
%B = sext <8 x i16> undef to <8 x i64>
%C = sext <8 x i32> undef to <8 x i64>
%D = sext <16 x i8>
undef to <16 x i32>
%E = sext <16 x i16> undef to <16 x i32>
%F = sext <32 x i8> undef to <32 x i16>
ret void
}

define void @trunc256() "min-legal-vector-width"="256" {
; VEC256-LABEL: 'trunc256'
; VEC256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %A = trunc <8 x i64> undef to <8 x
i32>
; VEC256-NEXT: Cost Model: Found an estimated cost of 10 for instruction: %B = trunc <8 x i64> undef to <8 x
i16>
; VEC256-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %C = trunc <8 x i64> undef to <8 x
i8>
; VEC256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %D = trunc <16 x i32> undef to <16 x
i16>
; VEC256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %E = trunc <16 x i32> undef to <16 x
i8>
; VEC256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %F = trunc <32 x i16> undef to <32 x
i8>
; VEC256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL512-LABEL: 'trunc256'
;
AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = trunc <8 x i64> undef to
<8 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %B = trunc <8 x i64> undef to
<8 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %C = trunc <8 x i64> undef to
<8 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %D = trunc <16 x i32> undef
to <16 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %E = trunc <16 x i32> undef to
<16 x i8>

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; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %F = trunc <32 x i16> undef to
<32 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX512-LABEL: 'trunc256'
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = trunc <8 x i64> undef to <8 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated
cost of 2 for instruction: %B = trunc <8 x i64> undef to <8 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %C = trunc <8 x i64> undef to <8 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %D = trunc <16 x i32> undef to <16 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %E = trunc <16 x i32> undef to <16 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %F = trunc <32 x i16> undef to <32 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
%A = trunc <8 x i64> undef to <8 x i32>
%B = trunc <8 x i64> undef to <8 x i16>
%C = trunc <8 x i64> undef to <8 x i8>
%D = trunc <16 x i32> undef to <16 x i16>
%E = trunc <16 x i32> undef to <16 x i8>
%F = trunc <32 x i16> undef to <32 x i8>
ret void
}

```

```

define i32 @zext256_vXi1() "min-legal-vector-width"="256" {
; AVX-LABEL: 'zext256_vXi1'
; AVX-NEXT: Cost Model: Found
an estimated cost of 1 for instruction: %V2i64 = zext <2 x i1> undef to <2 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i64 = zext <4 x i1> undef to <4 x
i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i64 = zext <8 x i1> undef to <8 x
i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i32 = zext <2 x i1> undef to <2 x
i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i32 = zext <4 x i1> undef to <4 x
i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i32 = zext <8 x i1> undef to <8 x
i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i32 = zext <16 x i1> undef to <16 x
i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i16 = zext <2 x i1> undef to <2 x
i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i16 = zext <4 x i1> undef to <4 x
i16>

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; AVX-NEXT:
  Cost Model: Found an estimated cost of 1 for instruction: %V8i16 = zext <8 x i1> undef to <8 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i16 = zext <16 x i1> undef to <16 x
i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V32i16 = zext <32 x i1> undef to <32 x
i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i8 = zext <2 x i1> undef to <2 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i8 = zext <4 x i1> undef to <4 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i8 = zext <8 x i1> undef to <8 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i8 = zext <16 x i1> undef to <16 x
i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V32i8 = zext <32 x i1> undef to <32 x
i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V64i8 = zext <64 x i1> undef
to <64 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; AVX512VL256-LABEL: 'zext256_vXi1'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = zext <2 x i1> undef
to <2 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = zext <4 x i1> undef
to <4 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V8i64 = zext <8 x i1> undef
to <8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = zext <2 x i1> undef
to <2 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = zext <4 x i1> undef
to <4 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = zext <8 x i1> undef
to <8 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i32 = zext <16 x i1>
undef to <16 x i32>
; AVX512VL256-NEXT:
  Cost Model: Found an estimated cost of 5 for instruction: %V2i16 = zext <2 x i1> undef to <2 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V4i16 = zext <4 x i1> undef
to <4 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V8i16 = zext <8 x i1> undef
to <8 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 12 for instruction: %V16i16 = zext <16 x i1>
undef to <16 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 24 for instruction: %V32i16 = zext <32 x i1>
undef to <32 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 6 for instruction: %V2i8 = zext <2 x i1> undef to
<2 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 6 for instruction: %V4i8 = zext <4 x i1> undef to
<4 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 6 for instruction: %V8i8 = zext <8 x i1> undef to
<8 x i8>

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; AVX512VL256-NEXT: Cost Model: Found an estimated
cost of 12 for instruction: %V16i8 = zext <16 x i1> undef to <16 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 25 for instruction: %V32i8 = zext <32 x i1>
undef to <32 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 50 for instruction: %V64i8 = zext <64 x i1>
undef to <64 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; AVX512VL512-LABEL: 'zext256_vXi1'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = zext <2 x i1> undef
to <2 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = zext <4 x i1> undef
to <4 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i64 = zext <8 x i1> undef
to <8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = zext <2 x i1> undef
to <2 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of
2 for instruction: %V4i32 = zext <4 x i1> undef to <4 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = zext <8 x i1> undef
to <8 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = zext <16 x i1>
undef to <16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V2i16 = zext <2 x i1> undef
to <2 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V4i16 = zext <4 x i1> undef
to <4 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i16 = zext <8 x i1> undef
to <8 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i16 = zext <16 x i1>
undef to <16 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 9 for instruction: %V32i16 = zext <32 x i1>
undef to <32 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V2i8
= zext <2 x i1> undef to <2 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V4i8 = zext <4 x i1> undef to
<4 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i8 = zext <8 x i1> undef to
<8 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i8 = zext <16 x i1> undef
to <16 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 9 for instruction: %V32i8 = zext <32 x i1> undef
to <32 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 19 for instruction: %V64i8 = zext <64 x i1>
undef to <64 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX256-LABEL: 'zext256_vXi1'

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; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = zext <2 x i1> undef to <2 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = zext <4 x i1> undef to <4 x
i64>
;
SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i64 = zext <8 x i1> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = zext <2 x i1> undef to <2 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = zext <4 x i1> undef to <4 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = zext <8 x i1> undef to <8 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i32 = zext <16 x i1> undef to
<16 x i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i16 = zext <2 x i1> undef to <2 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i16 = zext <4 x i1> undef to <4 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i16 = zext <8 x i1> undef to <8 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction:
%V16i16 = zext <16 x i1> undef to <16 x i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V32i16 = zext <32 x i1> undef to
<32 x i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i8 = zext <2 x i1> undef to <2 x
i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i8 = zext <4 x i1> undef to <4 x
i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i8 = zext <8 x i1> undef to <8 x
i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i8 = zext <16 x i1> undef to <16
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i8 = zext <32 x i1> undef to <32
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V64i8 = zext <64 x i1> undef to <64
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX512-LABEL: 'zext256_vXi1'
; SKX512-NEXT: Cost
Model: Found an estimated cost of 2 for instruction: %V2i64 = zext <2 x i1> undef to <2 x i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = zext <4 x i1> undef to <4 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i64 = zext <8 x i1> undef to <8 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = zext <2 x i1> undef to <2 x
i32>

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; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = zext <4 x i1> undef to <4 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = zext <8 x i1> undef to <8 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = zext <16 x i1> undef to
<16 x i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i16 = zext <2 x i1> undef to <2 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i16 = zext
<4 x i1> undef to <4 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i16 = zext <8 x i1> undef to <8 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i16 = zext <16 x i1> undef to
<16 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i16 = zext <32 x i1> undef to
<32 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i8 = zext <2 x i1> undef to <2 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i8 = zext <4 x i1> undef to <4 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i8 = zext <8 x i1> undef to <8 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i8 = zext <16 x i1> undef to <16
x i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i8 = zext <32 x i1> undef to <32
x i8>
; SKX512-NEXT: Cost Model: Found an estimated
cost of 2 for instruction: %V64i8 = zext <64 x i1> undef to <64 x i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
%V2i64 = zext <2 x i1> undef to <2 x i64>
%V4i64 = zext <4 x i1> undef to <4 x i64>
%V8i64 = zext <8 x i1> undef to <8 x i64>

%V2i32 = zext <2 x i1> undef to <2 x i32>
%V4i32 = zext <4 x i1> undef to <4 x i32>
%V8i32 = zext <8 x i1> undef to <8 x i32>
%V16i32 = zext <16 x i1> undef to <16 x i32>

%V2i16 = zext <2 x i1> undef to <2 x i16>
%V4i16 = zext <4 x i1> undef to <4 x i16>
%V8i16 = zext <8 x i1> undef to <8 x i16>
%V16i16 = zext <16 x i1> undef to <16 x i16>
%V32i16 = zext <32 x i1> undef to <32 x i16>

%V2i8 = zext <2 x i1> undef to <2 x i8>
%V4i8 = zext <4 x i1> undef to <4 x i8>
%V8i8 = zext <8 x i1> undef to <8 x i8>

```

%V16i8 = zext <16 x i1> undef to <16 x i8>

%V32i8 = zext <32 x i1> undef to <32 x i8>

%V64i8 = zext <64 x i1> undef to <64 x i8>

ret i32 undef

}

define i32 @sext256\_vXi1()

"min-legal-vector-width"="256" {

; AVX-LABEL: 'sext256\_vXi1'

; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I64 = sext i1 undef to i64

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = sext <2 x i1> undef to <2 x i64>

; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i64 = sext <4 x i1> undef to <4 x i64>

; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i64 = sext <8 x i1> undef to <8 x i64>

; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I32 = sext i1 undef to i32

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = sext <2 x i1> undef to <2 x i32>

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = sext <4 x i1> undef to <4 x i32>

; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i32 = sext <8 x i1> undef to <8 x i32>

; AVX-NEXT: Cost Model: Found an estimated cost  
of 4 for instruction: %V16i32 = sext <16 x i1> undef to <16 x i32>

; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I16 = sext i1 undef to i16

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i16 = sext <2 x i1> undef to <2 x i16>

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i16 = sext <4 x i1> undef to <4 x i16>

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i16 = sext <8 x i1> undef to <8 x i16>

; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i16 = sext <16 x i1> undef to <16 x i16>

; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V32i16 = sext <32 x i1> undef to <32 x i16>

; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I8 = sext i1 undef to i8

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i8 = sext <2 x i1> undef to <2 x i8>

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for  
instruction: %V4i8 = sext <4 x i1> undef to <4 x i8>

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i8 = sext <8 x i1> undef to <8 x i8>

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i8 = sext <16 x i1> undef to <16 x i8>

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i8 = sext <32 x i1> undef to <32 x i8>

; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V64i8 = sext <64 x i1> undef to <64 x i8>

```

; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; AVX512VL256-LABEL: 'sext256_vXi1'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I64 = sext i1 undef to i64
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i64 = sext <2 x i1> undef
to <2 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i64 = sext <4 x i1> undef
to <4 x i64>
; AVX512VL256-NEXT:
Cost Model: Found an estimated cost of 3 for instruction: %V8i64 = sext <8 x i1> undef to <8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I32 = sext i1 undef to i32
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i32 = sext <2 x i1> undef
to <2 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i32 = sext <4 x i1> undef
to <4 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i32 = sext <8 x i1> undef
to <8 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = sext <16 x i1>
undef to <16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I16 = sext i1 undef to i16
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V2i16 = sext <2 x i1> undef
to <2 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 4 for instruction:
%V4i16 = sext <4 x i1> undef to <4 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i16 = sext <8 x i1> undef
to <8 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 10 for instruction: %V16i16 = sext <16 x i1>
undef to <16 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 20 for instruction: %V32i16 = sext <32 x i1>
undef to <32 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I8 = sext i1 undef to i8
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V2i8 = sext <2 x i1> undef to
<2 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V4i8 = sext <4 x i1> undef to
<4 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V8i8 = sext <8 x i1> undef to
<8 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 10 for instruction: %V16i8 = sext <16 x i1>
undef to <16 x i8>
;
AVX512VL256-NEXT: Cost Model: Found an estimated cost of 21 for instruction: %V32i8 = sext <32 x i1>
undef to <32 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 42 for instruction: %V64i8 = sext <64 x i1>
undef to <64 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; AVX512VL512-LABEL: 'sext256_vXi1'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I64 = sext i1 undef to i64

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; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i64 = sext <2 x i1> undef
to <2 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i64 = sext <4 x i1> undef
to <4 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i64 = sext <8 x i1> undef
to <8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I32 = sext i1 undef to i32
; AVX512VL512-NEXT: Cost Model: Found an estimated
cost of 1 for instruction: %V2i32 = sext <2 x i1> undef to <2 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i32 = sext <4 x i1> undef
to <4 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i32 = sext <8 x i1> undef
to <8 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i32 = sext <16 x i1>
undef to <16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I16 = sext i1 undef to i16
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i16 = sext <2 x i1> undef
to <2 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i16 = sext <4 x i1> undef
to <4 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i16 = sext <8 x i1> undef
to <8 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V16i16 =
sext <16 x i1> undef to <16 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 7 for instruction: %V32i16 = sext <32 x i1>
undef to <32 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I8 = sext i1 undef to i8
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i8 = sext <2 x i1> undef to
<2 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i8 = sext <4 x i1> undef to
<4 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i8 = sext <8 x i1> undef to
<8 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V16i8 = sext <16 x i1> undef
to <16 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 7 for instruction: %V32i8 = sext <32 x i1> undef
to <32 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 15 for instruction: %V64i8 = sext <64 x i1>
undef to <64 x i8>
; AVX512VL512-NEXT:
Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX256-LABEL: 'sext256_vXi1'
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I64 = sext i1 undef to i64
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i64 = sext <2 x i1> undef to <2 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i64 = sext <4 x i1> undef to <4 x
i64>

```

```

; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i64 = sext <8 x i1> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I32 = sext i1 undef to i32
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i32 = sext <2 x i1> undef to <2 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i32 = sext <4 x i1> undef to <4 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i32 = sext <8 x i1> undef
to <8 x i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = sext <16 x i1> undef to
<16 x i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I16 = sext i1 undef to i16
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i16 = sext <2 x i1> undef to <2 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i16 = sext <4 x i1> undef to <4 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i16 = sext <8 x i1> undef to <8 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i16 = sext <16 x i1> undef to
<16 x i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i16 = sext <32 x i1> undef to
<32 x i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I8 = sext i1 undef to i8
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i8
= sext <2 x i1> undef to <2 x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i8 = sext <4 x i1> undef to <4 x
i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i8 = sext <8 x i1> undef to <8 x
i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i8 = sext <16 x i1> undef to <16
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V32i8 = sext <32 x i1> undef to <32
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V64i8 = sext <64 x i1> undef to <64
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX512-LABEL: 'sext256_vXi1'
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I64 = sext i1 undef to i64
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i64 = sext <2 x i1> undef to <2 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated
cost of 1 for instruction: %V4i64 = sext <4 x i1> undef to <4 x i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i64 = sext <8 x i1> undef to <8 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I32 = sext i1 undef to i32
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i32 = sext <2 x i1> undef to <2 x
i32>

```

```

; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i32 = sext <4 x i1> undef to <4 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i32 = sext <8 x i1> undef to <8 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i32 = sext <16 x i1> undef to
<16 x i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I16 = sext i1 undef to i16
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i16 = sext <2 x i1> undef to <2 x
i16>
; SKX512-NEXT: Cost Model:
Found an estimated cost of 1 for instruction: %V4i16 = sext <4 x i1> undef to <4 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i16 = sext <8 x i1> undef to <8 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i16 = sext <16 x i1> undef to
<16 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V32i16 = sext <32 x i1> undef to
<32 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I8 = sext i1 undef to i8
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i8 = sext <2 x i1> undef to <2 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i8 = sext <4 x i1> undef to <4 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i8 = sext <8 x i1> undef to <8 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i8 = sext <16 x i1> undef to <16
x i8>
;
SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V32i8 = sext <32 x i1> undef to <32
x i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V64i8 = sext <64 x i1> undef to <64
x i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
%i64 = sext i1 undef to i64
%V2i64 = sext <2 x i1> undef to <2 x i64>
%V4i64 = sext <4 x i1> undef to <4 x i64>
%V8i64 = sext <8 x i1> undef to <8 x i64>

%i32 = sext i1 undef to i32
%V2i32 = sext <2 x i1> undef to <2 x i32>
%V4i32 = sext <4 x i1> undef to <4 x i32>
%V8i32 = sext <8 x i1> undef to <8 x i32>
%V16i32 = sext <16 x i1> undef to <16 x i32>

%i16 = sext i1 undef to i16
%V2i16 = sext <2 x i1> undef to <2 x i16>
%V4i16 = sext <4 x i1> undef to <4 x i16>
%V8i16 = sext <8 x i1> undef to <8 x i16>

```



%V16i16 = sext <16 x i1> undef to <16 x i16>

%V32i16 = sext <32 x i1> undef to <32 x i16>

%I8 = sext i1 undef to i8

%V2i8 = sext <2

x i1> undef to <2 x i8>

%V4i8 = sext <4 x i1> undef to <4 x i8>

%V8i8 = sext <8 x i1> undef to <8 x i8>

%V16i8 = sext <16 x i1> undef to <16 x i8>

%V32i8 = sext <32 x i1> undef to <32 x i8>

%V64i8 = sext <64 x i1> undef to <64 x i8>

ret i32 undef

}

define i32 @trunc\_vXi1() "min-legal-vector-width"="256" {

; AVX-LABEL: 'trunc\_vXi1'

; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V2i64 = trunc <2 x i64> undef to <2 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V4i64 = trunc <4 x i64> undef to <4 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 9 for instruction: %V8i64 = trunc <8 x i64> undef to <8 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 11 for instruction: %V16i64 = trunc <16 x i64> undef to <16 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i64 = trunc <32 x i64> undef to <32 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i64 = trunc <64 x i64> undef to <64 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i32 = trunc <2 x i32> undef to <2 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V4i32 = trunc <4 x i32> undef to <4 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = trunc <8 x i32> undef to <8 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V16i32 = trunc <16 x i32> undef to <16 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i32 = trunc <32 x i32> undef to <32 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i32 = trunc <64 x i32> undef to <64 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i16 = trunc <2 x i16> undef to <2 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i16 = trunc <4 x i16> undef to <4 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V8i16 = trunc <8 x i16> undef to <8 x i1>

; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i16 = trunc <16 x i16> undef to <16

```

x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i16 = trunc <32 x i16> undef to <32
x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i16 = trunc <64 x i16> undef to <64
x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i8 = trunc <2 x i8> undef to <2 x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i8 = trunc <4 x i8> undef to <4 x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i8 = trunc <8 x i8> undef to <8 x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V16i8 = trunc <16 x i8> undef to <16 x
i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i8 = trunc <32 x i8> undef to <32 x
i1>
; AVX-NEXT:
  Cost Model: Found an estimated cost of 0 for instruction: %V64i8 = trunc <64 x i8> undef to <64 x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; AVX512VL256-LABEL: 'trunc_vXi1'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = trunc <2 x i64>
undef to <2 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = trunc <4 x i64>
undef to <4 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 9 for instruction: %V8i64 = trunc <8 x i64>
undef to <8 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 11 for instruction: %V16i64 = trunc <16 x i64>
undef to <16 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i64 = trunc <32 x i64>
undef to <32 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i64 = trunc <64 x i64>
undef to <64 x i1>
; AVX512VL256-NEXT: Cost Model:
  Found an estimated cost of 2 for instruction: %V2i32 = trunc <2 x i32> undef to <2 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = trunc <4 x i32>
undef to <4 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = trunc <8 x i32>
undef to <8 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i32 = trunc <16 x i32>
undef to <16 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V32i32 = trunc <32 x i32>
undef to <32 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 16 for instruction: %V64i32 = trunc <64 x i32>
undef to <64 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i16 = trunc <2 x i16>
undef to <2 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i16 = trunc <4 x i16>
undef to <4 x i1>
; AVX512VL256-NEXT: Cost Model: Found an
  estimated cost of 3 for instruction: %V8i16 = trunc <8 x i16> undef to <8 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V16i16 = trunc <16 x i16>

```

```

undef to <16 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 16 for instruction: %V32i16 = trunc <32 x i16>
undef to <32 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 32 for instruction: %V64i16 = trunc <64 x i16>
undef to <64 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i8 = trunc <2 x i8> undef
to <2 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i8 = trunc <4 x i8> undef
to <4 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i8 = trunc <8 x i8> undef
to <8 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V16i8 = trunc <16 x i8>
undef to <16 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of
0 for instruction: %V32i8 = trunc <32 x i8> undef to <32 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i8 = trunc <64 x i8>
undef to <64 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; AVX512VL512-LABEL: 'trunc_vXi1'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = trunc <2 x i64>
undef to <2 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = trunc <4 x i64>
undef to <4 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i64 = trunc <8 x i64>
undef to <8 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 11 for instruction: %V16i64 = trunc <16 x i64>
undef to <16 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i64 = trunc <32 x i64>
undef to <32 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction:
%V64i64 = trunc <64 x i64> undef to <64 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = trunc <2 x i32>
undef to <2 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = trunc <4 x i32>
undef to <4 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = trunc <8 x i32>
undef to <8 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = trunc <16 x i32>
undef to <16 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V32i32 = trunc <32 x i32>
undef to <32 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V64i32 = trunc <64 x i32>
undef to <64 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i16 = trunc <2 x i16>
undef to <2 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction:

```

```

%V4i16 = trunc <4 x i16> undef to <4 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i16 = trunc <8 x i16>
undef to <8 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V16i16 = trunc <16 x i16>
undef to <16 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i16 = trunc <32 x i16>
undef to <32 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i16 = trunc <64 x i16>
undef to <64 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i8 = trunc <2 x i8> undef
to <2 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i8 = trunc <4 x i8> undef
to <4 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i8 = trunc <8 x i8> undef
to <8 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V16i8 = trunc <16 x
i8> undef to <16 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i8 = trunc <32 x i8>
undef to <32 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i8 = trunc <64 x i8>
undef to <64 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX256-LABEL: 'trunc_vXi1'
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = trunc <2 x i64> undef to <2
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = trunc <4 x i64> undef to <4
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 9 for instruction: %V8i64 = trunc <8 x i64> undef to <8
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 11 for instruction: %V16i64 = trunc <16 x i64> undef to
<16 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i64 = trunc <32 x i64> undef to
<32 x i1>
; SKX256-NEXT:
Cost Model: Found an estimated cost of 0 for instruction: %V64i64 = trunc <64 x i64> undef to <64 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = trunc <2 x i32> undef to <2
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = trunc <4 x i32> undef to <4
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = trunc <8 x i32> undef to <8
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i32 = trunc <16 x i32> undef to
<16 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i32 = trunc <32 x i32> undef to
<32 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i32 = trunc <64 x i32> undef to
<64 x i1>

```

```

; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i16 = trunc <2 x i16> undef to <2
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction:
%V4i16 = trunc <4 x i16> undef to <4 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i16 = trunc <8 x i16> undef to <8
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i16 = trunc <16 x i16> undef to
<16 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V32i16 = trunc <32 x i16> undef to
<32 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V64i16 = trunc <64 x i16> undef to
<64 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i8 = trunc <2 x i8> undef to <2 x
i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i8 = trunc <4 x i8> undef to <4 x
i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i8 = trunc <8 x i8> undef to <8 x
i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i8 = trunc <16 x i8> undef to
<16 x i1>
; SKX256-NEXT:
Cost Model: Found an estimated cost of 2 for instruction: %V32i8 = trunc <32 x i8> undef to <32 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V64i8 = trunc <64 x i8> undef to
<64 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX512-LABEL: 'trunc_vXi1'
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = trunc <2 x i64> undef to <2
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = trunc <4 x i64> undef to <4
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i64 = trunc <8 x i64> undef to <8
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 11 for instruction: %V16i64 = trunc <16 x i64> undef to
<16 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i64 = trunc <32 x i64> undef to
<32 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction:
%V64i64 = trunc <64 x i64> undef to <64 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = trunc <2 x i32> undef to <2
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = trunc <4 x i32> undef to <4
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = trunc <8 x i32> undef to <8
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = trunc <16 x i32> undef to
<16 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i32 = trunc <32 x i32> undef to

```

```

<32 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i32 = trunc <64 x i32> undef to
<64 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i16 = trunc <2 x i16> undef to <2
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i16 = trunc <4 x i16> undef to <4
x i1>
;
SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i16 = trunc <8 x i16> undef to <8
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i16 = trunc <16 x i16> undef to
<16 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i16 = trunc <32 x i16> undef to
<32 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V64i16 = trunc <64 x i16> undef to
<64 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i8 = trunc <2 x i8> undef to <2 x
i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i8 = trunc <4 x i8> undef to <4 x
i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i8 = trunc <8 x i8> undef to <8 x
i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i8 = trunc <16 x i8> undef to
<16 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for
instruction: %V32i8 = trunc <32 x i8> undef to <32 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V64i8 = trunc <64 x i8> undef to
<64 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
%V2i64 = trunc <2 x i64> undef to <2 x i1>
%V4i64 = trunc <4 x i64> undef to <4 x i1>
%V8i64 = trunc <8 x i64> undef to <8 x i1>
%V16i64 = trunc <16 x i64> undef to <16 x i1>
%V32i64 = trunc <32 x i64> undef to <32 x i1>
%V64i64 = trunc <64 x i64> undef to <64 x i1>

%V2i32 = trunc <2 x i32> undef to <2 x i1>
%V4i32 = trunc <4 x i32> undef to <4 x i1>
%V8i32 = trunc <8 x i32> undef to <8 x i1>
%V16i32 = trunc <16 x i32> undef to <16 x i1>
%V32i32 = trunc <32 x i32> undef to <32 x i1>
%V64i32 = trunc <64 x i32> undef to <64 x i1>

%V2i16 = trunc <2 x i16> undef to <2 x i1>
%V4i16 = trunc <4 x i16> undef to <4 x i1>
%V8i16 = trunc <8 x i16> undef to <8 x i1>
%V16i16 = trunc <16 x i16> undef to

```

```

<16 x i1>
%V32i16 = trunc <32 x i16> undef to <32 x i1>
%V64i16 = trunc <64 x i16> undef to <64 x i1>

%V2i8 = trunc <2 x i8> undef to <2 x i1>
%V4i8 = trunc <4 x i8> undef to <4 x i1>
%V8i8 = trunc <8 x i8> undef to <8 x i1>
%V16i8 = trunc <16 x i8> undef to <16 x i1>
%V32i8 = trunc <32 x i8> undef to <32 x i1>
%V64i8 = trunc <64 x i8> undef to <64 x i1>

ret i32 undef
}

```

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; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

; RUN: llc -mtriple=riscv64 -mattr=+m -verify-machineinstrs < %s \

; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64

;

; Get the actual value of the overflow bit.

;

define zeroext i1 @saddo1.i32(i32 signext %v1, i32 signext %v2, ptr %res) {

; RV64-LABEL: saddo1.i32:

; RV64: # %bb.0: # %entry

; RV64-NEXT: addw a3, a0, a1

; RV64-NEXT: slt a0, a3, a0

; RV64-NEXT: slti a1, a1, 0

; RV64-NEXT: xor a0, a1, a0

; RV64-NEXT: sw a3, 0(a2)

; RV64-NEXT: ret

entry:

%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 %v2)

%val = extractvalue {i32, i1} %t, 0

%obit = extractvalue {i32, i1} %t, 1

store i32 %val, ptr %res

ret i1 %obit

}

; Test the immediate version.

define zeroext i1 @saddo2.i32(i32 signext %v1, ptr %res) {

; RV64-LABEL: saddo2.i32:

; RV64: # %bb.0: # %entry

; RV64-NEXT: addiw a2, a0, 4

; RV64-NEXT: slt a0, a2, a0

; RV64-NEXT:

sw a2, 0(a1)

; RV64-NEXT: ret

entry:

%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 4)

%val = extractvalue {i32, i1} %t, 0

%obit = extractvalue {i32, i1} %t, 1

store i32 %val, ptr %res

ret i1 %obit

}

; Test negative immediates.

define zeroext i1 @saddo3.i32(i32 signext %v1, ptr %res) {

; RV64-LABEL: saddo3.i32:

; RV64: # %bb.0: # %entry

; RV64-NEXT: addiw a2, a0, -4

```

; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 -4)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

; Test immediates that are too large to be encoded.
define zeroext i1 @saddo4.i32(i32 signext %v1, ptr %res) {
; RV64-LABEL: saddo4.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  lui a2, 4096
; RV64-NEXT:  addi a2, a2, -1
; RV64-NEXT:  addw a2, a0, a2
; RV64-NEXT:  slt
a0, a2, a0
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 16777215)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @saddo1.i64(i64 %v1, i64 %v2, ptr %res) {
; RV64-LABEL: saddo1.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a3, a0, a1
; RV64-NEXT:  slt a0, a3, a0
; RV64-NEXT:  slti a1, a1, 0
; RV64-NEXT:  xor a0, a1, a0
; RV64-NEXT:  sd a3, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.sadd.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

```

```

define zeroext i1 @saddo2.i64(i64 %v1, ptr %res) {
; RV64-LABEL: saddo2.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addi a2, a0, 4
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  sd a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1}
@llvm.sadd.with.overflow.i64(i64 %v1, i64 4)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @saddo3.i64(i64 %v1, ptr %res) {
; RV64-LABEL: saddo3.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addi a2, a0, -4
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  sd a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.sadd.with.overflow.i64(i64 %v1, i64 -4)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @uaddo.i32(i32 signext %v1, i32 signext %v2, ptr %res) {
; RV64-LABEL: uaddo.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a1, a0, a1
; RV64-NEXT:  sltu a0, a1, a0
; RV64-NEXT:  sw a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32,
i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

```



```

define zeroext i1 @uaddo.i32.constant(i32 signext %v1, ptr %res) {
; RV64-LABEL: uaddo.i32.constant:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addiw a2, a0, -2
; RV64-NEXT:  sltu a0, a2, a0
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 -2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @uaddo.i32.constant_one(i32 signext %v1, ptr %res) {
; RV64-LABEL: uaddo.i32.constant_one:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addiw a2, a0, 1
; RV64-NEXT:  seqz a0, a2
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 1)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @uaddo.i64(i64 %v1, i64 %v2, ptr
%res) {
; RV64-LABEL: uaddo.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a1, a0, a1
; RV64-NEXT:  sltu a0, a1, a0
; RV64-NEXT:  sd a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @uaddo.i64.constant_one(i64 %v1, ptr %res) {
; RV64-LABEL: uaddo.i64.constant_one:

```

```

; RV64:    # %bb.0: # %entry
; RV64-NEXT:  addi a2, a0, 1
; RV64-NEXT:  seqz a0, a2
; RV64-NEXT:  sd a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 1)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @ssubo1.i32(i32 signext %v1, i32 signext %v2, ptr %res) {
; RV64-LABEL: ssubo1.i32:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  sgtz a3, a1
; RV64-NEXT:  subw a1,
a0, a1
; RV64-NEXT:  slt a0, a1, a0
; RV64-NEXT:  xor a0, a3, a0
; RV64-NEXT:  sw a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.ssub.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @ssubo2.i32(i32 signext %v1, ptr %res) {
; RV64-LABEL: ssubo2.i32:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  addiw a2, a0, 4
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.ssub.with.overflow.i32(i32 %v1, i32 -4)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @ssubo.i64(i64 %v1, i64 %v2, ptr %res) {
; RV64-LABEL: ssubo.i64:

```

```

; RV64:    # %bb.0: # %entry
; RV64-NEXT:  sgtz a3, a1
; RV64-NEXT:  sub a1, a0, a1
; RV64-NEXT:  slt a0, a1, a0
; RV64-NEXT:  xor a0, a3, a0
; RV64-NEXT:  sd a1,
0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.ssub.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @usubo.i32(i32 signext %v1, i32 signext %v2, ptr %res) {
; RV64-LABEL: usubo.i32:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  subw a1, a0, a1
; RV64-NEXT:  sltu a0, a0, a1
; RV64-NEXT:  sw a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.usub.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @usubo.i32.constant.rhs(i32 signext %v1, ptr %res) {
; RV64-LABEL: usubo.i32.constant.rhs:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  addiw a2, a0, 2
; RV64-NEXT:  sltu a0, a0, a2
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.usub.with.overflow.i32(i32 %v1, i32 -2)

%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @usubo.i32.constant.lhs(i32 signext %v1, ptr %res) {

```

```

; RV64-LABEL: usubo.i32.constant.lhs:
; RV64:      # %bb.0: # %entry
; RV64-NEXT: li a2, -2
; RV64-NEXT: subw a2, a2, a0
; RV64-NEXT: addi a0, a2, 1
; RV64-NEXT: seqz a0, a0
; RV64-NEXT: sw a2, 0(a1)
; RV64-NEXT: ret

entry:
%t = call {i32, i1} @llvm.usub.with.overflow.i32(i32 -2, i32 %v1)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @usubo.i64(i64 %v1, i64 %v2, ptr %res) {
; RV64-LABEL: usubo.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT: sub a1, a0, a1
; RV64-NEXT: sltu a0, a0, a1
; RV64-NEXT: sd a1, 0(a2)
; RV64-NEXT: ret

entry:
%t = call {i64, i1} @llvm.usub.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t,
1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @smulo.i32(i32 signext %v1, i32 signext %v2, ptr %res) {
; RV64-LABEL: smulo.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT: mul a1, a0, a1
; RV64-NEXT: srai a0, a1, 32
; RV64-NEXT: sraiw a3, a1, 31
; RV64-NEXT: xor a0, a0, a3
; RV64-NEXT: snez a0, a0
; RV64-NEXT: sw a1, 0(a2)
; RV64-NEXT: ret

entry:
%t = call {i32, i1} @llvm.smul.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit

```

```
}
```

```
define zeroext i1 @smulo2.i32(i32 signext %v1, ptr %res) {  
; RV64-LABEL: smulo2.i32:  
; RV64:      # %bb.0: # %entry  
; RV64-NEXT:  li a2, 13  
; RV64-NEXT:  mul a2, a0, a2  
; RV64-NEXT:  srai a0, a2, 32  
; RV64-NEXT:  sraiw a3, a2, 31  
; RV64-NEXT:  xor a0, a0, a3  
; RV64-NEXT:  snez a0, a0  
; RV64-NEXT:  sw a2, 0(a1)  
; RV64-NEXT:  ret  
entry:  
%t = call {i32, i1} @llvm.smul.with.overflow.i32(i32 %v1, i32  
13)  
%val = extractvalue {i32, i1} %t, 0  
%obit = extractvalue {i32, i1} %t, 1  
store i32 %val, ptr %res  
ret i1 %obit  
}
```

```
define zeroext i1 @smulo.i64(i64 %v1, i64 %v2, ptr %res) {  
; RV64-LABEL: smulo.i64:  
; RV64:      # %bb.0: # %entry  
; RV64-NEXT:  mulh a3, a0, a1  
; RV64-NEXT:  mul a1, a0, a1  
; RV64-NEXT:  srai a0, a1, 63  
; RV64-NEXT:  xor a0, a3, a0  
; RV64-NEXT:  snez a0, a0  
; RV64-NEXT:  sd a1, 0(a2)  
; RV64-NEXT:  ret  
entry:  
%t = call {i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 %v2)  
%val = extractvalue {i64, i1} %t, 0  
%obit = extractvalue {i64, i1} %t, 1  
store i64 %val, ptr %res  
ret i1 %obit  
}
```

```
define zeroext i1 @smulo2.i64(i64 %v1, ptr %res) {  
; RV64-LABEL: smulo2.i64:  
; RV64:      # %bb.0: # %entry  
; RV64-NEXT:  li a2, 13  
; RV64-NEXT:  mulh a3, a0, a2  
; RV64-NEXT:  mul a2, a0, a2  
; RV64-NEXT:  srai a0, a2, 63  
; RV64-NEXT:  xor a0, a3, a0
```

```

; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  sd a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call
{i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 13)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @umulo.i32(i32 signext %v1, i32 signext %v2, ptr %res) {
; RV64-LABEL: umulo.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  slli a1, a1, 32
; RV64-NEXT:  slli a0, a0, 32
; RV64-NEXT:  mulhu a1, a0, a1
; RV64-NEXT:  srai a0, a1, 32
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  sw a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.umul.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @umulo2.i32(i32 signext %v1, ptr %res) {
; RV64-LABEL: umulo2.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  li a2, 13
; RV64-NEXT:  slli a2, a2, 32
; RV64-NEXT:  slli a0, a0, 32
; RV64-NEXT:  mulhu a2, a0, a2
; RV64-NEXT:  srli a0, a2, 32
; RV64-NEXT:
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.umul.with.overflow.i32(i32 %v1, i32 13)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

```

```
}
```

; Similar to umulo.i32, but storing the overflow and returning the result.

```
define signext i32 @umulo3.i32(i32 signext %0, i32 signext %1, ptr %2) {  
; RV64-LABEL: umulo3.i32:  
; RV64:      # %bb.0:  
; RV64-NEXT: slli a1, a1, 32  
; RV64-NEXT: slli a0, a0, 32  
; RV64-NEXT: mulhu a0, a0, a1  
; RV64-NEXT: srai a1, a0, 32  
; RV64-NEXT: snez a1, a1  
; RV64-NEXT: sext.w a0, a0  
; RV64-NEXT: sw a1, 0(a2)  
; RV64-NEXT: ret  
%4 = tail call { i32, i1 } @llvm.umul.with.overflow.i32(i32 %0, i32 %1)  
%5 = extractvalue { i32, i1 } %4, 1  
%6 = extractvalue { i32, i1 } %4, 0  
%7 = zext i1 %5 to i32  
store i32 %7, ptr %2, align 4  
ret i32 %6  
}
```

```
define zeroext i1 @umulo.i64(i64 %v1, i64 %v2, ptr %res) {  
; RV64-LABEL: umulo.i64:  
;  
; RV64:      # %bb.0: # %entry  
; RV64-NEXT: mulhu a3, a0, a1  
; RV64-NEXT: snez a3, a3  
; RV64-NEXT: mul a0, a0, a1  
; RV64-NEXT: sd a0, 0(a2)  
; RV64-NEXT: mv a0, a3  
; RV64-NEXT: ret  
entry:  
%t = call { i64, i1 } @llvm.umul.with.overflow.i64(i64 %v1, i64 %v2)  
%val = extractvalue { i64, i1 } %t, 0  
%obit = extractvalue { i64, i1 } %t, 1  
store i64 %val, ptr %res  
ret i1 %obit  
}
```

```
define zeroext i1 @umulo2.i64(i64 %v1, ptr %res) {  
; RV64-LABEL: umulo2.i64:  
; RV64:      # %bb.0: # %entry  
; RV64-NEXT: li a3, 13  
; RV64-NEXT: mulhu a2, a0, a3  
; RV64-NEXT: snez a2, a2  
; RV64-NEXT: mul a0, a0, a3  
; RV64-NEXT: sd a0, 0(a1)
```

```

; RV64-NEXT:  mv a0, a2
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.umul.with.overflow.i64(i64 %v1, i64 13)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

;
; Check the use of the overflow bit in combination with a select instruction.
;
define i32 @saddo.select.i32(i32
  signext %v1, i32 signext %v2) {
; RV64-LABEL: saddo.select.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a2, a0, a1
; RV64-NEXT:  slt a2, a2, a0
; RV64-NEXT:  slti a3, a1, 0
; RV64-NEXT:  bne a3, a2, .LBB28_2
; RV64-NEXT: # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT: .LBB28_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = select i1 %obit, i32 %v1, i32 %v2
ret i32 %ret
}

define i1 @saddo.not.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: saddo.not.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a2, a0, a1
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  slti a1, a1, 0
; RV64-NEXT:  xor a0, a1, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```



```

define i64 @saddo.select.i64(i64
  %v1, i64 %v2) {
; RV64-LABEL: saddo.select.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a2, a0, a1
; RV64-NEXT:  slt a2, a2, a0
; RV64-NEXT:  slti a3, a1, 0
; RV64-NEXT:  bne a3, a2, .LBB30_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB30_2: # %entry
; RV64-NEXT:  ret
entry:
  %t = call {i64, i1} @llvm.sadd.with.overflow.i64(i64 %v1, i64 %v2)
  %obit = extractvalue {i64, i1} %t, 1
  %ret = select i1 %obit, i64 %v1, i64 %v2
  ret i64 %ret
}

```

```

define i1 @saddo.not.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: saddo.not.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a2, a0, a1
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  slti a1, a1, 0
; RV64-NEXT:  xor a0, a1, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
  %t = call {i64, i1} @llvm.sadd.with.overflow.i64(i64 %v1, i64 %v2)
  %obit = extractvalue {i64, i1} %t, 1
  %ret = xor i1 %obit, true
  ret i1 %ret
}

```

```

define i32 @uaddo.select.i32(i32 signext %v1,
  i32 signext %v2) {
; RV64-LABEL: uaddo.select.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a2, a0, a1
; RV64-NEXT:  bltu a2, a0, .LBB32_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB32_2: # %entry
; RV64-NEXT:  ret
entry:
  %t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 %v2)

```

```

%obit = extractvalue {i32, i1} %t, 1
%ret = select i1 %obit, i32 %v1, i32 %v2
ret i32 %ret
}

define i1 @uaddo.not.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: uaddo.not.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a1, a0, a1
; RV64-NEXT:  sltu a0, a1, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

define i64 @uaddo.select.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: uaddo.select.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a2, a0, a1
; RV64-NEXT:
; RV64-NEXT:  bltu a2, a0, .LBB34_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB34_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = select i1 %obit, i64 %v1, i64 %v2
ret i64 %ret
}

define i1 @uaddo.not.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: uaddo.not.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a1, a0, a1
; RV64-NEXT:  sltu a0, a1, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```

```
}
```

```
define i32 @ssubo.select.i32(i32 signext %v1, i32 signext %v2) {  
; RV64-LABEL: ssubo.select.i32:  
; RV64:      # %bb.0: # %entry  
; RV64-NEXT:  sgtz a2, a1  
; RV64-NEXT:  subw a3, a0, a1  
; RV64-NEXT:  slt a3, a3, a0  
; RV64-NEXT:  bne a2, a3, .LBB36_2  
; RV64-NEXT:  # %bb.1: # %entry  
; RV64-NEXT:  mv a0,  
a1  
; RV64-NEXT:  .LBB36_2: # %entry  
; RV64-NEXT:  ret  
entry:  
%t = call {i32, i1} @llvm.ssub.with.overflow.i32(i32 %v1, i32 %v2)  
%obit = extractvalue {i32, i1} %t, 1  
%ret = select i1 %obit, i32 %v1, i32 %v2  
ret i32 %ret  
}
```

```
define i1 @ssubo.not.i32(i32 signext %v1, i32 signext %v2) {  
; RV64-LABEL: ssubo.not.i32:  
; RV64:      # %bb.0: # %entry  
; RV64-NEXT:  sgtz a2, a1  
; RV64-NEXT:  subw a1, a0, a1  
; RV64-NEXT:  slt a0, a1, a0  
; RV64-NEXT:  xor a0, a2, a0  
; RV64-NEXT:  xori a0, a0, 1  
; RV64-NEXT:  ret  
entry:  
%t = call {i32, i1} @llvm.ssub.with.overflow.i32(i32 %v1, i32 %v2)  
%obit = extractvalue {i32, i1} %t, 1  
%ret = xor i1 %obit, true  
ret i1 %ret  
}
```

```
define i64 @ssubo.select.i64(i64 %v1, i64 %v2) {  
; RV64-LABEL: ssubo.select.i64:  
; RV64:      # %bb.0: # %entry  
; RV64-NEXT:  sgtz a2, a1  
; RV64-NEXT:  sub a3, a0, a1  
; RV64-NEXT:  slt a3, a3, a0  
; RV64-NEXT:  bne a2, a3, .LBB38_2  
; RV64-NEXT:  # %bb.1: # %entry  
; RV64-NEXT:  mv a0, a1  
; RV64-NEXT:
```

```
.LBB38_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.ssub.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = select i1 %obit, i64 %v1, i64 %v2
ret i64 %ret
}
```

```
define i1 @ssub.not.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: ssub.not.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sgtz a2, a1
; RV64-NEXT:  sub a1, a0, a1
; RV64-NEXT:  slt a0, a1, a0
; RV64-NEXT:  xor a0, a2, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.ssub.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}
```

```
define i32 @usubo.select.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: usubo.select.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  subw a2, a0, a1
; RV64-NEXT:  bltu a0, a2, .LBB40_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB40_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.usub.with.overflow.i32(i32
%v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = select i1 %obit, i32 %v1, i32 %v2
ret i32 %ret
}
```

```
define i1 @usubo.not.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: usubo.not.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  subw a1, a0, a1
; RV64-NEXT:  sltu a0, a0, a1
; RV64-NEXT:  xori a0, a0, 1
}
```

```
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.usub.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}
```

```
define i64 @usubo.select.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: usubo.select.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sub a2, a0, a1
; RV64-NEXT:  bltu a0, a2, .LBB42_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB42_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.usub.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = select i1 %obit, i64 %v1, i64 %v2
ret i64 %ret
}
```

```
define
i1 @usubo.not.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: usubo.not.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sub a1, a0, a1
; RV64-NEXT:  sltu a0, a0, a1
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.usub.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}
```

```
define i32 @smulo.select.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: smulo.select.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mul a2, a0, a1
; RV64-NEXT:  srai a3, a2, 32
; RV64-NEXT:  sraiw a2, a2, 31
; RV64-NEXT:  bne a3, a2, .LBB44_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
```

```

; RV64-NEXT: .LBB44_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.smul.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = select i1 %obit, i32 %v1, i32 %v2
ret i32 %ret
}

```

```

define i1 @smulo.not.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL:
smulo.not.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mul a0, a0, a1
; RV64-NEXT:  srai a1, a0, 32
; RV64-NEXT:  sraiw a0, a0, 31
; RV64-NEXT:  xor a0, a1, a0
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.smul.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```

```

define i64 @smulo.select.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: smulo.select.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mulh a2, a0, a1
; RV64-NEXT:  mul a3, a0, a1
; RV64-NEXT:  srai a3, a3, 63
; RV64-NEXT:  bne a2, a3, .LBB46_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB46_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = select i1 %obit, i64 %v1, i64 %v2
ret i64 %ret
}

```

```

define i1 @smulo.not.i64(i64 %v1, i64 %v2) {
; RV64-LABEL:

```

```

smulo.not.i64:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  mulh a2, a0, a1
; RV64-NEXT:  mul a0, a0, a1
; RV64-NEXT:  srai a0, a0, 63
; RV64-NEXT:  xor a0, a2, a0
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```

```

define i32 @umulo.select.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: umulo.select.i32:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  slli a2, a1, 32
; RV64-NEXT:  slli a3, a0, 32
; RV64-NEXT:  mulhu a2, a3, a2
; RV64-NEXT:  srai a2, a2, 32
; RV64-NEXT:  bnez a2, .LBB48_2
; RV64-NEXT: # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT: .LBB48_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.umul.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = select i1 %obit, i32 %v1, i32 %v2
ret i32 %ret
}

```

```

define
i1 @umulo.not.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: umulo.not.i32:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  slli a1, a1, 32
; RV64-NEXT:  slli a0, a0, 32
; RV64-NEXT:  mulhu a0, a0, a1
; RV64-NEXT:  srai a0, a0, 32
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.umul.with.overflow.i32(i32 %v1, i32 %v2)

```

```

%obit = extractvalue {i32, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

define i64 @umulo.select.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: umulo.select.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mulhu a2, a0, a1
; RV64-NEXT:  bnez a2, .LBB50_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB50_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.umul.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = select i1 %obit, i64 %v1, i64 %v2
ret i64 %ret
}

define i1 @umulo.not.i64(i64 %v1, i64 %v2)
{
; RV64-LABEL: umulo.not.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mulhu a0, a0, a1
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.umul.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

;
; Check the use of the overflow bit in combination with a branch instruction.
;
define zeroext i1 @saddo.br.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: saddo.br.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a2, a0, a1
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  slti a1, a1, 0
; RV64-NEXT:  beq a1, a0, .LBB52_2
; RV64-NEXT:  # %bb.1: # %overflow

```



```

; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT:  .LBB52_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
br i1
%obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

```

```

define zeroext i1 @saddo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: saddo.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a2, a0, a1
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  slti a1, a1, 0
; RV64-NEXT:  beq a1, a0, .LBB53_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT:  .LBB53_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.sadd.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

```

```

define zeroext i1 @uaddo.br.i32(i32 %v1, i32 %v2) {
; RV64-LABEL: uaddo.br.i32:
; RV64:      # %bb.0: # %entry

```

```

; RV64-NEXT:   addw a1, a0, a1
; RV64-NEXT:   sext.w a0, a0
; RV64-NEXT:   bgeu a1, a0, .LBB54_2
; RV64-NEXT:   # %bb.1: # %overflow
;
RV64-NEXT:   li a0, 0
; RV64-NEXT:   ret
; RV64-NEXT:   .LBB54_2: # %continue
; RV64-NEXT:   li a0, 1
; RV64-NEXT:   ret
entry:
%t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @uaddo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: uaddo.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:   add a1, a0, a1
; RV64-NEXT:   bgeu a1, a0, .LBB55_2
; RV64-NEXT:   # %bb.1: # %overflow
; RV64-NEXT:   li a0, 0
; RV64-NEXT:   ret
; RV64-NEXT:   .LBB55_2: # %continue
; RV64-NEXT:   li a0, 1
; RV64-NEXT:   ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @ssubo.br.i32(i32

```

```

    signext %v1, i32 signext %v2) {
; RV64-LABEL: ssubo.br.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sgtz a2, a1
; RV64-NEXT:  subw a1, a0, a1
; RV64-NEXT:  slt a0, a1, a0
; RV64-NEXT:  beq a2, a0, .LBB56_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT:  .LBB56_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
    %t = call {i32, i1} @llvm.ssub.with.overflow.i32(i32 %v1, i32 %v2)
    %val = extractvalue {i32, i1} %t, 0
    %obit = extractvalue {i32, i1} %t, 1
    br i1 %obit, label %overflow, label %continue

overflow:
    ret i1 false

continue:
    ret i1 true
}

```

```

define zeroext i1 @ssubo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: ssubo.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sgtz a2, a1
; RV64-NEXT:  sub a1, a0, a1
; RV64-NEXT:  slt a0, a1, a0
; RV64-NEXT:  beq a2, a0, .LBB57_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT:  .LBB57_2: # %continue
;
    RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
    %t = call {i64, i1} @llvm.ssub.with.overflow.i64(i64 %v1, i64 %v2)
    %val = extractvalue {i64, i1} %t, 0
    %obit = extractvalue {i64, i1} %t, 1
    br i1 %obit, label %overflow, label %continue

overflow:
    ret i1 false

```

```

continue:
    ret i1 true
}

define zeroext i1 @usubo.br.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: usubo.br.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  subw a1, a0, a1
; RV64-NEXT:  bgeu a0, a1, .LBB58_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB58_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
    %t = call {i32, i1} @llvm.usub.with.overflow.i32(i32 %v1, i32 %v2)
    %val = extractvalue {i32, i1} %t, 0
    %obit = extractvalue {i32, i1} %t, 1
    br i1 %obit, label %overflow, label %continue

overflow:
    ret i1 false

continue:
    ret i1 true
}

define zeroext i1 @usubo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: usubo.br.i64:
;
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sub a1, a0, a1
; RV64-NEXT:  bgeu a0, a1, .LBB59_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB59_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
    %t = call {i64, i1} @llvm.usub.with.overflow.i64(i64 %v1, i64 %v2)
    %val = extractvalue {i64, i1} %t, 0
    %obit = extractvalue {i64, i1} %t, 1
    br i1 %obit, label %overflow, label %continue

overflow:

```

```

ret i1 false

continue:
ret i1 true
}

define zeroext i1 @smulo.br.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: smulo.br.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mul a0, a0, a1
; RV64-NEXT:  srai a1, a0, 32
; RV64-NEXT:  sraiw a0, a0, 31
; RV64-NEXT:  beq a1, a0, .LBB60_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB60_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.smul.with.overflow.i32(i32
%v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @smulo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: smulo.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mulh a2, a0, a1
; RV64-NEXT:  mul a0, a0, a1
; RV64-NEXT:  srai a0, a0, 63
; RV64-NEXT:  beq a2, a0, .LBB61_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB61_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 %v2)

```

```

%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

```

```

overflow:
ret i1 false

```

```

continue:
ret i1 true
}

```

```

define zeroext i1 @smulo2.br.i64(i64 %v1) {
; RV64-LABEL: smulo2.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  li a1, -13
; RV64-NEXT:
    mulh a2, a0, a1
; RV64-NEXT:  mul a0, a0, a1
; RV64-NEXT:  srai a0, a0, 63
; RV64-NEXT:  beq a2, a0, .LBB62_2
; RV64-NEXT: # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB62_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
    %t = call {i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 -13)
    %val = extractvalue {i64, i1} %t, 0
    %obit = extractvalue {i64, i1} %t, 1
    br i1 %obit, label %overflow, label %continue

```

```

overflow:
ret i1 false

```

```

continue:
ret i1 true
}

```

```

define zeroext i1 @umulo.br.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: umulo.br.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  slli a1, a1, 32
; RV64-NEXT:  slli a0, a0, 32
; RV64-NEXT:  mulhu a0, a0, a1
; RV64-NEXT:  srai a0, a0, 32
; RV64-NEXT:  beqz a0, .LBB63_2
; RV64-NEXT: # %bb.1: # %overflow

```

```

; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT:  .LBB63_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call
{i32, i1} @llvm.umul.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @umulo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: umulo.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mulhu a0, a0, a1
; RV64-NEXT:  beqz a0, .LBB64_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT:  .LBB64_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.umul.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @umulo2.br.i64(i64 %v1) {
; RV64-LABEL: umulo2.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a1, a0, a0
; RV64-NEXT:  bgeu a1, a0,

```

```

.LBB65_2
; RV64-NEXT: # %bb.1: # %overflow
; RV64-NEXT: li a0, 0
; RV64-NEXT: ret
; RV64-NEXT: .LBB65_2: # %continue
; RV64-NEXT: li a0, 1
; RV64-NEXT: ret
entry:
%t = call {i64, i1} @llvm.umul.with.overflow.i64(i64 %v1, i64 2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @uaddo.i64.constant(i64 %v1, ptr %res) {
; RV64-LABEL: uaddo.i64.constant:
; RV64:    # %bb.0: # %entry
; RV64-NEXT: addi a2, a0, 2
; RV64-NEXT: sltu a0, a2, a0
; RV64-NEXT: sd a2, 0(a1)
; RV64-NEXT: ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @uaddo.i64.constant_2048(i64 %v1, ptr %res) {
; RV64-LABEL: uaddo.i64.constant_2048:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:
    addi a2, a0, 2047
; RV64-NEXT: addi a2, a2, 1
; RV64-NEXT: sltu a0, a2, a0
; RV64-NEXT: sd a2, 0(a1)
; RV64-NEXT: ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 2048)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1

```



```

store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @uaddo.i64.constant_2049(i64 %v1, ptr %res) {
; RV64-LABEL: uaddo.i64.constant_2049:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addi a2, a0, 2047
; RV64-NEXT:  addi a2, a2, 2
; RV64-NEXT:  sltu a0, a2, a0
; RV64-NEXT:  sd a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 2049)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

```

```

define i64 @uaddo.i64.constant_setcc_on_overflow_flag(ptr %p) {
; RV64-LABEL: uaddo.i64.constant_setcc_on_overflow_flag:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  ld a1, 0(a0)
;
; RV64-NEXT:  addi a0, a1, 2
; RV64-NEXT:  bltu a0, a1, .LBB69_2
; RV64-NEXT:  # %bb.1: # %IfOverflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  .LBB69_2: # %IfNoOverflow
; RV64-NEXT:  ret
entry:
%v1 = load i64, ptr %p
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %IfNoOverflow, label %IfOverflow
IfOverflow:
ret i64 0
IfNoOverflow:
ret i64 %val
}

```

```

declare {i32, i1} @llvm.sadd.with.overflow.i32(i32, i32) nounwind readnone
declare {i64, i1} @llvm.sadd.with.overflow.i64(i64, i64) nounwind readnone
declare {i32, i1} @llvm.uadd.with.overflow.i32(i32, i32) nounwind readnone
declare {i64, i1} @llvm.uadd.with.overflow.i64(i64, i64) nounwind readnone
declare {i32, i1} @llvm.ssub.with.overflow.i32(i32, i32) nounwind readnone

```

```

declare {i64, i1} @llvm.ssub.with.overflow.i64(i64, i64) nounwind readnone
declare {i32, i1} @llvm.usub.with.overflow.i32(i32, i32) nounwind readnone
declare
  {i64, i1} @llvm.usub.with.overflow.i64(i64, i64) nounwind readnone
declare {i32, i1} @llvm.smul.with.overflow.i32(i32, i32) nounwind readnone
declare {i64, i1} @llvm.smul.with.overflow.i64(i64, i64) nounwind readnone
declare {i32, i1} @llvm.umul.with.overflow.i32(i32, i32) nounwind readnone
declare {i64, i1} @llvm.umul.with.overflow.i64(i64, i64) nounwind readnone

```

=====

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```
add_lldb_library(lldbPluginObjectContainerBSDArchive PLUGIN
ObjectContainerBSDArchive.cpp
```

```
LINK_LIBS
```

```
  lldbCore
```

```
  lldbHost
```

```
  lldbSymbol
```

```
LINK_COMPONENTS
```

```
  Support
```

```
)
```

```
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
```

```
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
```

```
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64I %s
```

```
; RUN: llc -mtriple=riscv64 -mattr=+m -verify-machineinstrs < %s \
```

```
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64IM %s
```

```
define i32 @udiv(i32 %a, i32 %b) nounwind {
```

```
; RV64I-LABEL: udiv:
```

```
; RV64I:      # %bb.0:
```

```
; RV64I-NEXT:  addi sp, sp, -16
```

```
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
```

```
; RV64I-NEXT:  slli a0, a0, 32
```

```
; RV64I-NEXT:  srli a0, a0, 32
```

```
; RV64I-NEXT:  slli a1, a1, 32
```

```
; RV64I-NEXT:  srli a1, a1, 32
```

```
; RV64I-NEXT:  call __udivdi3
```

```
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
```

```
; RV64I-NEXT:  addi sp, sp, 16
```

```
; RV64I-NEXT:  ret
```

```
;
```

```
; RV64IM-LABEL: udiv:
```

```
; RV64IM:      # %bb.0:
```

```
; RV64IM-NEXT:  divuw a0, a0, a1
```

```
; RV64IM-NEXT:  ret
```

```
%1 = udiv i32 %a, %b
```

```
ret i32 %1
```

```
}
```



```

define i32 @udiv_constant(i32 %a) nounwind {
; RV64I-LABEL:
    udiv_constant:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv_constant:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 32
; RV64IM-NEXT:  lui a1, 838861
; RV64IM-NEXT:  addi a1, a1, -819
; RV64IM-NEXT:  slli a1, a1, 32
; RV64IM-NEXT:  mulhu a0, a0, a1
; RV64IM-NEXT:  srli a0, a0, 34
; RV64IM-NEXT:  ret
    %1 = udiv i32 %a, 5
    ret i32 %1
}

```

```

define i32 @udiv_pow2(i32 %a) nounwind {
; RV64I-LABEL: udiv_pow2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a0, a0, 3
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv_pow2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  srliw a0, a0, 3
; RV64IM-NEXT:  ret
    %1 = udiv i32 %a, 8
    ret i32 %1
}

```

```

define i32 @udiv_constant_lhs(i32
    %a) nounwind {
; RV64I-LABEL: udiv_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill

```

```

; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a1, a0, 32
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  divuw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = udiv i32 10, %a
ret i32 %1
}

```

```

define i64 @udiv64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: udiv64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  tail __udivdi3
;
; RV64IM-LABEL: udiv64:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  divu a0, a0, a1
; RV64IM-NEXT:  ret
%1 = udiv i64 %a, %b
ret i64 %1
}

```

```

define i64 @udiv64_constant(i64 %a) nounwind {
; RV64I-LABEL: udiv64_constant:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:
;         tail __udivdi3
;
; RV64IM-LABEL: udiv64_constant:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  lui a1, 838861
; RV64IM-NEXT:  addiw a1, a1, -819
; RV64IM-NEXT:  slli a2, a1, 32
; RV64IM-NEXT:  add a1, a1, a2
; RV64IM-NEXT:  mulhu a0, a0, a1
; RV64IM-NEXT:  srli a0, a0, 2
; RV64IM-NEXT:  ret
%1 = udiv i64 %a, 5
ret i64 %1
}

```

```

}

define i64 @udiv64_constant_lhs(i64 %a) nounwind {
; RV64I-LABEL: udiv64_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  mv a1, a0
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  tail __udivdi3
;
; RV64IM-LABEL: udiv64_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  divu a0, a1, a0
; RV64IM-NEXT:  ret
%1 = udiv i64 10, %a
ret i64 %1
}

```

```

define i8 @udiv8(i8 %a, i8 %b) nounwind {
; RV64I-LABEL: udiv8:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  andi a0, a0, 255
; RV64I-NEXT:  andi a1, a1, 255
; RV64I-NEXT:  call
__udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv8:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  andi a1, a1, 255
; RV64IM-NEXT:  andi a0, a0, 255
; RV64IM-NEXT:  divuw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = udiv i8 %a, %b
ret i8 %1
}

```

```

define i8 @udiv8_constant(i8 %a) nounwind {
; RV64I-LABEL: udiv8_constant:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  andi a0, a0, 255
; RV64I-NEXT:  li a1, 5

```

```

; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv8_constant:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  andi a0, a0, 255
; RV64IM-NEXT:  li a1, 205
; RV64IM-NEXT:  mul a0, a0, a1
; RV64IM-NEXT:  srliw a0, a0, 10
; RV64IM-NEXT:  ret
%1 = udiv i8 %a, 5
ret i8 %1
}

```

```

define i8 @udiv8_pow2(i8 %a) nounwind
{
; RV64I-LABEL: udiv8_pow2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 56
; RV64I-NEXT:  srli a0, a0, 59
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv8_pow2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 56
; RV64IM-NEXT:  srli a0, a0, 59
; RV64IM-NEXT:  ret
%1 = udiv i8 %a, 8
ret i8 %1
}

```

```

define i8 @udiv8_constant_lhs(i8 %a) nounwind {
; RV64I-LABEL: udiv8_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  andi a1, a0, 255
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv8_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  andi a0, a0, 255

```

```

; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  divuw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = udiv i8 10, %a
ret i8 %1
}

define i16 @udiv16(i16 %a, i16 %b) nounwind {
; RV64I-LABEL: udiv16:
;
RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  lui a2, 16
; RV64I-NEXT:  addiw a2, a2, -1
; RV64I-NEXT:  and a0, a0, a2
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv16:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  lui a2, 16
; RV64IM-NEXT:  addi a2, a2, -1
; RV64IM-NEXT:  and a1, a1, a2
; RV64IM-NEXT:  and a0, a0, a2
; RV64IM-NEXT:  divuw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = udiv i16 %a, %b
ret i16 %1
}

```

```

define i16 @udiv16_constant(i16 %a) nounwind {
; RV64I-LABEL: udiv16_constant:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp)
# 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;

```

```

; RV64IM-LABEL: udiv16_constant:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  lui a1, 52429
; RV64IM-NEXT:  slli a1, a1, 4
; RV64IM-NEXT:  slli a0, a0, 48
; RV64IM-NEXT:  mulhu a0, a0, a1
; RV64IM-NEXT:  srliw a0, a0, 18
; RV64IM-NEXT:  ret
%1 = udiv i16 %a, 5
ret i16 %1
}

define i16 @udiv16_pow2(i16 %a) nounwind {
; RV64I-LABEL: udiv16_pow2:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 51
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv16_pow2:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 48
; RV64IM-NEXT:  srli a0, a0, 51
; RV64IM-NEXT:  ret
%1 = udiv i16 %a, 8
ret i16 %1
}

define i16 @udiv16_constant_lhs(i16 %a) nounwind {
; RV64I-LABEL: udiv16_constant_lhs:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a1, a0, 48
; RV64I-NEXT:
    li a0, 10
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv16_constant_lhs:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 48
; RV64IM-NEXT:  srli a0, a0, 48
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  divuw a0, a1, a0

```

```

; RV64IM-NEXT:  ret
%1 = udiv i16 10, %a
ret i16 %1
}

define i32 @sdiv(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: sdiv:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  sext.w a1, a1
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  divw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i32 %a, %b
ret i32 %1
}

define i32 @sdiv_constant(i32 %a) nounwind {
; RV64I-LABEL: sdiv_constant:
;
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv_constant:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  sext.w a0, a0
; RV64IM-NEXT:  lui a1, 419430
; RV64IM-NEXT:  addiw a1, a1, 1639
; RV64IM-NEXT:  mul a0, a0, a1
; RV64IM-NEXT:  srli a1, a0, 63
; RV64IM-NEXT:  srai a0, a0, 33
; RV64IM-NEXT:  addw a0, a0, a1
; RV64IM-NEXT:  ret

```

```

%1 = sdiv i32 %a, 5
ret i32 %1
}

```

```

define i32 @sdiv_pow2(i32 %a) nounwind {
; RV64I-LABEL: sdiv_pow2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  srliw a1, a1, 29
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  sraiw a0, a0, 3
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv_pow2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  sraiw a1, a0,
31
; RV64IM-NEXT:  srliw a1, a1, 29
; RV64IM-NEXT:  add a0, a0, a1
; RV64IM-NEXT:  sraiw a0, a0, 3
; RV64IM-NEXT:  ret
%1 = sdiv i32 %a, 8
ret i32 %1
}

```

```

define i32 @sdiv_pow2_2(i32 %a) nounwind {
; RV64I-LABEL: sdiv_pow2_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  srliw a1, a1, 16
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  sraiw a0, a0, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv_pow2_2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  sraiw a1, a0, 31
; RV64IM-NEXT:  srliw a1, a1, 16
; RV64IM-NEXT:  add a0, a0, a1
; RV64IM-NEXT:  sraiw a0, a0, 16
; RV64IM-NEXT:  ret
%1 = sdiv i32 %a, 65536
ret i32 %1
}

```

```

define i32 @sdiv_constant_lhs(i32 %a) nounwind {
; RV64I-LABEL: sdiv_constant_lhs:
; RV64I:      # %bb.0:

```



```

; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sext.w a1, a0
; RV64I-NEXT:  li a0, -10
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded
Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, -10
; RV64IM-NEXT:  divw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = sdiv i32 -10, %a
ret i32 %1
}

```

```

define i64 @sdiv64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: sdiv64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  tail __divdi3
;
; RV64IM-LABEL: sdiv64:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  div a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i64 %a, %b
ret i64 %1
}

```

```

define i64 @sdiv64_constant(i64 %a) nounwind {
; RV64I-LABEL: sdiv64_constant:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  tail __divdi3
;
; RV64IM-LABEL: sdiv64_constant:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  lui a1, %hi(.LCPI21_0)
; RV64IM-NEXT:  ld a1, %lo(.LCPI21_0)(a1)
; RV64IM-NEXT:  mulh a0, a0, a1
; RV64IM-NEXT:  srli a1, a0, 63
; RV64IM-NEXT:  srai a0, a0, 1
; RV64IM-NEXT:  add a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i64 %a,

```

5

```
ret i64 %1
}
```

```
define i64 @sdiv64_constant_lhs(i64 %a) nounwind {
; RV64I-LABEL: sdiv64_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  mv a1, a0
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  tail __divdi3
;
; RV64IM-LABEL: sdiv64_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  div a0, a1, a0
; RV64IM-NEXT:  ret
%1 = sdiv i64 10, %a
ret i64 %1
}
```

; Although this sdiv has two sexti32 operands, it shouldn't compile to divw on  
; RV64M as that wouldn't produce the correct result for e.g. INT\_MIN/-1.

```
define i64 @sdiv64_sext_operands(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: sdiv64_sext_operands:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  sext.w a1, a1
; RV64I-NEXT:  tail __divdi3
;
; RV64IM-LABEL: sdiv64_sext_operands:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  sext.w a0, a0
; RV64IM-NEXT:  sext.w a1, a1
; RV64IM-NEXT:  div a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sext i32 %a to i64
%2 = sext i32 %b to
i64
%3 = sdiv i64 %1, %2
ret i64 %3
}
```

```
define i8 @sdiv8(i8 %a, i8 %b) nounwind {
; RV64I-LABEL: sdiv8:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
```

```

; RV64I-NEXT:  slli a1, a1, 24
; RV64I-NEXT:  sraiw a1, a1, 24
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:  sraiw a0, a0, 24
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv8:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a1, a1, 24
; RV64IM-NEXT:  sraiw a1, a1, 24
; RV64IM-NEXT:  slli a0, a0, 24
; RV64IM-NEXT:  sraiw a0, a0, 24
; RV64IM-NEXT:  divw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i8 %a, %b
ret i8 %1
}

```

```

define i8 @sdiv8_constant(i8 %a) nounwind {
; RV64I-LABEL: sdiv8_constant:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:
    sraiw a0, a0, 24
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv8_constant:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 24
; RV64IM-NEXT:  sraiw a0, a0, 24
; RV64IM-NEXT:  li a1, 103
; RV64IM-NEXT:  mul a0, a0, a1
; RV64IM-NEXT:  sraiw a1, a0, 9
; RV64IM-NEXT:  slli a0, a0, 48
; RV64IM-NEXT:  srli a0, a0, 63
; RV64IM-NEXT:  addw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = sdiv i8 %a, 5
ret i8 %1
}

```

```
}
```

```
define i8 @sdiv8_pow2(i8 %a) nounwind {  
; RV64I-LABEL: sdiv8_pow2:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: slli a1, a0, 24  
; RV64I-NEXT: sraiw a1, a1, 24  
; RV64I-NEXT: slli a1, a1, 49  
; RV64I-NEXT: srli a1, a1, 61  
; RV64I-NEXT: add a0, a0, a1  
; RV64I-NEXT: slli a0, a0, 24  
; RV64I-NEXT: sraiw a0, a0, 27  
; RV64I-NEXT: ret  
;  
; RV64IM-LABEL: sdiv8_pow2:  
; RV64IM:      # %bb.0:  
; RV64IM-NEXT: slli a1, a0,  
24  
; RV64IM-NEXT: sraiw a1, a1, 24  
; RV64IM-NEXT: slli a1, a1, 49  
; RV64IM-NEXT: srli a1, a1, 61  
; RV64IM-NEXT: add a0, a0, a1  
; RV64IM-NEXT: slli a0, a0, 24  
; RV64IM-NEXT: sraiw a0, a0, 27  
; RV64IM-NEXT: ret  
%1 = sdiv i8 %a, 8  
ret i8 %1  
}
```

```
define i8 @sdiv8_constant_lhs(i8 %a) nounwind {  
; RV64I-LABEL: sdiv8_constant_lhs:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: addi sp, sp, -16  
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill  
; RV64I-NEXT: slli a0, a0, 24  
; RV64I-NEXT: sraiw a1, a0, 24  
; RV64I-NEXT: li a0, -10  
; RV64I-NEXT: call __divdi3  
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload  
; RV64I-NEXT: addi sp, sp, 16  
; RV64I-NEXT: ret  
;  
; RV64IM-LABEL: sdiv8_constant_lhs:  
; RV64IM:      # %bb.0:  
; RV64IM-NEXT: slli a0, a0, 24  
; RV64IM-NEXT: sraiw a0, a0, 24  
; RV64IM-NEXT: li a1, -10  
; RV64IM-NEXT: divw a0, a1, a0
```

```

; RV64IM-NEXT:  ret
%1 = sdiv i8 -10, %a
ret i8 %1
}

define i16 @sdiv16(i16 %a, i16 %b) nounwind {
; RV64I-LABEL:
sdiv16:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a1, a1, 16
; RV64I-NEXT:  sraiw a1, a1, 16
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a0, a0, 16
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv16:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a1, a1, 16
; RV64IM-NEXT:  sraiw a1, a1, 16
; RV64IM-NEXT:  slli a0, a0, 16
; RV64IM-NEXT:  sraiw a0, a0, 16
; RV64IM-NEXT:  divw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i16 %a, %b
ret i16 %1
}

define i16 @sdiv16_constant(i16 %a) nounwind {
; RV64I-LABEL: sdiv16_constant:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a0, a0, 16
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:
    ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv16_constant:
; RV64IM:      # %bb.0:

```

```

; RV64IM-NEXT:  slli a0, a0, 16
; RV64IM-NEXT:  sraiw a0, a0, 16
; RV64IM-NEXT:  lui a1, 6
; RV64IM-NEXT:  addi a1, a1, 1639
; RV64IM-NEXT:  mul a0, a0, a1
; RV64IM-NEXT:  srliw a1, a0, 31
; RV64IM-NEXT:  sraiw a0, a0, 17
; RV64IM-NEXT:  addw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i16 %a, 5
ret i16 %1
}

```

```

define i16 @sdiv16_pow2(i16 %a) nounwind {
; RV64I-LABEL: sdiv16_pow2:
; RV64I:      # %bb.0:
; RV64I-NEXT: slli a1, a0, 16
; RV64I-NEXT: sraiw a1, a1, 16
; RV64I-NEXT: slli a1, a1, 33
; RV64I-NEXT: srli a1, a1, 61
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: slli a0, a0, 16
; RV64I-NEXT: sraiw a0, a0, 19
; RV64I-NEXT: ret
;
; RV64IM-LABEL: sdiv16_pow2:
; RV64IM:     # %bb.0:
; RV64IM-NEXT: slli a1, a0, 16
; RV64IM-NEXT: sraiw a1, a1, 16
; RV64IM-NEXT: slli a1, a1, 33
;
; RV64IM-NEXT: srli a1, a1, 61
; RV64IM-NEXT: add a0, a0, a1
; RV64IM-NEXT: slli a0, a0, 16
; RV64IM-NEXT: sraiw a0, a0, 19
; RV64IM-NEXT: ret
%1 = sdiv i16 %a, 8
ret i16 %1
}

```

```

define i16 @sdiv16_constant_lhs(i16 %a) nounwind {
; RV64I-LABEL: sdiv16_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: slli a0, a0, 16
; RV64I-NEXT: sraiw a1, a0, 16
; RV64I-NEXT: li a0, -10

```

```

; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv16_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 16
; RV64IM-NEXT:  sraiw a0, a0, 16
; RV64IM-NEXT:  li a1, -10
; RV64IM-NEXT:  divw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = sdiv i16 -10, %a
ret i16 %1
}

```

LLVM System Interface Library

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; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \

; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64I %s

; Check indexed and unindexed, sext, zext and anyext loads

```
define dso_local i64 @lb(ptr %a) nounwind {  
; RV64I-LABEL: lb:  
; RV64I:    # %bb.0:  
; RV64I-NEXT:  lb a1, 1(a0)  
; RV64I-NEXT:  lbu zero, 0(a0)  
; RV64I-NEXT:  mv a0, a1  
; RV64I-NEXT:  ret  
%1 = getelementptr i8, ptr %a, i32 1  
%2 = load i8, ptr %1  
%3 = sext i8 %2 to i64  
; the unused load will produce an anyext for selection  
%4 = load volatile i8, ptr %a  
ret i64 %3  
}
```

```
define dso_local i64 @lh(ptr %a) nounwind {  
; RV64I-LABEL: lh:  
; RV64I:    # %bb.0:  
; RV64I-NEXT:  lh a1, 4(a0)
```

```

; RV64I-NEXT:  lh zero, 0(a0)
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  ret
%1 = getelementptr i16, ptr %a, i32 2
%2 = load i16, ptr %1
%3 = sext i16 %2 to i64
; the unused load will produce an anyext for selection
%4 = load volatile i16, ptr %a
ret i64 %3
}

```

```

define dso_local i64 @lw(ptr %a) nounwind {
; RV64I-LABEL: lw:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lw a1, 12(a0)
; RV64I-NEXT:  lw zero, 0(a0)
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  ret
%1 = getelementptr i32, ptr %a, i32 3
%2 = load i32, ptr %1
%3 = sext i32 %2 to i64
; the unused load will produce an anyext for selection
%4 = load volatile i32, ptr %a
ret i64 %3
}

```

```

define dso_local i64 @lbu(ptr %a) nounwind {
; RV64I-LABEL: lbu:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lbu a1, 4(a0)
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  ret
%1 = getelementptr i8, ptr %a, i32 4
%2 = load i8, ptr %1
%3 = zext i8 %2 to i64
%4 = load volatile i8, ptr %a
%5 = zext i8 %4 to i64
%6 = add i64 %3, %5
ret i64 %6
}

```

```

define dso_local i64 @lhu(ptr %a) nounwind {
; RV64I-LABEL: lhu:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lhu a1, 10(a0)
; RV64I-NEXT:  lhu a0, 0(a0)
; RV64I-NEXT:

```

```

    add a0, a1, a0
; RV64I-NEXT:  ret
%1 = getelementptr i16, ptr %a, i32 5
%2 = load i16, ptr %1
%3 = zext i16 %2 to i64
%4 = load volatile i16, ptr %a
%5 = zext i16 %4 to i64
%6 = add i64 %3, %5
ret i64 %6
}

```

```

define dso_local i64 @lwu(ptr %a) nounwind {
; RV64I-LABEL: lwu:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lwu a1, 24(a0)
; RV64I-NEXT:  lwu a0, 0(a0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  ret
%1 = getelementptr i32, ptr %a, i32 6
%2 = load i32, ptr %1
%3 = zext i32 %2 to i64
%4 = load volatile i32, ptr %a
%5 = zext i32 %4 to i64
%6 = add i64 %3, %5
ret i64 %6
}

```

; 64-bit loads and stores

```

define dso_local i64 @ld(ptr %a) nounwind {
; RV64I-LABEL: ld:
; RV64I:      # %bb.0:
; RV64I-NEXT:  ld a1, 80(a0)
; RV64I-NEXT:  ld zero, 0(a0)
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  ret
%1 = getelementptr i64, ptr %a, i32 10
%2 = load i64, ptr %1
%3 = load volatile i64, ptr %a
ret i64 %2
}

```

```

define dso_local void @sd(ptr %a, i64 %b)
nounwind {
; RV64I-LABEL: sd:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sd a1, 0(a0)
; RV64I-NEXT:  sd a1, 88(a0)

```



```

; RV64I-NEXT:  ret
store i64 %b, ptr %a
%1 = getelementptr i64, ptr %a, i32 11
store i64 %b, ptr %1
ret void
}

; Check load and store to an i1 location
define dso_local i64 @load_sext_zext_anyext_i1(ptr %a) nounwind {
; RV64I-LABEL: load_sext_zext_anyext_i1:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lbu a1, 1(a0)
; RV64I-NEXT:  lbu a2, 2(a0)
; RV64I-NEXT:  lbu zero, 0(a0)
; RV64I-NEXT:  sub a0, a2, a1
; RV64I-NEXT:  ret
; sextload i1
%1 = getelementptr i1, ptr %a, i32 1
%2 = load i1, ptr %1
%3 = sext i1 %2 to i64
; zextload i1
%4 = getelementptr i1, ptr %a, i32 2
%5 = load i1, ptr %4
%6 = zext i1 %5 to i64
%7 = add i64 %3, %6
; extload i1 (anyext). Produced as the load is unused.
%8 = load volatile i1, ptr %a
ret i64 %7
}

define dso_local i16 @load_sext_zext_anyext_i1_i16(ptr %a) nounwind {
; RV64I-LABEL: load_sext_zext_anyext_i1_i16:
;
; RV64I:      # %bb.0:
; RV64I-NEXT:  lbu a1, 1(a0)
; RV64I-NEXT:  lbu a2, 2(a0)
; RV64I-NEXT:  lbu zero, 0(a0)
; RV64I-NEXT:  subw a0, a2, a1
; RV64I-NEXT:  ret
; sextload i1
%1 = getelementptr i1, ptr %a, i32 1
%2 = load i1, ptr %1
%3 = sext i1 %2 to i16
; zextload i1
%4 = getelementptr i1, ptr %a, i32 2
%5 = load i1, ptr %4
%6 = zext i1 %5 to i16
%7 = add i16 %3, %6

```

```

; extload i1 (anyext). Produced as the load is unused.
%8 = load volatile i1, ptr %a
ret i16 %7
}

; Check load and store to a global
@G = dso_local global i64 0

define dso_local i64 @ld_sd_global(i64 %a) nounwind {
; RV64I-LABEL: ld_sd_global:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a2, %hi(G)
; RV64I-NEXT:  ld a1, %lo(G)(a2)
; RV64I-NEXT:  addi a3, a2, %lo(G)
; RV64I-NEXT:  sd a0, %lo(G)(a2)
; RV64I-NEXT:  ld zero, 72(a3)
; RV64I-NEXT:  sd a0, 72(a3)
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  ret
%1 = load volatile i64, ptr @G
store i64 %a, ptr @G
%2 = getelementptr
i64, ptr @G, i64 9
%3 = load volatile i64, ptr %2
store i64 %a, ptr %2
ret i64 %1
}

define i64 @lw_near_local(ptr %a) {
; RV64I-LABEL: lw_near_local:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a0, a0, 2047
; RV64I-NEXT:  ld a0, 9(a0)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 257
%2 = load volatile i64, ptr %1
ret i64 %2
}

define void @st_near_local(ptr %a, i64 %b) {
; RV64I-LABEL: st_near_local:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a0, a0, 2047
; RV64I-NEXT:  sd a1, 9(a0)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 257
store i64 %b, ptr %1
ret void

```

```

}

define i64 @lw_sw_near_local(ptr %a, i64 %b) {
; RV64I-LABEL: lw_sw_near_local:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a2, a0, 2047
; RV64I-NEXT:  ld a0, 9(a2)
; RV64I-NEXT:  sd a1, 9(a2)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 257
%2 = load volatile i64, ptr %1
store i64 %b, ptr %1
ret i64 %2
}

define
i64 @lw_far_local(ptr %a) {
; RV64I-LABEL: lw_far_local:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 8
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, -8(a0)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 4095
%2 = load volatile i64, ptr %1
ret i64 %2
}

define void @st_far_local(ptr %a, i64 %b) {
; RV64I-LABEL: st_far_local:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a2, 8
; RV64I-NEXT:  add a0, a0, a2
; RV64I-NEXT:  sd a1, -8(a0)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 4095
store i64 %b, ptr %1
ret void
}

define i64 @lw_sw_far_local(ptr %a, i64 %b) {
; RV64I-LABEL: lw_sw_far_local:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a2, 8
; RV64I-NEXT:  add a2, a0, a2
; RV64I-NEXT:  ld a0, -8(a2)
; RV64I-NEXT:  sd a1, -8(a2)
; RV64I-NEXT:  ret

```

```

%1 = getelementptr inbounds i64, ptr %a, i64 4095
%2 = load volatile i64, ptr %1
store i64 %b, ptr %1
ret i64 %2
}

```

```

; Make sure we don't fold the addiw
; into the load offset. The sign extend of the
; addiw is required.
define i64 @lw_really_far_local(ptr %a) {
; RV64I-LABEL: lw_really_far_local:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 524288
; RV64I-NEXT:  addiw a1, a1, -2048
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 268435200
%2 = load volatile i64, ptr %1
ret i64 %2
}

```

```

; Make sure we don't fold the addiw into the store offset. The sign extend of
; the addiw is required.
define void @st_really_far_local(ptr %a, i64 %b) {
; RV64I-LABEL: st_really_far_local:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a2, 524288
; RV64I-NEXT:  addiw a2, a2, -2048
; RV64I-NEXT:  add a0, a0, a2
; RV64I-NEXT:  sd a1, 0(a0)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 268435200
store i64 %b, ptr %1
ret void
}

```

```

; Make sure we don't fold the addiw into the load/store offset. The sign extend
; of the addiw is required.
define
i64 @lw_sw_really_far_local(ptr %a, i64 %b) {
; RV64I-LABEL: lw_sw_really_far_local:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a2, 524288
; RV64I-NEXT:  addiw a2, a2, -2048
; RV64I-NEXT:  add a2, a0, a2
; RV64I-NEXT:  ld a0, 0(a2)
; RV64I-NEXT:  sd a1, 0(a2)

```

```

; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 268435200
%2 = load volatile i64, ptr %1
store i64 %b, ptr %1
ret i64 %2
}

%struct.quux = type { i32, [0 x i8] }

; Make sure we don't remove the addi and fold the C from
; (add (addi FrameIndex, C), X) into the store address.
; FrameIndex cannot be the operand of an ADD. We must keep the ADDI.
define void @addi_fold_crash(i64 %arg) nounwind {
; RV64I-LABEL: addi_fold_crash:
; RV64I:      # %bb.0: # %bb
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  addi a1, sp, 4
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  sb zero, 0(a0)
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  call snork
; RV64I-NEXT:
    ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
bb:
%tmp = alloca %struct.quux, align 8
%tmp1 = getelementptr inbounds %struct.quux, ptr %tmp, i64 0, i32 1
%tmp2 = getelementptr inbounds %struct.quux, ptr %tmp, i64 0, i32 1, i64 %arg
store i8 0, ptr %tmp2, align 1
call void @snork(ptr %tmp1)
ret void
}

declare void @snork(ptr)
; NOTE: Assertions have been autogenerated by utils/update_test_checks.py UTC_ARGS: --function-signature --
scrub-attributes
; RUN: opt -S -passes=argpromotion < %s | FileCheck %s
; Test that we only promote arguments when the caller/callee have compatible
; function attributes.

target triple = "x86_64-unknown-linux-gnu"

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %arg, ptr
readonly %arg1) #0 {
; CHECK-LABEL: define {{{^@}}} @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512

```

```

; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: store <8 x i64> [[ARG1_VAL]], ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %arg) #0 {
; CHECK-LABEL: define {{{^@}+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer512
; CHECK-SAME:
(ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT: call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr
[[TMP2]], <8 x i64> [[TMP_VAL]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define
internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %arg, ptr readonly
%arg1) #1 {
; CHECK-LABEL: define {{{^@}+}}@callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: store <8 x i64> [[ARG1_VAL]], ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1

```

```

store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %arg) #1 {
; CHECK-LABEL: define {{{^@}+}}@avx512_legal512_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT: call fastcc
void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr [[TMP2]], <8 x i64>
[[TMP_VAL]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr %arg, ptr
readonly %arg1) #1 {
; CHECK-LABEL: define {{{^@}+}}@callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: store <8 x i64> [[ARG1_VAL]],
ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr %arg) #0 {
; CHECK-LABEL: define {{{^@}+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])

```

```

; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT: call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr
[[TMP2]], <8 x i64> [[TMP_VAL]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align
32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr %arg, ptr
readonly %arg1) #0 {
; CHECK-LABEL: define {{^[^@]+}}@callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512
; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: store <8 x i64> [[ARG1_VAL]], ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr %arg) #1 {
; CHECK-LABEL: define {{^[^@]+}}@avx512_legal512_prefer256_call_avx512_legal512_prefer512
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT:
bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT: call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr
[[TMP2]], <8 x i64> [[TMP_VAL]])

```



```

; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should not promote
define internal fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr
%arg, ptr readonly %arg1) #1 {
; CHECK-LABEL: define {{{^@}+}}@callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], ptr readonly [[ARG1:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1]]
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %arg) #2 {
; CHECK-LABEL: define {{{^@}+}}@avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: call fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr
[[TMP2]], ptr [[TMP]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)

```

```

%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should not promote
define internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %arg, ptr
readonly %arg1) #2 {
; CHECK-LABEL: define {{{^@+}}}@callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], ptr readonly [[ARG1:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1]]
; CHECK-NEXT: store <8 x i64>
[[TMP]], ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %arg) #1 {
; CHECK-LABEL: define {{{^@+}}}@avx512_legal512_prefer256_call_avx512_legal256_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr
[[TMP2]], ptr [[TMP]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64
32, i1 false)
call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %arg, ptr readonly

```

```

%arg1) #3 {
; CHECK-LABEL: define {{^[^@]+}}@callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT:   store <8 x i64> [[ARG1_VAL]], ptr [[ARG]]
; CHECK-NEXT:   ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %arg) #4 {
; CHECK-LABEL: define {{^[^@]+}}@avx2_legal256_prefer256_call_avx2_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT:   [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT:
; CHECK-NEXT:   [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT:   call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT:   [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT:   call fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr
[[TMP2]], <8 x i64> [[TMP_VAL]])
; CHECK-NEXT:   [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT:   store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT:   ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr %arg, ptr readonly
%arg1) #4 {
;
; CHECK-LABEL: define {{^[^@]+}}@callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT:   store <8 x i64> [[ARG1_VAL]], ptr [[ARG]]
; CHECK-NEXT:   ret void
;

```

```

bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr %arg) #3 {
; CHECK-LABEL: define {[^@]+}@avx2_legal512_prefer256_call_avx2_legal256_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT: call fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr
[[TMP2]], <8 x i64> [[TMP_VAL]])
; CHECK-NEXT: [[TMP4:%.*]] = load
<8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; If the arguments are scalar, its ok to promote.
define internal i32 @scalar_callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %X, ptr %Y)
#2 {
; CHECK-LABEL: define
{[^\@]+}@scalar_callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (i32 [[X_VAL:%.*]], i32 [[Y_VAL:%.*]])
; CHECK-NEXT: [[C:%.*]] = add i32 [[X_VAL]], [[Y_VAL]]
; CHECK-NEXT: ret i32 [[C]]
;
%A = load i32, ptr %X
%B = load i32, ptr %Y
%C = add i32 %A, %B
ret i32 %C
}

define i32 @scalar_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr

```

```

%B) #2 {
; CHECK-LABEL: define {{{^@}+}}@scalar_avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[B:%.*]])
; CHECK-NEXT:  [[A:%.*]] = alloca i32
; CHECK-NEXT:  store i32 1, ptr [[A]]
; CHECK-NEXT:  [[A_VAL:%.*]] = load i32, ptr [[A]]
; CHECK-NEXT:  [[B_VAL:%.*]] = load i32, ptr [[B]]
; CHECK-NEXT:  [[C:%.*]] = call i32
@scalar_callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(i32 [[A_VAL]], i32 [[B_VAL]])
; CHECK-NEXT:  ret i32 [[C]]
;
%A = alloca i32
store i32 1, ptr %A
%C = call i32 @scalar_callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %A, ptr %B)
ret i32 %C
}

```

; If the arguments are scalar, its ok to promote.

```

define internal i32 @scalar_callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %X, ptr %Y)
#2 {
; CHECK-LABEL: define
{{{^@}+}}@scalar_callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256
; CHECK-SAME: (i32 [[X_VAL:%.*]],
i32 [[Y_VAL:%.*]])
; CHECK-NEXT:  [[C:%.*]] = add i32 [[X_VAL]], [[Y_VAL]]
; CHECK-NEXT:  ret i32 [[C]]
;
%A = load i32, ptr %X
%B = load i32, ptr %Y
%C = add i32 %A, %B
ret i32 %C
}

```

```

define i32 @scalar_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %B) #2 {
; CHECK-LABEL: define {{{^@}+}}@scalar_avx512_legal512_prefer256_call_avx512_legal256_prefer256
; CHECK-SAME: (ptr [[B:%.*]])
; CHECK-NEXT:  [[A:%.*]] = alloca i32
; CHECK-NEXT:  store i32 1, ptr [[A]]
; CHECK-NEXT:  [[A_VAL:%.*]] = load i32, ptr [[A]]
; CHECK-NEXT:  [[B_VAL:%.*]] = load i32, ptr [[B]]
; CHECK-NEXT:  [[C:%.*]] = call i32
@scalar_callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(i32 [[A_VAL]], i32 [[B_VAL]])
; CHECK-NEXT:  ret i32 [[C]]
;
%A = alloca i32
store i32 1, ptr %A
%C = call i32 @scalar_callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %A, ptr %B)
ret i32 %C

```

```

}

; Function Attrs: argmemonly nounwind
declare void @llvm.memset.p0.i64(ptr
    nocapture writeonly, i8, i64, i1) #5

attributes #0 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-
width"="512" "prefer-vector-width"="512" }
attributes #1 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-
width"="512" "prefer-vector-width"="256" }
attributes #2 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-
width"="256" "prefer-vector-width"="256" }
attributes #3 = { inlinehint norecurse nounwind uwtable "target-features"="+avx2" "min-legal-vector-width"="512"
"prefer-vector-width"="256" }
attributes #4 = { inlinehint norecurse nounwind uwtable "target-features"="+avx2" "min-legal-vector-width"="256"
"prefer-vector-width"="256" }
attributes #5 = { argmemonly nounwind }
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -mattr=+zbc -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBC-ZBKC
; RUN: llc -mtriple=riscv64 -mattr=+zbbc -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBC-ZBKC

declare i64 @llvm.riscv.clmul.i64(i64 %a, i64 %b)

define i64 @clmul64(i64 %a, i64 %b) nounwind {
; RV64ZBC-ZBKC-LABEL: clmul64:
; RV64ZBC-ZBKC:      # %bb.0:
; RV64ZBC-ZBKC-NEXT:  clmul a0, a0, a1
; RV64ZBC-ZBKC-NEXT:  ret
    %tmp = call i64 @llvm.riscv.clmul.i64(i64 %a, i64 %b)
    ret i64 %tmp
}

declare i64 @llvm.riscv.clmulh.i64(i64 %a, i64 %b)

define i64 @clmul64h(i64 %a, i64 %b) nounwind {
; RV64ZBC-ZBKC-LABEL: clmul64h:
; RV64ZBC-ZBKC:      # %bb.0:
; RV64ZBC-ZBKC-NEXT:  clmulh a0, a0, a1
; RV64ZBC-ZBKC-NEXT:  ret
    %tmp = call i64 @llvm.riscv.clmulh.i64(i64 %a, i64 %b)
    ret i64 %tmp
}

declare
i32 @llvm.riscv.clmul.i32(i32 %a, i32 %b)

```

```

define signext i32 @clmul32(i32 signext %a, i32 signext %b) nounwind {
; RV64ZBC-ZBKC-LABEL: clmul32:
; RV64ZBC-ZBKC:      # %bb.0:
; RV64ZBC-ZBKC-NEXT:  clmul a0, a0, a1
; RV64ZBC-ZBKC-NEXT:  sext.w a0, a0
; RV64ZBC-ZBKC-NEXT:  ret
%tmp = call i32 @llvm.riscv.clmul.i32(i32 %a, i32 %b)
ret i32 %tmp
}

declare i32 @llvm.riscv.clmulh.i32(i32 %a, i32 %b)

define signext i32 @clmul32h(i32 signext %a, i32 signext %b) nounwind {
; RV64ZBC-ZBKC-LABEL: clmul32h:
; RV64ZBC-ZBKC:      # %bb.0:
; RV64ZBC-ZBKC-NEXT:  slli a1, a1, 32
; RV64ZBC-ZBKC-NEXT:  slli a0, a0, 32
; RV64ZBC-ZBKC-NEXT:  clmulh a0, a0, a1
; RV64ZBC-ZBKC-NEXT:  srai a0, a0, 32
; RV64ZBC-ZBKC-NEXT:  ret
%tmp = call i32 @llvm.riscv.clmulh.i32(i32 %a, i32 %b)
ret i32 %tmp
}

; FIXME: We could avoid the slli instructions by using clmul+srai since the
; inputs are zero extended.
define signext i32 @clmul32h_zext(i32 zeroext %a, i32 zeroext %b) nounwind {
;
; RV64ZBC-ZBKC-LABEL: clmul32h_zext:
; RV64ZBC-ZBKC:      # %bb.0:
; RV64ZBC-ZBKC-NEXT:  slli a1, a1, 32
; RV64ZBC-ZBKC-NEXT:  slli a0, a0, 32
; RV64ZBC-ZBKC-NEXT:  clmulh a0, a0, a1
; RV64ZBC-ZBKC-NEXT:  srai a0, a0, 32
; RV64ZBC-ZBKC-NEXT:  ret
%tmp = call i32 @llvm.riscv.clmulh.i32(i32 %a, i32 %b)
ret i32 %tmp
}

```

# 1.161 libssh 0.11.2-r0

## 1.161.1 Available under license :

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## 1.162 tcpdump 4.99.5-r1

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```
# -*- perl -*-
```

```
$testlist = [  
  # This specific test fails on OpenBSD because the .pcap file uses DLT_RAW,  
  # which OpenBSD treats as DLT_LOOP.  
  {  
    config_unset => 'IS_OPENBSD',  
    name => 'heap-overflow-1',  
    input => 'heap-overflow-1.pcap',  
    output => 'heap-overflow-1.out',  
    args => '-v'  
  },  
];  
  
1;
```

## 1.163 python 3.12.12-r0

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <https://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <https://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

All

Python releases are Open Source (see <https://opensource.org> for the Open Source Definition). Historically, most, but not all, Python releases have also been GPL-compatible; the table below summarizes the various releases.

| Release        | Derived from | Year      | Owner      | GPL-compatible? (1) |
|----------------|--------------|-----------|------------|---------------------|
| 0.9.0 thru 1.2 |              | 1991-1995 | CWI        | yes                 |
| 1.3 thru 1.5.2 | 1.2          | 1995-1999 | CNRI       | yes                 |
| 1.6            | 1.5.2        | 2000      | CNRI       | no                  |
| 2.0            | 1.6          | 2000      | BeOpen.com | no                  |
| 1.6.1          | 1.6          | 2001      | CNRI       | yes (2)             |
| 2.1            | 2.0+1.6.1    | 2001      | PSF        | no                  |
| 2.0.1          | 2.0+1.6.1    | 2001      | PSF        | yes                 |
| 2.1.1          | 2.1+2.0.1    | 2001      | PSF        | yes                 |
| 2.1.2          | 2.1.1        | 2002      | PSF        | yes                 |
| 2.1.3          | 2.1.2        | 2002      | PSF        | yes                 |
| 2.2 and above  | 2.1.1        | 2001-now  |            |                     |
| PSF            | yes          |           |            |                     |

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## 1.165 libsmi 0.5.0-r4

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-----

tools/shhopt.c, tools/shhopt.h:

Title: shhopt - library for parsing command line options.

Version: 1.1.2

Entered-date: 23MAR97

Description: C-functions for parsing command line options, both  
traditional one-character options, and GNU'ish  
--long-options.

Keywords: programming, library, lib, commandline, options

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Primary-site: <http://www.ifi.uio.no/~sverrehu/pub-unix/>

Alternate-site: [sunsite.unc.edu /pub/Linux/libs  
shhopt-1.1.2.tar.gz](http://sunsite.unc.edu/pub/Linux/libs/shhopt-1.1.2.tar.gz)

Platforms: Requires ANSI C-compiler.

Copying-policy: BeerWare: If you have the time and  
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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <http://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <http://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations (now Zope Corporation, see <http://www.zope.com>). In 2001, the Python Software Foundation (PSF, see <http://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation is a sponsoring member of the PSF.

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| Release        | Derived from | Year      | Owner      | GPL-compatible? (1) |
|----------------|--------------|-----------|------------|---------------------|
| 0.9.0 thru 1.2 |              | 1991-1995 | CWI        | yes                 |
| 1.3 thru 1.5.2 | 1.2          | 1995-1999 | CNRI       | yes                 |
| 1.6            | 1.5.2        | 2000      | CNRI       | no                  |
| 2.0            | 1.6          | 2000      | BeOpen.com | no                  |
| 1.6.1          | 1.6          | 2001      | CNRI       | yes (2)             |
| 2.1            | 2.0+1.6.1    | 2001      | PSF        | no                  |
| 2.0.1          | 2.0+1.6.1    | 2001      | PSF        | yes                 |
| 2.1.1          | 2.1+2.0.1    | 2001      | PSF        | yes                 |
| 2.2            | 2.1.1        | 2001      | PSF        | yes                 |
| 2.1.2          | 2.1.1        | 2002      | PSF        | yes                 |
| 2.1.3          |              |           |            |                     |
| 2.1.2          | 2002         | PSF       | yes        |                     |
| 2.2.1          | 2.2          | 2002      | PSF        | yes                 |
| 2.2.2          | 2.2.1        | 2002      | PSF        | yes                 |
| 2.2.3          | 2.2.2        | 2003      | PSF        | yes                 |
| 2.3            | 2.2.2        | 2002-2003 | PSF        | yes                 |
| 2.3.1          | 2.3          | 2002-2003 | PSF        | yes                 |
| 2.3.2          | 2.3.1        | 2002-2003 | PSF        | yes                 |
| 2.3.3          | 2.3.2        | 2002-2003 | PSF        | yes                 |
| 2.3.4          | 2.3.3        | 2004      | PSF        | yes                 |
| 2.3.5          | 2.3.4        | 2005      | PSF        | yes                 |
| 2.4            | 2.3          | 2004      | PSF        | yes                 |
| 2.4.1          | 2.4          | 2005      | PSF        | yes                 |
| 2.4.2          | 2.4.1        | 2005      | PSF        | yes                 |
| 2.4.3          | 2.4.2        | 2006      | PSF        | yes                 |
| 2.4.4          | 2.4.3        | 2006      | PSF        | yes                 |
| 2.5            | 2.4          | 2006      | PSF        | yes                 |
| 2.5.1          | 2.5          | 2007      | PSF        | yes                 |
| 2.5.2          | 2.5.1        | 2008      | PSF        | yes                 |
| 2.5.3          | 2.5.2        | 2008      | PSF        | yes                 |
| 2.6            | 2.5          | 2008      | PSF        | yes                 |
| 2.6.1          | 2.6          | 2008      | PSF        | yes                 |
| 2.6.2          | 2.6.1        | 2009      | PSF        | yes                 |
| 2.6.3          | 2.6.2        | 2009      | PSF        | yes                 |
| 2.6.4          | 2.6.3        | 2009      | PSF        | yes                 |
| 2.6.5          | 2.6.4        | 2010      | PSF        | yes                 |
| 3.0            | 2.6          | 2008      | PSF        | yes                 |
| 3.0.1          | 3.0          | 2009      | PSF        | yes                 |
| 3.1            | 3.0.1        | 2009      | PSF        | yes                 |

|       |     |      |     |     |
|-------|-----|------|-----|-----|
| 3.1.1 | 3.1 | 2009 | PSF | yes |
| 3.1.2 | 3.1 | 2010 | PSF | yes |
| 3.2   | 3.1 | 2010 | PSF | yes |

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(2) According to Richard Stallman, 1.6.1 is not GPL-compatible, because its license has a choice of law clause. According to CNRI, however, Stallman's lawyer has told CNRI's lawyer that 1.6.1 is "not incompatible" with the GPL.

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If you're making a patch, please add your name below in alphabetical order,  
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# 1.170 inflect 7.3.1

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# 1.175 Idns 1.8.4-r0

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# 1.176 typing-extensions 4.12.2

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <https://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <https://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

All

Python releases are Open Source (see <https://opensource.org> for the Open Source Definition). Historically, most, but not all, Python releases have also been GPL-compatible; the table below summarizes the various releases.

| Release        | Derived<br>from | Year      | Owner      | GPL-<br>compatible? (1) |
|----------------|-----------------|-----------|------------|-------------------------|
| 0.9.0 thru 1.2 |                 | 1991-1995 | CWI        | yes                     |
| 1.3 thru 1.5.2 | 1.2             | 1995-1999 | CNRI       | yes                     |
| 1.6            | 1.5.2           | 2000      | CNRI       | no                      |
| 2.0            | 1.6             | 2000      | BeOpen.com | no                      |
| 1.6.1          | 1.6             | 2001      | CNRI       | yes (2)                 |
| 2.1            | 2.0+1.6.1       | 2001      | PSF        | no                      |
| 2.0.1          | 2.0+1.6.1       | 2001      | PSF        | yes                     |
| 2.1.1          | 2.1+2.0.1       | 2001      | PSF        | yes                     |
| 2.1.2          | 2.1.1           | 2002      | PSF        | yes                     |
| 2.1.3          | 2.1.2           | 2002      | PSF        | yes                     |
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## 1.177 pam 1.7.0-r4

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```
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This is free software, and you are welcome to redistribute it
under certain conditions; type `show c' for details.
```

The hypothetical commands

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

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

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```
# Automatically generated by apkbuidl-cpan, template 4
# Contributor: Valery Kartel <valery.kartel@gmail.com>
# Maintainer: Celeste <cielesti@protonmail.com>
maintainer="Celeste <cielesti@protonmail.com>"
pkgname=perl-bsd-resource
pkgver=1.2911
pkgrel=10
#_pkgreal is used by apkbuidl-cpan to find modules at MetaCpan
_pkgreal=BSD-Resource
pkgdesc="Perl extension implements the BSD process resource limit functions"
url="https://metacpan.org/release/BSD-Resource/"
arch="all"
license="Artistic-2.0 OR LGPL-2.0"
depends="perl"
makedepends="perl-dev"
```

```

subpackages="$pkgname-doc"
source="https://cpan.metacpan.org/authors/id/J/JH/JHI/BSD-Resource-$pkgver.tar.gz"
builddir="$srcdir/$_pkgreal-$pkgver"

build() {
    export CFLAGS=$(perl -MConfig -E 'say $Config{ccflags}')
    PERL_MM_USE_DEFAULT=1 perl -I. Makefile.PL \
        INSTALLDIRS=vendor \
        NO_PACKLIST=1 \
        NO_PERLLOCAL=1
    make
}

check() {
    export CFLAGS=$(perl -MConfig -E 'say $Config{ccflags}')
    make test
}

package() {
    make DESTDIR="$pkgdir" install
}

sha512sums="
d0032d41c7c0468ed1c6d8f57b885f6cb97a5039d754c8cb60b2067daedaf53bd15fb6561a3d0f828df16dfa5417f663b
8065ba65f4fea16dc9262728b3b6b85
    BSD-Resource-1.2911.tar.gz
"

# Contributor: Maxim Karasev <begs@disroot.org>
# Maintainer: mio <miyopan@e.email>
pkgname=bsd-games
pkgver=3.3
pkgrel=2
pkgdesc="traditional text mode games from BSD"
url="https://bsd-games.sourceforge.io/"
arch="all"
license="BSD-3-Clause"
install="$pkgname.post-install"
makedepends="ncurses-dev coreutils" # configure causes busybox expr error
subpackages="$pkgname-doc"
source="https://sourceforge.net/projects/bsd-games/files/bsd-games-$pkgver.tar.gz
0001-bsd-games-scores-dir.patch
"

options="!check" # no tests

build() {
    # some GNU autoconf options are ignored, but it works
    ./configure \
        --build=$CBUILD \

```

```

--host=$CHOST \
--prefix=/usr \
--sysconfdir=/etc \
--mandir=/usr/share/man \
--scoredir=/usr/share/$pkgname
make
}

package() {
make DESTDIR="$pkgdir" install
install -Dm644 LICENSE "$pkgdir"/usr/share/licenses/bsd-games/LICENSE
}

sha512sums="
aaf36d09d4fe68514a5c279063d7e77a9a9a84c447037cba974b29faa07eb80c2aab2379d0699c196b5c27ffe1b2bb2c6
8d3390143e0e62d5e3d210ccfb61294
    bsd-games-3.3.tar.gz
e1def0d4835a877242c4173fae862e278a7858738e0bacacbb045a42bcabec2aa7c72d000bbd2421ce35fe66cdc1f52c0
577b7e278029ca5ed50f7aab22319f6 0001-bsd-games-scores-dir.patch
"

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```

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# Maintainer: Natanael Copa <ncopa@alpinelinux.org>

pkgname=libart-lgpl

pkgver=2.3.21

pkgrel=8

pkgdesc="A library for high-performance 2D graphics"

url="https://www.levien.com/libart/"

```
arch="all"
options="!check" # No test suite.
license="GPL-2.0-or-later"
subpackages="$pkgname-dev"
source="https://download.gnome.org/sources/libart_lgpl/2.3/libart_lgpl-$pkgver.tar.bz2"
"
```

```
builddir="$srcdir"/libart_lgpl-$pkgver
```

```
prepare() {
    update_config_sub
    default_prepare
}
```

```
build() {
    ./configure \
        --build=$CBUILD \
        --host=$CHOST \
        --prefix=/usr
    make
}
```

```
package() {
    make DESTDIR="$pkgdir" install
}
```

```
sha512sums="8a632a6a4da59e5e8c02ec2f5a57e36d182b325b46513765425e5f171ff9ae326af1b133725beba28f7e7
6654309e001aee9bace727b5b4c8589405256a3c020 libart_lgpl-2.3.21.tar.bz2"
mini_sendmail - accept email on behalf of real sendmail
```

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# Contributor: Patrycja Rosa <alpine@ptrcnull.me>

# Maintainer: Patrycja Rosa <alpine@ptrcnull.me>

pkgname=bsd-compat-headers

pkgver=0.7.2

pkgrel=6

pkgdesc="BSD compatibility headers (cdefs, queue, tree)"

url="https://gitlab.alpinelinux.org/alpine/aports"

arch="noarch"

license="BSD-2-Clause AND BSD-3-Clause"

source="

cdefs.h

queue.h

tree.h

"

builddir="\$srcdir"

options="!check" # just headers

package() {

mkdir -p "\$pkgdir"

install -Dm644 -t "\$pkgdir"/usr/include/sys \

cdefs.h queue.h tree.h

}

sha512sums="

37c8fc73c7aea7b490f7850927e2bb91d12137c9e59e22c084146d515696dbc7973b5de92f4c987ba080dd2502ba8312  
7006442c3f019b6447a620c0cae73178 cdefs.h

2f0d5e6e4dc3350285cf17009265dddcbe12431c111868eea39bc8cb038ab7c1f2acacbb21735c4e9d4a1fd106a8fc0f86  
11ea33987d4faba37dde5ce6da0750 queue.h

d9ac210d81feb8ad2655bc80fb065d3fe20ae4417b32b4a1711e6738a4870140005c13373b5d1846ef3ce5ae6da45f2da  
cef2092881eded0a2e94f6a07752ef3 tree.h

"

# Contributor: Carlo Landmeter <clandmeter@alpinelinux.org>

# Maintainer: Kevin Daudt <kdaudt@alpinelinux.org>

pkgname=spdx-licenses

pkgver=3.26.0

pkgrel=0

pkgdesc="Various data formats for the SPDX License List"

url="https://spdx.org/"

arch="noarch"

options="!check" # no test suite

license="CC-BY-3.0"

source="license-list-data-\$pkgver.tar.gz::https://github.com/spdx/license-list-data/archive/v\$pkgver.tar.gz"

builddir="\$srcdir/license-list-data-\$pkgver"

```
subpackages="$pkgname-list"
```

```
_types="html json rdfa rdft rdfturtle rdfxml template text"
```

```
for type in $_types; do
    subpackages="$subpackages $pkgname-$type:_subpkg"
done
```

```
package() {
    mkdir -p "$pkgdir"
}
```

```
_subpkg() {
    local type=${subpkgname/$pkgname-/}
    pkgdesc="$pkgdesc ($type)"
    install_if="$pkgname=$pkgver-r$pkgrel"
    mkdir -p "$subpkgdir"/usr/share/spdx
    cp -r "$builddir"/$type "$subpkgdir"/usr/share/spdx/
}
```

```
list() {
    pkgdesc="$pkgdesc (licence list)"
    mkdir -p "$subpkgdir"/usr/share/spdx
    local i; for i in "$builddir"/text/*.txt;
    do
        local license=${i##*/}
        echo ${license%.*} >> "$subpkgdir"/usr/share/spdx/license.lst
    done
}
```

```
sha512sums="
67e618d4642dfe4f366935d9514d6f7941d3711e77c49bc1b340ac572d36015981b8f10c72a9f80f1d83e132ae7e5093c
0155e0c0e786e4777ee16d1cb7b885a  license-list-data-3.26.0.tar.gz
"
```

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The Kohonen neural network code for color optimization was written by Anthony Dekker.

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The X-Spline code was written Carole Blanc (blanc@labri.u-bordeaux.fr) and Christophe Schlick (schlick@labri.u-bordeaux.fr) starting from an initial implementation done by C. Feuille, S. Grosbois, L. Maziere and L. Minihot as a student practice (Universite Bordeaux, France). For additional information about X-splines, see:

"X-Splines: A Spline Model Designed for the End User" by C. Blanc and C. Schlick, Proceedings of SIGGRAPH'95

<http://dept-info.labri.u-bordeaux.fr/~schlick/DOC/sig1.html>

# Contributor: Dhruvin Gandhi <contact@dhruvin>

# Maintainer: Patrycja Rosa <alpine@ptrcnull.me>

pkgname=py3-license-expression

\_pkgname=license\_expression

pkgver=30.4.1

pkgrel=0

pkgdesc="Library to parse, compare, simplify and normalize license expressions"

url="https://github.com/nexB/license-expression"

arch="noarch"

license="Apache-2.0"

depends="python3 py3-boolean.py"

makedepends="py3-setuptools py3-setuptools\_scm py3-gpep517 py3-wheel"

checkdepends="py3-pytest py3-pytest-xdist"

subpackages="\$pkgname-pyc"

source="https://files.pythonhosted.org/packages/source/l/\_pkgname/\_pkgname-\$pkgver.tar.gz"

builddir="\$srcdir/\$pkgname-\$pkgver"

```
build() {
    gpep517 build-wheel \
        --wheel-dir .dist \
        --output-fd 3 3>&1 >&2
}
```

```
check() {
    python3 -m venv --clear --without-pip --system-site-packages .testenv
    .testenv/bin/python3 -m installer .dist/*.whl
    .testenv/bin/python3 -m pytest
}
```

```
package() {
    python3 -m installer -d "$pkgdir" \
        .dist/*.whl
}
```

```

sha512sums="
114c630f098939757e49187e35b4e54883266a2ee9ca283724992420ef4c860f9606a8342da0ab74d93627c10805f312
fda3f699cbc7c4fbd47a71e220440fb0
license_expression-30.4.1.tar.gz
"
/* $NetBSD: queue.h,v 1.70 2015/11/02 15:21:23 christos Exp $ */

/*
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 * SUCH DAMAGE.
 *
 * @(#)queue.h 8.5 (Berkeley) 8/20/94
 */

#ifndef _SYS_QUEUE_H_
#define _SYS_QUEUE_H_

/*
 * This file defines five types of data structures: singly-linked lists,
 * lists, simple queues, tail queues, and circular queues.
 *
 * A singly-linked list is headed by a single forward pointer. The

```

- \* elements are singly linked for minimum space and pointer manipulation
- \* overhead at the expense of  $O(n)$  removal for arbitrary elements. New
- \* elements can be added to the list after an existing element or at the
- \* head of the list. Elements being removed from the head of the list
- \* should use the explicit macro for this purpose for optimum
- \* efficiency. A singly-linked list may only be traversed in the forward
- \* direction. Singly-linked lists are ideal for applications with large
- \* datasets and few or no removals or for implementing a LIFO queue.
- \*
- \* A list is headed by a single forward pointer (or an array of forward
- \* pointers for a hash table header). The elements are doubly linked
- \* so that an arbitrary element can be removed without a need to
- \* traverse the list. New elements can be added to the list before
- \* or after an existing element or at the head of the list. A list
- \* may only be traversed in the forward direction.
- \*
- \* A simple queue is headed by a pair of pointers, one the head of the
- \* list and the
- other to the tail of the list. The elements are singly
- \* linked to save space, so elements can only be removed from the
- \* head of the list. New elements can be added to the list after
- \* an existing element, at the head of the list, or at the end of the
- \* list. A simple queue may only be traversed in the forward direction.
- \*
- \* A tail queue is headed by a pair of pointers, one to the head of the
- \* list and the other to the tail of the list. The elements are doubly
- \* linked so that an arbitrary element can be removed without a need to
- \* traverse the list. New elements can be added to the list before or
- \* after an existing element, at the head of the list, or at the end of
- \* the list. A tail queue may be traversed in either direction.
- \*
- \* A circle queue is headed by a pair of pointers, one to the head of the
- \* list and the other to the tail of the list. The elements are doubly
- \* linked so that an arbitrary element can be removed without a need to
- \* traverse the list. New elements
- can be added to the list before or after
- \* an existing element, at the head of the list, or at the end of the list.
- \* A circle queue may be traversed in either direction, but has a more
- \* complex end of list detection.
- \*
- \* For details on the use of these macros, see the queue(3) manual page.
- \*/
- /\*
- \* Include the definition of NULL only on NetBSD because sys/null.h
- \* is not available elsewhere. This conditional makes the header
- \* portable and it can simply be dropped verbatim into any system.

```

* The caveat is that on other systems some other header
* must provide NULL before the macros can be used.
*/
#ifdef __NetBSD__
#include <sys/null.h>
#endif

#ifdef QUEUEDEBUG
# if defined(_KERNEL)
#  define QUEUEDEBUG_ABORT(...) panic(__VA_ARGS__)
# else
#  include <err.h>
#  define QUEUEDEBUG_ABORT(...) err(1, __VA_ARGS__)
# endif
#endif

/*
* Singly-linked List definitions.
*/
#define SLIST_HEAD(name, type) \
struct name { \
    struct type *slh_first; /* first \
    element */ \
}

#define SLIST_HEAD_INITIALIZER(head) \
{ NULL }

#define SLIST_ENTRY(type) \
struct { \
    struct type *sle_next; /* next element */ \
}

/*
* Singly-linked List access methods.
*/
#define SLIST_FIRST(head) ((head)->slh_first)
#define SLIST_END(head) NULL
#define SLIST_EMPTY(head) ((head)->slh_first == NULL)
#define SLIST_NEXT(elm, field) ((elm)->field.sle_next)

#define SLIST_FOREACH(var, head, field) \
for((var) = (head)->slh_first; \
    (var) != SLIST_END(head); \
    (var) = (var)->field.sle_next)

#define SLIST_FOREACH_SAFE(var, head, field, tvar) \
for ((var) = SLIST_FIRST((head)); \

```

```

    (var) != SLIST_END(head) &&  \
    ((tvar) = SLIST_NEXT((var), field), 1);  \
    (var) = (tvar))

/*
 * Singly-linked List functions.
 */
#define SLIST_INIT(head) do {  \
    (head)->slh_first = SLIST_END(head);  \
} while (/*CONSTCOND*/0)

#define SLIST_INSERT_AFTER(slistelm, elm, field) do {  \
    (elm)->field.sle_next = (slistelm)->field.sle_next;  \
    (slistelm)->field.sle_next  \
    = (elm);  \
} while (/*CONSTCOND*/0)

#define SLIST_INSERT_HEAD(head, elm, field) do {  \
    (elm)->field.sle_next = (head)->slh_first;  \
    (head)->slh_first = (elm);  \
} while (/*CONSTCOND*/0)

#define SLIST_REMOVE_AFTER(slistelm, field) do {  \
    (slistelm)->field.sle_next =  \
        SLIST_NEXT(SLIST_NEXT((slistelm), field), field);  \
} while (/*CONSTCOND*/0)

#define SLIST_REMOVE_HEAD(head, field) do {  \
    (head)->slh_first = (head)->slh_first->field.sle_next;  \
} while (/*CONSTCOND*/0)

#define SLIST_REMOVE(head, elm, type, field) do {  \
    if ((head)->slh_first == (elm)) {  \
        SLIST_REMOVE_HEAD((head), field);  \
    }  \
    else {  \
        struct type *curelm = (head)->slh_first;  \
        while(curelm->field.sle_next != (elm))  \
            curelm = curelm->field.sle_next;  \
        curelm->field.sle_next =  \
            curelm->field.sle_next->field.sle_next;  \
    }  \
} while (/*CONSTCOND*/0)

/*
 * List definitions.

```

```

*/
#define LIST_HEAD(name, type) \
struct name { \
    struct type *lh_first; /* first element */ \
}

#define LIST_HEAD_INITIALIZER(head) \
{ NULL }

#define LIST_ENTRY(type) \
struct { \
    struct type *le_next; /* next element */ \
    struct type **le_prev; /* address of previous next element */ \
}

/*
 * List access methods.
 */
#define LIST_FIRST(head) ((head)->lh_first)
#define LIST_END(head) NULL
#define LIST_EMPTY(head) ((head)->lh_first == LIST_END(head))
#define LIST_NEXT(elm, field) ((elm)->field.le_next)

#define LIST_FOREACH(var, head, field) \
for ((var) = ((head)->lh_first); \
     (var) != LIST_END(head); \
     (var) = ((var)->field.le_next))

#define LIST_FOREACH_SAFE(var, head, field, tvar) \
for ((var) = LIST_FIRST((head)); \
     (var) != LIST_END(head) && \
     ((tvar) = LIST_NEXT((var), field), 1); \
     (var) = (tvar))

#define LIST_MOVE(head1, head2) do { \
    LIST_INIT((head2)); \
    if (!LIST_EMPTY((head1))) \
    { \
        (head2)->lh_first = (head1)->lh_first; \
        LIST_INIT((head1)); \
    } \
} while (/*CONSTCOND*/0)

/*
 * List functions.
 */
#ifdef QUEUEDEBUG
#define QUEUEDEBUG_LIST_INSERT_HEAD(head, elm, field) \

```

```

if ((head)->lh_first && \
    (head)->lh_first->field.le_prev != &(head)->lh_first) \
    QUEUEDEBUG_ABORT("LIST_INSERT_HEAD %p %s:%d", (head), \
        __FILE__, __LINE__);
#define QUEUEDEBUG_LIST_OP(elm, field) \
if ((elm)->field.le_next && \
    (elm)->field.le_next->field.le_prev != \
    &(elm)->field.le_next) \
    QUEUEDEBUG_ABORT("LIST_* forw %p %s:%d", (elm), \
        __FILE__, __LINE__); \
if (*(elm)->field.le_prev != (elm)) \
    QUEUEDEBUG_ABORT("LIST_* back %p %s:%d", (elm), \
        __FILE__, __LINE__);
#define QUEUEDEBUG_LIST_POSTREMOVE(elm, field) \
(elm)->field.le_next = (void *)1L; \
(elm)->field.le_prev = (void *)1L;
#else
#define QUEUEDEBUG_LIST_INSERT_HEAD(head, elm, field)
#define QUEUEDEBUG_LIST_OP(elm,
    field)
#define QUEUEDEBUG_LIST_POSTREMOVE(elm, field)
#endif

#define LIST_INIT(head) do { \
    (head)->lh_first = LIST_END(head); \
} while (/*CONSTCOND*/0)

#define LIST_INSERT_AFTER(listelm, elm, field) do { \
    QUEUEDEBUG_LIST_OP((listelm), field) \
    if (((elm)->field.le_next = (listelm)->field.le_next) != \
        LIST_END(head)) \
        (listelm)->field.le_next->field.le_prev = \
            &(elm)->field.le_next; \
    (listelm)->field.le_next = (elm); \
    (elm)->field.le_prev = &(listelm)->field.le_next; \
} while (/*CONSTCOND*/0)

#define LIST_INSERT_BEFORE(listelm, elm, field) do { \
    QUEUEDEBUG_LIST_OP((listelm), field) \
    (elm)->field.le_prev = (listelm)->field.le_prev; \
    (elm)->field.le_next = (listelm); \
    *(listelm)->field.le_prev = (elm); \
    (listelm)->field.le_prev = &(elm)->field.le_next; \
} while (/*CONSTCOND*/0)

#define LIST_INSERT_HEAD(head, elm, field) do { \
    QUEUEDEBUG_LIST_INSERT_HEAD((head), (elm), field) \
    if (((elm)->field.le_next

```

```

= (head)->lh_first) != LIST_END(head))\
(head)->lh_first->field.le_prev = &(elm)->field.le_next;\
(head)->lh_first = (elm); \
(elm)->field.le_prev = &(head)->lh_first; \
} while (/*CONSTCOND*/0)

#define LIST_REMOVE(elm, field) do { \
    QUEUEDEBUG_LIST_OP((elm), field) \
    if ((elm)->field.le_next != NULL) \
        (elm)->field.le_next->field.le_prev = \
            (elm)->field.le_prev; \
    *(elm)->field.le_prev = (elm)->field.le_next; \
    QUEUEDEBUG_LIST_POSTREMOVE((elm), field) \
} while (/*CONSTCOND*/0)

#define LIST_REPLACE(elm, elm2, field) do { \
    if (((elm2)->field.le_next = (elm)->field.le_next) != NULL) \
        (elm2)->field.le_next->field.le_prev = \
            &(elm2)->field.le_next; \
    (elm2)->field.le_prev = (elm)->field.le_prev; \
    *(elm2)->field.le_prev = (elm2); \
    QUEUEDEBUG_LIST_POSTREMOVE((elm), field) \
} while (/*CONSTCOND*/0)

/*
 * Simple queue definitions.
 */
#define SIMPLEQ_HEAD(name, type) \
struct name { \
    struct \
    type *sqh_first; /* first element */ \
    struct type **sqh_last; /* addr of last next element */ \
}

#define SIMPLEQ_HEAD_INITIALIZER(head) \
{ NULL, &(head).sqh_first }

#define SIMPLEQ_ENTRY(type) \
struct { \
    struct type *sqe_next; /* next element */ \
}

/*
 * Simple queue access methods.
 */
#define SIMPLEQ_FIRST(head) ((head)->sqh_first)
#define SIMPLEQ_END(head) NULL
#define SIMPLEQ_EMPTY(head) ((head)->sqh_first == SIMPLEQ_END(head))

```



```

#define SIMPLEQ_NEXT(elm, field) ((elm)->field.sqe_next)

#define SIMPLEQ_FOREACH(var, head, field) \
for ((var) = ((head)->sqh_first); \
     (var) != SIMPLEQ_END(head); \
     (var) = ((var)->field.sqe_next))

#define SIMPLEQ_FOREACH_SAFE(var, head, field, next) \
for ((var) = ((head)->sqh_first); \
     (var) != SIMPLEQ_END(head) && \
     ((next = ((var)->field.sqe_next)), 1); \
     (var) = (next))

/*
 * Simple queue functions.
 */
#define SIMPLEQ_INIT(head) do { \
    (head)->sqh_first = NULL; \
    (head)->sqh_last \
    = &(head)->sqh_first; \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_INSERT_HEAD(head, elm, field) do { \
    if (((elm)->field.sqe_next = (head)->sqh_first) == NULL) \
        (head)->sqh_last = &(elm)->field.sqe_next; \
    (head)->sqh_first = (elm); \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_INSERT_TAIL(head, elm, field) do { \
    (elm)->field.sqe_next = NULL; \
    *(head)->sqh_last = (elm); \
    (head)->sqh_last = &(elm)->field.sqe_next; \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_INSERT_AFTER(head, listelm, elm, field) do { \
    if (((elm)->field.sqe_next = (listelm)->field.sqe_next) == NULL) \
        (head)->sqh_last = &(elm)->field.sqe_next; \
    (listelm)->field.sqe_next = (elm); \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_REMOVE_HEAD(head, field) do { \
    if (((head)->sqh_first = (head)->sqh_first->field.sqe_next) == NULL) \
        (head)->sqh_last = &(head)->sqh_first; \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_REMOVE_AFTER(head, elm, field) do { \
    if

```

```

(((elm)->field.sqe_next = (elm)->field.sqe_next->field.sqe_next) \
 == NULL) \
(head)->sqh_last = &(elm)->field.sqe_next; \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_REMOVE(head, elm, type, field) do { \
if ((head)->sqh_first == (elm)) { \
SIMPLEQ_REMOVE_HEAD((head), field); \
} else { \
struct type *curelm = (head)->sqh_first; \
while (curelm->field.sqe_next != (elm)) \
curelm = curelm->field.sqe_next; \
if ((curelm->field.sqe_next = \
curelm->field.sqe_next->field.sqe_next) == NULL) \
(head)->sqh_last = &(curelm)->field.sqe_next; \
} \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_CONCAT(head1, head2) do { \
if (!SIMPLEQ_EMPTY((head2))) { \
*(head1)->sqh_last = (head2)->sqh_first; \
(head1)->sqh_last = (head2)->sqh_last; \
SIMPLEQ_INIT((head2)); \
} \
} while (/*CONSTCOND*/0)

#define SIMPLEQ_LAST(head, type, field) \
(SIMPLEQ_EMPTY((head)) ? \
NULL : \
((struct type \
*)(void *) \
((char *)((head)->sqh_last) - offsetof(struct type, field))))

/*
 * Tail queue definitions.
 */
#define _TAILQ_HEAD(name, type, qual) \
struct name { \
qual type *tqh_first; /* first element */ \
qual type *qual *tqh_last; /* addr of last next element */ \
}
#define TAILQ_HEAD(name, type) _TAILQ_HEAD(name, struct type,)

#define TAILQ_HEAD_INITIALIZER(head) \
{ TAILQ_END(head), &(head).tqh_first }

#define _TAILQ_ENTRY(type, qual) \
struct { \

```

```

qual type *tqe_next; /* next element */ \
qual type *qual *tqe_prev; /* address of previous next element */\
}
#define TAILQ_ENTRY(type) _TAILQ_ENTRY(struct type,)

/*
 * Tail queue access methods.
 */
#define TAILQ_FIRST(head) ((head)->tqh_first)
#define TAILQ_END(head) (NULL)
#define TAILQ_NEXT(elm, field) ((elm)->field.tqe_next)
#define TAILQ_LAST(head, headname) \
    (((struct headname *) (void *) ((head)->tqh_last))->tqh_last)
#define TAILQ_PREV(elm, headname, field) \
    (((struct headname *) (void *) ((elm)->field.tqe_prev))->tqh_last)
#define TAILQ_EMPTY(head) (TAILQ_FIRST(head) == TAILQ_END(head))

#define TAILQ_FOREACH(var, head, field) \
    for ((var) = ((head)->tqh_first); \
        (var) != TAILQ_END(head); \
        (var) = ((var)->field.tqe_next))

#define TAILQ_FOREACH_SAFE(var, head, field, next) \
    for ((var) = ((head)->tqh_first); \
        (var) != TAILQ_END(head) && \
        ((next) = TAILQ_NEXT(var, field), 1); (var) = (next))

#define TAILQ_FOREACH_REVERSE(var, head, headname, field) \
    for ((var) = TAILQ_LAST((head), headname); \
        (var) != TAILQ_END(head); \
        (var) = TAILQ_PREV((var), headname, field))

#define TAILQ_FOREACH_REVERSE_SAFE(var, head, headname, field, prev) \
    for ((var) = TAILQ_LAST((head), headname); \
        (var) != TAILQ_END(head) && \
        ((prev) = TAILQ_PREV((var), headname, field), 1); (var) = (prev))

/*
 * Tail queue functions.
 */
#if defined(QUEUEDEBUG)
#define QUEUEDEBUG_TAILQ_INSERT_HEAD(head, \
    elm, field) \
    if ((head)->tqh_first && \
        (head)->tqh_first->field.tqe_prev != &(head)->tqh_first) \
        QUEUEDEBUG_ABORT("TAILQ_INSERT_HEAD %p %s:%d", (head), \

```

```

    __FILE__, __LINE__);
#define QUEUEDEBUG_TAILQ_INSERT_TAIL(head, elm, field) \
    if (*(head)->tqh_last != NULL) \
        QUEUEDEBUG_ABORT("TAILQ_INSERT_TAIL %p %s:%d", (head), \
            __FILE__, __LINE__);
#define QUEUEDEBUG_TAILQ_OP(elm, field) \
    if ((elm)->field.tqe_next && \
        (elm)->field.tqe_next->field.tqe_prev != \
            &(elm)->field.tqe_next) \
        QUEUEDEBUG_ABORT("TAILQ_* forw %p %s:%d", (elm), \
            __FILE__, __LINE__); \
    if (*(elm)->field.tqe_prev != (elm)) \
        QUEUEDEBUG_ABORT("TAILQ_* back %p %s:%d", (elm), \
            __FILE__, __LINE__);
#define QUEUEDEBUG_TAILQ_PREREMOVE(head, elm, field) \
    if ((elm)->field.tqe_next == NULL && \
        (head)->tqh_last != &(elm)->field.tqe_next) \
        QUEUEDEBUG_ABORT("TAILQ_PREREMOVE head %p elm %p %s:%d", \
            (head), (elm), __FILE__, \
            __LINE__);
#define QUEUEDEBUG_TAILQ_POSTREMOVE(elm, field) \
    (elm)->field.tqe_next = (void *)1L; \
    (elm)->field.tqe_prev = (void *)1L;
#else
#define QUEUEDEBUG_TAILQ_INSERT_HEAD(head, elm, field)
#define QUEUEDEBUG_TAILQ_INSERT_TAIL(head, elm, field)
#define QUEUEDEBUG_TAILQ_OP(elm, field)
#define QUEUEDEBUG_TAILQ_PREREMOVE(head, elm, field)
#define QUEUEDEBUG_TAILQ_POSTREMOVE(elm, field)
#endif

#define TAILQ_INIT(head) do { \
    (head)->tqh_first = TAILQ_END(head); \
    (head)->tqh_last = &(head)->tqh_first; \
} while (/*CONSTCOND*/0)

#define TAILQ_INSERT_HEAD(head, elm, field) do { \
    QUEUEDEBUG_TAILQ_INSERT_HEAD((head), (elm), field) \
    if (((elm)->field.tqe_next = (head)->tqh_first) != TAILQ_END(head)) \
        (head)->tqh_first->field.tqe_prev = \
            &(elm)->field.tqe_next; \
    else \
        (head)->tqh_last = &(elm)->field.tqe_next; \
    (head)->tqh_first = (elm); \
    (elm)->field.tqe_prev = &(head)->tqh_first; \
} while (/*CONSTCOND*/0)

#define TAILQ_INSERT_TAIL(head,

```

```

elm, field) do { \
    QUEUEDEBUG_TAILQ_INSERT_TAIL((head), (elm), field) \
    (elm)->field.tqe_next = TAILQ_END(head); \
    (elm)->field.tqe_prev = (head)->tqh_last; \
    *(head)->tqh_last = (elm); \
    (head)->tqh_last = &(elm)->field.tqe_next; \
} while (/*CONSTCOND*/0)

```

```

#define TAILQ_INSERT_AFTER(head, listelm, elm, field) do { \
    QUEUEDEBUG_TAILQ_OP((listelm), field) \
    if (((elm)->field.tqe_next = (listelm)->field.tqe_next) != \
        TAILQ_END(head)) \
    (elm)->field.tqe_next->field.tqe_prev = \
        &(elm)->field.tqe_next; \
    else \
    (head)->tqh_last = &(elm)->field.tqe_next; \
    (listelm)->field.tqe_next = (elm); \
    (elm)->field.tqe_prev = &(listelm)->field.tqe_next; \
} while (/*CONSTCOND*/0)

```

```

#define TAILQ_INSERT_BEFORE(listelm, elm, field) do { \
    QUEUEDEBUG_TAILQ_OP((listelm), field) \
    (elm)->field.tqe_prev = (listelm)->field.tqe_prev; \
    (elm)->field.tqe_next = (listelm); \
    *(listelm)->field.tqe_prev = (elm); \
    (listelm)->field.tqe_prev \
    = &(elm)->field.tqe_next; \
} while (/*CONSTCOND*/0)

```

```

#define TAILQ_REMOVE(head, elm, field) do { \
    QUEUEDEBUG_TAILQ_PREREMOVE((head), (elm), field) \
    QUEUEDEBUG_TAILQ_OP((elm), field) \
    if (((elm)->field.tqe_next) != TAILQ_END(head)) \
    (elm)->field.tqe_next->field.tqe_prev = \
        (elm)->field.tqe_prev; \
    else \
    (head)->tqh_last = (elm)->field.tqe_prev; \
    *(elm)->field.tqe_prev = (elm)->field.tqe_next; \
    QUEUEDEBUG_TAILQ_POSTREMOVE((elm), field); \
} while (/*CONSTCOND*/0)

```

```

#define TAILQ_REPLACE(head, elm, elm2, field) do { \
    if (((elm2)->field.tqe_next = (elm)->field.tqe_next) != \
        TAILQ_END(head)) \
    (elm2)->field.tqe_next->field.tqe_prev = \
        &(elm2)->field.tqe_next; \
    else \
    (head)->tqh_last = &(elm2)->field.tqe_next; \
} while (/*CONSTCOND*/0)

```

```

        (elm2)->field.tqe_prev = (elm)->field.tqe_prev; \
        *(elm2)->field.tqe_prev = (elm2); \
    QUEUEDEBUG_TAILQ_POSTREMOVE((elm),
    field); \
} while (/*CONSTCOND*/0)

#define TAILQ_CONCAT(head1, head2, field) do { \
    if (!TAILQ_EMPTY(head2)) { \
        *(head1)->tqh_last = (head2)->tqh_first; \
        (head2)->tqh_first->field.tqe_prev = (head1)->tqh_last; \
        (head1)->tqh_last = (head2)->tqh_last; \
        TAILQ_INIT((head2)); \
    } \
} while (/*CONSTCOND*/0)

/*
 * Singly-linked Tail queue declarations.
 */
#define STAILQ_HEAD(name, type) \
struct name { \
    struct type *stqh_first; /* first element */ \
    struct type **stqh_last; /* addr of last next element */ \
}

#define STAILQ_HEAD_INITIALIZER(head) \
{ NULL, &(head).stqh_first }

#define STAILQ_ENTRY(type) \
struct { \
    struct type *stqe_next; /* next element */ \
}

/*
 * Singly-linked Tail queue access methods.
 */
#define STAILQ_FIRST(head) ((head)->stqh_first)
#define STAILQ_END(head) NULL
#define STAILQ_NEXT(elm, field) ((elm)->field.stqe_next)
#define STAILQ_EMPTY(head) (STAILQ_FIRST(head) \
    == STAILQ_END(head))

/*
 * Singly-linked Tail queue functions.
 */
#define STAILQ_INIT(head) do { \
    (head)->stqh_first = NULL; \
    (head)->stqh_last = &(head)->stqh_first; \
} while (/*CONSTCOND*/0)

```

```

#define STAILQ_INSERT_HEAD(head, elm, field) do { \
    if (((elm)->field.stqe_next = (head)->stqh_first) == NULL) \
        (head)->stqh_last = &(elm)->field.stqe_next; \
    (head)->stqh_first = (elm); \
} while (/*CONSTCOND*/0)

#define STAILQ_INSERT_TAIL(head, elm, field) do { \
    (elm)->field.stqe_next = NULL; \
    *(head)->stqh_last = (elm); \
    (head)->stqh_last = &(elm)->field.stqe_next; \
} while (/*CONSTCOND*/0)

#define STAILQ_INSERT_AFTER(head, listelm, elm, field) do { \
    if (((elm)->field.stqe_next = (listelm)->field.stqe_next) == NULL) \
        (head)->stqh_last = &(elm)->field.stqe_next; \
    (listelm)->field.stqe_next = (elm); \
} while (/*CONSTCOND*/0)

#define STAILQ_REMOVE_HEAD(head, field) do { \
    if (((head)->stqh_first = (head)->stqh_first->field.stqe_next) \
        == NULL) \
        (head)->stqh_last = &(head)->stqh_first; \
} while (/*CONSTCOND*/0)

#define STAILQ_REMOVE(head, elm, type, field) do { \
    if ((head)->stqh_first == (elm)) { \
        STAILQ_REMOVE_HEAD((head), field); \
    } else { \
        struct type *curelm = (head)->stqh_first; \
        while (curelm->field.stqe_next != (elm)) \
            curelm = curelm->field.stqe_next; \
        if ((curelm->field.stqe_next = \
            curelm->field.stqe_next->field.stqe_next) == NULL) \
            (head)->stqh_last = &(curelm)->field.stqe_next; \
    } \
} while (/*CONSTCOND*/0)

#define STAILQ_FOREACH(var, head, field) \
    for ((var) = ((head)->stqh_first); \
        (var); \
        (var) = ((var)->field.stqe_next))

#define STAILQ_FOREACH_SAFE(var, head, field, tvar) \
    for ((var) = STAILQ_FIRST((head)); \
        (var) && ((tvar) = STAILQ_NEXT((var), field), 1); \
        (var) = (tvar))

```

```

#define STAILQ_CONCAT(head1, head2) do { \
    if (!STAILQ_EMPTY((head2))) { \
        *(head1)->stqh_last \
        = (head2)->stqh_first; \
        (head1)->stqh_last = (head2)->stqh_last; \
        STAILQ_INIT((head2)); \
    } \
} while (/*CONSTCOND*/0)

#define STAILQ_LAST(head, type, field) \
(STAILQ_EMPTY((head)) ? \
    NULL : \
    ((struct type *) (void *) \
    ((char *)((head)->stqh_last) - offsetof(struct type, field))))

#ifdef _KERNEL
/*
 * Circular queue definitions. Do not use. We still keep the macros
 * for compatibility but because of pointer aliasing issues their use
 * is discouraged!
 */

/*
 * __launder_type(): We use this ugly hack to work around the the compiler
 * noticing that two types may not alias each other and elide tests in code.
 * We hit this in the CIRCLEQ macros when comparing 'struct name *' and
 * 'struct type *' (see CIRCLEQ_HEAD()). Modern compilers (such as GCC
 * 4.8) declare these comparisons as always false, causing the code to
 * not run as designed.
 *
 * This hack is only to be used for comparisons and thus can be fully const.
 * Do not use for assignment.
 *
 * If we ever choose to change the ABI of the CIRCLEQ macros, we could fix
 * this by changing the head/tail sentinel values, but see the note above
 * this one.
 */
static __inline const void * __launder_type(const void *);
static __inline const void *
__launder_type(const void *__x)
{
    __asm __volatile("" : "+r" (__x));
    return __x;
}

#ifdef QUEUEDEBDEBUG
#define QUEUEDEBDEBUG_CIRCLEQ_HEAD(head, field) \

```



```

if ((head)->cqh_first != CIRCLEQ_ENDC(head) && \
    (head)->cqh_first->field.cqe_prev != CIRCLEQ_ENDC(head)) \
    QUEUEDEBBUG_ABORT("CIRCLEQ head forw %p %s:%d", (head), \
        __FILE__, __LINE__); \
if ((head)->cqh_last != CIRCLEQ_ENDC(head) && \
    (head)->cqh_last->field.cqe_next != CIRCLEQ_ENDC(head)) \
    QUEUEDEBBUG_ABORT("CIRCLEQ head back %p %s:%d", (head), \
        __FILE__, __LINE__);
#define QUEUEDEBBUG_CIRCLEQ_ELM(head, elm, field) \
if ((elm)->field.cqe_next == CIRCLEQ_ENDC(head)) { \
    if ((head)->cqh_last != (elm)) \
        QUEUEDEBBUG_ABORT("CIRCLEQ \
elm last %p %s:%d", \
            (elm), __FILE__, __LINE__); \
} else { \
    if ((elm)->field.cqe_next->field.cqe_prev != (elm)) \
        QUEUEDEBBUG_ABORT("CIRCLEQ elm forw %p %s:%d", \
            (elm), __FILE__, __LINE__); \
} \
if ((elm)->field.cqe_prev == CIRCLEQ_ENDC(head)) { \
    if ((head)->cqh_first != (elm)) \
        QUEUEDEBBUG_ABORT("CIRCLEQ elm first %p %s:%d", \
            (elm), __FILE__, __LINE__); \
} else { \
    if ((elm)->field.cqe_prev->field.cqe_next != (elm)) \
        QUEUEDEBBUG_ABORT("CIRCLEQ elm prev %p %s:%d", \
            (elm), __FILE__, __LINE__); \
}
#define QUEUEDEBBUG_CIRCLEQ_POSTREMOVE(elm, field) \
(elm)->field.cqe_next = (void *)1L; \
(elm)->field.cqe_prev = (void *)1L;
#else
#define QUEUEDEBBUG_CIRCLEQ_HEAD(head, field)
#define QUEUEDEBBUG_CIRCLEQ_ELM(head, elm, field)
#define QUEUEDEBBUG_CIRCLEQ_POSTREMOVE(elm, field)
#endif

#define CIRCLEQ_HEAD(name, type) \
struct name { \
    struct type *cqh_first; /* \
    first element */ \
    struct type *cqh_last; /* last element */ \
}

#define CIRCLEQ_HEAD_INITIALIZER(head) \
{ CIRCLEQ_END(&head), CIRCLEQ_END(&head) }

#define CIRCLEQ_ENTRY(type) \

```

```

struct {
    \
    struct type *cqe_next; /* next element */ \
    struct type *cqe_prev; /* previous element */ \
}

/*
 * Circular queue functions.
 */

#define CIRCLEQ_INIT(head) do { \
    (head)->cqh_first = CIRCLEQ_END(head); \
    (head)->cqh_last = CIRCLEQ_END(head); \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_INSERT_AFTER(head, listelm, elm, field) do { \
    QUEUEDEBBUG_CIRCLEQ_HEAD((head), field) \
    QUEUEDEBBUG_CIRCLEQ_ELM((head), (listelm), field) \
    (elm)->field.cqe_next = (listelm)->field.cqe_next; \
    (elm)->field.cqe_prev = (listelm); \
    if ((listelm)->field.cqe_next == CIRCLEQ_ENDC(head)) \
        (head)->cqh_last = (elm); \
    else \
        (listelm)->field.cqe_next->field.cqe_prev = (elm); \
    (listelm)->field.cqe_next = (elm); \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_INSERT_BEFORE(head, \
    listelm, elm, field) do { \
    QUEUEDEBBUG_CIRCLEQ_HEAD((head), field) \
    QUEUEDEBBUG_CIRCLEQ_ELM((head), (listelm), field) \
    (elm)->field.cqe_next = (listelm); \
    (elm)->field.cqe_prev = (listelm)->field.cqe_prev; \
    if ((listelm)->field.cqe_prev == CIRCLEQ_ENDC(head)) \
        (head)->cqh_first = (elm); \
    else \
        (listelm)->field.cqe_prev->field.cqe_next = (elm); \
    (listelm)->field.cqe_prev = (elm); \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_INSERT_HEAD(head, elm, field) do { \
    QUEUEDEBBUG_CIRCLEQ_HEAD((head), field) \
    (elm)->field.cqe_next = (head)->cqh_first; \
    (elm)->field.cqe_prev = CIRCLEQ_END(head); \
    if ((head)->cqh_last == CIRCLEQ_ENDC(head)) \
        (head)->cqh_last = (elm); \
    else \
        (head)->cqh_first->field.cqe_prev = (elm); \
    (head)->cqh_first = (elm); \
} while (/*CONSTCOND*/0)

```

```

#define CIRCLEQ_INSERT_TAIL(head, elm, field) do { \
    QUEUEDEBUG_CIRCLEQ_HEAD((head), field) \
    (elm)->field.cqe_next \
    = CIRCLEQ_END(head); \
    (elm)->field.cqe_prev = (head)->cqh_last; \
    if ((head)->cqh_first == CIRCLEQ_ENDC(head)) \
        (head)->cqh_first = (elm); \
    else \
        (head)->cqh_last->field.cqe_next = (elm); \
    (head)->cqh_last = (elm); \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_REMOVE(head, elm, field) do { \
    QUEUEDEBUG_CIRCLEQ_HEAD((head), field) \
    QUEUEDEBUG_CIRCLEQ_ELM((head), (elm), field) \
    if ((elm)->field.cqe_next == CIRCLEQ_ENDC(head)) \
        (head)->cqh_last = (elm)->field.cqe_prev; \
    else \
        (elm)->field.cqe_next->field.cqe_prev = \
            (elm)->field.cqe_prev; \
    if ((elm)->field.cqe_prev == CIRCLEQ_ENDC(head)) \
        (head)->cqh_first = (elm)->field.cqe_next; \
    else \
        (elm)->field.cqe_prev->field.cqe_next = \
            (elm)->field.cqe_next; \
    QUEUEDEBUG_CIRCLEQ_POSTREMOVE((elm), field) \
} while (/*CONSTCOND*/0)

#define CIRCLEQ_FOREACH(var, head, field) \
    for ((var) = ((head)->cqh_first); \
        (var) != CIRCLEQ_ENDC(head); \
        (var) \
        = ((var)->field.cqe_next))

#define CIRCLEQ_FOREACH_REVERSE(var, head, field) \
    for ((var) = ((head)->cqh_last); \
        (var) != CIRCLEQ_ENDC(head); \
        (var) = ((var)->field.cqe_prev))

/*
 * Circular queue access methods.
 */

#define CIRCLEQ_FIRST(head) ((head)->cqh_first)
#define CIRCLEQ_LAST(head) ((head)->cqh_last)
/* For comparisons */
#define CIRCLEQ_ENDC(head) (__launter_type(head))
/* For assignments */

```

```

#define CIRCLEQ_END(head) ((void *)(head))
#define CIRCLEQ_NEXT(elm, field) ((elm)->field.cqe_next)
#define CIRCLEQ_PREV(elm, field) ((elm)->field.cqe_prev)
#define CIRCLEQ_EMPTY(head) \
    (CIRCLEQ_FIRST(head) == CIRCLEQ_ENDC(head))

#define CIRCLEQ_LOOP_NEXT(head, elm, field) \
    (((elm)->field.cqe_next == CIRCLEQ_ENDC(head)) \
     ? ((head)->cqh_first) \
     : (elm->field.cqe_next))
#define CIRCLEQ_LOOP_PREV(head, elm, field) \
    (((elm)->field.cqe_prev == CIRCLEQ_ENDC(head)) \
     ? ((head)->cqh_last) \
     : \
     (elm->field.cqe_prev))
#endif /* !_KERNEL */

#endif /* !_SYS_QUEUE_H_ */
#ifndef _SYS_CDEFS_H_
#define _SYS_CDEFS_H_

#warning usage of non-standard #include <sys/cdefs.h> is deprecated

#undef __P
#undef __PMT

#define __P(args) args
#define __PMT(args) args

#define __CONCAT(x,y) x ## y
#define __STRING(x) #x

#ifdef __cplusplus
# define __BEGIN_DECLS extern "C" {
# define __END_DECLS }
#else
# define __BEGIN_DECLS
# define __END_DECLS
#endif

#if defined(__GNUC__) && !defined(__cplusplus)
# define __THROW __attribute__((__nothrow__))
# define __NTH(fct) __attribute__((__nothrow__)) fct
#else
# define __THROW
# define __NTH(fct) fct
#endif

```

```

#endif /* _SYS_CDEFS_H_ */
# Contributor: Fabian Affolter <fabian@affolter-engineering.ch>
# Maintainer: Fabian Affolter <fabian@affolter-engineering.ch>
pkgname=py3-flake8-copyright
_pkgname=flake8-copyright
pkgver=0.2.4
pkgrel=3
pkgdesc="Extension for flake8 which checks for copyrights"
options="!check" # No testsuite
url="https://github.com/savoirfairelinux/flake8-copyright"
arch="noarch"
license="MIT"
depends="py3-flake8 py3-setuptools"
makedepends="py3-gpep517 py3-wheel"
subpackages="$pkgname-pyc"
source="https://files.pythonhosted.org/packages/source/${_pkgname:0:1}/${_pkgname}/${_pkgname}-${pkgver}.tar.gz"
builddir="$srcdir"/$_pkgname-$pkgver

replaces="py-flake8-copyright" # Backwards compatibility
provides="py-flake8-copyright=${pkgver}-r${pkgrel}" # Backwards compatibility

build() {
    gpep517 build-wheel \
        --wheel-dir .dist \
        --output-fd 3 3>&1 >&2
}

package() {
    gpep517 install-wheel --destdir "$pkgdir" \
        .dist/*.whl
}

sha512sums="
a6ab47e1bb715618f075c51f398e18180404871b3b0faf1c2d30701d5203db6bc23771bf22ffb5bafcd8ee856b9b64237
b316bd503ae7dceed6ca284ccd5a74d
    flake8-copyright-0.2.4.tar.gz
"

# Maintainer: fossdd <fossdd@pwned.life>
pkgname=cargo-license
pkgver=0.6.1
pkgrel=1
pkgdesc="Cargo subcommand to see license of dependencies"
url="https://github.com/onur/cargo-license"
arch="all"
license="MIT"
makedepends="cargo cargo-auditable"
source="$pkgname-$pkgver.tar.gz::https://crates.io/api/v1/crates/cargo-license/$pkgver/download"

```

```

prepare() {
    default_prepare

    cargo fetch --target="$CTARGET" --locked
}

build() {
    cargo auditable build --release --frozen
}

check() {
    cargo test --frozen
}

package() {
    install -Dm755 target/release/cargo-license -t "$pkgdir"/usr/bin
}

sha512sums="
36215145e79965be090ae2f5ce6f5eb208465eb67a94c26bed1fe70a131c46c6dc35695e30852759b7366883fbc3caf00
272d796ac634f0a5e1d49232b6b29d5  cargo-license-0.6.1.tar.gz
"

/* $NetBSD: tree.h,v 1.20 2013/09/14 13:20:45 joerg Exp $ */
/* $OpenBSD: tree.h,v 1.13 2011/07/09 00:19:45 pirofti Exp $ */
/* Modified by Void Linux. */
/*
* Copyright 2002 Niels Provos <provos@citi.umich.edu>
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*
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* NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE,
* DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY
* THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT
* (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF

```

\* THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

\*/

#ifndef \_SYS\_TREE\_H\_

#define \_SYS\_TREE\_H\_

#ifdef \_\_GNUC\_\_

#define \_\_GNUC\_PREREQ\_\_(x, y) \\\n ((\_\_GNUC\_\_ == (x) && \_\_GNUC\_MINOR\_\_ >= (y)) || \\\n (\_\_GNUC\_\_ > (x)))

#else

#define \_\_GNUC\_PREREQ\_\_(x, y) 0

#endif

#if \_\_GNUC\_PREREQ\_\_(2, 7) || defined(\_\_lint\_\_)

#define \_sys\_tree\_h\_unused \_\_attribute\_\_((\_\_unused\_\_))

#else

#define \_sys\_tree\_h\_unused /\* delete \*/

#endif

/\*

\* This file defines data structures for different types of trees:

\* splay trees and red-black trees.

\*

\* A splay tree is a self-organizing

data structure. Every operation

\* on the tree causes a splay to happen. The splay moves the requested

\* node to the root of the tree and partly rebalances it.

\*

\* This has the benefit that request locality causes faster lookups as

\* the requested nodes move to the top of the tree. On the other hand,

\* every lookup causes memory writes.

\*

\* The Balance Theorem bounds the total access time for m operations

\* and n inserts on an initially empty tree as  $O((m + n) \lg n)$ . The

\* amortized cost for a sequence of m accesses to a splay tree is  $O(\lg n)$ ;

\*

\* A red-black tree is a binary search tree with the node color as an

\* extra attribute. It fulfills a set of conditions:

\* - every search path from the root to a leaf consists of the

\* same number of black nodes,

\* - each red node (except for the root) has a black parent,

\* - each leaf node is black.

\*

\* Every operation on a red-black tree is bounded as  $O(\lg n)$ .

\* The maximum height of a red-black tree is  $2 \lg (n+1)$ .

\*/

```

#define SPLAY_HEAD(name, type)  \
struct name {                  \
    struct type *sph_root; /* root of the tree */ \
}

#define SPLAY_INITIALIZER(root) \
{ NULL }

#define SPLAY_INIT(root) do { \
    (root)->sph_root = NULL; \
} while (/*CONSTCOND*/ 0)

#define SPLAY_ENTRY(type) \
struct { \
    struct type *spe_left; /* left element */ \
    struct type *spe_right; /* right element */ \
}

#define SPLAY_LEFT(elm, field) (elm)->field.spe_left
#define SPLAY_RIGHT(elm, field) (elm)->field.spe_right
#define SPLAY_ROOT(head) (head)->sph_root
#define SPLAY_EMPTY(head) (SPLAY_ROOT(head) == NULL)

/* SPLAY_ROTATE_{LEFT,RIGHT} expect that tmp hold SPLAY_{RIGHT,LEFT} */
#define SPLAY_ROTATE_RIGHT(head, tmp, field) do { \
    SPLAY_LEFT((head)->sph_root, field) = SPLAY_RIGHT(tmp, field); \
    SPLAY_RIGHT(tmp, field) = (head)->sph_root; \
    (head)->sph_root = tmp; \
} while (/*CONSTCOND*/ 0)

#define SPLAY_ROTATE_LEFT(head, tmp, field) do { \
    SPLAY_RIGHT((head)->sph_root, \
    field) = SPLAY_LEFT(tmp, field); \
    SPLAY_LEFT(tmp, field) = (head)->sph_root; \
    (head)->sph_root = tmp; \
} while (/*CONSTCOND*/ 0)

#define SPLAY_LINKLEFT(head, tmp, field) do { \
    SPLAY_LEFT(tmp, field) = (head)->sph_root; \
    tmp = (head)->sph_root; \
    (head)->sph_root = SPLAY_LEFT((head)->sph_root, field); \
} while (/*CONSTCOND*/ 0)

#define SPLAY_LINKRIGHT(head, tmp, field) do { \
    SPLAY_RIGHT(tmp, field) = (head)->sph_root; \
    tmp = (head)->sph_root; \
    (head)->sph_root = SPLAY_RIGHT((head)->sph_root, field); \
} while (/*CONSTCOND*/ 0)

```



```

#define SPLAY_ASSEMBLE(head, node, left, right, field) do { \
    SPLAY_RIGHT(left, field) = SPLAY_LEFT((head)->sph_root, field); \
    SPLAY_LEFT(right, field) = SPLAY_RIGHT((head)->sph_root, field); \
    SPLAY_LEFT((head)->sph_root, field) = SPLAY_RIGHT(node, field); \
    SPLAY_RIGHT((head)->sph_root, field) = SPLAY_LEFT(node, field); \
} while (/*CONSTCOND*/ 0)

```

/\* Generates prototypes and inline functions \*/

```

#define
    SPLAY_PROTOTYPE(name, type, field, cmp) \
void name##_SPLAY(struct name *, struct type *); \
void name##_SPLAY_MINMAX(struct name *, int); \
struct type *name##_SPLAY_INSERT(struct name *, struct type *); \
struct type *name##_SPLAY_REMOVE(struct name *, struct type *); \
    \
/* Finds the node with the same key as elm */ \
static __inline struct type * \
name##_SPLAY_FIND(struct name *head, struct type *elm) \
{ \
    if (SPLAY_EMPTY(head)) \
        return(NULL); \
    name##_SPLAY(head, elm); \
    if ((cmp)(elm, (head)->sph_root) == 0) \
        return (head->sph_root); \
    return (NULL); \
} \
    \
static __inline _sys_tree_h_unused struct type * \
name##_SPLAY_NEXT(struct name *head, struct type *elm) \
{ \
    name##_SPLAY(head, elm); \
    if (SPLAY_RIGHT(elm, field) != NULL) { \
        elm = SPLAY_RIGHT(elm, field); \
        while (SPLAY_LEFT(elm, field) != NULL) { \
            elm = SPLAY_LEFT(elm, field); \
        } \
    } \
    else \
        elm = NULL; \
    return (elm); \
} \
    \
static _sys_tree_h_unused __inline struct type * \
name##_SPLAY_MIN_MAX(struct name *head, int val) \
{ \
    name##_SPLAY_MINMAX(head, val); \
}

```

```

    return (SPLAY_ROOT(head)); \
}

/* Main splay operation.
 * Moves node close to the key of elm to top
 */
#define SPLAY_GENERATE(name, type, field, cmp) \
struct type * \
name##_SPLAY_INSERT(struct name *head, struct type *elm) \
{ \
    if (SPLAY_EMPTY(head)) { \
        SPLAY_LEFT(elm, field) = SPLAY_RIGHT(elm, field) = NULL; \
    } else { \
        int __comp; \
        name##_SPLAY(head, elm); \
        __comp = (cmp)(elm, (head)->sph_root); \
        if (__comp < 0) { \
            SPLAY_LEFT(elm, field) = SPLAY_LEFT((head)->sph_root, field); \
            SPLAY_RIGHT(elm, field) = (head)->sph_root; \
            SPLAY_LEFT((head)->sph_root, field) = NULL; \
        } else if (__comp > 0) { \
            SPLAY_RIGHT(elm, \
field) = SPLAY_RIGHT((head)->sph_root, field); \
            SPLAY_LEFT(elm, field) = (head)->sph_root; \
            SPLAY_RIGHT((head)->sph_root, field) = NULL; \
        } else \
            return ((head)->sph_root); \
    } \
    (head)->sph_root = (elm); \
    return (NULL); \
} \
\
struct type * \
name##_SPLAY_REMOVE(struct name *head, struct type *elm) \
{ \
    struct type *__tmp; \
    if (SPLAY_EMPTY(head)) \
        return (NULL); \
    name##_SPLAY(head, elm); \
    if ((cmp)(elm, (head)->sph_root) == 0) { \
        if (SPLAY_LEFT((head)->sph_root, field) == NULL) { \
            (head)->sph_root = SPLAY_RIGHT((head)->sph_root, field); \
        } else { \
            __tmp = SPLAY_RIGHT((head)->sph_root, field); \
            (head)->sph_root = SPLAY_LEFT((head)->sph_root, field); \
            name##_SPLAY(head, elm); \
            SPLAY_RIGHT((head)->sph_root, field) = __tmp; \
        } \
    } \
} \

```

```

    return (elm);    \
}    \
return (NULL);    \
}    \
    \
void    \
name##_SPLAY(struct
name *head, struct type *elm) \
{    \
    struct type __node, *__left, *__right, *__tmp; \
    int __comp;    \
    \
    SPLAY_LEFT(&__node, field) = SPLAY_RIGHT(&__node, field) = NULL;\
    __left = __right = &__node;    \
    \
    while ((__comp = (cmp)(elm, (head)->sph_root)) != 0) { \
        if (__comp < 0) {    \
            __tmp = SPLAY_LEFT((head)->sph_root, field); \
            if (__tmp == NULL)    \
                break;    \
            if ((cmp)(elm, __tmp) < 0){    \
                SPLAY_ROTATE_RIGHT(head, __tmp, field); \
                if (SPLAY_LEFT((head)->sph_root, field) == NULL)\
                    break;    \
            }    \
            SPLAY_LINKLEFT(head, __right, field); \
        } else if (__comp > 0) {    \
            __tmp = SPLAY_RIGHT((head)->sph_root, field); \
            if (__tmp == NULL)    \
                break;    \
            if ((cmp)(elm, __tmp) > 0){    \
                SPLAY_ROTATE_LEFT(head, __tmp, field); \
                if (SPLAY_RIGHT((head)->sph_root, field) == NULL)\
                    break;    \
            }    \
            SPLAY_LINKRIGHT(head, __left, field); \
        }    \
    }    \
    SPLAY_ASSEMBLE(head,
    &__node, __left, __right, field); \
}    \
    \
/* Splay with either the minimum or the maximum element \
 * Used to find minimum or maximum element in tree. \
 */    \
void name##_SPLAY_MINMAX(struct name *head, int __comp) \
{    \
    struct type __node, *__left, *__right, *__tmp; \

```

```

\
SPLAY_LEFT(&__node, field) = SPLAY_RIGHT(&__node, field) = NULL;\
__left = __right = &__node;  \
\
while (1) {  \
if (__comp < 0) {  \
__tmp = SPLAY_LEFT((head)->sph_root, field);\
if (__tmp == NULL)  \
break;  \
if (__comp < 0){  \
SPLAY_ROTATE_RIGHT(head, __tmp, field);\
if (SPLAY_LEFT((head)->sph_root, field) == NULL)\
break;  \
}  \
SPLAY_LINKLEFT(head, __right, field); \
} else if (__comp > 0) {  \
__tmp = SPLAY_RIGHT((head)->sph_root, field);\
if (__tmp == NULL)  \
break;  \
if (__comp > 0) {  \
SPLAY_ROTATE_LEFT(head, __tmp, field);\
if (SPLAY_RIGHT((head)->sph_root,
field) == NULL)\
break;  \
}  \
SPLAY_LINKRIGHT(head, __left, field); \
}  \
}  \
SPLAY_ASSEMBLE(head, &__node, __left, __right, field); \
}

#define SPLAY_NEGINF -1
#define SPLAY_INF 1

#define SPLAY_INSERT(name, x, y) name##_SPLAY_INSERT(x, y)
#define SPLAY_REMOVE(name, x, y) name##_SPLAY_REMOVE(x, y)
#define SPLAY_FIND(name, x, y) name##_SPLAY_FIND(x, y)
#define SPLAY_NEXT(name, x, y) name##_SPLAY_NEXT(x, y)
#define SPLAY_MIN(name, x) (SPLAY_EMPTY(x) ? NULL \
: name##_SPLAY_MIN_MAX(x, SPLAY_NEGINF))
#define SPLAY_MAX(name, x) (SPLAY_EMPTY(x) ? NULL \
: name##_SPLAY_MIN_MAX(x, SPLAY_INF))

#define SPLAY_FOREACH(x, name, head)  \
for ((x) = SPLAY_MIN(name, head);  \
(x) != NULL;  \
(x) = SPLAY_NEXT(name, head, x))

```

```

/* Macros that define a red-black tree */
#define RB_HEAD(name, type) \
struct name { \
    struct type *rbh_root; /* root of the tree */ \
}

#define RB_INITIALIZER(root) \
{ \
    NULL \
}

#define RB_INIT(root) do { \
    (root)->rbh_root = NULL; \
} while (/*CONSTCOND*/ 0)

#define RB_BLACK 0
#define RB_RED 1
#define RB_ENTRY(type) \
struct { \
    struct type *rbe_left; /* left element */ \
    struct type *rbe_right; /* right element */ \
    struct type *rbe_parent; /* parent element */ \
    int rbe_color; /* node color */ \
}

#define RB_LEFT(elm, field) (elm)->field.rbe_left
#define RB_RIGHT(elm, field) (elm)->field.rbe_right
#define RB_PARENT(elm, field) (elm)->field.rbe_parent
#define RB_COLOR(elm, field) (elm)->field.rbe_color
#define RB_ROOT(head) (head)->rbh_root
#define RB_EMPTY(head) (RB_ROOT(head) == NULL)

#define RB_SET(elm, parent, field) do { \
    RB_PARENT(elm, field) = parent; \
    RB_LEFT(elm, field) = RB_RIGHT(elm, field) = NULL; \
    RB_COLOR(elm, field) = RB_RED; \
} while (/*CONSTCOND*/ 0)

#define RB_SET_BLACKRED(black, red, field) do { \
    RB_COLOR(black, field) = RB_BLACK; \
    RB_COLOR(red, field) \
    = RB_RED; \
} while (/*CONSTCOND*/ 0)

#ifndef RB_AUGMENT
#define RB_AUGMENT(x) do {} while (/*CONSTCOND*/ 0)
#endif

#define RB_ROTATE_LEFT(head, elm, tmp, field) do { \

```

```

(tmp) = RB_RIGHT(elm, field); \
if ((RB_RIGHT(elm, field) = RB_LEFT(tmp, field)) != NULL) { \
    RB_PARENT(RB_LEFT(tmp, field), field) = (elm); \
} \
RB_AUGMENT(elm); \
if ((RB_PARENT(tmp, field) = RB_PARENT(elm, field)) != NULL) { \
    if ((elm) == RB_LEFT(RB_PARENT(elm, field), field)) \
        RB_LEFT(RB_PARENT(elm, field), field) = (tmp); \
    else \
        RB_RIGHT(RB_PARENT(elm, field), field) = (tmp); \
} else \
    (head)->rbh_root = (tmp); \
RB_LEFT(tmp, field) = (elm); \
RB_PARENT(elm, field) = (tmp); \
RB_AUGMENT(tmp); \
if ((RB_PARENT(tmp, field))) \
    RB_AUGMENT(RB_PARENT(tmp, field)); \
} while (/*CONSTCOND*/ 0)

#define RB_ROTATE_RIGHT(head, elm, tmp, field) do { \
    (tmp) = RB_LEFT(elm, field); \
    if ((RB_LEFT(elm, field) = RB_RIGHT(tmp, field)) \
        != NULL) { \
        RB_PARENT(RB_RIGHT(tmp, field), field) = (elm); \
    } \
    RB_AUGMENT(elm); \
    if ((RB_PARENT(tmp, field) = RB_PARENT(elm, field)) != NULL) { \
        if ((elm) == RB_LEFT(RB_PARENT(elm, field), field)) \
            RB_LEFT(RB_PARENT(elm, field), field) = (tmp); \
        else \
            RB_RIGHT(RB_PARENT(elm, field), field) = (tmp); \
    } else \
        (head)->rbh_root = (tmp); \
    RB_RIGHT(tmp, field) = (elm); \
    RB_PARENT(elm, field) = (tmp); \
    RB_AUGMENT(tmp); \
    if ((RB_PARENT(tmp, field))) \
        RB_AUGMENT(RB_PARENT(tmp, field)); \
} while (/*CONSTCOND*/ 0)

/* Generates prototypes and inline functions */
#define RB_PROTOTYPE(name, type, field, cmp) \
    RB_PROTOTYPE_INTERNAL(name, type, field, cmp,)
#define RB_PROTOTYPE_STATIC(name, type, field, cmp) \
    RB_PROTOTYPE_INTERNAL(name, type, field, cmp, _sys_tree_h_unused static)
#define RB_PROTOTYPE_INTERNAL(name, type, field, cmp, attr) \
    attr void name##_RB_INSERT_COLOR(struct name *, struct

```

```

type *); \
attr void name##_RB_REMOVE_COLOR(struct name *, struct type *, struct type *);\
attr struct type *name##_RB_REMOVE(struct name *, struct type *); \
attr struct type *name##_RB_INSERT(struct name *, struct type *); \
attr struct type *name##_RB_FIND(struct name *, struct type *); \
attr struct type *name##_RB_NFIND(struct name *, struct type *); \
attr struct type *name##_RB_NEXT(struct type *); \
attr struct type *name##_RB_PREV(struct type *); \
attr struct type *name##_RB_MINMAX(struct name *, int); \
\

/* Main rb operation.
* Moves node close to the key of elm to top
*/
#define RB_GENERATE(name, type, field, cmp) \
    RB_GENERATE_INTERNAL(name, type, field, cmp,)
#define RB_GENERATE_STATIC(name, type, field, cmp) \
    RB_GENERATE_INTERNAL(name, type, field, cmp, _sys_tree_h_unused static)
#define RB_GENERATE_INTERNAL(name, type, field, cmp, attr) \
attr void \
name##_RB_INSERT_COLOR(struct name *head, struct type *elm) \
{ \
    struct type \
    *parent, *gparent, *tmp; \
    while ((parent = RB_PARENT(elm, field)) != NULL && \
        RB_COLOR(parent, field) == RB_RED) { \
        gparent = RB_PARENT(parent, field); \
        if (parent == RB_LEFT(gparent, field)) { \
            tmp = RB_RIGHT(gparent, field); \
            if (tmp && RB_COLOR(tmp, field) == RB_RED) { \
                RB_COLOR(tmp, field) = RB_BLACK; \
                RB_SET_BLACKRED(parent, gparent, field);\
                elm = gparent; \
                continue; \
            } \
            if (RB_RIGHT(parent, field) == elm) { \
                RB_ROTATE_LEFT(head, parent, tmp, field);\
                tmp = parent; \
                parent = elm; \
                elm = tmp; \
            } \
            RB_SET_BLACKRED(parent, gparent, field); \
            RB_ROTATE_RIGHT(head, gparent, tmp, field); \
        } else { \
            tmp = RB_LEFT(gparent, field); \
            if (tmp && RB_COLOR(tmp, field) == RB_RED) { \
                RB_COLOR(tmp, field) = RB_BLACK; \
                RB_SET_BLACKRED(parent, gparent, field);\

```

```

    elm = gparent; \
    continue; \
} \
if (RB_LEFT(parent, field) == elm)
{ \
    RB_ROTATE_RIGHT(head, parent, tmp, field);\
    tmp = parent; \
    parent = elm; \
    elm = tmp; \
} \
RB_SET_BLACKRED(parent, gparent, field); \
RB_ROTATE_LEFT(head, gparent, tmp, field); \
} \
} \
RB_COLOR(head->rbh_root, field) = RB_BLACK; \
} \
\
attr void \
name##_RB_REMOVE_COLOR(struct name *head, struct type *parent, struct type *elm) \
{ \
    struct type *tmp; \
    while ((elm == NULL || RB_COLOR(elm, field) == RB_BLACK) && \
        elm != RB_ROOT(head)) { \
        if (RB_LEFT(parent, field) == elm) { \
            tmp = RB_RIGHT(parent, field); \
            if (RB_COLOR(tmp, field) == RB_RED) { \
                RB_SET_BLACKRED(tmp, parent, field); \
                RB_ROTATE_LEFT(head, parent, tmp, field);\
                tmp = RB_RIGHT(parent, field); \
            } \
            if ((RB_LEFT(tmp, field) == NULL || \
                RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) && \
                (RB_RIGHT(tmp, field) == NULL || \
                RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK)) {\
                RB_COLOR(tmp, field) = RB_RED; \
                elm = parent; \
                parent = RB_PARENT(elm, field); \
            } else { \
                if (RB_RIGHT(tmp, field) == NULL || \
                    RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK) {\
                    struct type *oleft; \
                    if ((oleft = RB_LEFT(tmp, field)) \
                        != NULL) \
                        RB_COLOR(oleft, field) = RB_BLACK;\
                    RB_COLOR(tmp, field) = RB_RED; \
                    RB_ROTATE_RIGHT(head, tmp, oleft, field);\
                    tmp = RB_RIGHT(parent, field); \

```



```

    } \
    RB_COLOR(tmp, field) = RB_COLOR(parent, field);\
    RB_COLOR(parent, field) = RB_BLACK;\
    if (RB_RIGHT(tmp, field)) \
        RB_COLOR(RB_RIGHT(tmp, field), field) = RB_BLACK;\
    RB_ROTATE_LEFT(head, parent, tmp, field);\
    elm = RB_ROOT(head); \
    break; \
} \
} else { \
    tmp = RB_LEFT(parent, field); \
    if (RB_COLOR(tmp, field) == RB_RED) { \
        RB_SET_BLACKRED(tmp, parent, field);\
        RB_ROTATE_RIGHT(head, parent, tmp, field);\
        tmp
= RB_LEFT(parent, field); \
    } \
    if ((RB_LEFT(tmp, field) == NULL || \
        RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) &&\
        (RB_RIGHT(tmp, field) == NULL || \
        RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK)) {\
        RB_COLOR(tmp, field) = RB_RED; \
        elm = parent; \
        parent = RB_PARENT(elm, field); \
    } else { \
        if (RB_LEFT(tmp, field) == NULL || \
            RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) {\
            struct type *oright; \
            if ((oright = RB_RIGHT(tmp, field)) \
                != NULL) \
                RB_COLOR(oright, field) = RB_BLACK;\
            RB_COLOR(tmp, field) = RB_RED; \
            RB_ROTATE_LEFT(head, tmp, oright, field);\
            tmp = RB_LEFT(parent, field); \
        } \
        RB_COLOR(tmp, field) = RB_COLOR(parent, field);\
        RB_COLOR(parent, field) = RB_BLACK;\
        if (RB_LEFT(tmp, field)) \
            RB_COLOR(RB_LEFT(tmp, field), field) = RB_BLACK;\
        RB_ROTATE_RIGHT(head, parent, tmp, field);\
        elm = RB_ROOT(head); \
        break; \
    } \
} \
} \
if
(elm) \
    RB_COLOR(elm, field) = RB_BLACK; \

```

```

}    \
    \
attr struct type *    \
name##_RB_REMOVE(struct name *head, struct type *elm) \
{    \
    struct type *child, *parent, *old = elm; \
    int color;    \
    if (RB_LEFT(elm, field) == NULL) \
        child = RB_RIGHT(elm, field); \
    else if (RB_RIGHT(elm, field) == NULL) \
        child = RB_LEFT(elm, field); \
    else {    \
        struct type *left; \
        elm = RB_RIGHT(elm, field); \
        while ((left = RB_LEFT(elm, field)) != NULL) \
            elm = left; \
        child = RB_RIGHT(elm, field); \
        parent = RB_PARENT(elm, field); \
        color = RB_COLOR(elm, field); \
        if (child) \
            RB_PARENT(child, field) = parent; \
        if (parent) {    \
            if (RB_LEFT(parent, field) == elm) \
                RB_LEFT(parent, field) = child; \
            else \
                RB_RIGHT(parent, field) = child; \
            RB_AUGMENT(parent); \
        } else \
            RB_ROOT(head)
    = child; \
    if (RB_PARENT(elm, field) == old) \
        parent = elm; \
    (elm)->field = (old)->field; \
    if (RB_PARENT(old, field)) { \
        if (RB_LEFT(RB_PARENT(old, field), field) == old)\
            RB_LEFT(RB_PARENT(old, field), field) = elm;\
        else \
            RB_RIGHT(RB_PARENT(old, field), field) = elm;\
        RB_AUGMENT(RB_PARENT(old, field)); \
    } else \
        RB_ROOT(head) = elm; \
    RB_PARENT(RB_LEFT(old, field), field) = elm; \
    if (RB_RIGHT(old, field)) \
        RB_PARENT(RB_RIGHT(old, field), field) = elm; \
    if (parent) {    \
        left = parent; \
        do {    \
            RB_AUGMENT(left); \

```

```

    } while ((left = RB_PARENT(left, field)) != NULL); \
} \
goto color; \
} \
parent = RB_PARENT(elm, field); \
color = RB_COLOR(elm, field); \
if (child) \
    RB_PARENT(child, field) = parent; \
if (parent) { \
    if (RB_LEFT(parent, field) == elm) \
        RB_LEFT(parent, field) = child; \
    else \
        RB_RIGHT(parent, \
field) = child; \
    RB_AUGMENT(parent); \
} else \
    RB_ROOT(head) = child; \
color: \
if (color == RB_BLACK) \
    name##_RB_REMOVE_COLOR(head, parent, child); \
return (old); \
} \
\
/* Inserts a node into the RB tree */ \
attr struct type * \
name##_RB_INSERT(struct name *head, struct type *elm) \
{ \
    struct type *tmp; \
    struct type *parent = NULL; \
    int comp = 0; \
    tmp = RB_ROOT(head); \
    while (tmp) { \
        parent = tmp; \
        comp = (cmp)(elm, parent); \
        if (comp < 0) \
            tmp = RB_LEFT(tmp, field); \
        else if (comp > 0) \
            tmp = RB_RIGHT(tmp, field); \
        else \
            return (tmp); \
    } \
    RB_SET(elm, parent, field); \
    if (parent != NULL) { \
        if (comp < 0) \
            RB_LEFT(parent, field) = elm; \
        else \
            RB_RIGHT(parent, field) = elm; \
        RB_AUGMENT(parent); \
    }

```

```

} else    \
    RB_ROOT(head) = elm;    \
name##_RB_INSERT_COLOR(head,
elm);    \
return (NULL);    \
}    \
    \

/* Finds the node with the same key as elm */    \
attr struct type *    \
name##_RB_FIND(struct name *head, struct type *elm)    \
{    \
    struct type *tmp = RB_ROOT(head);    \
    int comp;    \
    while (tmp) {    \
        comp = cmp(elm, tmp);    \
        if (comp < 0)    \
            tmp = RB_LEFT(tmp, field);    \
        else if (comp > 0)    \
            tmp = RB_RIGHT(tmp, field);    \
        else    \
            return (tmp);    \
    }    \
    return (NULL);    \
}    \
    \

/* Finds the first node greater than or equal to the search key */    \
attr struct type *    \
name##_RB_NFIND(struct name *head, struct type *elm)    \
{    \
    struct type *tmp = RB_ROOT(head);    \
    struct type *res = NULL;    \
    int comp;    \
    while (tmp) {    \
        comp = cmp(elm, tmp);    \
        if (comp < 0) {    \
            res = tmp;    \
            tmp = RB_LEFT(tmp, field);    \
        }    \
        else if (comp > 0)    \
            tmp =
RB_RIGHT(tmp, field);    \
        else    \
            return (tmp);    \
    }    \
    return (res);    \
}    \
    \

/* ARGSUSED */    \

```

```

attr struct type *    \
name##_RB_NEXT(struct type *elm)    \
{    \
if (RB_RIGHT(elm, field)) {    \
elm = RB_RIGHT(elm, field);    \
while (RB_LEFT(elm, field))    \
elm = RB_LEFT(elm, field);    \
} else {    \
if (RB_PARENT(elm, field) &&    \
(elm == RB_LEFT(RB_PARENT(elm, field), field))) \
elm = RB_PARENT(elm, field);    \
else {    \
while (RB_PARENT(elm, field) &&    \
(elm == RB_RIGHT(RB_PARENT(elm, field), field)))\
elm = RB_PARENT(elm, field);    \
elm = RB_PARENT(elm, field);    \
}    \
}    \
return (elm);    \
}    \
    \
/* ARGSUSED */    \
attr struct type *    \
name##_RB_PREV(struct type *elm)    \
{    \
if (RB_LEFT(elm, field)) {    \
elm = RB_LEFT(elm, field);    \
while (RB_RIGHT(elm, field))    \
elm = RB_RIGHT(elm, field);    \
}    \
else {    \
if (RB_PARENT(elm, field) &&    \
(elm == RB_RIGHT(RB_PARENT(elm, field), field))) \
elm = RB_PARENT(elm, field);    \
else {    \
while (RB_PARENT(elm, field) &&    \
(elm == RB_LEFT(RB_PARENT(elm, field), field)))\
elm = RB_PARENT(elm, field);    \
elm = RB_PARENT(elm, field);    \
}    \
}    \
return (elm);    \
}    \
    \
attr struct type *    \
name##_RB_MINMAX(struct name *head, int val)    \
{    \
struct type *tmp = RB_ROOT(head);    \

```

```

struct type *parent = NULL;  \
while (tmp) {  \
    parent = tmp;  \
    if (val < 0)  \
        tmp = RB_LEFT(tmp, field);  \
    else  \
        tmp = RB_RIGHT(tmp, field);  \
}  \
return (parent);  \
}

#define RB_NEGINF -1
#define RB_INF 1

#define RB_INSERT(name, x, y) name##_RB_INSERT(x, y)
#define RB_REMOVE(name, x, y) name##_RB_REMOVE(x, y)
#define RB_FIND(name, x, y) name##_RB_FIND(x, y)
#define RB_NFIND(name, x, y) name##_RB_NFIND(x,
y)
#define RB_NEXT(name, x, y) name##_RB_NEXT(y)
#define RB_PREV(name, x, y) name##_RB_PREV(y)
#define RB_MIN(name, x) name##_RB_MINMAX(x, RB_NEGINF)
#define RB_MAX(name, x) name##_RB_MINMAX(x, RB_INF)

#define RB_FOREACH(x, name, head)  \
for ((x) = RB_MIN(name, head);  \
    (x) != NULL;  \
    (x) = name##_RB_NEXT(x))

#define RB_FOREACH_FROM(x, name, y)  \
for ((x) = (y);  \
    ((x) != NULL) && ((y) = name##_RB_NEXT(x), (x) != NULL); \
    (x) = (y))

#define RB_FOREACH_SAFE(x, name, head, y)  \
for ((x) = RB_MIN(name, head);  \
    ((x) != NULL) && ((y) = name##_RB_NEXT(x), (x) != NULL); \
    (x) = (y))

#define RB_FOREACH_REVERSE(x, name, head)  \
for ((x) = RB_MAX(name, head);  \
    (x) != NULL;  \
    (x) = name##_RB_PREV(x))

#define RB_FOREACH_REVERSE_FROM(x, name, y)  \
for ((x) = (y);  \
    ((x) != NULL) && ((y) = name##_RB_PREV(x), (x) != NULL); \
    (x) = (y))

```

```
#define RB_FOREACH_REVERSE_SAFE(x, name,
head, y) \
for ((x) = RB_MAX(name, head); \
(x) != NULL) && ((y) = name##_RB_PREV(x), (x) != NULL); \
(x) = (y))

#endif /* _SYS_TREE_H_ */
pkgname=linux-headers
pkgver=6.14.2 # Follow the latest Linux stable
_kernver=${pkgver%.*}
pkgrel=0
pkgdesc="Linux system headers"
url="https://kernel.org/"
arch="all" # Headers are architecture specific
license="GPL-2.0-only"
makedepends="perl"
options="!check !dbg !strip !tracedeps !archcheck"
source="https://kernel.org/pub/linux/kernel/v6.x/linux-${_kernver}.tar.xz
revert-broken-uapi.patch
0003-remove-inclusion-of-sysinfo.h-in-kernel.h.patch
```

# 1.178 packaging 24.2

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# 1.179 ncurses 6.5\_p20250503-r0

## 1.179.1 Available under license :

```
# Contributor: Patrycja Rosa <alpine@ptrcnull.me>
# Maintainer: Patrycja Rosa <alpine@ptrcnull.me>
pkgname=bsd-compat-headers
pkgver=0.7.2
pkgrel=6
pkgdesc="BSD compatibility headers (cdefs, queue, tree)"
url="https://gitlab.alpinelinux.org/alpine/aports"
arch="noarch"
license="BSD-2-Clause AND BSD-3-Clause"
source="
cdefs.h
queue.h
tree.h
"
buildddir="$srcdir"
options="!check" # just headers

package() {
    mkdir -p "$pkgdir"
    install -Dm644 -t "$pkgdir"/usr/include/sys \
        cdefs.h queue.h tree.h
}
sha512sums="
37c8fc73c7aea7b490f7850927e2bb91d12137c9e59e22c084146d515696dbc7973b5de92f4c987ba080dd2502ba8312
7006442c3f019b6447a620c0cae73178 cdefs.h
2f0d5e6e4dc3350285cf17009265dddcb12431c111868eea39bc8cb038ab7c1f2acacbb21735c4e9d4a1fd106a8fc0f86
11ea33987d4faba37dde5ce6da0750 queue.h
d9ac210d81feb8ad2655bc80fb065d3fe20ae4417b32b4a1711e6738a4870140005c13373b5d1846ef3ce5ae6da45f2da
cef2092881eded0a2e94f6a07752ef3 tree.h
"

# Automatically generated by apkbuild-cpan, template 4
# Contributor: Valery Kartel <valery.kartel@gmail.com>
# Maintainer: Celeste <cielesti@protonmail.com>
maintainer="Celeste <cielesti@protonmail.com>"
pkgname=perl-bsd-resource
pkgver=1.2911
pkgrel=10
#_pkgreal is used by apkbuild-cpan to find modules at MetaCpan
_pkgreal=BSD-Resource
pkgdesc="Perl extension implements the BSD process resource limit functions"
url="https://metacpan.org/release/BSD-Resource/"
arch="all"
license="Artistic-2.0 OR LGPL-2.0"
```

```

depends="perl"
makedepends="perl-dev"
subpackages="$pkgname-doc"
source="https://cpan.metacpan.org/authors/id/J/JH/JHI/BSD-Resource-$pkgver.tar.gz"
builddir="$srcdir/$_pkgreal-$pkgver"

build() {
    export CFLAGS=$(perl -MConfig -E 'say $Config{ccflags}')
    PERL_MM_USE_DEFAULT=1 perl -I. Makefile.PL \
        INSTALLDIRS=vendor \
        NO_PACKLIST=1 \
        NO_PERLLOCAL=1
    make
}

check() {
    export CFLAGS=$(perl -MConfig -E 'say $Config{ccflags}')
    make test
}

package() {
    make DESTDIR="$pkgdir" install
}

sha512sums="
d0032d41c7c0468ed1c6d8f57b885f6cb97a5039d754c8cb60b2067daedaf53bd15fb6561a3d0f828df16dfa5417f663b
8065ba65f4fea16dc9262728b3b6b85
    BSD-Resource-1.2911.tar.gz
"

# Contributor: Fabian Affolter <fabian@affolter-engineering.ch>
# Maintainer: Fabian Affolter <fabian@affolter-engineering.ch>
pkgname=py3-flake8-copyright
_pkgname=flake8-copyright
pkgver=0.2.4
pkgrel=3
pkgdesc="Extension for flake8 which checks for copyrights"
options="!check" # No testsuite
url="https://github.com/savoirfairelinux/flake8-copyright"
arch="noarch"
license="MIT"
depends="py3-flake8 py3-setuptools"
makedepends="py3-gpep517 py3-wheel"
subpackages="$pkgname-pyc"
source="https://files.pythonhosted.org/packages/source/${_pkgname:0:1}/${_pkgname}/${_pkgname}-${pkgver}.tar.gz"
builddir="$srcdir"/$_pkgname-$pkgver

replaces="py-flake8-copyright" # Backwards compatibility
provides="py-flake8-copyright=$pkgver-r$pkgrel" # Backwards compatibility

```

```

build() {
    gpep517 build-wheel \
        --wheel-dir .dist \
        --output-fd 3 3>&1 >&2
}

package() {
    gpep517 install-wheel --destdir "$pkgdir" \
        .dist/*.whl
}

sha512sums="
a6ab47e1bb715618f075c51f398e18180404871b3b0faf1c2d30701d5203db6bc23771bf22ffb5bafcd8ee856b9b64237
b316bd503ae7dceed6ca284ccd5a74d
    flake8-copyright-0.2.4.tar.gz
"

#ifndef _SYS_CDEFS_H_
#define _SYS_CDEFS_H_

#warning usage of non-standard #include <sys/cdefs.h> is deprecated

#undef __P
#undef __PMT

#define __P(args) args
#define __PMT(args) args

#define __CONCAT(x,y) x ## y
#define __STRING(x) #x

#ifdef __cplusplus
# define __BEGIN_DECLS extern "C" {
# define __END_DECLS }
#else
# define __BEGIN_DECLS
# define __END_DECLS
#endif

#if defined(__GNUC__) && !defined(__cplusplus)
# define __THROW __attribute__((__nothrow__))
# define __NTH(fct) __attribute__((__nothrow__)) fct
#else
# define __THROW
# define __NTH(fct)    fct
#endif

#endif /* _SYS_CDEFS_H_ */

```

```

# Maintainer: fossdd <fossdd@pwned.life>
pkgname=cargo-license
pkgver=0.6.1
pkgrel=1
pkgdesc="Cargo subcommand to see license of dependencies"
url="https://github.com/onur/cargo-license"
arch="all"
license="MIT"
makedepends="cargo cargo-auditable"
source="$pkgname-$pkgver.tar.gz::https://crates.io/api/v1/crates/cargo-license/$pkgver/download"

prepare() {
    default_prepare

    cargo fetch --target="$CTARGET" --locked
}

build() {
    cargo auditable build --release --frozen
}

check() {
    cargo test --frozen
}

package() {
    install -Dm755 target/release/cargo-license -t "$pkgdir"/usr/bin
}

sha512sums="
36215145e79965be090ae2f5ce6f5eb208465eb67a94c26bed1fe70a131c46c6dc35695e30852759b7366883fbc3caf00
272d796ac634f0a5e1d49232b6b29d5  cargo-license-0.6.1.tar.gz
"

/* $NetBSD: tree.h,v 1.20 2013/09/14 13:20:45 joerg Exp $ */
/* $OpenBSD: tree.h,v 1.13 2011/07/09 00:19:45 pirofti Exp $ */
/* Modified by Void Linux. */
/*
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```

```

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* THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.
*/

```

```

#ifndef _SYS_TREE_H_
#define _SYS_TREE_H_

```

```

#ifdef __GNUC__
#define __GNUC_PREREQ__(x, y) \
  ((__GNUC__ == (x) && __GNUC_MINOR__ >= (y)) || \
   (__GNUC__ > (x)))
#else
#define __GNUC_PREREQ__(x, y) 0
#endif

```

```

#if __GNUC_PREREQ__(2, 7) || defined(__lint__)
#define _sys_tree_h_unused __attribute__((__unused__))
#else
#define _sys_tree_h_unused /* delete */
#endif

```

```

/*
* This file defines data structures for different types of trees:
* splay trees and red-black trees.
*
* A splay tree is a self-organizing
  data structure. Every operation
* on the tree causes a splay to happen. The splay moves the requested
* node to the root of the tree and partly rebalances it.
*
* This has the benefit that request locality causes faster lookups as
* the requested nodes move to the top of the tree. On the other hand,
* every lookup causes memory writes.
*
* The Balance Theorem bounds the total access time for m operations
* and n inserts on an initially empty tree as O((m + n)lg n). The
* amortized cost for a sequence of m accesses to a splay tree is O(lg n);
*

```



```

* A red-black tree is a binary search tree with the node color as an
* extra attribute. It fulfills a set of conditions:
* - every search path from the root to a leaf consists of the
*   same number of black nodes,
* - each red node (except for the root) has a black parent,
* - each leaf node is black.
*
* Every operation on a red-black tree is bounded as  $O(\lg n)$ .
* The maximum height of a red-black tree is  $2\lg(n+1)$ .
*/

#define SPLAY_HEAD(name, type) \
struct name { \
    struct type *sph_root; /* root of the tree */ \
}

#define SPLAY_INITIALIZER(root) \
{ NULL }

#define SPLAY_INIT(root) do { \
    (root)->sph_root = NULL; \
} while (/*CONSTCOND*/ 0)

#define SPLAY_ENTRY(type) \
struct { \
    struct type *spe_left; /* left element */ \
    struct type *spe_right; /* right element */ \
}

#define SPLAY_LEFT(elm, field) (elm)->field.spe_left
#define SPLAY_RIGHT(elm, field) (elm)->field.spe_right
#define SPLAY_ROOT(head) (head)->sph_root
#define SPLAY_EMPTY(head) (SPLAY_ROOT(head) == NULL)

/* SPLAY_ROTATE_{LEFT,RIGHT} expect that tmp hold SPLAY_{RIGHT,LEFT} */
#define SPLAY_ROTATE_RIGHT(head, tmp, field) do { \
    SPLAY_LEFT((head)->sph_root, field) = SPLAY_RIGHT(tmp, field); \
    SPLAY_RIGHT(tmp, field) = (head)->sph_root; \
    (head)->sph_root = tmp; \
} while (/*CONSTCOND*/ 0)

#define SPLAY_ROTATE_LEFT(head, tmp, field) do { \
    SPLAY_RIGHT((head)->sph_root, \
    field) = SPLAY_LEFT(tmp, field); \
    SPLAY_LEFT(tmp, field) = (head)->sph_root; \
    (head)->sph_root = tmp; \
} while (/*CONSTCOND*/ 0)

```

```

#define SPLAY_LINKLEFT(head, tmp, field) do { \
    SPLAY_LEFT(tmp, field) = (head)->sph_root; \
    tmp = (head)->sph_root; \
    (head)->sph_root = SPLAY_LEFT((head)->sph_root, field); \
} while (/*CONSTCOND*/ 0)

#define SPLAY_LINKRIGHT(head, tmp, field) do { \
    SPLAY_RIGHT(tmp, field) = (head)->sph_root; \
    tmp = (head)->sph_root; \
    (head)->sph_root = SPLAY_RIGHT((head)->sph_root, field); \
} while (/*CONSTCOND*/ 0)

#define SPLAY_ASSEMBLE(head, node, left, right, field) do { \
    SPLAY_RIGHT(left, field) = SPLAY_LEFT((head)->sph_root, field); \
    SPLAY_LEFT(right, field) = SPLAY_RIGHT((head)->sph_root, field); \
    SPLAY_LEFT((head)->sph_root, field) = SPLAY_RIGHT(node, field); \
    SPLAY_RIGHT((head)->sph_root, field) = SPLAY_LEFT(node, field); \
} while (/*CONSTCOND*/ 0)

/* Generates prototypes and inline functions */

#define
    SPLAY_PROTOTYPE(name, type, field, cmp) \
void name##_SPLAY(struct name *, struct type *); \
void name##_SPLAY_MINMAX(struct name *, int); \
struct type *name##_SPLAY_INSERT(struct name *, struct type *); \
struct type *name##_SPLAY_REMOVE(struct name *, struct type *); \
\
/* Finds the node with the same key as elm */ \
static __inline struct type * \
name##_SPLAY_FIND(struct name *head, struct type *elm) \
{ \
    if (SPLAY_EMPTY(head)) \
        return(NULL); \
    name##_SPLAY(head, elm); \
    if ((cmp)(elm, (head)->sph_root) == 0) \
        return (head->sph_root); \
    return (NULL); \
} \
\
static __inline _sys_tree_h_unused struct type * \
name##_SPLAY_NEXT(struct name *head, struct type *elm) \
{ \
    name##_SPLAY(head, elm); \
    if (SPLAY_RIGHT(elm, field) != NULL) { \
        elm = SPLAY_RIGHT(elm, field); \
        while (SPLAY_LEFT(elm, field) != NULL) { \
            elm = SPLAY_LEFT(elm, field); \

```

```

    } \
}
else \
    elm = NULL; \
return (elm); \
} \
\
static __sys_tree_h_unused __inline struct type * \
name##_SPLAY_MIN_MAX(struct name *head, int val) \
{ \
    name##_SPLAY_MINMAX(head, val); \
    return (SPLAY_ROOT(head)); \
}

/* Main splay operation.
 * Moves node close to the key of elm to top
 */
#define SPLAY_GENERATE(name, type, field, cmp) \
struct type * \
name##_SPLAY_INSERT(struct name *head, struct type *elm) \
{ \
    if (SPLAY_EMPTY(head)) { \
        SPLAY_LEFT(elm, field) = SPLAY_RIGHT(elm, field) = NULL; \
    } else { \
        int __comp; \
        name##_SPLAY(head, elm); \
        __comp = (cmp)(elm, (head)->sph_root); \
        if (__comp < 0) { \
            SPLAY_LEFT(elm, field) = SPLAY_LEFT((head)->sph_root, field); \
            SPLAY_RIGHT(elm, field) = (head)->sph_root; \
            SPLAY_LEFT((head)->sph_root, field) = NULL; \
        } else if (__comp > 0) { \
            SPLAY_RIGHT(elm, \
field) = SPLAY_RIGHT((head)->sph_root, field); \
            SPLAY_LEFT(elm, field) = (head)->sph_root; \
            SPLAY_RIGHT((head)->sph_root, field) = NULL; \
        } else \
            return ((head)->sph_root); \
    } \
    (head)->sph_root = (elm); \
    return (NULL); \
} \
\
struct type * \
name##_SPLAY_REMOVE(struct name *head, struct type *elm) \
{ \
    struct type *__tmp; \
    if (SPLAY_EMPTY(head)) \

```

```

return (NULL); \
name##_SPLAY(head, elm); \
if ((cmp)(elm, (head)->sph_root) == 0) { \
    if (SPLAY_LEFT((head)->sph_root, field) == NULL) { \
        (head)->sph_root = SPLAY_RIGHT((head)->sph_root, field);\
    } else { \
        __tmp = SPLAY_RIGHT((head)->sph_root, field); \
        (head)->sph_root = SPLAY_LEFT((head)->sph_root, field);\
        name##_SPLAY(head, elm); \
        SPLAY_RIGHT((head)->sph_root, field) = __tmp; \
    } \
    return (elm); \
} \
return (NULL); \
} \
\
void \
name##_SPLAY(struct
name *head, struct type *elm) \
{ \
    struct type __node, *__left, *__right, *__tmp; \
    int __comp; \
    \
    SPLAY_LEFT(&__node, field) = SPLAY_RIGHT(&__node, field) = NULL;\
    __left = __right = &__node; \
    \
    while ((__comp = (cmp)(elm, (head)->sph_root)) != 0) { \
        if (__comp < 0) { \
            __tmp = SPLAY_LEFT((head)->sph_root, field); \
            if (__tmp == NULL) \
                break; \
            if ((cmp)(elm, __tmp) < 0){ \
                SPLAY_ROTATE_RIGHT(head, __tmp, field); \
                if (SPLAY_LEFT((head)->sph_root, field) == NULL)\
                    break; \
            } \
            SPLAY_LINKLEFT(head, __right, field); \
        } else if (__comp > 0) { \
            __tmp = SPLAY_RIGHT((head)->sph_root, field); \
            if (__tmp == NULL) \
                break; \
            if ((cmp)(elm, __tmp) > 0){ \
                SPLAY_ROTATE_LEFT(head, __tmp, field); \
                if (SPLAY_RIGHT((head)->sph_root, field) == NULL)\
                    break; \
            } \
            SPLAY_LINKRIGHT(head, __left, field); \
        } \
    }

```

```

} \
SPLAY_ASSEMBLE(head,
&__node, __left, __right, field); \
} \
\
/* Splay with either the minimum or the maximum element \
* Used to find minimum or maximum element in tree. \
*/ \
void name##_SPLAY_MINMAX(struct name *head, int __comp) \
{ \
    struct type __node, *__left, *__right, *__tmp; \
    \
    SPLAY_LEFT(&__node, field) = SPLAY_RIGHT(&__node, field) = NULL; \
    __left = __right = &__node; \
    \
    while (1) { \
        if (__comp < 0) { \
            __tmp = SPLAY_LEFT((head)->sph_root, field); \
            if (__tmp == NULL) \
                break; \
            if (__comp < 0){ \
                SPLAY_ROTATE_RIGHT(head, __tmp, field); \
                if (SPLAY_LEFT((head)->sph_root, field) == NULL) \
                    break; \
            } \
            SPLAY_LINKLEFT(head, __right, field); \
        } else if (__comp > 0) { \
            __tmp = SPLAY_RIGHT((head)->sph_root, field); \
            if (__tmp == NULL) \
                break; \
            if (__comp > 0) { \
                SPLAY_ROTATE_LEFT(head, __tmp, field); \
                if (SPLAY_RIGHT((head)->sph_root, \
field) == NULL) \
                    break; \
            } \
            SPLAY_LINKRIGHT(head, __left, field); \
        } \
    } \
    SPLAY_ASSEMBLE(head, &__node, __left, __right, field); \
}

```

```

#define SPLAY_NEGINF -1

```

```

#define SPLAY_INF 1

```

```

#define SPLAY_INSERT(name, x, y) name##_SPLAY_INSERT(x, y)

```

```

#define SPLAY_REMOVE(name, x, y) name##_SPLAY_REMOVE(x, y)

```

```

#define SPLAY_FIND(name, x, y) name##_SPLAY_FIND(x, y)

```

```

#define SPLAY_NEXT(name, x, y) name##_SPLAY_NEXT(x, y)
#define SPLAY_MIN(name, x) (SPLAY_EMPTY(x) ? NULL \
    : name##_SPLAY_MIN_MAX(x, SPLAY_NEGINF))
#define SPLAY_MAX(name, x) (SPLAY_EMPTY(x) ? NULL \
    : name##_SPLAY_MIN_MAX(x, SPLAY_INF))

#define SPLAY_FOREACH(x, name, head) \
    for ((x) = SPLAY_MIN(name, head); \
        (x) != NULL; \
        (x) = SPLAY_NEXT(name, head, x))

/* Macros that define a red-black tree */
#define RB_HEAD(name, type) \
    struct name { \
        struct type *rbh_root; /* root of the tree */ \
    }

#define RB_INITIALIZER(root) \
    { \
        NULL \
    }

#define RB_INIT(root) do { \
    (root)->rbh_root = NULL; \
} while (/*CONSTCOND*/ 0)

#define RB_BLACK 0
#define RB_RED 1
#define RB_ENTRY(type) \
    struct { \
        struct type *rbe_left; /* left element */ \
        struct type *rbe_right; /* right element */ \
        struct type *rbe_parent; /* parent element */ \
        int rbe_color; /* node color */ \
    }

#define RB_LEFT(elm, field) (elm)->field.rbe_left
#define RB_RIGHT(elm, field) (elm)->field.rbe_right
#define RB_PARENT(elm, field) (elm)->field.rbe_parent
#define RB_COLOR(elm, field) (elm)->field.rbe_color
#define RB_ROOT(head) (head)->rbh_root
#define RB_EMPTY(head) (RB_ROOT(head) == NULL)

#define RB_SET(elm, parent, field) do { \
    RB_PARENT(elm, field) = parent; \
    RB_LEFT(elm, field) = RB_RIGHT(elm, field) = NULL; \
    RB_COLOR(elm, field) = RB_RED; \
} while (/*CONSTCOND*/ 0)

```

```

#define RB_SET_BLACKRED(black, red, field) do { \
    RB_COLOR(black, field) = RB_BLACK; \
    RB_COLOR(red, field) \
    = RB_RED; \
} while (/*CONSTCOND*/ 0)

#ifndef RB_AUGMENT
#define RB_AUGMENT(x) do {} while (/*CONSTCOND*/ 0)
#endif

#define RB_ROTATE_LEFT(head, elm, tmp, field) do { \
    (tmp) = RB_RIGHT(elm, field); \
    if ((RB_RIGHT(elm, field) = RB_LEFT(tmp, field)) != NULL) { \
        RB_PARENT(RB_LEFT(tmp, field), field) = (elm); \
    } \
    RB_AUGMENT(elm); \
    if ((RB_PARENT(tmp, field) = RB_PARENT(elm, field)) != NULL) { \
        if ((elm) == RB_LEFT(RB_PARENT(elm, field), field)) \
            RB_LEFT(RB_PARENT(elm, field), field) = (tmp); \
        else \
            RB_RIGHT(RB_PARENT(elm, field), field) = (tmp); \
    } else \
        (head)->rbh_root = (tmp); \
    RB_LEFT(tmp, field) = (elm); \
    RB_PARENT(elm, field) = (tmp); \
    RB_AUGMENT(tmp); \
    if ((RB_PARENT(tmp, field))) \
        RB_AUGMENT(RB_PARENT(tmp, field)); \
} while (/*CONSTCOND*/ 0)

#define RB_ROTATE_RIGHT(head, elm, tmp, field) do { \
    (tmp) = RB_LEFT(elm, field); \
    if ((RB_LEFT(elm, field) = RB_RIGHT(tmp, field)) \
        != NULL) { \
        RB_PARENT(RB_RIGHT(tmp, field), field) = (elm); \
    } \
    RB_AUGMENT(elm); \
    if ((RB_PARENT(tmp, field) = RB_PARENT(elm, field)) != NULL) { \
        if ((elm) == RB_LEFT(RB_PARENT(elm, field), field)) \
            RB_LEFT(RB_PARENT(elm, field), field) = (tmp); \
        else \
            RB_RIGHT(RB_PARENT(elm, field), field) = (tmp); \
    } else \
        (head)->rbh_root = (tmp); \
    RB_RIGHT(tmp, field) = (elm); \
    RB_PARENT(elm, field) = (tmp); \
    RB_AUGMENT(tmp); \
    if ((RB_PARENT(tmp, field))) \

```

```

    RB_AUGMENT(RB_PARENT(tmp, field)); \
} while (/*CONSTCOND*/ 0)

/* Generates prototypes and inline functions */
#define RB_PROTOTYPE(name, type, field, cmp) \
    RB_PROTOTYPE_INTERNAL(name, type, field, cmp,)
#define RB_PROTOTYPE_STATIC(name, type, field, cmp) \
    RB_PROTOTYPE_INTERNAL(name, type, field, cmp, _sys_tree_h_unused static)
#define RB_PROTOTYPE_INTERNAL(name, type, field, cmp, attr) \
    attr void name##_RB_INSERT_COLOR(struct name *, struct \
    type *); \
    attr void name##_RB_REMOVE_COLOR(struct name *, struct type *, struct type *);\
    attr struct type *name##_RB_REMOVE(struct name *, struct type *); \
    attr struct type *name##_RB_INSERT(struct name *, struct type *); \
    attr struct type *name##_RB_FIND(struct name *, struct type *); \
    attr struct type *name##_RB_NFIND(struct name *, struct type *); \
    attr struct type *name##_RB_NEXT(struct type *); \
    attr struct type *name##_RB_PREV(struct type *); \
    attr struct type *name##_RB_MINMAX(struct name *, int); \
    \

/* Main rb operation.
 * Moves node close to the key of elm to top
 */
#define RB_GENERATE(name, type, field, cmp) \
    RB_GENERATE_INTERNAL(name, type, field, cmp,)
#define RB_GENERATE_STATIC(name, type, field, cmp) \
    RB_GENERATE_INTERNAL(name, type, field, cmp, _sys_tree_h_unused static)
#define RB_GENERATE_INTERNAL(name, type, field, cmp, attr) \
    attr void \
    name##_RB_INSERT_COLOR(struct name *head, struct type *elm) \
    { \
        struct type \
        *parent, *gparent, *tmp; \
        while ((parent = RB_PARENT(elm, field)) != NULL && \
            RB_COLOR(parent, field) == RB_RED) { \
            gparent = RB_PARENT(parent, field); \
            if (parent == RB_LEFT(gparent, field)) { \
                tmp = RB_RIGHT(gparent, field); \
                if (tmp && RB_COLOR(tmp, field) == RB_RED) { \
                    RB_COLOR(tmp, field) = RB_BLACK; \
                    RB_SET_BLACKRED(parent, gparent, field);\
                    elm = gparent; \
                    continue; \
                } \
            } \
            if (RB_RIGHT(parent, field) == elm) { \
                RB_ROTATE_LEFT(head, parent, tmp, field);\
                tmp = parent; \

```



```

    parent = elm; \
    elm = tmp; \
} \
RB_SET_BLACKRED(parent, gparent, field); \
RB_ROTATE_RIGHT(head, gparent, tmp, field); \
} else { \
    tmp = RB_LEFT(gparent, field); \
    if (tmp && RB_COLOR(tmp, field) == RB_RED) { \
        RB_COLOR(tmp, field) = RB_BLACK; \
        RB_SET_BLACKRED(parent, gparent, field); \
        elm = gparent; \
        continue; \
    } \
    if (RB_LEFT(parent, field) == elm)
{ \
    RB_ROTATE_RIGHT(head, parent, tmp, field); \
    tmp = parent; \
    parent = elm; \
    elm = tmp; \
} \
    RB_SET_BLACKRED(parent, gparent, field); \
    RB_ROTATE_LEFT(head, gparent, tmp, field); \
} \
} \
RB_COLOR(head->rbh_root, field) = RB_BLACK; \
} \
\
attr void \
name##_RB_REMOVE_COLOR(struct name *head, struct type *parent, struct type *elm) \
{ \
    struct type *tmp; \
    while ((elm == NULL || RB_COLOR(elm, field) == RB_BLACK) && \
        elm != RB_ROOT(head)) { \
        if (RB_LEFT(parent, field) == elm) { \
            tmp = RB_RIGHT(parent, field); \
            if (RB_COLOR(tmp, field) == RB_RED) { \
                RB_SET_BLACKRED(tmp, parent, field); \
                RB_ROTATE_LEFT(head, parent, tmp, field); \
                tmp = RB_RIGHT(parent, field); \
            } \
            if ((RB_LEFT(tmp, field) == NULL || \
                RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) && \
                (RB_RIGHT(tmp, field) == NULL || \
                RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK)) { \
                RB_COLOR(tmp, field) = RB_RED; \
                elm = parent; \
                parent = RB_PARENT(elm, field); \

```

```

} else { \
if (RB_RIGHT(tmp, field) == NULL || \
    RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK) {\
    struct type *oleft; \
    if ((oleft = RB_LEFT(tmp, field)) \
        != NULL) \
        RB_COLOR(oleft, field) = RB_BLACK;\
    RB_COLOR(tmp, field) = RB_RED; \
    RB_ROTATE_RIGHT(head, tmp, oleft, field);\
    tmp = RB_RIGHT(parent, field); \
} \
RB_COLOR(tmp, field) = RB_COLOR(parent, field);\
RB_COLOR(parent, field) = RB_BLACK; \
if (RB_RIGHT(tmp, field)) \
    RB_COLOR(RB_RIGHT(tmp, field), field) = RB_BLACK;\
RB_ROTATE_LEFT(head, parent, tmp, field);\
elm = RB_ROOT(head); \
break; \
} \
} else { \
tmp = RB_LEFT(parent, field); \
if (RB_COLOR(tmp, field) == RB_RED) { \
    RB_SET_BLACKRED(tmp, parent, field); \
    RB_ROTATE_RIGHT(head, parent, tmp, field);\
    tmp
= RB_LEFT(parent, field); \
} \
if ((RB_LEFT(tmp, field) == NULL || \
    RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) &&\
    (RB_RIGHT(tmp, field) == NULL || \
    RB_COLOR(RB_RIGHT(tmp, field), field) == RB_BLACK)) {\
    RB_COLOR(tmp, field) = RB_RED; \
    elm = parent; \
    parent = RB_PARENT(elm, field); \
} else { \
if (RB_LEFT(tmp, field) == NULL || \
    RB_COLOR(RB_LEFT(tmp, field), field) == RB_BLACK) {\
    struct type *oright; \
    if ((oright = RB_RIGHT(tmp, field)) \
        != NULL) \
        RB_COLOR(oright, field) = RB_BLACK;\
    RB_COLOR(tmp, field) = RB_RED; \
    RB_ROTATE_LEFT(head, tmp, oright, field);\
    tmp = RB_LEFT(parent, field); \
} \
RB_COLOR(tmp, field) = RB_COLOR(parent, field);\
RB_COLOR(parent, field) = RB_BLACK; \
if (RB_LEFT(tmp, field)) \

```

```

    RB_COLOR(RB_LEFT(tmp, field), field) = RB_BLACK;\
    RB_ROTATE_RIGHT(head, parent, tmp, field);\
    elm = RB_ROOT(head); \
    break; \
} \
} \
} \
if
(elm) \
    RB_COLOR(elm, field) = RB_BLACK; \
} \
\
attr struct type * \
name##_RB_REMOVE(struct name *head, struct type *elm) \
{ \
    struct type *child, *parent, *old = elm; \
    int color; \
    if (RB_LEFT(elm, field) == NULL) \
        child = RB_RIGHT(elm, field); \
    else if (RB_RIGHT(elm, field) == NULL) \
        child = RB_LEFT(elm, field); \
    else { \
        struct type *left; \
        elm = RB_RIGHT(elm, field); \
        while ((left = RB_LEFT(elm, field)) != NULL) \
            elm = left; \
        child = RB_RIGHT(elm, field); \
        parent = RB_PARENT(elm, field); \
        color = RB_COLOR(elm, field); \
        if (child) \
            RB_PARENT(child, field) = parent; \
        if (parent) { \
            if (RB_LEFT(parent, field) == elm) \
                RB_LEFT(parent, field) = child; \
            else \
                RB_RIGHT(parent, field) = child; \
            RB_AUGMENT(parent); \
        } else \
            RB_ROOT(head)
    = child; \
    if (RB_PARENT(elm, field) == old) \
        parent = elm; \
    (elm)->field = (old)->field; \
    if (RB_PARENT(old, field)) { \
        if (RB_LEFT(RB_PARENT(old, field), field) == old)\
            RB_LEFT(RB_PARENT(old, field), field) = elm;\
        else \
            RB_RIGHT(RB_PARENT(old, field), field) = elm;\
    }

```

```

    RB_AUGMENT(RB_PARENT(old, field)); \
} else \
    RB_ROOT(head) = elm; \
    RB_PARENT(RB_LEFT(old, field), field) = elm; \
    if (RB_RIGHT(old, field)) \
        RB_PARENT(RB_RIGHT(old, field), field) = elm; \
    if (parent) { \
        left = parent; \
        do { \
            RB_AUGMENT(left); \
        } while ((left = RB_PARENT(left, field)) != NULL); \
    } \
    goto color; \
} \
parent = RB_PARENT(elm, field); \
color = RB_COLOR(elm, field); \
if (child) \
    RB_PARENT(child, field) = parent; \
if (parent) { \
    if (RB_LEFT(parent, field) == elm) \
        RB_LEFT(parent, field) = child; \
    else \
        RB_RIGHT(parent, field) = child; \
    RB_AUGMENT(parent); \
} else \
    RB_ROOT(head) = child; \
color: \
if (color == RB_BLACK) \
    name##_RB_REMOVE_COLOR(head, parent, child); \
return (old); \
} \
\
/* Inserts a node into the RB tree */ \
attr struct type * \
name##_RB_INSERT(struct name *head, struct type *elm) \
{ \
    struct type *tmp; \
    struct type *parent = NULL; \
    int comp = 0; \
    tmp = RB_ROOT(head); \
    while (tmp) { \
        parent = tmp; \
        comp = (cmp)(elm, parent); \
        if (comp < 0) \
            tmp = RB_LEFT(tmp, field); \
        else if (comp > 0) \
            tmp = RB_RIGHT(tmp, field); \
    }

```

```

else    \
    return (tmp);    \
}    \
RB_SET(elm, parent, field);    \
if (parent != NULL) {    \
    if (comp < 0)    \
        RB_LEFT(parent, field) = elm;    \
    else    \
        RB_RIGHT(parent, field) = elm;    \
    RB_AUGMENT(parent);    \
} else    \
    RB_ROOT(head) = elm;    \
name##_RB_INSERT_COLOR(head,
elm);    \
return (NULL);    \
}    \
    \
/* Finds the node with the same key as elm */    \
attr struct type *    \
name##_RB_FIND(struct name *head, struct type *elm)    \
{    \
    struct type *tmp = RB_ROOT(head);    \
    int comp;    \
    while (tmp) {    \
        comp = cmp(elm, tmp);    \
        if (comp < 0)    \
            tmp = RB_LEFT(tmp, field);    \
        else if (comp > 0)    \
            tmp = RB_RIGHT(tmp, field);    \
        else    \
            return (tmp);    \
    }    \
    return (NULL);    \
}    \
    \
/* Finds the first node greater than or equal to the search key */    \
attr struct type *    \
name##_RB_NFIND(struct name *head, struct type *elm)    \
{    \
    struct type *tmp = RB_ROOT(head);    \
    struct type *res = NULL;    \
    int comp;    \
    while (tmp) {    \
        comp = cmp(elm, tmp);    \
        if (comp < 0) {    \
            res = tmp;    \
            tmp = RB_LEFT(tmp, field);    \
        }    \
    }    \
}

```

```

else if (comp > 0) \
    tmp =
RB_RIGHT(tmp, field); \
else \
    return (tmp); \
} \
return (res); \
} \
\
/* ARGSUSED */ \
attr struct type * \
name##_RB_NEXT(struct type *elm) \
{ \
    if (RB_RIGHT(elm, field)) { \
        elm = RB_RIGHT(elm, field); \
        while (RB_LEFT(elm, field)) \
            elm = RB_LEFT(elm, field); \
    } else { \
        if (RB_PARENT(elm, field) && \
            (elm == RB_LEFT(RB_PARENT(elm, field), field))) \
            elm = RB_PARENT(elm, field); \
        else { \
            while (RB_PARENT(elm, field) && \
                (elm == RB_RIGHT(RB_PARENT(elm, field), field))) \
                elm = RB_PARENT(elm, field); \
            elm = RB_PARENT(elm, field); \
        } \
    } \
    return (elm); \
} \
\
/* ARGSUSED */ \
attr struct type * \
name##_RB_PREV(struct type *elm) \
{ \
    if (RB_LEFT(elm, field)) { \
        elm = RB_LEFT(elm, field); \
        while (RB_RIGHT(elm, field)) \
            elm = RB_RIGHT(elm, field); \
    } \
    else { \
        if (RB_PARENT(elm, field) && \
            (elm == RB_RIGHT(RB_PARENT(elm, field), field))) \
            elm = RB_PARENT(elm, field); \
        else { \
            while (RB_PARENT(elm, field) && \
                (elm == RB_LEFT(RB_PARENT(elm, field), field))) \
                elm = RB_PARENT(elm, field); \
        } \
    } \
}

```

```

    elm = RB_PARENT(elm, field); \
} \
} \
return (elm); \
} \
\
attr struct type * \
name##_RB_MINMAX(struct name *head, int val) \
{ \
    struct type *tmp = RB_ROOT(head); \
    struct type *parent = NULL; \
    while (tmp) { \
        parent = tmp; \
        if (val < 0) \
            tmp = RB_LEFT(tmp, field); \
        else \
            tmp = RB_RIGHT(tmp, field); \
    } \
    return (parent); \
}

#define RB_NEGINF -1
#define RB_INF 1

#define RB_INSERT(name, x, y) name##_RB_INSERT(x, y)
#define RB_REMOVE(name, x, y) name##_RB_REMOVE(x, y)
#define RB_FIND(name, x, y) name##_RB_FIND(x, y)
#define RB_NFIND(name, x, y) name##_RB_NFIND(x, \
y)
#define RB_NEXT(name, x, y) name##_RB_NEXT(y)
#define RB_PREV(name, x, y) name##_RB_PREV(y)
#define RB_MIN(name, x) name##_RB_MINMAX(x, RB_NEGINF)
#define RB_MAX(name, x) name##_RB_MINMAX(x, RB_INF)

#define RB_FOREACH(x, name, head) \
for ((x) = RB_MIN(name, head); \
(x) != NULL; \
(x) = name##_RB_NEXT(x))

#define RB_FOREACH_FROM(x, name, y) \
for ((x) = (y); \
((x) != NULL) && ((y) = name##_RB_NEXT(x), (x) != NULL); \
(x) = (y))

#define RB_FOREACH_SAFE(x, name, head, y) \
for ((x) = RB_MIN(name, head); \
((x) != NULL) && ((y) = name##_RB_NEXT(x), (x) != NULL); \
(x) = (y))

```

```

#define RB_FOREACH_REVERSE(x, name, head) \
for ((x) = RB_MAX(name, head); \
(x) != NULL; \
(x) = name##_RB_PREV(x))

#define RB_FOREACH_REVERSE_FROM(x, name, y) \
for ((x) = (y); \
((x) != NULL) && ((y) = name##_RB_PREV(x), (x) != NULL); \
(x) = (y))

#define RB_FOREACH_REVERSE_SAFE(x, name, \
head, y) \
for ((x) = RB_MAX(name, head); \
((x) != NULL) && ((y) = name##_RB_PREV(x), (x) != NULL); \
(x) = (y))

#endif /* _SYS_TREE_H_ */
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```

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```
# Maintainer: Natanael Copa <ncopa@alpinelinux.org>
```

```
pkgname=libart-lgpl
```

```
pkgver=2.3.21
```

```
pkgrel=8
```

```
pkgdesc="A library for high-performance 2D graphics"
```

```
url="https://www.levien.com/libart/"
```

```
arch="all"
```

```
options="!check" # No test suite.
```

```
license="LGPL-2.0-or-later"
```

```
subpackages="$pkgname-dev"
```

```
source="https://download.gnome.org/sources/libart-lgpl/2.3/libart-lgpl-$pkgver.tar.bz2"
```

```
"
```

```
builddir="$srcdir"/libart-lgpl-$pkgver
```

```
prepare() {  
    update_config_sub  
    default_prepare  
}
```

```
build() {  
    ./configure \  
    --build=$CBUILD \  
    --host=$CHOST \  
    --prefix=/usr  
    make  
}
```

```
package() {  
    make DESTDIR="$pkgdir" install  
}
```

```
sha512sums="8a632a6a4da59e5e8c02ec2f5a57e36d182b325b46513765425e5f171ff9ae326af1b133725beba28f7e7"
```

6654309e001aee9bace727b5b4c8589405256a3c020 libart\_lgpl-2.3.21.tar.bz2"

mini\_sendmail - accept email on behalf of real sendmail

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## 1.180 truststore 0.10.1

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# 1.181 c-ares 1.34.5-r0

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## 1.182 socat 1.8.0.3-r1

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diff -r -N -U 3 --no-dereference socat-1.8.0.2/CHANGES socat-1.8.0.3/CHANGES

Found in path(s):

\* /socat-1-8-0-3-patch-gz/socat-1.8.0.3.patch

## 1.183 clang18 18.1.8-r5

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 * Configuration for FreeBSD based systems with netlink support  
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```

```
#define CONFIG_AUTO_ROUTES  
#define CONFIG_SELF_CONSCIOUS  
#define CONFIG_MULTIPLE_TABLES
```

```

#define CONFIG_SINGLE_ROUTE
#define CONFIG_ASSUME_ONLINK

#define CONFIG_SKIP_MC_BIND
#define CONFIG_NO_IFACE_BIND
#define CONFIG_USE_HDRINCL

#define CONFIG_INCLUDE_SYSIO_H "sysdep/bsd/sysio.h"
#define CONFIG_INCLUDE_KRTSYS_H "sysdep/linux/krt-sys.h"
#define CONFIG_INCLUDE_NLSYS_H "sysdep/bsd-netlink/netlink-sys.h"

/*
Link: sysdep/unix
Link: sysdep/bsd-netlink
*/
/*
* Configuration for *BSD based systems (tested on FreeBSD and NetBSD)
*
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#define CONFIG_SELF_CONSCIOUS
#define CONFIG_MULTIPLE_TABLES
#define CONFIG_SINGLE_ROUTE
#define CONFIG_ASSUME_ONLINK

#define CONFIG_SKIP_MC_BIND
#define CONFIG_NO_IFACE_BIND
#define CONFIG_USE_HDRINCL

#define CONFIG_INCLUDE_SYSIO_H "sysdep/bsd/sysio.h"
#define CONFIG_INCLUDE_KRTSYS_H "sysdep/bsd/krt-sys.h"

/*
Link: sysdep/unix
Link: sysdep/bsd
*/
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* Netlink FreeBSD-specific functions
*
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*/

```

```

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#define _BIRD_NETLINK_SYS_H_

#include <netlink/netlink.h>
#include <netlink/netlink_route.h>

#ifndef AF_MPLS
#define AF_MPLS 39
#endif

#ifndef SO_RCVBUFFORCE
#define SO_RCVBUFFORCE SO_RCVBUF
#endif

static inline int
netlink_error_to_os(int error)
{
    return (error);
}

#endif
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## 1.185 llvm18 18.1.8-r5

### 1.185.1 Available under license :

; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

; RUN: llc < %s -mtriple=aarch64-- | FileCheck %s

; A shuffle mask with all undef elements is always legal.

```
define <4 x i32> @PR41535(<2 x i32> %p1, <2 x i32> %p2) {
; CHECK-LABEL: PR41535:
; CHECK:      // %bb.0:
; CHECK-NEXT:  ext v0.8b, v0.8b, v1.8b, #4
; CHECK-NEXT:  mov v0.d[1], v0.d[0]
; CHECK-NEXT:  ret
%cat1 = shufflevector <2 x i32> %p1, <2 x i32> undef, <4 x i32> <i32 undef, i32 1, i32 undef, i32 undef>
%cat2 = shufflevector <2 x i32> %p2, <2 x i32> undef, <4 x i32> <i32 0, i32 undef, i32 undef, i32 undef>
%r = shufflevector <4 x i32> %cat1, <4 x i32> %cat2, <4 x i32> <i32 undef, i32 undef, i32 1, i32 4>
ret <4 x i32> %r
}
```

```
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=amdgc -mcpu=fiji < %s | FileCheck -enable-var-scope --check-prefixes=GCN,GCN-
SAFE,VI,VI-SAFE %s
; RUN: llc -enable-no-signed-zeros-fp-math -mtriple=amdgc -mcpu=fiji < %s | FileCheck -enable-var-scope --
check-prefixes=GCN,GCN-NSZ,VI,VI-NSZ %s
```

```
; -----
; rcp tests
; -----
```

```
define half @v_fneg_rcp_f16(half %a) #0 {
; GCN-LABEL: v_fneg_rcp_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_rcp_f16_e64 v0, -v0
; GCN-NEXT:  s_setpc_b64 s[30:31]
%rcp = call half @llvm.amdgc.rcp.f16(half %a)
%fneg = fneg half %rcp
ret half %fneg
}
```

```
define half @v_fneg_rcp_fneg_f16(half %a) #0 {
; GCN-LABEL: v_fneg_rcp_fneg_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:
v_rcp_f16_e32 v0, v0
; GCN-NEXT:  s_setpc_b64 s[30:31]
%fneg.a = fneg half %a
%rcp = call half @llvm.amdgc.rcp.f16(half %fneg.a)
%fneg = fneg half %rcp
ret half %fneg
}
```

```
define { half, half } @v_fneg_rcp_store_use_fneg_f16(half %a) #0 {
; GCN-LABEL: v_fneg_rcp_store_use_fneg_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_rcp_f16_e32 v2, v0
; GCN-NEXT:  v_xor_b32_e32 v1, 0x8000, v0
; GCN-NEXT:  v_mov_b32_e32 v0, v2
; GCN-NEXT:  s_setpc_b64 s[30:31]
%fneg.a = fneg half %a
%rcp = call half @llvm.amdgc.rcp.f16(half %fneg.a)
%fneg = fneg half %rcp
%insert.0 = insertvalue { half, half } poison, half %fneg, 0
%insert.1 = insertvalue { half, half } %insert.0, half %fneg.a, 1
ret { half, half } %insert.1
}
```

```

}

define { half, half } @v_fneg_rcp_multi_use_fneg_f16(half %a, half %c) #0 {
; GCN-LABEL: v_fneg_rcp_multi_use_fneg_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:
    v_rcp_f16_e32 v2, v0
; GCN-NEXT:  v_mul_f16_e64 v1, -v0, v1
; GCN-NEXT:  v_mov_b32_e32 v0, v2
; GCN-NEXT:  s_setpc_b64 s[30:31]
    %fneg.a = fneg half %a
    %rcp = call half @llvm.amdgcn.rcp.f16(half %fneg.a)
    %fneg = fneg half %rcp
    %use1 = fmul half %fneg.a, %c
    %insert.0 = insertvalue { half, half } poison, half %fneg, 0
    %insert.1 = insertvalue { half, half } %insert.0, half %use1, 1
    ret { half, half } %insert.1
}

```

```

; -----
; sin tests
; -----

```

```

define half @v_fneg_amdgcn_sin_f16(half %a) #0 {
; GCN-LABEL: v_fneg_amdgcn_sin_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_sin_f16_e64 v0, -v0
; GCN-NEXT:  s_setpc_b64 s[30:31]
    %sin = call half @llvm.amdgcn.sin.f16(half %a)
    %fneg = fneg half %sin
    ret half %fneg
}

```

```

; -----
;
; vinterp tests
; -----

```

```

define { float, float } @v_fneg_interp_p1_f16(float %a, float %b) #0 {
; GCN-LABEL: v_fneg_interp_p1_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_mul_f32_e64 v1, v0, -v1
; GCN-NEXT:  s_mov_b32 m0, 0
; GCN-NEXT:  s_setreg_imm32_b32 hwreg(HW_REG_MODE, 2, 2), 3
; GCN-NEXT:  v_interp_p1ll_f16 v0, v1, attr0.x

```



```

; GCN-NEXT:  v_interp_p1l_f16 v1, v1, attr0.y
; GCN-NEXT:  s_setpc_b64 s[30:31]
%mul = fmul float %a, %b
%fneg = fneg float %mul
%intrap0 = call float @llvm.amdgcn.interp.p1.f16(float %fneg, i32 0, i32 0, i1 false, i32 0)
%intrap1 = call float @llvm.amdgcn.interp.p1.f16(float %fneg, i32 1, i32 0, i1 false, i32 0)
%insert.0 = insertvalue { float, float } poison, float %intrap0, 0
%insert.1 = insertvalue { float, float } %insert.0, float %intrap1, 1
ret { float, float } %insert.1
}

define
{ half, half } @v_fneg_interp_p2_f16(float %a, float %b) #0 {
; GCN-LABEL: v_fneg_interp_p2_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_mul_f32_e64 v1, v0, -v1
; GCN-NEXT:  v_mov_b32_e32 v2, 4.0
; GCN-NEXT:  s_mov_b32 m0, 0
; GCN-NEXT:  s_setreg_imm32_b32 hwreg(HW_REG_MODE, 2, 2), 3
; GCN-NEXT:  v_interp_p2_f16 v0, v1, attr0.x, v2
; GCN-NEXT:  v_interp_p2_f16 v1, v1, attr0.y, v2
; GCN-NEXT:  s_setpc_b64 s[30:31]
%mul = fmul float %a, %b
%fneg = fneg float %mul
%intrap0 = call half @llvm.amdgcn.interp.p2.f16(float 4.0, float %fneg, i32 0, i32 0, i1 false, i32 0)
%intrap1 = call half @llvm.amdgcn.interp.p2.f16(float 4.0, float %fneg, i32 1, i32 0, i1 false, i32 0)
%insert.0 = insertvalue { half, half } poison, half %intrap0, 0
%insert.1 = insertvalue { half, half } %insert.0, half %intrap1, 1
ret { half, half } %insert.1
}

; -----
;
; arithmetic.fence tests
; -----

; FIXME: Legalization/promote is broken
define half @v_fneg_arithmetic_fence_f16(half %a) #0 {
; GCN-LABEL: v_fneg_arithmetic_fence_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  ; ARITH_FENCE
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_xor_b32_e32 v0, 0x8000, v0
; GCN-NEXT:  s_setpc_b64 s[30:31]
%fence = call half @llvm.arithmetic.fence.f16(half %a)
%fneg = fneg half %fence
ret half %fneg

```

```

}

define half @v_fneg_arithmetic_fence_fmul_f16(half %a, half %b) #0 {
; GCN-LABEL: v_fneg_arithmetic_fence_fmul_f16:
; GCN:      ; %bb.0:
; GCN-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; GCN-NEXT:  v_mul_f16_e32 v0, v0, v1
; GCN-NEXT:  ;ARITH_FENCE
; GCN-NEXT:  v_xor_b32_e32 v0, 0x8000, v0
; GCN-NEXT:  s_setpc_b64 s[30:31]
%mul = fmul half %a, %b
%fence = call half @llvm.arithmetic.fence.f16(half %mul)
%fneg = fneg half %fence
ret half
%fneg
}

declare half @llvm.amdgcn.rcp.f16(half) #1
declare half @llvm.amdgcn.sin.f16(half) #1
declare half @llvm.arithmetic.fence.f16(half) #1
declare float @llvm.amdgcn.interp.p1.f16(float, i32, i32, i1, i32) #0
declare half @llvm.amdgcn.interp.p2.f16(float, float, i32, i32, i1, i32) #0

attributes #0 = { nounwind "denormal-fp-math-f32"="preserve-sign,preserve-sign" }
attributes #1 = { nounwind readnone }
attributes #2 = { nounwind "unsafe-fp-math"="true" }
attributes #3 = { nounwind "no-signed-zeros-fp-math"="true" }
attributes #4 = { nounwind "amdgpu-ieee"="false" "denormal-fp-math-f32"="preserve-sign,preserve-sign" }
;; NOTE: These prefixes are unused and the list is autogenerated. Do not add tests below this line:
; GCN-NSZ: {{.*}}
; GCN-SAFE: {{.*}}
; VI: {{.*}}
; VI-NSZ: {{.*}}
; VI-SAFE: {{.*}}
; NOTE: Assertions have been autogenerated by utils/update_test_checks.py UTC_ARGS: --function-signature --
check-attributes --check-globals
; RUN: opt -aa-pipeline=basic-aa -passes=attributor -attributor-manifest-internal -attributor-annotate-decl-cs -S <
%s | FileCheck %s --check-prefixes=CHECK,TUNIT
; RUN: opt -aa-pipeline=basic-aa -passes=attributor-cgscscc -attributor-manifest-internal -attributor-annotate-decl-cs -
S < %s | FileCheck %s --check-prefixes=CHECK,CGSCC
; Test that we only promote arguments when the caller/callee have compatible
; function attributes.

target triple = "x86_64-unknown-linux-gnu"

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %arg, ptr
readonly %arg1) #0 {

```

```

;
; CHECK: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{^@+}}@callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512
; CHECK-SAME:
(ptr noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[ARG:%.*]], <8 x i64>
[[TMP0:%.*]]) #[[ATTR0:[0-9]+]] {
; CHECK-NEXT: bb:
; CHECK-NEXT: [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT: store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %arg) #0 {
;
; TUNIT: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{^@+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer512
; TUNIT-SAME: (ptr nocapture norecurse writeonly [[ARG:%.*]]) #[[ATTR0]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align
32
; TUNIT-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5:[0-9]+]]
; TUNIT-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; TUNIT-NEXT: call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr
noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6:[0-9]+]]
; TUNIT-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT: ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {{^@+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer512
; CGSCC-SAME: (ptr nocapture
norecurse noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]]) #[[ATTR0]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32

```

```

; CGSCC-NEXT:  call void @llvm.memset.p0.i64(ptr noalias nocapture nofree noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5:[0-9]+]]
; CGSCC-NEXT:  [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT:  call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr
noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6:[0-9]+]]
; CGSCC-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT:  ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void
@llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %arg, ptr
readonly %arg1) #1 {
;
; CHECK: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{^[^@]+}}@callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], <8 x i64> [[TMP0:%.*]]) #[[ATTR1:[0-9]+]] {
; CHECK-NEXT: bb:
; CHECK-NEXT:  [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT:  store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT:  [[TMP:%.*]] = load <8 x
i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT:  store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT:  ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %arg) #1 {
;
; TUNIT: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable

```

```

; TUNIT-LABEL: define {{^[^@]+}}@avx512_legal512_prefer256_call_avx512_legal512_prefer256
; TUNIT-SAME: (ptr nocapture norelease writeonly [[ARG:%.*]]) #[[ATTR1]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT:  [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT:  [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT:  call void @llvm.memset.p0.i64(ptr noalias nocapture norelease noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT:  [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; TUNIT-NEXT:
    call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr noalias nocapture
norelease noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64> [[TMP0]]) #[[ATTR6]]
; TUNIT-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT:  ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress norelease norecuse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {{^[^@]+}}@avx512_legal512_prefer256_call_avx512_legal512_prefer256
; CGSCC-SAME: (ptr nocapture norelease noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR1]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT:  [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT:  [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT:  call void @llvm.memset.p0.i64(ptr noalias nocapture norelease noundef nonnull writeonly align 64
dereferenceable(64)
[[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT:  [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT:  call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr
noalias nocapture norelease noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6]]
; CGSCC-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT:  ret void
;
bb:
    %tmp = alloca <8 x i64>, align 32
    %tmp2 = alloca <8 x i64>, align 32
    call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
    call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)
    %tmp4 = load <8 x i64>, ptr %tmp2, align 32
    store <8 x i64> %tmp4, ptr %arg, align 2
    ret void
}

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr
%arg, ptr readonly %arg1) #1 {
;

```

```

; CHECK: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{^(^@)+}}@callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], <8 x i64> [[TMP0:%.*]]) #[[ATTR1]] {
; CHECK-NEXT: bb:
; CHECK-NEXT: [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT: store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr %arg) #0 {
;
; TUNIT: Function Attrs: inlinehint mustprogress norecurse nosync nounwind
willreturn memory(argmem: readwrite) uwtable
; TUNIT-LABEL: define {{^(^@)+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer256
; TUNIT-SAME: (ptr nocapture norecurse writeonly [[ARG:%.*]]) #[[ATTR0]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; TUNIT-NEXT: call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr
noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6]]
; TUNIT-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT:
ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {{^(^@)+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer256
; CGSCC-SAME: (ptr nocapture norecurse noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR0]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]

```

```

; CGSCC-NEXT:  [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT:  call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr
noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6]]
; CGSCC-NEXT:
    [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT:  ret void
;
bb:
    %tmp = alloca <8 x i64>, align 32
    %tmp2 = alloca <8 x i64>, align 32
    call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
    call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)
    %tmp4 = load <8 x i64>, ptr %tmp2, align 32
    store <8 x i64> %tmp4, ptr %arg, align 2
    ret void
}

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr %arg, ptr
readonly %arg1) #0 {
;
; CHECK: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{^[^@]+}}@callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512
; CHECK-SAME: (ptr noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]],
    <8 x i64> [[TMP0:%.*]]) #[[ATTR0]] {
; CHECK-NEXT: bb:
; CHECK-NEXT:  [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT:  store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT:  [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT:  store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT:  ret void
;
bb:
    %tmp = load <8 x i64>, ptr %arg1
    store <8 x i64> %tmp, ptr %arg
    ret void
}

define void @avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr %arg) #1 {
;
; TUNIT: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{^[^@]+}}@avx512_legal512_prefer256_call_avx512_legal512_prefer512
; TUNIT-SAME: (ptr nocapture nofree writeonly [[ARG:%.*]]) #[[ATTR1]] {

```

```

; TUNIT-NEXT: bb:
; TUNIT-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: call void @llvm.memset.p0.i64(ptr
noalias nocapture nofree noundef nonnull writeonly align 32 dereferenceable(64) [[TMP]], i8 noundef 0, i64
noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; TUNIT-NEXT: call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr
noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6]]
; TUNIT-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT: ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define { {^@}+ } @avx512_legal512_prefer256_call_avx512_legal512_prefer512
; CGSCC-SAME: (ptr nocapture nofree noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR1]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT:
[[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture nofree noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT: call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr
noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64>
[[TMP0]]) #[[ATTR6]]
; CGSCC-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr
%tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should not promote
define internal fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %arg, ptr
readonly %arg1) #1 {
;

```



```

; CHECK: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{^(^@)+}}@callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], ptr noalias nocapture norecurse noundef nonnull readonly align 64 dereferenceable(64) [[ARG1:%.*]])
#[[ATTR1]] {
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1]], align 64
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %arg) #2 {
;
; TUNIT: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{^(^@)+}}@avx512_legal256_prefer256_call_avx512_legal512_prefer256
; TUNIT-SAME: (ptr nocapture norecurse writeonly [[ARG:%.*]]) #[[ATTR2:[0-9]+]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT: call fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr
noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], ptr noalias
nocapture norecurse noundef nonnull readonly align 64 dereferenceable(64)
[[TMP]]) #[[ATTR6]]
; TUNIT-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT: ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {{^(^@)+}}@avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CGSCC-SAME: (ptr nocapture norecurse noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR2:[0-9]+]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT: call fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr
noalias

```

```

    nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], ptr noalias nocapture
    nofree noundef nonnull readonly align 64 dereferenceable(64) [[TMP]]) #[[ATTR6]]
; CGSCC-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT:  ret void
;
bb:
    %tmp = alloca <8 x i64>, align 32
    %tmp2 = alloca <8 x i64>, align 32
    call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
    call fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)
    %tmp4 = load <8 x i64>, ptr %tmp2, align 32
    store <8 x i64> %tmp4, ptr %arg, align 2
    ret void
}

; This should not promote
define internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %arg, ptr
readonly %arg1) #2 {
;
; CHECK: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
;
    CHECK-LABEL: define {{^[^@]+}}@callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256
; CHECK-SAME: (ptr noalias nocapture nofree noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], ptr noalias nocapture nofree noundef nonnull readonly align 64 dereferenceable(64) [[ARG1:%.*]])
#[[ATTR2:[0-9]+]] {
; CHECK-NEXT: bb:
; CHECK-NEXT:  [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1]], align 64
; CHECK-NEXT:  store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT:  ret void
;
bb:
    %tmp = load <8 x i64>, ptr %arg1
    store <8 x i64> %tmp, ptr %arg
    ret void
}

define void @avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %arg) #1 {
;
; TUNIT: Function Attrs: inlinehint mustprogress nofree norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{^[^@]+}}@avx512_legal512_prefer256_call_avx512_legal256_prefer256
; TUNIT-SAME: (ptr nocapture nofree writeonly [[ARG:%.*]]) #[[ATTR1]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT:
    [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT:  [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32

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; TUNIT-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT: call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr
noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], ptr noalias
nocapture norecurse noundef nonnull readonly align 64 dereferenceable(64) [[TMP]]) #[[ATTR6]]
; TUNIT-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT: ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define {{^@+}}@avx512_legal512_prefer256_call_avx512_legal256_prefer256
;
CGSCC-SAME: (ptr nocapture norecurse noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR1]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT: call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr
noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], ptr noalias
nocapture norecurse noundef nonnull readonly align 64 dereferenceable(64) [[TMP]]) #[[ATTR6]]
; CGSCC-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>,
align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %arg, ptr readonly
%arg1) #3 {
;
; CHECK: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{^@+}}@callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256
; CHECK-SAME: (ptr noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], <8 x i64> [[TMP0:%.*]]) #[[ATTR3:[0-9]+]] {
; CHECK-NEXT: bb:

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; CHECK-NEXT: [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT: store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: [[TMP:%.*]]
= load <8 x i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %arg) #4 {
;
; TUNIT: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define { { (^@)+ } } @avx2_legal256_prefer256_call_avx2_legal512_prefer256
; TUNIT-SAME: (ptr nocapture norecurse writeonly [[ARG:%.*]]) # [[ATTR3]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) # [[ATTR5]]
; TUNIT-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
;
TUNIT-NEXT: call fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr noalias
nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64> [[TMP0]])
# [[ATTR6]]
; TUNIT-NEXT: [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT: store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT: ret void
;
; CGSCC: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CGSCC-LABEL: define { { (^@)+ } } @avx2_legal256_prefer256_call_avx2_legal512_prefer256
; CGSCC-SAME: (ptr nocapture norecurse noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
# [[ATTR3]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT: call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]],
i8 noundef 0, i64 noundef 32, i1 noundef false) # [[ATTR5]]
; CGSCC-NEXT: [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT: call fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr noalias
nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64> [[TMP0]])
# [[ATTR6]]

```

```

; CGSCC-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; CGSCC-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT:  ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr
%arg, ptr readonly %arg1) #4 {
;
; CHECK: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; CHECK-LABEL: define {{^[^@]+}}@callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256
; CHECK-SAME: (ptr noalias nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64)
[[ARG:%.*]], <8 x i64> [[TMP0:%.*]]) #[[ATTR3]] {
; CHECK-NEXT: bb:
; CHECK-NEXT:  [[ARG1_PRIV:%.*]] = alloca <8 x i64>, align 64
; CHECK-NEXT:  store <8 x i64> [[TMP0]], ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT:  [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1_PRIV]], align 64
; CHECK-NEXT:  store <8 x i64> [[TMP]], ptr [[ARG]], align 64
; CHECK-NEXT:  ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr %arg) #3 {
;
; TUNIT: Function Attrs: inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem:
readwrite) uwtable
; TUNIT-LABEL: define {{^[^@]+}}@avx2_legal512_prefer256_call_avx2_legal256_prefer256
; TUNIT-SAME: (ptr nocapture norecurse writeonly [[ARG:%.*]]) #[[ATTR3]] {
; TUNIT-NEXT: bb:
; TUNIT-NEXT:  [[TMP:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT:  [[TRUETMP2:%.*]] = alloca <8 x i64>, align 32
; TUNIT-NEXT:  call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 32
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; TUNIT-NEXT:  [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64

```

```

; TUNIT-NEXT:  call fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr noalias
nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64> [[TMP0]])
#[[ATTR6]]
; TUNIT-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>, ptr [[TRUETMP2]], align 64
; TUNIT-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; TUNIT-NEXT:  ret void
;
; CGSCC: Function
Attrs: inlinehint mustprogress norecurse noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]] uwtable
; CGSCC-LABEL: define {{^(^@)+}}@avx2_legal512_prefer256_call_avx2_legal256_prefer256
; CGSCC-SAME: (ptr nocapture norecurse noundef nonnull writeonly align 2 dereferenceable(64) [[ARG:%.*]])
#[[ATTR3]] {
; CGSCC-NEXT: bb:
; CGSCC-NEXT:  [[TMP:%.*]] = alloca <8 x i64>, align 32
; CGSCC-NEXT:  [[TRUETMP2:%.*]] = alloca <8 x i64>, align 64
; CGSCC-NEXT:  call void @llvm.memset.p0.i64(ptr noalias nocapture norecurse noundef nonnull writeonly align 64
dereferenceable(64) [[TMP]], i8 noundef 0, i64 noundef 32, i1 noundef false) #[[ATTR5]]
; CGSCC-NEXT:  [[TMP0:%.*]] = load <8 x i64>, ptr [[TMP]], align 64
; CGSCC-NEXT:  call fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr noalias
nocapture norecurse noundef nonnull writeonly align 64 dereferenceable(64) [[TRUETMP2]], <8 x i64> [[TMP0]])
#[[ATTR6]]
; CGSCC-NEXT:  [[TRUETMP4:%.*]] = load <8 x i64>,
ptr [[TRUETMP2]], align 64
; CGSCC-NEXT:  store <8 x i64> [[TRUETMP4]], ptr [[ARG]], align 2
; CGSCC-NEXT:  ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; Function Attrs: argmemonly nounwind
declare void @llvm.memset.p0.i64(ptr nocapture writeonly, i8, i64, i1) #5

attributes #0 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-
width"="512" "prefer-vector-width"="512" }
attributes #1 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-
width"="512" "prefer-vector-width"="256" }
attributes #2 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-
width"="256"
"prefer-vector-width"="256" }
attributes #3 = { inlinehint norecurse nounwind uwtable "target-features"="+avx2" "min-legal-vector-width"="512"
"prefer-vector-width"="256" }

```

```

attributes #4 = { inlinehint norecurse nounwind uwtable "target-features"="+avx2" "min-legal-vector-width"="256"
"prefer-vector-width"="256" }
attributes #5 = { argmemonly nounwind }
;
; TUNIT: attributes #[[ATTR0]] = { inlinehint mustprogress norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="512" "target-
features"="+avx512vl" }
; TUNIT: attributes #[[ATTR1]] = { inlinehint mustprogress norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="256" "target-
features"="+avx512vl" }
; TUNIT: attributes #[[ATTR2]] = { inlinehint mustprogress norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="256" "prefer-vector-width"="256"
"target-features"="+avx512vl" }
; TUNIT: attributes #[[ATTR3]] = { inlinehint mustprogress norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="256" "target-
features"="+avx2" }
; TUNIT: attributes #[[ATTR4:[0-9]+]] = { norecurse nosync nounwind willreturn memory(argmem: write) }
; TUNIT: attributes #[[ATTR5]] = { norecurse willreturn memory(write) }
; TUNIT: attributes #[[ATTR6]] = { norecurse nosync nounwind willreturn }
;
; CGSCC: attributes #[[ATTR0]] = { inlinehint mustprogress norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="512" "target-
features"="+avx512vl" }
; CGSCC: attributes #[[ATTR1]] = { inlinehint mustprogress norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="256" "target-
features"="+avx512vl" }
; CGSCC: attributes #[[ATTR2]]
= { inlinehint mustprogress norecurse nosync nounwind willreturn memory(argmem: readwrite) uwtable
"min-legal-vector-width"="256" "prefer-vector-width"="256" "target-features"="+avx512vl" }
; CGSCC: attributes #[[ATTR3]] = { inlinehint mustprogress norecurse nosync nounwind willreturn
memory(argmem: readwrite) uwtable "min-legal-vector-width"="512" "prefer-vector-width"="256" "target-
features"="+avx2" }
; CGSCC: attributes #[[ATTR4:[0-9]+]] = { norecurse nosync nounwind willreturn memory(argmem: write) }
; CGSCC: attributes #[[ATTR5]] = { norecurse willreturn memory(write) }
; CGSCC: attributes #[[ATTR6]] = { norecurse nounwind willreturn }
;
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64I
; RUN: llc -mtriple=riscv64 -mattr=+zbb -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBB

declare i32 @llvm.ctlz.i32(i32, i1)

define signext i32 @ctlz_i32(i32 signext %a) nounwind {
; RV64I-LABEL: ctlz_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT: beqz a0, .LBB0_2

```

```

; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:
    not a0, a0
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addi a2, a2, 1365
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  lui a1, 209715
; RV64I-NEXT:  addi a1, a1, 819
; RV64I-NEXT:  and a2, a0, a1
; RV64I-NEXT:  srliw a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srliw a0, a0, 24
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
; RV64I-NEXT: .LBB0_2:
; RV64I-NEXT:  li a0, 32
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: ctlz_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  clzw a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvm.ctlz.i32(i32 %a, i1 false)

```



```

ret i32 %1
}

```

```

define signext i32 @log2_i32(i32 signext %a) nounwind {
; RV64I-LABEL: log2_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT: beqz a0, .LBB1_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 2
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 8
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 16
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: not a0, a0
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT:
;   srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 24
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: j .LBB1_3
; RV64I-NEXT: .LBB1_2:
; RV64I-NEXT: li a0, 32
; RV64I-NEXT: .LBB1_3: # %cond.end

```

```

; RV64I-NEXT:  li a1, 31
; RV64I-NEXT:  subw a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: log2_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  clzw a0, a0
; RV64ZBB-NEXT:  li a1, 31
; RV64ZBB-NEXT:  subw a0, a1, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvmctlz.i32(i32 %a, i1 false)
%2 = sub i32 31, %1
ret i32 %2
}

```

```

define signext i32 @log2_ceil_i32(i32 signext %a) nounwind {
; RV64I-LABEL: log2_ceil_i32:
; RV64I:        # %bb.0:
; RV64I-NEXT:   addi sp, sp, -16
; RV64I-NEXT:   sd ra,
; RV64I-NEXT:   8(sp) # 8-byte Folded Spill
; RV64I-NEXT:   sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:   addiw a0, a0, -1
; RV64I-NEXT:   li s0, 32
; RV64I-NEXT:   li a1, 32
; RV64I-NEXT:   beqz a0, .LBB2_2
; RV64I-NEXT:   # %bb.1: # %cond.false
; RV64I-NEXT:   srliw a1, a0, 1
; RV64I-NEXT:   or a0, a0, a1
; RV64I-NEXT:   srliw a1, a0, 2
; RV64I-NEXT:   or a0, a0, a1
; RV64I-NEXT:   srliw a1, a0, 4
; RV64I-NEXT:   or a0, a0, a1
; RV64I-NEXT:   srliw a1, a0, 8
; RV64I-NEXT:   or a0, a0, a1
; RV64I-NEXT:   srliw a1, a0, 16
; RV64I-NEXT:   or a0, a0, a1
; RV64I-NEXT:   not a0, a0
; RV64I-NEXT:   srliw a1, a0, 1
; RV64I-NEXT:   lui a2, 349525
; RV64I-NEXT:   addi a2, a2, 1365
; RV64I-NEXT:   and a1, a1, a2
; RV64I-NEXT:   subw a0, a0, a1
; RV64I-NEXT:   lui a1, 209715
; RV64I-NEXT:   addi a1, a1, 819
; RV64I-NEXT:   and a2, a0, a1
; RV64I-NEXT:   srliw a0, a0, 2
; RV64I-NEXT:   and a0, a0, a1

```

```

; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:
    addw a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srliw a1, a0, 24
; RV64I-NEXT:  .LBB2_2: # %cond.end
; RV64I-NEXT:  subw a0, s0, a1
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: log2_ceil_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  addi a0, a0, -1
; RV64ZBB-NEXT:  clzw a0, a0
; RV64ZBB-NEXT:  li a1, 32
; RV64ZBB-NEXT:  subw a0, a1, a0
; RV64ZBB-NEXT:  ret
%1 = sub i32 %a, 1
%2 = call i32 @llvmctlz.i32(i32 %1, i1 false)
%3 = sub i32 32, %2
ret i32 %3
}

define signext i32 @findLastSet_i32(i32 signext %a) nounwind {
; RV64I-LABEL: findLastSet_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
;
    RV64I-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:  mv s0, a0
; RV64I-NEXT:  srliw a0, a0, 1
; RV64I-NEXT:  or a0, s0, a0
; RV64I-NEXT:  srliw a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 16

```

```

; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: not a0, a0
; RV64I-NEXT: srlw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srlw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srlw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT:
    addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srlw a0, a0, 24
; RV64I-NEXT: xori a0, a0, 31
; RV64I-NEXT: snez a1, s0
; RV64I-NEXT: addiw a1, a1, -1
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64ZBB-LABEL: findLastSet_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT: clzw a1, a0
; RV64ZBB-NEXT: xori a1, a1, 31
; RV64ZBB-NEXT: snez a0, a0
; RV64ZBB-NEXT: addiw a0, a0, -1
; RV64ZBB-NEXT: or a0, a0, a1
; RV64ZBB-NEXT: ret
%1 = call i32 @llvmctlz.i32(i32 %a, i1 true)
%2 = xor i32 31, %1
%3 = icmp eq i32 %a, 0
%4 = select i1 %3, i32 -1, i32 %2
ret i32 %4
}

define i32 @ctlz_lshr_i32(i32 signext %a) {

```

```

; RV64I-LABEL: ctiz_lshr_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a0, a0, 1
; RV64I-NEXT:  beqz a0, .LBB4_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp,
-16
; RV64I-NEXT:  .cfi_def_cfa_offset 16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  .cfi_offset ra, -8
; RV64I-NEXT:  srlw a1, a0, 1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srlw a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srlw a1, a0, 4
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srlw a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srlw a1, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  srlw a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addi a2, a2, 1365
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  lui a1, 209715
; RV64I-NEXT:  addi a1, a1, 819
; RV64I-NEXT:  and a2, a0, a1
; RV64I-NEXT:  srlw a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srlw a1, a0, 4
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  and a0,
a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srlw a0, a0, 24
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
; RV64I-NEXT: .LBB4_2:
; RV64I-NEXT:  li a0, 32
; RV64I-NEXT:  ret

```

```

;
; RV64ZBB-LABEL: ctlz_lshr_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT: srliw a0, a0, 1
; RV64ZBB-NEXT: clzw a0, a0
; RV64ZBB-NEXT: ret
%1 = lshr i32 %a, 1
%2 = call i32 @llvm.ctlz.i32(i32 %1, i1 false)
ret i32 %2
}

declare i64 @llvm.ctlz.i64(i64, i1)

define i64 @ctlz_i64(i64 %a) nounwind {
; RV64I-LABEL: ctlz_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: beqz a0, .LBB5_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: srli a1, a0, 1
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srli a1, a0, 2
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srli a1, a0, 4
; RV64I-NEXT:
    or a0, a0, a1
; RV64I-NEXT: srli a1, a0, 8
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srli a1, a0, 16
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srli a1, a0, 32
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: not a0, a0
; RV64I-NEXT: srli a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addiw a2, a2, 1365
; RV64I-NEXT: slli a3, a2, 32
; RV64I-NEXT: add a2, a2, a3
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: sub a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addiw a1, a1, 819
; RV64I-NEXT: slli a2, a1, 32
; RV64I-NEXT: add a1, a1, a2
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srli a0, a0, 2
; RV64I-NEXT: and a0, a0, a1

```

```

; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srli a1, a0, 4
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: slli a2, a1, 32
; RV64I-NEXT: add a1, a1, a2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT:
    addiw a1, a1, 257
; RV64I-NEXT: slli a2, a1, 32
; RV64I-NEXT: add a1, a1, a2
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srli a0, a0, 56
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
; RV64I-NEXT: .LBB5_2:
; RV64I-NEXT: li a0, 64
; RV64I-NEXT: ret
;
; RV64ZBB-LABEL: ctlz_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT: clz a0, a0
; RV64ZBB-NEXT: ret
%1 = call i64 @llvm.ctlz.i64(i64 %a, i1 false)
ret i64 %1
}

```

```

declare i32 @llvm.cttz.i32(i32, i1)

```

```

define signext i32 @cttz_i32(i32 signext %a) nounwind {
; RV64I-LABEL: cttz_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT: beqz a0, .LBB6_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: negw a1, a0
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 30667
; RV64I-NEXT: addiw a1, a1, 1329
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 27
;
    RV64I-NEXT: lui a1, %hi(.LCPI6_0)
; RV64I-NEXT: addi a1, a1, %lo(.LCPI6_0)

```

```

; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
; RV64I-NEXT:  .LBB6_2:
; RV64I-NEXT:  li a0, 32
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: cttz_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  ctzw a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 false)
ret i32 %1
}

define signext i32 @cttz_zero_undef_i32(i32 signext %a) nounwind {
; RV64I-LABEL: cttz_zero_undef_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  negw a1, a0
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 30667
; RV64I-NEXT:  addiw a1, a1, 1329
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srlw a0, a0, 27
; RV64I-NEXT:  lui a1, %hi(.LCPI7_0)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI7_0)
; RV64I-NEXT:
    add a0, a1, a0
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: cttz_zero_undef_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  ctzw a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)
ret i32 %1
}

define signext i32 @findFirstSet_i32(i32 signext %a) nounwind {
; RV64I-LABEL: findFirstSet_i32:
; RV64I:      # %bb.0:

```



```

; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:  mv s0, a0
; RV64I-NEXT:  negw a0, a0
; RV64I-NEXT:  and a0, s0, a0
; RV64I-NEXT:  lui a1, 30667
; RV64I-NEXT:  addiw a1, a1, 1329
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srliw a0, a0, 27
; RV64I-NEXT:  lui a1, %hi(.LCPI8_0)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI8_0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  snez a1, s0
; RV64I-NEXT:
    addi a1, a1, -1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: findFirstSet_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  ctzw a1, a0
; RV64ZBB-NEXT:  snez a0, a0
; RV64ZBB-NEXT:  addiw a0, a0, -1
; RV64ZBB-NEXT:  or a0, a0, a1
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)
%2 = icmp eq i32 %a, 0
%3 = select i1 %2, i32 -1, i32 %1
ret i32 %3
}

define signext i32 @ffs_i32(i32 signext %a) nounwind {
; RV64I-LABEL: ffs_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:  mv s0, a0
; RV64I-NEXT:  negw a0, a0
; RV64I-NEXT:  and a0, s0, a0
; RV64I-NEXT:  lui a1, 30667
; RV64I-NEXT:  addiw a1, a1, 1329
; RV64I-NEXT:  call __muldi3

```

```

; RV64I-NEXT:
    srlw a0, a0, 27
; RV64I-NEXT:  lui a1, %hi(.LCPI9_0)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI9_0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  seqz a1, s0
; RV64I-NEXT:  addi a1, a1, -1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: ffs_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  ctzw a1, a0
; RV64ZBB-NEXT:  addi a1, a1, 1
; RV64ZBB-NEXT:  seqz a0, a0
; RV64ZBB-NEXT:  addi a0, a0, -1
; RV64ZBB-NEXT:  and a0, a0, a1
; RV64ZBB-NEXT:  zext.h a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)
%2 = add i32 %1, 1
%3 = icmp eq i32 %a, 0
%4 = select i1 %3, i32 0, i32 %2
ret i32 %4
}

declare i64 @llvm.cttz.i64(i64, i1)

define i64 @cttz_i64(i64
    %a) nounwind {
; RV64I-LABEL: cttz_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  beqz a0, .LBB10_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  neg a1, a0
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, %hi(.LCPI10_0)
; RV64I-NEXT:  ld a1, %lo(.LCPI10_0)(a1)
; RV64I-NEXT:  call __muldi3

```

```

; RV64I-NEXT: srli a0, a0, 58
; RV64I-NEXT: lui a1, %hi(.LCPI10_1)
; RV64I-NEXT: addi a1, a1, %lo(.LCPI10_1)
; RV64I-NEXT: add a0, a1, a0
; RV64I-NEXT: lbu a0, 0(a0)
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
; RV64I-NEXT: .LBB10_2:
; RV64I-NEXT: li a0, 64
; RV64I-NEXT: ret
;
; RV64ZBB-LABEL: cttz_i64:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT: ctz a0, a0
; RV64ZBB-NEXT: ret
%1 = call i64 @llvm.cttz.i64(i64 %a, i1 false)
ret i64 %1
}

```

```
declare i32 @llvm.ctpop.i32(i32)
```

```

define signext i32 @ctpop_i32(i32
  signext %a) nounwind {
; RV64I-LABEL: ctpop_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 24

```

```

; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: ctpop_i32:
; RV64ZBB:     # %bb.0:
; RV64ZBB-NEXT: cpopw
a0, a0
; RV64ZBB-NEXT: ret
%1 = call i32 @llvm.ctpop.i32(i32 %a)
ret i32 %1
}

```

```

define signext i32 @ctpop_i32_load(ptr %p) nounwind {

```

```

; RV64I-LABEL: ctpop_i32_load:
; RV64I:      # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: lw a0, 0(a0)
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 24
; RV64I-NEXT: ld ra, 8(sp)
# 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64ZBB-LABEL: ctpop_i32_load:
; RV64ZBB:     # %bb.0:
; RV64ZBB-NEXT: lw a0, 0(a0)
; RV64ZBB-NEXT: cpopw a0, a0

```

```
; RV64ZBB-NEXT:  ret
%a = load i32, ptr %p
%1 = call i32 @llvm.ctpop.i32(i32 %a)
ret i32 %1
}
```

```
declare i64 @llvm.ctpop.i64(i64)
```

```
define i64 @ctpop_i64(i64 %a) nounwind {
; RV64I-LABEL: ctpop_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  srli a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addiw a2, a2, 1365
; RV64I-NEXT:  slli a3, a2, 32
; RV64I-NEXT:  add a2, a2, a3
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  sub a0, a0, a1
; RV64I-NEXT:  lui a1, 209715
; RV64I-NEXT:  addiw a1, a1, 819
; RV64I-NEXT:  slli a2, a1, 32
; RV64I-NEXT:  add a1, a1, a2
; RV64I-NEXT:  and a2, a0, a1
; RV64I-NEXT:  srli a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2,
a0
; RV64I-NEXT:  srli a1, a0, 4
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  slli a2, a1, 32
; RV64I-NEXT:  add a1, a1, a2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  slli a2, a1, 32
; RV64I-NEXT:  add a1, a1, a2
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srli a0, a0, 56
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: ctpop_i64:
; RV64ZBB:    # %bb.0:
```

```

; RV64ZBB-NEXT:  cpop a0, a0
; RV64ZBB-NEXT:  ret
%1 = call i64 @llvm.ctpop.i64(i64 %a)
ret i64 %1
}

define signext i32 @sextb_i32(i32 signext %a) nounwind {
; RV64I-LABEL: sextb_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 56
; RV64I-NEXT:  srai a0, a0, 56
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: sextb_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  sext.b a0, a0
; RV64ZBB-NEXT:
ret
%shl = shl i32 %a, 24
%shr = ashr exact i32 %shl, 24
ret i32 %shr
}

define i64 @sextb_i64(i64 %a) nounwind {
; RV64I-LABEL: sextb_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 56
; RV64I-NEXT:  srai a0, a0, 56
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: sextb_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  sext.b a0, a0
; RV64ZBB-NEXT:  ret
%shl = shl i64 %a, 56
%shr = ashr exact i64 %shl, 56
ret i64 %shr
}

define signext i32 @sextb_i32(i32 signext %a) nounwind {
; RV64I-LABEL: sextb_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srai a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: sextb_i32:
; RV64ZBB:    # %bb.0:

```

```

; RV64ZBB-NEXT:  sext.h a0, a0
; RV64ZBB-NEXT:  ret
%shl = shl i32 %a, 16
%shr = ashr exact i32 %shl, 16
ret i32 %shr
}

define i64 @sexth_i64(i64 %a) nounwind {
; RV64I-LABEL: sexth_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srai a0, a0, 48
; RV64I-NEXT:
    ret
;
; RV64ZBB-LABEL: sexth_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  sext.h a0, a0
; RV64ZBB-NEXT:  ret
%shl = shl i64 %a, 48
%shr = ashr exact i64 %shl, 48
ret i64 %shr
}

define signext i32 @min_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: min_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  blt a0, a1, .LBB18_2
; RV64I-NEXT:  # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  .LBB18_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: min_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  min a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp slt i32 %a, %b
%cond = select i1 %cmp, i32 %a, i32 %b
ret i32 %cond
}

define i64 @min_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: min_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  blt a0, a1, .LBB19_2
; RV64I-NEXT:  # %bb.1:
; RV64I-NEXT:  mv a0, a1

```

```

; RV64I-NEXT: .LBB19_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: min_i64:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  min a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp
slt i64 %a, %b
%cond = select i1 %cmp, i64 %a, i64 %b
ret i64 %cond
}

define signext i32 @max_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: max_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  blt a1, a0, .LBB20_2
; RV64I-NEXT:  # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  .LBB20_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: max_i32:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  max a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp sgt i32 %a, %b
%cond = select i1 %cmp, i32 %a, i32 %b
ret i32 %cond
}

define i64 @max_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: max_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  blt a1, a0, .LBB21_2
; RV64I-NEXT:  # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  .LBB21_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: max_i64:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  max a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp sgt i64 %a, %b
%cond = select i1 %cmp, i64 %a, i64 %b
ret i64 %cond
}

```



```

define signext i32 @minu_i32(i32 signext
    %a, i32 signext %b) nounwind {
; RV64I-LABEL: minu_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  bltu a0, a1, .LBB22_2
; RV64I-NEXT: # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT: .LBB22_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: minu_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  minu a0, a0, a1
; RV64ZBB-NEXT:  ret
    %cmp = icmp ult i32 %a, %b
    %cond = select i1 %cmp, i32 %a, i32 %b
    ret i32 %cond
}

```

```

define i64 @minu_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: minu_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  bltu a0, a1, .LBB23_2
; RV64I-NEXT: # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT: .LBB23_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: minu_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  minu a0, a0, a1
; RV64ZBB-NEXT:  ret
    %cmp = icmp ult i64 %a, %b
    %cond = select i1 %cmp, i64 %a, i64 %b
    ret i64 %cond
}

```

```

define signext i32 @maxu_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: maxu_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  bltu a1,
    a0, .LBB24_2
; RV64I-NEXT: # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT: .LBB24_2:
; RV64I-NEXT:  ret
;

```

```

; RV64ZBB-LABEL: maxu_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  maxu a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp ugt i32 %a, %b
%cond = select i1 %cmp, i32 %a, i32 %b
ret i32 %cond
}

define i64 @maxu_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: maxu_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  bltu a1, a0, .LBB25_2
; RV64I-NEXT: # %bb.1:
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT: .LBB25_2:
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: maxu_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  maxu a0, a0, a1
; RV64ZBB-NEXT:  ret
%cmp = icmp ugt i64 %a, %b
%cond = select i1 %cmp, i64 %a, i64 %b
ret i64 %cond
}

declare i32 @llvm.abs.i32(i32, i1 immarg)

define i32 @abs_i32(i32 %x) {
; RV64I-LABEL: abs_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL:
abs_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  sraiw a1, a0, 31
; RV64ZBB-NEXT:  xor a0, a0, a1
; RV64ZBB-NEXT:  subw a0, a0, a1
; RV64ZBB-NEXT:  ret
%abs = tail call i32 @llvm.abs.i32(i32 %x, i1 true)
ret i32 %abs
}

```

```

define signext i32 @abs_i32_sext(i32 signext %x) {
; RV64I-LABEL: abs_i32_sext:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: abs_i32_sext:
; RV64ZBB:     # %bb.0:
; RV64ZBB-NEXT:  sraiw a1, a0, 31
; RV64ZBB-NEXT:  xor a0, a0, a1
; RV64ZBB-NEXT:  subw a0, a0, a1
; RV64ZBB-NEXT:  ret
%abs = tail call i32 @llvm.abs.i32(i32 %x, i1 true)
ret i32 %abs
}

```

```

declare i64 @llvm.abs.i64(i64, i1 immarg)

```

```

define i64 @abs_i64(i64 %x) {
; RV64I-LABEL: abs_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srai a1, a0, 63
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  sub a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: abs_i64:
; RV64ZBB:
; RV64ZBB:     # %bb.0:
; RV64ZBB-NEXT:  neg a1, a0
; RV64ZBB-NEXT:  max a0, a0, a1
; RV64ZBB-NEXT:  ret
%abs = tail call i64 @llvm.abs.i64(i64 %x, i1 true)
ret i64 %abs
}

```

```

define i32 @zexth_i32(i32 %a) nounwind {
; RV64I-LABEL: zexth_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: zexth_i32:
; RV64ZBB:     # %bb.0:
; RV64ZBB-NEXT:  slli a0, a0, 48

```

```

; RV64ZBB-NEXT:  srli a0, a0, 48
; RV64ZBB-NEXT:  ret
%and = and i32 %a, 65535
ret i32 %and
}

define i64 @zexth_i64(i64 %a) nounwind {
; RV64I-LABEL: zexth_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: zexth_i64:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  zext.h a0, a0
; RV64ZBB-NEXT:  ret
%and = and i64 %a, 65535
ret i64 %and
}

declare i32 @llvm.bswap.i32(i32)

define signext i32 @bswap_i32(i32 signext %a) nounwind {
; RV64I-LABEL: bswap_i32:
;
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a0, 8
; RV64I-NEXT:  lui a2, 16
; RV64I-NEXT:  addiw a2, a2, -256
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  srliw a3, a0, 24
; RV64I-NEXT:  or a1, a1, a3
; RV64I-NEXT:  and a2, a0, a2
; RV64I-NEXT:  slliw a2, a2, 8
; RV64I-NEXT:  slliw a0, a0, 24
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: bswap_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  rev8 a0, a0
; RV64ZBB-NEXT:  srai a0, a0, 32
; RV64ZBB-NEXT:  ret
%1 = tail call i32 @llvm.bswap.i32(i32 %a)
ret i32 %1
}

```

```

; Similar to bswap_i32 but the result is not sign extended.
define void @bswap_i32_nosext(i32 signext %a, ptr %x) nounwind {
; RV64I-LABEL: bswap_i32_nosext:
; RV64I:      # %bb.0:
; RV64I-NEXT: srliw a2, a0, 8
; RV64I-NEXT: lui a3, 16
; RV64I-NEXT: addi a3, a3, -256
; RV64I-NEXT: and a2, a2, a3
; RV64I-NEXT: srliw a4, a0, 24
; RV64I-NEXT: or a2, a2, a4
; RV64I-NEXT:
; and a3, a0, a3
; RV64I-NEXT: slli a3, a3, 8
; RV64I-NEXT: slli a0, a0, 24
; RV64I-NEXT: or a0, a0, a3
; RV64I-NEXT: or a0, a0, a2
; RV64I-NEXT: sw a0, 0(a1)
; RV64I-NEXT: ret
;
; RV64ZBB-LABEL: bswap_i32_nosext:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT: rev8 a0, a0
; RV64ZBB-NEXT: srli a0, a0, 32
; RV64ZBB-NEXT: sw a0, 0(a1)
; RV64ZBB-NEXT: ret
%1 = tail call i32 @llvm.bswap.i32(i32 %a)
store i32 %1, ptr %x
ret void
}

```

```

declare i64 @llvm.bswap.i64(i64)

```

```

define i64 @bswap_i64(i64 %a) {
; RV64I-LABEL: bswap_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: srli a1, a0, 40
; RV64I-NEXT: lui a2, 16
; RV64I-NEXT: addiw a2, a2, -256
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: srli a3, a0, 56
; RV64I-NEXT: or a1, a1, a3
; RV64I-NEXT: srli a3, a0, 24
; RV64I-NEXT: lui a4, 4080
; RV64I-NEXT: and a3, a3, a4
; RV64I-NEXT: srli a5, a0, 8
; RV64I-NEXT: srliw a5, a5, 24
; RV64I-NEXT: slli a5, a5, 24

```

```

; RV64I-NEXT:  or a3, a5, a3
; RV64I-NEXT:
    or a1, a3, a1
; RV64I-NEXT:  and a4, a0, a4
; RV64I-NEXT:  slli a4, a4, 24
; RV64I-NEXT:  srliw a3, a0, 24
; RV64I-NEXT:  slli a3, a3, 32
; RV64I-NEXT:  or a3, a4, a3
; RV64I-NEXT:  and a2, a0, a2
; RV64I-NEXT:  slli a2, a2, 40
; RV64I-NEXT:  slli a0, a0, 56
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  or a0, a0, a3
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: bswap_i64:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  rev8 a0, a0
; RV64ZBB-NEXT:  ret
    %1 = call i64 @llvm.bswap.i64(i64 %a)
    ret i64 %1
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN:  -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64I
; RUN: llc -mtriple=riscv64 -mattr=+zbkb -verify-machineinstrs < %s \
; RUN:  -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBKB

```

```

define signext i32 @pack_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: pack_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  slliw a1, a1, 16
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i32:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  packw a0, a0, a1
; RV64ZBKB-NEXT:  ret
    %shl = and i32 %a, 65535
    %shl1 = shl i32 %b, 16
    %or = or i32 %shl1, %shl
    ret i32 %or
}

```

```

define signext i32 @pack_i32_2(i16 zeroext %a, i16 zeroext %b) nounwind {
; RV64I-LABEL: pack_i32_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slliw
a1, a1, 16
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i32_2:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  packw a0, a0, a1
; RV64ZBKB-NEXT:  ret
%zexta = zext i16 %a to i32
%zextb = zext i16 %b to i32
%shl1 = shl i32 %zextb, 16
%or = or i32 %shl1, %zexta
ret i32 %or
}

; Test case where we don't have a sign_extend_inreg after the or.
define signext i32 @pack_i32_3(i16 zeroext %0, i16 zeroext %1, i32 signext %2) {
; RV64I-LABEL: pack_i32_3:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  addw a0, a0, a2
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i32_3:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  packw a0, a1, a0
; RV64ZBKB-NEXT:  addw a0, a0, a2
; RV64ZBKB-NEXT:  ret
%4 = zext i16 %0 to i32
%5 = shl nuw i32 %4, 16
%6 = zext i16 %1 to i32
%7 = or i32 %5, %6
%8 = add i32 %7, %2
ret i32 %8
}

define i64 @pack_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: pack_i64:
;
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32

```

```

; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i64:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  pack a0, a0, a1
; RV64ZBKB-NEXT:  ret
%shl = and i64 %a, 4294967295
%shl1 = shl i64 %b, 32
%or = or i64 %shl1, %shl
ret i64 %or
}

```

```

define i64 @pack_i64_2(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: pack_i64_2:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i64_2:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  pack a0, a0, a1
; RV64ZBKB-NEXT:  ret
%zexta = zext i32 %a to i64
%zextb = zext i32 %b to i64
%shl1 = shl i64 %zextb, 32
%or = or i64 %shl1, %zexta
ret i64 %or
}

```

```

define i64 @pack_i64_3(ptr %0, ptr %1) {
; RV64I-LABEL: pack_i64_3:
; RV64I:    #
%bb.0:
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  lwu a1, 0(a1)
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i64_3:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  lw a0, 0(a0)
; RV64ZBKB-NEXT:  lwu a1, 0(a1)
; RV64ZBKB-NEXT:  pack a0, a1, a0

```



```
; RV64ZBKB-NEXT:  ret
%3 = load i32, ptr %0, align 4
%4 = zext i32 %3 to i64
%5 = shl i64 %4, 32
%6 = load i32, ptr %1, align 4
%7 = zext i32 %6 to i64
%8 = or i64 %5, %7
ret i64 %8
}
```

```
define signext i32 @packh_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: packh_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  andi a0, a0, 255
; RV64I-NEXT:  slli a1, a1, 56
; RV64I-NEXT:  srli a1, a1, 48
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: packh_i32:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  packh a0, a0, a1
; RV64ZBKB-NEXT:  ret
%and = and i32 %a, 255
%and1 = shl i32 %b, 8
%shl = and i32 %and1, 65280
%or = or
i32 %shl, %and
ret i32 %or
}
```

```
define i32 @packh_i32_2(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: packh_i32_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  andi a0, a0, 255
; RV64I-NEXT:  andi a1, a1, 255
; RV64I-NEXT:  slliw a1, a1, 8
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: packh_i32_2:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  packh a0, a0, a1
; RV64ZBKB-NEXT:  ret
%and = and i32 %a, 255
%and1 = and i32 %b, 255
%shl = shl i32 %and1, 8
%or = or i32 %shl, %and
```

```
ret i32 %or
}
```

```
define i64 @packh_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: packh_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: andi a0, a0, 255
; RV64I-NEXT: slli a1, a1, 56
; RV64I-NEXT: srli a1, a1, 48
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBKB-LABEL: packh_i64:
; RV64ZBKB:   # %bb.0:
; RV64ZBKB-NEXT: packh a0, a0, a1
; RV64ZBKB-NEXT: ret
%and = and i64 %a, 255
%and1 = shl i64 %b, 8
%shl = and i64 %and1, 65280
%or = or i64 %shl,
%and
ret i64 %or
}
```

```
define i64 @packh_i64_2(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: packh_i64_2:
; RV64I:      # %bb.0:
; RV64I-NEXT: andi a0, a0, 255
; RV64I-NEXT: andi a1, a1, 255
; RV64I-NEXT: slli a1, a1, 8
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBKB-LABEL: packh_i64_2:
; RV64ZBKB:   # %bb.0:
; RV64ZBKB-NEXT: packh a0, a0, a1
; RV64ZBKB-NEXT: ret
%and = and i64 %a, 255
%and1 = and i64 %b, 255
%shl = shl i64 %and1, 8
%or = or i64 %shl, %and
ret i64 %or
}
```

```
define zeroext i16 @packh_i16(i8 zeroext %a, i8 zeroext %b) nounwind {
; RV64I-LABEL: packh_i16:
; RV64I:      # %bb.0:
; RV64I-NEXT: slliw a1, a1, 8
```

```

; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: packh_i16:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  packh a0, a0, a1
; RV64ZBKB-NEXT:  ret
%zext = zext i8 %a to i16
%zext1 = zext i8 %b to i16
%shl = shl i16 %zext1, 8
%or = or i16 %shl, %zext
ret i16 %or
}

```

```

define zeroext i16 @packh_i16_2(i8
  zeroext %0, i8 zeroext %1, i8 zeroext %2) {
; RV64I-LABEL: packh_i16_2:
; RV64I:    # %bb.0:
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  slli a0, a0, 8
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: packh_i16_2:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  add a0, a1, a0
; RV64ZBKB-NEXT:  packh a0, a2, a0
; RV64ZBKB-NEXT:  ret
%4 = add i8 %1, %0
%5 = zext i8 %4 to i16
%6 = shl i16 %5, 8
%7 = zext i8 %2 to i16
%8 = or i16 %6, %7
ret i16 %8
}

```

```

define i64 @pack_i64_allWUsers(i32 signext %0, i32 signext %1, i32 signext %2) {
; RV64I-LABEL: pack_i64_allWUsers:
; RV64I:    # %bb.0:
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  slli a2, a2, 32
; RV64I-NEXT:  srli a2, a2, 32
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  ret
;

```

```

; RV64ZBKB-LABEL: pack_i64_allWUsers:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  add a0, a1, a0
; RV64ZBKB-NEXT:
    pack a0, a2, a0
; RV64ZBKB-NEXT:  ret
%4 = add i32 %1, %0
%5 = zext i32 %4 to i64
%6 = shl i64 %5, 32
%7 = zext i32 %2 to i64
%8 = or i64 %6, %7
ret i64 %8
}

define signext i32 @pack_i32_allWUsers(i16 zeroext %0, i16 zeroext %1, i16 zeroext %2) {
; RV64I-LABEL: pack_i32_allWUsers:
; RV64I:    # %bb.0:
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  slliw a0, a0, 16
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL: pack_i32_allWUsers:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  add a0, a1, a0
; RV64ZBKB-NEXT:  packw a0, a2, a0
; RV64ZBKB-NEXT:  ret
%4 = add i16 %1, %0
%5 = zext i16 %4 to i32
%6 = shl i32 %5, 16
%7 = zext i16 %2 to i32
%8 = or i32 %6, %7
ret i32 %8
}

define i64 @pack_i64_imm() {
; RV64I-LABEL: pack_i64_imm:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 65793
; RV64I-NEXT:  addiw a0, a0, 16
; RV64I-NEXT:  slli a1, a0, 32
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBKB-LABEL:
    pack_i64_imm:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  lui a0, 65793

```

```

; RV64ZBKB-NEXT:  addi a0, a0, 16
; RV64ZBKB-NEXT:  pack a0, a0, a0
; RV64ZBKB-NEXT:  ret
ret i64 1157442765409226768 ; 0x0101010101010101
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -riscv-disable-using-constant-pool-for-large-ints -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=RV64I,RV64-NOPOOL
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=RV64I,RV64I-POOL
; RUN: llc -mtriple=riscv64 -riscv-disable-using-constant-pool-for-large-ints -mattr=+zba \
; RUN: -riscv-experimental-rv64-legal-i32 -verify-machineinstrs < %s | FileCheck %s -check-prefix=RV64IZBA
; RUN: llc -mtriple=riscv64 -riscv-disable-using-constant-pool-for-large-ints -mattr=+zbb \
; RUN: -riscv-experimental-rv64-legal-i32 -verify-machineinstrs < %s | FileCheck %s -check-prefix=RV64IZBB
; RUN: llc -mtriple=riscv64 -riscv-disable-using-constant-pool-for-large-ints -mattr=+zbs \
; RUN: -riscv-experimental-rv64-legal-i32 -verify-machineinstrs < %s | FileCheck
% s -check-prefix=RV64IZBS
; RUN: llc -mtriple=riscv64 -riscv-disable-using-constant-pool-for-large-ints -mattr=+xtheadbb \
; RUN: -riscv-experimental-rv64-legal-i32 -verify-machineinstrs < %s | FileCheck %s -check-
prefix=RV64IXTHEADBB

; Materializing constants

; TODO: It would be preferable if anyext constant returns were sign rather
; than zero extended. See PR39092. For now, mark returns as explicitly signext
; (this matches what Clang would generate for equivalent C/C++ anyway).

define signext i32 @zero() nounwind {
; RV64I-LABEL: zero:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, 0
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: zero:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: zero:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, 0
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: zero:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, 0
; RV64IZBS-NEXT:  ret
;

```

```

; RV64IXTHEADBB-LABEL: zero:
; RV64IXTHEADBB:    # %bb.0:
;
RV64IXTHEADBB-NEXT:  li a0, 0
; RV64IXTHEADBB-NEXT:  ret
ret i32 0
}

define signext i32 @pos_small() nounwind {
; RV64I-LABEL: pos_small:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a0, 2047
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: pos_small:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 2047
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: pos_small:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, 2047
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: pos_small:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, 2047
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: pos_small:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, 2047
; RV64IXTHEADBB-NEXT:  ret
ret i32 2047
}

define signext i32 @neg_small() nounwind {
; RV64I-LABEL: neg_small:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a0, -2048
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: neg_small:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, -2048
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL:

```

```

neg_small:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, -2048
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: neg_small:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, -2048
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: neg_small:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -2048
; RV64IXTHEADBB-NEXT:  ret
ret i32 -2048
}

```

```

define signext i32 @pos_i32() nounwind {
; RV64I-LABEL: pos_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 423811
; RV64I-NEXT:  addiw a0, a0, -1297
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: pos_i32:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 423811
; RV64IZBA-NEXT:  addiw a0, a0, -1297
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: pos_i32:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 423811
; RV64IZBB-NEXT:  addiw a0, a0, -1297
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: pos_i32:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 423811
; RV64IZBS-NEXT:  addiw a0, a0, -1297
; RV64IZBS-NEXT:
ret
;
; RV64IXTHEADBB-LABEL: pos_i32:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 423811
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1297
; RV64IXTHEADBB-NEXT:  ret

```

```

ret i32 1735928559
}

define signext i32 @neg_i32() nounwind {
; RV64I-LABEL: neg_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 912092
; RV64I-NEXT:  addiw a0, a0, -273
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: neg_i32:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 912092
; RV64IZBA-NEXT:  addiw a0, a0, -273
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: neg_i32:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 912092
; RV64IZBB-NEXT:  addiw a0, a0, -273
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: neg_i32:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 912092
; RV64IZBS-NEXT:  addiw a0, a0, -273
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: neg_i32:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 912092
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -273
;
RV64IXTHEADBB-NEXT:  ret
ret i32 -559038737
}

define signext i32 @pos_i32_hi20_only() nounwind {
; RV64I-LABEL: pos_i32_hi20_only:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 16
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: pos_i32_hi20_only:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 16
; RV64IZBA-NEXT:  ret
;

```



```

; RV64IZBB-LABEL: pos_i32_hi20_only:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 16
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: pos_i32_hi20_only:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 16
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: pos_i32_hi20_only:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 16
; RV64IXTHEADBB-NEXT:  ret
ret i32 65536 ; 0x10000
}

```

```

define signext i32 @neg_i32_hi20_only() nounwind {
; RV64I-LABEL: neg_i32_hi20_only:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 1048560
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: neg_i32_hi20_only:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0,
1048560
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: neg_i32_hi20_only:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1048560
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: neg_i32_hi20_only:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 1048560
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: neg_i32_hi20_only:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1048560
; RV64IXTHEADBB-NEXT:  ret
ret i32 -65536 ; -0x10000
}

```

; This can be materialized with ADDI+SLLI, improving compressibility.

```

define signext i32 @imm_left_shifted_addi() nounwind {
; RV64I-LABEL: imm_left_shifted_addi:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a0, 32
; RV64I-NEXT: addiw a0, a0, -64
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_left_shifted_addi:
; RV64IZBA:   # %bb.0:
; RV64IZBA-NEXT: lui a0, 32
; RV64IZBA-NEXT: addiw a0, a0, -64
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_left_shifted_addi:
; RV64IZBB:   # %bb.0:
; RV64IZBB-NEXT: lui a0, 32
;
; RV64IZBB-NEXT: addiw a0, a0, -64
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_left_shifted_addi:
; RV64IZBS:   # %bb.0:
; RV64IZBS-NEXT: lui a0, 32
; RV64IZBS-NEXT: addiw a0, a0, -64
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_left_shifted_addi:
; RV64IXTHEADBB:   # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 32
; RV64IXTHEADBB-NEXT: addiw a0, a0, -64
; RV64IXTHEADBB-NEXT: ret
ret i32 131008 ; 0x1FFC0
}

```

; This can be materialized with ADDI+SRLI, improving compressibility.

```

define signext i32 @imm_right_shifted_addi() nounwind {
; RV64I-LABEL: imm_right_shifted_addi:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a0, 524288
; RV64I-NEXT: addiw a0, a0, -1
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_right_shifted_addi:
; RV64IZBA:   # %bb.0:
; RV64IZBA-NEXT: lui a0, 524288
; RV64IZBA-NEXT: addiw a0, a0, -1
; RV64IZBA-NEXT: ret

```

```

;
; RV64IZBB-LABEL: imm_right_shifted_addi:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 524288
; RV64IZBB-NEXT:
;               addiw a0, a0, -1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_right_shifted_addi:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 524288
; RV64IZBS-NEXT:  addiw a0, a0, -1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_right_shifted_addi:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 524288
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1
; RV64IXTHEADBB-NEXT:  ret
;               ret i32 2147483647 ; 0x7FFFFFFF
}

```

; This can be materialized with LUI+SRLI, improving compressibility.

```

define signext i32 @imm_right_shifted_lui() nounwind {
; RV64I-LABEL: imm_right_shifted_lui:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 56
; RV64I-NEXT:  addiw a0, a0, 580
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_right_shifted_lui:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 56
; RV64IZBA-NEXT:  addiw a0, a0, 580
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_right_shifted_lui:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 56
; RV64IZBB-NEXT:
;               addiw a0, a0, 580
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_right_shifted_lui:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 56
; RV64IZBS-NEXT:  addiw a0, a0, 580

```

```

; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_right_shifted_lui:
; RV64IXTHEADBB:   # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 56
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 580
; RV64IXTHEADBB-NEXT:  ret
ret i32 229956 ; 0x38244
}

```

```

define i64 @imm64_1() nounwind {
; RV64I-LABEL: imm64_1:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, 1
; RV64I-NEXT:  slli a0, a0, 31
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_1:
; RV64IZBA:   # %bb.0:
; RV64IZBA-NEXT:  li a0, 1
; RV64IZBA-NEXT:  slli a0, a0, 31
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_1:
; RV64IZBB:   # %bb.0:
; RV64IZBB-NEXT:  li a0, 1
; RV64IZBB-NEXT:  slli a0, a0, 31
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_1:
; RV64IZBS:   # %bb.0:
; RV64IZBS-NEXT:  bseti a0, zero, 31
; RV64IZBS-NEXT:  ret
;
;
RV64IXTHEADBB-LABEL: imm64_1:
; RV64IXTHEADBB:   # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, 1
; RV64IXTHEADBB-NEXT:  slli a0, a0, 31
; RV64IXTHEADBB-NEXT:  ret
ret i64 2147483648 ; 0x8000_0000
}

```

```

define i64 @imm64_2() nounwind {
; RV64I-LABEL: imm64_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, -1
; RV64I-NEXT:  srli a0, a0, 32

```

```

; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_2:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, -1
; RV64IZBA-NEXT:  srli a0, a0, 32
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_2:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, -1
; RV64IZBB-NEXT:  srli a0, a0, 32
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_2:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, -1
; RV64IZBS-NEXT:  srli a0, a0, 32
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_2:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -1
; RV64IXTHEADBB-NEXT:  srli a0, a0, 32
; RV64IXTHEADBB-NEXT:  ret
ret i64 4294967295 ;
0xFFFF_FFFF
}

```

```

define i64 @imm64_3() nounwind {
; RV64I-LABEL: imm64_3:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a0, 1
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_3:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 1
; RV64IZBA-NEXT:  slli a0, a0, 32
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_3:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, 1
; RV64IZBB-NEXT:  slli a0, a0, 32
; RV64IZBB-NEXT:  ret
;

```

```

; RV64IZBS-LABEL: imm64_3:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  bseti a0, zero, 32
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_3:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, 1
; RV64IXTHEADBB-NEXT:  slli a0, a0, 32
; RV64IXTHEADBB-NEXT:  ret
ret i64 4294967296 ; 0x1_0000_0000
}

define i64 @imm64_4() nounwind {
; RV64I-LABEL: imm64_4:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a0, -1
; RV64I-NEXT:  slli a0, a0, 63
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_4:
; RV64IZBA:
    # %bb.0:
; RV64IZBA-NEXT:  li a0, -1
; RV64IZBA-NEXT:  slli a0, a0, 63
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_4:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, -1
; RV64IZBB-NEXT:  slli a0, a0, 63
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_4:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  bseti a0, zero, 63
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_4:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -1
; RV64IXTHEADBB-NEXT:  slli a0, a0, 63
; RV64IXTHEADBB-NEXT:  ret
ret i64 9223372036854775808 ; 0x8000_0000_0000_0000
}

define i64 @imm64_5() nounwind {
; RV64I-LABEL: imm64_5:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  li a0, -1
; RV64I-NEXT:  slli a0, a0, 63
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_5:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, -1
; RV64IZBA-NEXT:  slli a0, a0, 63
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_5:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, -1
; RV64IZBB-NEXT:
;               slli a0, a0, 63
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_5:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  bseti a0, zero, 63
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_5:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -1
; RV64IXTHEADBB-NEXT:  slli a0, a0, 63
; RV64IXTHEADBB-NEXT:  ret
ret i64 -9223372036854775808 ; 0x8000_0000_0000_0000
}

```

```

define i64 @imm64_6() nounwind {
; RV64I-LABEL: imm64_6:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 9321
; RV64I-NEXT:  addi a0, a0, -1329
; RV64I-NEXT:  slli a0, a0, 35
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_6:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 9321
; RV64IZBA-NEXT:  addi a0, a0, -1329
; RV64IZBA-NEXT:  slli a0, a0, 35
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_6:
; RV64IZBB:    # %bb.0:

```

```

; RV64IZBB-NEXT:  lui a0, 9321
; RV64IZBB-NEXT:  addi a0, a0, -1329
; RV64IZBB-NEXT:  slli a0, a0, 35
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_6:
;
RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 9321
; RV64IZBS-NEXT:  addi a0, a0, -1329
; RV64IZBS-NEXT:  slli a0, a0, 35
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_6:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 9321
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1329
; RV64IXTHEADBB-NEXT:  slli a0, a0, 35
; RV64IXTHEADBB-NEXT:  ret
ret i64 1311768464867721216 ; 0x1234_5678_0000_0000
}

```

```

define i64 @imm64_7() nounwind {
; RV64I-LABEL: imm64_7:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a0, 7
; RV64I-NEXT:  slli a0, a0, 36
; RV64I-NEXT:  addi a0, a0, 11
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:  addi a0, a0, 15
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_7:
; RV64IZBA:  # %bb.0:
; RV64IZBA-NEXT:  li a0, 7
; RV64IZBA-NEXT:  slli a0, a0, 36
; RV64IZBA-NEXT:  addi a0, a0, 11
; RV64IZBA-NEXT:  slli a0, a0, 24
; RV64IZBA-NEXT:  addi a0, a0, 15
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_7:
; RV64IZBB:  #
%bb.0:
; RV64IZBB-NEXT:  li a0, 7
; RV64IZBB-NEXT:  slli a0, a0, 36
; RV64IZBB-NEXT:  addi a0, a0, 11
; RV64IZBB-NEXT:  slli a0, a0, 24

```



```

; RV64IZBB-NEXT:  addi a0, a0, 15
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_7:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  li a0, 7
; RV64IZBS-NEXT:  slli a0, a0, 36
; RV64IZBS-NEXT:  addi a0, a0, 11
; RV64IZBS-NEXT:  slli a0, a0, 24
; RV64IZBS-NEXT:  addi a0, a0, 15
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_7:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, 7
; RV64IXTHEADBB-NEXT:  slli a0, a0, 36
; RV64IXTHEADBB-NEXT:  addi a0, a0, 11
; RV64IXTHEADBB-NEXT:  slli a0, a0, 24
; RV64IXTHEADBB-NEXT:  addi a0, a0, 15
; RV64IXTHEADBB-NEXT:  ret
ret i64 8070450532432478223 ; 0x7000_0000_0B00_000F
}

```

; TODO: it can be preferable to put constants that are expensive to materialise  
into the constant pool, especially for -Os.

```

define i64 @imm64_8() nounwind {
; RV64-NOPOOL-LABEL: imm64_8:
; RV64-NOPOOL:
;   # %bb.0:
; RV64-NOPOOL-NEXT:  lui a0, 583
; RV64-NOPOOL-NEXT:  addiw a0, a0, -1875
; RV64-NOPOOL-NEXT:  slli a0, a0, 14
; RV64-NOPOOL-NEXT:  addi a0, a0, -947
; RV64-NOPOOL-NEXT:  slli a0, a0, 12
; RV64-NOPOOL-NEXT:  addi a0, a0, 1511
; RV64-NOPOOL-NEXT:  slli a0, a0, 13
; RV64-NOPOOL-NEXT:  addi a0, a0, -272
; RV64-NOPOOL-NEXT:  ret
;
; RV64I-POOL-LABEL: imm64_8:
; RV64I-POOL:      # %bb.0:
; RV64I-POOL-NEXT:  lui a0, %hi(.LCPI17_0)
; RV64I-POOL-NEXT:  ld a0, %lo(.LCPI17_0)(a0)
; RV64I-POOL-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_8:
; RV64IZBA:      # %bb.0:
; RV64IZBA-NEXT:  lui a0, 596523

```

```

; RV64IZBA-NEXT:  addi a0, a0, 965
; RV64IZBA-NEXT:  slli.uw a0, a0, 13
; RV64IZBA-NEXT:  addi a0, a0, -1347
; RV64IZBA-NEXT:  slli a0, a0, 12
; RV64IZBA-NEXT:  addi a0, a0, -529
; RV64IZBA-NEXT:  slli a0, a0, 4
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_8:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 583
; RV64IZBB-NEXT:  addiw
a0, a0, -1875
; RV64IZBB-NEXT:  slli a0, a0, 14
; RV64IZBB-NEXT:  addi a0, a0, -947
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1511
; RV64IZBB-NEXT:  slli a0, a0, 13
; RV64IZBB-NEXT:  addi a0, a0, -272
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_8:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 583
; RV64IZBS-NEXT:  addiw a0, a0, -1875
; RV64IZBS-NEXT:  slli a0, a0, 14
; RV64IZBS-NEXT:  addi a0, a0, -947
; RV64IZBS-NEXT:  slli a0, a0, 12
; RV64IZBS-NEXT:  addi a0, a0, 1511
; RV64IZBS-NEXT:  slli a0, a0, 13
; RV64IZBS-NEXT:  addi a0, a0, -272
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_8:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 583
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1875
; RV64IXTHEADBB-NEXT:  slli a0, a0, 14
; RV64IXTHEADBB-NEXT:  addi a0, a0, -947
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1511
; RV64IXTHEADBB-NEXT:  slli a0, a0, 13
; RV64IXTHEADBB-NEXT:
    addi a0, a0, -272
; RV64IXTHEADBB-NEXT:  ret
ret i64 1311768467463790320 ; 0x1234_5678_9ABC_DEF0
}

```

```

define i64 @imm64_9() nounwind {
; RV64I-LABEL: imm64_9:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, -1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_9:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, -1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_9:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, -1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_9:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, -1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_9:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -1
; RV64IXTHEADBB-NEXT:  ret
ret i64 -1
}

```

; Various cases where extraneous ADDIs can be inserted where a (left shifted)  
; LUI suffices.

```

define i64 @imm_left_shifted_lui_1() nounwind {
; RV64I-LABEL: imm_left_shifted_lui_1:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 262145
; RV64I-NEXT:  slli a0, a0, 1
;
RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_left_shifted_lui_1:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 262145
; RV64IZBA-NEXT:  slli a0, a0, 1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_left_shifted_lui_1:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 262145

```

```

; RV64IZBB-NEXT:  slli a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_left_shifted_lui_1:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 262145
; RV64IZBS-NEXT:  slli a0, a0, 1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_left_shifted_lui_1:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 262145
; RV64IXTHEADBB-NEXT:  slli a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 2147491840 ; 0x8000_2000
}

```

```

define i64 @imm_left_shifted_lui_2() nounwind {
; RV64I-LABEL: imm_left_shifted_lui_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 262145
; RV64I-NEXT:  slli a0, a0, 2
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_left_shifted_lui_2:
; RV64IZBA:
# %bb.0:
; RV64IZBA-NEXT:  lui a0, 262145
; RV64IZBA-NEXT:  slli a0, a0, 2
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_left_shifted_lui_2:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 262145
; RV64IZBB-NEXT:  slli a0, a0, 2
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_left_shifted_lui_2:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 262145
; RV64IZBS-NEXT:  slli a0, a0, 2
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_left_shifted_lui_2:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 262145
; RV64IXTHEADBB-NEXT:  slli a0, a0, 2
; RV64IXTHEADBB-NEXT:  ret
}

```

```
ret i64 4294983680 ; 0x1_0000_4000
}
```

```
define i64 @imm_left_shifted_lui_3() nounwind {
; RV64I-LABEL: imm_left_shifted_lui_3:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a0, 4097
; RV64I-NEXT: slli a0, a0, 20
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_left_shifted_lui_3:
; RV64IZBA:   # %bb.0:
; RV64IZBA-NEXT: lui a0, 4097
; RV64IZBA-NEXT: slli a0, a0, 20
;
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_left_shifted_lui_3:
; RV64IZBB:   # %bb.0:
; RV64IZBB-NEXT: lui a0, 4097
; RV64IZBB-NEXT: slli a0, a0, 20
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_left_shifted_lui_3:
; RV64IZBS:   # %bb.0:
; RV64IZBS-NEXT: lui a0, 4097
; RV64IZBS-NEXT: slli a0, a0, 20
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_left_shifted_lui_3:
; RV64IXTHEADBB:   # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 4097
; RV64IXTHEADBB-NEXT: slli a0, a0, 20
; RV64IXTHEADBB-NEXT: ret
ret i64 17596481011712 ; 0x1001_0000_0000
}
```

; Various cases where extraneous ADDIs can be inserted where a (right shifted)  
; LUI suffices, or where multiple ADDIs can be used instead of a single LUI.

```
define i64 @imm_right_shifted_lui_1() nounwind {
; RV64I-LABEL: imm_right_shifted_lui_1:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a0, 983056
; RV64I-NEXT: srli a0, a0, 16
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_right_shifted_lui_1:
```

```

; RV64IZBA:
    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 983056
; RV64IZBA-NEXT:  srli a0, a0, 16
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_right_shifted_lui_1:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 983056
; RV64IZBB-NEXT:  srli a0, a0, 16
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_right_shifted_lui_1:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 983056
; RV64IZBS-NEXT:  srli a0, a0, 16
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_right_shifted_lui_1:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 983056
; RV64IXTHEADBB-NEXT:  srli a0, a0, 16
; RV64IXTHEADBB-NEXT:  ret
ret i64 281474976706561 ; 0xFFFF_FFFF_F001
}

```

```

define i64 @imm_right_shifted_lui_2() nounwind {
; RV64I-LABEL: imm_right_shifted_lui_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 1044481
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  srli a0, a0, 24
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_right_shifted_lui_2:
; RV64IZBA:   # %bb.0:
; RV64IZBA-NEXT:
    lui a0, 1044481
; RV64IZBA-NEXT:  slli a0, a0, 12
; RV64IZBA-NEXT:  srli a0, a0, 24
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_right_shifted_lui_2:
; RV64IZBB:   # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1044481
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  srli a0, a0, 24
; RV64IZBB-NEXT:  ret
}

```

```

;
; RV64IZBS-LABEL: imm_right_shifted_lui_2:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 1044481
; RV64IZBS-NEXT:  slli a0, a0, 12
; RV64IZBS-NEXT:  srli a0, a0, 24
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_right_shifted_lui_2:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1044481
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  srli a0, a0, 24
; RV64IXTHEADBB-NEXT:  ret
ret i64 1099511623681 ; 0xFF_FFFF_F001
}

```

; We can materialize the upper bits with a single (shifted) LUI, but that option  
; can be missed due to the lower bits, which aren't just 1s or just 0s.

```

define i64 @imm_decoupled_lui_addi() nounwind
{
; RV64I-LABEL: imm_decoupled_lui_addi:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 4097
; RV64I-NEXT:  slli a0, a0, 20
; RV64I-NEXT:  addi a0, a0, -3
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_decoupled_lui_addi:
; RV64IZBA:  # %bb.0:
; RV64IZBA-NEXT:  lui a0, 4097
; RV64IZBA-NEXT:  slli a0, a0, 20
; RV64IZBA-NEXT:  addi a0, a0, -3
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_decoupled_lui_addi:
; RV64IZBB:  # %bb.0:
; RV64IZBB-NEXT:  lui a0, 4097
; RV64IZBB-NEXT:  slli a0, a0, 20
; RV64IZBB-NEXT:  addi a0, a0, -3
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_decoupled_lui_addi:
; RV64IZBS:  # %bb.0:
; RV64IZBS-NEXT:  lui a0, 4097
; RV64IZBS-NEXT:  slli a0, a0, 20
; RV64IZBS-NEXT:  addi a0, a0, -3

```

```

; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_decoupled_lui_addi:
; RV64IXTHEADBB:   # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 4097
; RV64IXTHEADBB-NEXT:  slli a0, a0, 20
; RV64IXTHEADBB-NEXT:  addi a0, a0, -3
; RV64IXTHEADBB-NEXT:
    ret
ret i64 17596481011709 ; 0x1000_FFFF_FFFD
}

```

; This constant can be materialized for RV64 with LUI+SRLI+XORI.

```

define i64 @imm_end_xori_1() nounwind {
; RV64I-LABEL: imm_end_xori_1:
; RV64I:       # %bb.0:
; RV64I-NEXT:  lui a0, 983040
; RV64I-NEXT:  srli a0, a0, 3
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_end_xori_1:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 983040
; RV64IZBA-NEXT:  srli a0, a0, 3
; RV64IZBA-NEXT:  not a0, a0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_end_xori_1:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 983040
; RV64IZBB-NEXT:  srli a0, a0, 3
; RV64IZBB-NEXT:  not a0, a0
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_end_xori_1:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 983040
; RV64IZBS-NEXT:  srli a0, a0, 3
; RV64IZBS-NEXT:  not a0, a0
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_end_xori_1:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:
    lui a0, 983040
; RV64IXTHEADBB-NEXT:  srli a0, a0, 3

```



```
; RV64IXTHEADBB-NEXT:  not a0, a0
; RV64IXTHEADBB-NEXT:  ret
ret i64 -2305843009180139521 ; 0xE000_0000_01FF_FFFF
}
```

; This constant can be materialized for RV64 with ADDI+SLLI+ADDI+ADDI.

```
define i64 @imm_end_2addi_1() nounwind {
; RV64I-LABEL: imm_end_2addi_1:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, -2047
; RV64I-NEXT:  slli a0, a0, 39
; RV64I-NEXT:  addi a0, a0, -2048
; RV64I-NEXT:  addi a0, a0, -1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_end_2addi_1:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, -2047
; RV64IZBA-NEXT:  slli a0, a0, 39
; RV64IZBA-NEXT:  addi a0, a0, -2048
; RV64IZBA-NEXT:  addi a0, a0, -1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_end_2addi_1:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, -2047
; RV64IZBB-NEXT:  slli a0, a0, 39
; RV64IZBB-NEXT:  addi a0, a0, -2048
; RV64IZBB-NEXT:  addi a0, a0, -1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_end_2addi_1:
;
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a0, -2047
; RV64IZBS-NEXT:  slli a0, a0, 39
; RV64IZBS-NEXT:  addi a0, a0, -2048
; RV64IZBS-NEXT:  addi a0, a0, -1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_end_2addi_1:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -2047
; RV64IXTHEADBB-NEXT:  slli a0, a0, 39
; RV64IXTHEADBB-NEXT:  addi a0, a0, -2048
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1
; RV64IXTHEADBB-NEXT:  ret
}
```

```
ret i64 -1125350151030785 ; 0xFFFC_007F_FFFF_F7FF
}
```

; This constant can be more efficiently materialized for RV64 if we use two  
; registers instead of one.

```
define i64 @imm_2reg_1() nounwind {
; RV64I-LABEL: imm_2reg_1:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 74565
; RV64I-NEXT:  addiw a0, a0, 1656
; RV64I-NEXT:  slli a1, a0, 57
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_2reg_1:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 74565
; RV64IZBA-NEXT:  addiw a0, a0, 1656
; RV64IZBA-NEXT:
;               slli a1, a0, 57
; RV64IZBA-NEXT:  add a0, a0, a1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_2reg_1:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 74565
; RV64IZBB-NEXT:  addiw a0, a0, 1656
; RV64IZBB-NEXT:  slli a1, a0, 57
; RV64IZBB-NEXT:  add a0, a0, a1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_2reg_1:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 74565
; RV64IZBS-NEXT:  addiw a0, a0, 1656
; RV64IZBS-NEXT:  slli a1, a0, 57
; RV64IZBS-NEXT:  add a0, a0, a1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_2reg_1:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 74565
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 1656
; RV64IXTHEADBB-NEXT:  slli a1, a0, 57
; RV64IXTHEADBB-NEXT:  add a0, a0, a1
; RV64IXTHEADBB-NEXT:  ret
ret i64 -1152921504301427080 ; 0xF000_0000_1234_5678
```

```

}

; FIXME: This should use a single ADDI for the immediate.
define void @imm_store_i16_neg1(ptr %p) nounwind {
; RV64I-LABEL: imm_store_i16_neg1:
;
RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  sh a1, 0(a0)
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_store_i16_neg1:
RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a1, -1
; RV64IZBA-NEXT:  sh a1, 0(a0)
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_store_i16_neg1:
RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a1, -1
; RV64IZBB-NEXT:  sh a1, 0(a0)
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_store_i16_neg1:
RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a1, -1
; RV64IZBS-NEXT:  sh a1, 0(a0)
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_store_i16_neg1:
RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  li a1, -1
; RV64IXTHEADBB-NEXT:  sh a1, 0(a0)
; RV64IXTHEADBB-NEXT:  ret
store i16 -1, ptr %p
ret void
}

```

```

; FIXME: This should use a single ADDI for the immediate.
define void @imm_store_i32_neg1(ptr %p) nounwind {
; RV64I-LABEL: imm_store_i32_neg1:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:
sw a1, 0(a0)
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_store_i32_neg1:

```

```

; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a1, -1
; RV64IZBA-NEXT:  sw a1, 0(a0)
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_store_i32_neg1:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a1, -1
; RV64IZBB-NEXT:  sw a1, 0(a0)
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_store_i32_neg1:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  li a1, -1
; RV64IZBS-NEXT:  sw a1, 0(a0)
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_store_i32_neg1:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a1, -1
; RV64IXTHEADBB-NEXT:  sw a1, 0(a0)
; RV64IXTHEADBB-NEXT:  ret
store i32 -1, ptr %p
ret void
}

```

```

define i64 @imm_5372288229() {
; RV64I-LABEL: imm_5372288229:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 160
; RV64I-NEXT:  addiw a0, a0, 437
; RV64I-NEXT:  slli a0, a0, 13
; RV64I-NEXT:  addi a0, a0, -795
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_5372288229:
; RV64IZBA:
;   # %bb.0:
; RV64IZBA-NEXT:  lui a0, 655797
; RV64IZBA-NEXT:  slli.uw a0, a0, 1
; RV64IZBA-NEXT:  addi a0, a0, -795
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_5372288229:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 160
; RV64IZBB-NEXT:  addiw a0, a0, 437
; RV64IZBB-NEXT:  slli a0, a0, 13

```

```

; RV64IZBB-NEXT:  addi a0, a0, -795
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_5372288229:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 263018
; RV64IZBS-NEXT:  addiw a0, a0, -795
; RV64IZBS-NEXT:  bseti a0, a0, 32
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_5372288229:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 160
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 437
; RV64IXTHEADBB-NEXT:  slli a0, a0, 13
; RV64IXTHEADBB-NEXT:  addi a0, a0, -795
; RV64IXTHEADBB-NEXT:  ret
ret i64 5372288229
}

```

```

define i64 @imm_neg_5372288229() {
; RV64I-LABEL: imm_neg_5372288229:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 1048416
; RV64I-NEXT:
    addiw a0, a0, -437
; RV64I-NEXT:  slli a0, a0, 13
; RV64I-NEXT:  addi a0, a0, 795
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_5372288229:
; RV64IZBA:      # %bb.0:
; RV64IZBA-NEXT:  lui a0, 611378
; RV64IZBA-NEXT:  addiw a0, a0, 265
; RV64IZBA-NEXT:  sh1add a0, a0, a0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_5372288229:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1048416
; RV64IZBB-NEXT:  addiw a0, a0, -437
; RV64IZBB-NEXT:  slli a0, a0, 13
; RV64IZBB-NEXT:  addi a0, a0, 795
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_5372288229:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 785558

```

```

; RV64IZBS-NEXT:    addiw a0, a0, 795
; RV64IZBS-NEXT:    bclri a0, a0, 32
; RV64IZBS-NEXT:    ret
;
; RV64IXTHEADBB-LABEL: imm_neg_5372288229:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:    lui a0, 1048416
; RV64IXTHEADBB-NEXT:    addiw a0, a0, -437
; RV64IXTHEADBB-NEXT:    slli a0, a0, 13
; RV64IXTHEADBB-NEXT:    addi a0, a0,
795
; RV64IXTHEADBB-NEXT:    ret
ret i64 -5372288229
}

```

```

define i64 @imm_8953813715() {
; RV64I-LABEL: imm_8953813715:
; RV64I:    # %bb.0:
; RV64I-NEXT:    lui a0, 267
; RV64I-NEXT:    addiw a0, a0, -637
; RV64I-NEXT:    slli a0, a0, 13
; RV64I-NEXT:    addi a0, a0, -1325
; RV64I-NEXT:    ret
;
; RV64IZBA-LABEL: imm_8953813715:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:    lui a0, 437198
; RV64IZBA-NEXT:    addiw a0, a0, -265
; RV64IZBA-NEXT:    sh2add a0, a0, a0
; RV64IZBA-NEXT:    ret
;
; RV64IZBB-LABEL: imm_8953813715:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:    lui a0, 267
; RV64IZBB-NEXT:    addiw a0, a0, -637
; RV64IZBB-NEXT:    slli a0, a0, 13
; RV64IZBB-NEXT:    addi a0, a0, -1325
; RV64IZBB-NEXT:    ret
;
; RV64IZBS-LABEL: imm_8953813715:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:    lui a0, 88838
; RV64IZBS-NEXT:    addiw a0, a0, -1325
; RV64IZBS-NEXT:    bseti a0, a0, 33
; RV64IZBS-NEXT:    ret
;
; RV64IXTHEADBB-LABEL: imm_8953813715:
; RV64IXTHEADBB:    # %bb.0:

```

```

;
RV64IXTHEADBB-NEXT:  lui a0, 267
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -637
; RV64IXTHEADBB-NEXT:  slli a0, a0, 13
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1325
; RV64IXTHEADBB-NEXT:  ret
ret i64 8953813715
}

define i64 @imm_neg_8953813715() {
; RV64I-LABEL: imm_neg_8953813715:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 1048309
; RV64I-NEXT:  addiw a0, a0, 637
; RV64I-NEXT:  slli a0, a0, 13
; RV64I-NEXT:  addi a0, a0, 1325
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_8953813715:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 611378
; RV64IZBA-NEXT:  addiw a0, a0, 265
; RV64IZBA-NEXT:  sh2add a0, a0, a0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_8953813715:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1048309
; RV64IZBB-NEXT:  addiw a0, a0, 637
; RV64IZBB-NEXT:  slli a0, a0, 13
; RV64IZBB-NEXT:  addi a0, a0, 1325
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_8953813715:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:
    lui a0, 959738
; RV64IZBS-NEXT:  addiw a0, a0, 1325
; RV64IZBS-NEXT:  bclri a0, a0, 33
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_8953813715:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1048309
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 637
; RV64IXTHEADBB-NEXT:  slli a0, a0, 13
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1325
; RV64IXTHEADBB-NEXT:  ret

```

```

ret i64 -8953813715
}

define i64 @imm_16116864687() {
; RV64I-LABEL: imm_16116864687:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 961
; RV64I-NEXT:  addiw a0, a0, -1475
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1711
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_16116864687:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 437198
; RV64IZBA-NEXT:  addiw a0, a0, -265
; RV64IZBA-NEXT:  sh3add a0, a0, a0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_16116864687:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 961
; RV64IZBB-NEXT:  addiw a0, a0, -1475
; RV64IZBB-NEXT:
;               slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1711
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_16116864687:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 961
; RV64IZBS-NEXT:  addiw a0, a0, -1475
; RV64IZBS-NEXT:  slli a0, a0, 12
; RV64IZBS-NEXT:  addi a0, a0, 1711
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_16116864687:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 961
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1475
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1711
; RV64IXTHEADBB-NEXT:  ret
ret i64 16116864687
}

define i64 @imm_neg_16116864687() {
; RV64I-LABEL: imm_neg_16116864687:

```



```

; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 1047615
; RV64I-NEXT:  addiw a0, a0, 1475
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, -1711
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_16116864687:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 611378
; RV64IZBA-NEXT:
; addiw a0, a0, 265
; RV64IZBA-NEXT:  sh3add a0, a0, a0
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_16116864687:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1047615
; RV64IZBB-NEXT:  addiw a0, a0, 1475
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, -1711
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_16116864687:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 1047615
; RV64IZBS-NEXT:  addiw a0, a0, 1475
; RV64IZBS-NEXT:  slli a0, a0, 12
; RV64IZBS-NEXT:  addi a0, a0, -1711
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_16116864687:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1047615
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 1475
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1711
; RV64IXTHEADBB-NEXT:  ret
ret i64 -16116864687
}

define i64 @imm_2344336315() {
; RV64I-LABEL: imm_2344336315:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 143087
; RV64I-NEXT:
; slli a0, a0, 2
; RV64I-NEXT:  addi a0, a0, -1093

```

```

; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_2344336315:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 143087
; RV64IZBA-NEXT:  slli a0, a0, 2
; RV64IZBA-NEXT:  addi a0, a0, -1093
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_2344336315:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 143087
; RV64IZBB-NEXT:  slli a0, a0, 2
; RV64IZBB-NEXT:  addi a0, a0, -1093
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_2344336315:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 143087
; RV64IZBS-NEXT:  slli a0, a0, 2
; RV64IZBS-NEXT:  addi a0, a0, -1093
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_2344336315:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 143087
; RV64IXTHEADBB-NEXT:  slli a0, a0, 2
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1093
; RV64IXTHEADBB-NEXT:  ret
ret i64 2344336315 ; 0x8bbbbbbb
}

define i64 @imm_70370820078523() {
; RV64-NOPOOL-LABEL: imm_70370820078523:
;
RV64-NOPOOL:    # %bb.0:
; RV64-NOPOOL-NEXT:  lui a0, 256
; RV64-NOPOOL-NEXT:  addiw a0, a0, 31
; RV64-NOPOOL-NEXT:  slli a0, a0, 12
; RV64-NOPOOL-NEXT:  addi a0, a0, -273
; RV64-NOPOOL-NEXT:  slli a0, a0, 14
; RV64-NOPOOL-NEXT:  addi a0, a0, -1093
; RV64-NOPOOL-NEXT:  ret
;
; RV64I-POOL-LABEL: imm_70370820078523:
; RV64I-POOL:    # %bb.0:
; RV64I-POOL-NEXT:  lui a0, %hi(.LCPI37_0)
; RV64I-POOL-NEXT:  ld a0, %lo(.LCPI37_0)(a0)

```

```

; RV64I-POOL-NEXT:  ret
;
; RV64IZBA-LABEL: imm_70370820078523:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 256
; RV64IZBA-NEXT:  addiw a0, a0, 31
; RV64IZBA-NEXT:  slli a0, a0, 12
; RV64IZBA-NEXT:  addi a0, a0, -273
; RV64IZBA-NEXT:  slli a0, a0, 14
; RV64IZBA-NEXT:  addi a0, a0, -1093
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_70370820078523:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 256
; RV64IZBB-NEXT:  addiw a0, a0, 31
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, -273
;
; RV64IZBB-NEXT:  slli a0, a0, 14
; RV64IZBB-NEXT:  addi a0, a0, -1093
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_70370820078523:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 506812
; RV64IZBS-NEXT:  addiw a0, a0, -1093
; RV64IZBS-NEXT:  bseti a0, a0, 46
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_70370820078523:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 256
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 31
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, -273
; RV64IXTHEADBB-NEXT:  slli a0, a0, 14
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1093
; RV64IXTHEADBB-NEXT:  ret
ret i64 70370820078523 ; 0x40007bbbbbbb
}

```

```

define i64 @imm_neg_9223372034778874949() {
; RV64I-LABEL: imm_neg_9223372034778874949:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 506812
; RV64I-NEXT:  addiw a0, a0, -1093
; RV64I-NEXT:  slli a1, a0, 63

```

```

; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_9223372034778874949:
;
RV64IZBA:      # %bb.0:
; RV64IZBA-NEXT:  lui a0, 506812
; RV64IZBA-NEXT:  addiw a0, a0, -1093
; RV64IZBA-NEXT:  slli a1, a0, 63
; RV64IZBA-NEXT:  add a0, a0, a1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_9223372034778874949:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 506812
; RV64IZBB-NEXT:  addiw a0, a0, -1093
; RV64IZBB-NEXT:  slli a1, a0, 63
; RV64IZBB-NEXT:  add a0, a0, a1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_9223372034778874949:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 506812
; RV64IZBS-NEXT:  addiw a0, a0, -1093
; RV64IZBS-NEXT:  bseti a0, a0, 63
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_9223372034778874949:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 506812
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1093
; RV64IXTHEADBB-NEXT:  slli a1, a0, 63
; RV64IXTHEADBB-NEXT:  add a0, a0, a1
; RV64IXTHEADBB-NEXT:  ret
ret i64 -9223372034778874949 ; 0x8000000007bbbbbbb
}

```

```

define
i64 @imm_neg_9223301666034697285() {
; RV64-NOPOOL-LABEL: imm_neg_9223301666034697285:
; RV64-NOPOOL:      # %bb.0:
; RV64-NOPOOL-NEXT:  lui a0, 917505
; RV64-NOPOOL-NEXT:  slli a0, a0, 8
; RV64-NOPOOL-NEXT:  addi a0, a0, 31
; RV64-NOPOOL-NEXT:  slli a0, a0, 12
; RV64-NOPOOL-NEXT:  addi a0, a0, -273
; RV64-NOPOOL-NEXT:  slli a0, a0, 14
; RV64-NOPOOL-NEXT:  addi a0, a0, -1093

```

```

; RV64-NOPOOL-NEXT:  ret
;
; RV64I-POOL-LABEL: imm_neg_9223301666034697285:
; RV64I-POOL:        # %bb.0:
; RV64I-POOL-NEXT:   lui a0, %hi(.LCPI39_0)
; RV64I-POOL-NEXT:   ld a0, %lo(.LCPI39_0)(a0)
; RV64I-POOL-NEXT:   ret
;
; RV64IZBA-LABEL: imm_neg_9223301666034697285:
; RV64IZBA:          # %bb.0:
; RV64IZBA-NEXT:     lui a0, 917505
; RV64IZBA-NEXT:     slli a0, a0, 8
; RV64IZBA-NEXT:     addi a0, a0, 31
; RV64IZBA-NEXT:     slli a0, a0, 12
; RV64IZBA-NEXT:     addi a0, a0, -273
; RV64IZBA-NEXT:     slli a0, a0, 14
; RV64IZBA-NEXT:     addi a0, a0, -1093
; RV64IZBA-NEXT:     ret
;
; RV64IZBB-LABEL:
imm_neg_9223301666034697285:
; RV64IZBB:          # %bb.0:
; RV64IZBB-NEXT:     lui a0, 917505
; RV64IZBB-NEXT:     slli a0, a0, 8
; RV64IZBB-NEXT:     addi a0, a0, 31
; RV64IZBB-NEXT:     slli a0, a0, 12
; RV64IZBB-NEXT:     addi a0, a0, -273
; RV64IZBB-NEXT:     slli a0, a0, 14
; RV64IZBB-NEXT:     addi a0, a0, -1093
; RV64IZBB-NEXT:     ret
;
; RV64IZBS-LABEL: imm_neg_9223301666034697285:
; RV64IZBS:          # %bb.0:
; RV64IZBS-NEXT:     lui a0, 506812
; RV64IZBS-NEXT:     addiw a0, a0, -1093
; RV64IZBS-NEXT:     bseti a0, a0, 46
; RV64IZBS-NEXT:     bseti a0, a0, 63
; RV64IZBS-NEXT:     ret
;
; RV64IXTHEADBB-LABEL: imm_neg_9223301666034697285:
; RV64IXTHEADBB:     # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 917505
; RV64IXTHEADBB-NEXT:  slli a0, a0, 8
; RV64IXTHEADBB-NEXT:  addi a0, a0, 31
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, -273
; RV64IXTHEADBB-NEXT:  slli a0, a0, 14
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1093

```

```
; RV64IXTHEADBB-NEXT:  ret
ret i64 -9223301666034697285 ; 0x800040007bbbbbbb
}
```

```
define i64 @imm_neg_2219066437() {
; RV64I-LABEL: imm_neg_2219066437:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 913135
; RV64I-NEXT:  slli a0, a0, 2
; RV64I-NEXT:  addi a0, a0, -1093
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_2219066437:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 913135
; RV64IZBA-NEXT:  slli a0, a0, 2
; RV64IZBA-NEXT:  addi a0, a0, -1093
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_2219066437:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 913135
; RV64IZBB-NEXT:  slli a0, a0, 2
; RV64IZBB-NEXT:  addi a0, a0, -1093
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_2219066437:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 913135
; RV64IZBS-NEXT:  slli a0, a0, 2
; RV64IZBS-NEXT:  addi a0, a0, -1093
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_2219066437:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 913135
; RV64IXTHEADBB-NEXT:
    slli a0, a0, 2
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1093
; RV64IXTHEADBB-NEXT:  ret
ret i64 -2219066437 ; 0xffffffff7bbbbbbb
}
```

```
define i64 @imm_neg_8798043653189() {
; RV64I-LABEL: imm_neg_8798043653189:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 917475
; RV64I-NEXT:  addiw a0, a0, -273
```

```

; RV64I-NEXT:  slli a0, a0, 14
; RV64I-NEXT:  addi a0, a0, -1093
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_8798043653189:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 917475
; RV64IZBA-NEXT:  addiw a0, a0, -273
; RV64IZBA-NEXT:  slli a0, a0, 14
; RV64IZBA-NEXT:  addi a0, a0, -1093
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_8798043653189:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 917475
; RV64IZBB-NEXT:  addiw a0, a0, -273
; RV64IZBB-NEXT:  slli a0, a0, 14
; RV64IZBB-NEXT:  addi a0, a0, -1093
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_8798043653189:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 572348
; RV64IZBS-NEXT:
;   addiw a0, a0, -1093
; RV64IZBS-NEXT:  bclri a0, a0, 43
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_8798043653189:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 917475
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -273
; RV64IXTHEADBB-NEXT:  slli a0, a0, 14
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1093
; RV64IXTHEADBB-NEXT:  ret
;   ret i64 -8798043653189 ; 0xffff7ff8bbbbbbb
}

```

```

define i64 @imm_9223372034904144827() {
; RV64I-LABEL: imm_9223372034904144827:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 572348
; RV64I-NEXT:  addiw a0, a0, -1093
; RV64I-NEXT:  slli a1, a0, 63
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_9223372034904144827:

```

```

; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 572348
; RV64IZBA-NEXT:  addiw a0, a0, -1093
; RV64IZBA-NEXT:  slli a1, a0, 63
; RV64IZBA-NEXT:  add a0, a0, a1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_9223372034904144827:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:
    lui a0, 572348
; RV64IZBB-NEXT:  addiw a0, a0, -1093
; RV64IZBB-NEXT:  slli a1, a0, 63
; RV64IZBB-NEXT:  add a0, a0, a1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_9223372034904144827:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 572348
; RV64IZBS-NEXT:  addiw a0, a0, -1093
; RV64IZBS-NEXT:  bclri a0, a0, 63
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_9223372034904144827:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 572348
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1093
; RV64IXTHEADBB-NEXT:  slli a1, a0, 63
; RV64IXTHEADBB-NEXT:  add a0, a0, a1
; RV64IXTHEADBB-NEXT:  ret
    ret i64 9223372034904144827 ; 0x7fffffff8bbbbbbb
}

```

```

define i64 @imm_neg_9223354442718100411() {
; RV64-NOPOOL-LABEL: imm_neg_9223354442718100411:
; RV64-NOPOOL:    # %bb.0:
; RV64-NOPOOL-NEXT:  lui a0, 524287
; RV64-NOPOOL-NEXT:  slli a0, a0, 6
; RV64-NOPOOL-NEXT:  addi a0, a0, -29
; RV64-NOPOOL-NEXT:  slli a0, a0, 12
; RV64-NOPOOL-NEXT:
    addi a0, a0, -273
; RV64-NOPOOL-NEXT:  slli a0, a0, 14
; RV64-NOPOOL-NEXT:  addi a0, a0, -1093
; RV64-NOPOOL-NEXT:  ret
;
; RV64I-POOL-LABEL: imm_neg_9223354442718100411:
; RV64I-POOL:    # %bb.0:

```



```

; RV64I-POOL-NEXT: lui a0, %hi(.LCPI43_0)
; RV64I-POOL-NEXT: ld a0, %lo(.LCPI43_0)(a0)
; RV64I-POOL-NEXT: ret
;
; RV64IZBA-LABEL: imm_neg_9223354442718100411:
; RV64IZBA: # %bb.0:
; RV64IZBA-NEXT: lui a0, 524287
; RV64IZBA-NEXT: slli a0, a0, 6
; RV64IZBA-NEXT: addi a0, a0, -29
; RV64IZBA-NEXT: slli a0, a0, 12
; RV64IZBA-NEXT: addi a0, a0, -273
; RV64IZBA-NEXT: slli a0, a0, 14
; RV64IZBA-NEXT: addi a0, a0, -1093
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_neg_9223354442718100411:
; RV64IZBB: # %bb.0:
; RV64IZBB-NEXT: lui a0, 524287
; RV64IZBB-NEXT: slli a0, a0, 6
; RV64IZBB-NEXT: addi a0, a0, -29
; RV64IZBB-NEXT: slli a0, a0, 12
; RV64IZBB-NEXT: addi a0, a0, -273
; RV64IZBB-NEXT: slli a0, a0, 14
; RV64IZBB-NEXT:
; addi a0, a0, -1093
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_neg_9223354442718100411:
; RV64IZBS: # %bb.0:
; RV64IZBS-NEXT: lui a0, 572348
; RV64IZBS-NEXT: addiw a0, a0, -1093
; RV64IZBS-NEXT: bclri a0, a0, 44
; RV64IZBS-NEXT: bclri a0, a0, 63
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_neg_9223354442718100411:
; RV64IXTHEADBB: # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 524287
; RV64IXTHEADBB-NEXT: slli a0, a0, 6
; RV64IXTHEADBB-NEXT: addi a0, a0, -29
; RV64IXTHEADBB-NEXT: slli a0, a0, 12
; RV64IXTHEADBB-NEXT: addi a0, a0, -273
; RV64IXTHEADBB-NEXT: slli a0, a0, 14
; RV64IXTHEADBB-NEXT: addi a0, a0, -1093
; RV64IXTHEADBB-NEXT: ret
ret i64 9223354442718100411 ; 0x7fffefff8bbbbbbb
}

```

```

define i64 @imm_2863311530() {
; RV64I-LABEL: imm_2863311530:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 349525
; RV64I-NEXT:  addiw a0, a0, 1365
; RV64I-NEXT:  slli a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_2863311530:
; RV64IZBA:
;   # %bb.0:
; RV64IZBA-NEXT:  lui a0, 349525
; RV64IZBA-NEXT:  addiw a0, a0, 1365
; RV64IZBA-NEXT:  slli a0, a0, 1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_2863311530:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 349525
; RV64IZBB-NEXT:  addiw a0, a0, 1365
; RV64IZBB-NEXT:  slli a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_2863311530:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 349525
; RV64IZBS-NEXT:  addiw a0, a0, 1365
; RV64IZBS-NEXT:  slli a0, a0, 1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_2863311530:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 349525
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 1365
; RV64IXTHEADBB-NEXT:  slli a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 2863311530 ; #0xaaaaaaaa
}

```

```

define i64 @imm_neg_2863311530() {
; RV64I-LABEL: imm_neg_2863311530:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 699051
; RV64I-NEXT:  addiw a0, a0, -1365
; RV64I-NEXT:  slli a0,
a0, 1
; RV64I-NEXT:  ret
;

```

```

; RV64IZBA-LABEL: imm_neg_2863311530:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 699051
; RV64IZBA-NEXT:  addiw a0, a0, -1365
; RV64IZBA-NEXT:  slli a0, a0, 1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_2863311530:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 699051
; RV64IZBB-NEXT:  addiw a0, a0, -1365
; RV64IZBB-NEXT:  slli a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_2863311530:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 699051
; RV64IZBS-NEXT:  addiw a0, a0, -1365
; RV64IZBS-NEXT:  slli a0, a0, 1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_2863311530:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 699051
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1365
; RV64IXTHEADBB-NEXT:  slli a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 -2863311530 ; #0xffffffff55555556
}

```

```

define i64 @imm_2147486378() {
; RV64I-LABEL: imm_2147486378:
; RV64I:    # %bb.0:
; RV64I-NEXT:
    li a0, 1
; RV64I-NEXT:  slli a0, a0, 31
; RV64I-NEXT:  addi a0, a0, 1365
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_2147486378:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 1
; RV64IZBA-NEXT:  slli a0, a0, 31
; RV64IZBA-NEXT:  addi a0, a0, 1365
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_2147486378:
; RV64IZBB:    # %bb.0:

```

```

; RV64IZBB-NEXT:  li a0, 1
; RV64IZBB-NEXT:  slli a0, a0, 31
; RV64IZBB-NEXT:  addi a0, a0, 1365
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_2147486378:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  li a0, 1365
; RV64IZBS-NEXT:  bseti a0, a0, 31
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_2147486378:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, 1
; RV64IXTHEADBB-NEXT:  slli a0, a0, 31
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1365
; RV64IXTHEADBB-NEXT:  ret
ret i64 2147485013
}

define i64 @imm_neg_2147485013() {
; RV64I-LABEL: imm_neg_2147485013:
; RV64I:      # %bb.0:
; RV64I-NEXT:
    lui a0, 524288
; RV64I-NEXT:  addi a0, a0, -1365
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_2147485013:
; RV64IZBA:      # %bb.0:
; RV64IZBA-NEXT:  lui a0, 524288
; RV64IZBA-NEXT:  addi a0, a0, -1365
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_2147485013:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 524288
; RV64IZBB-NEXT:  addi a0, a0, -1365
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_2147485013:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 524288
; RV64IZBS-NEXT:  addi a0, a0, -1365
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_2147485013:
; RV64IXTHEADBB:  # %bb.0:

```

```

; RV64IXTHEADBB-NEXT: lui a0, 524288
; RV64IXTHEADBB-NEXT: addi a0, a0, -1365
; RV64IXTHEADBB-NEXT: ret
ret i64 -2147485013
}

define i64 @imm_12900924131259() {
; RV64I-LABEL: imm_12900924131259:
; RV64I:    # %bb.0:
; RV64I-NEXT: lui a0, 188
; RV64I-NEXT: addiw a0, a0, -1093
; RV64I-NEXT: slli a0, a0, 24
; RV64I-NEXT: addi a0,
a0, 1979
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_12900924131259:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: lui a0, 768955
; RV64IZBA-NEXT: slli.uw a0, a0, 12
; RV64IZBA-NEXT: addi a0, a0, 1979
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_12900924131259:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: lui a0, 188
; RV64IZBB-NEXT: addiw a0, a0, -1093
; RV64IZBB-NEXT: slli a0, a0, 24
; RV64IZBB-NEXT: addi a0, a0, 1979
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_12900924131259:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: lui a0, 188
; RV64IZBS-NEXT: addiw a0, a0, -1093
; RV64IZBS-NEXT: slli a0, a0, 24
; RV64IZBS-NEXT: addi a0, a0, 1979
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_12900924131259:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 188
; RV64IXTHEADBB-NEXT: addiw a0, a0, -1093
; RV64IXTHEADBB-NEXT: slli a0, a0, 24
; RV64IXTHEADBB-NEXT: addi a0, a0, 1979
; RV64IXTHEADBB-NEXT: ret
ret i64 12900924131259
}

```

```

define
i64 @imm_50394234880() {
; RV64I-LABEL: imm_50394234880:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 188
; RV64I-NEXT:  addiw a0, a0, -1093
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_50394234880:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768955
; RV64IZBA-NEXT:  slli.uw a0, a0, 4
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_50394234880:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 188
; RV64IZBB-NEXT:  addiw a0, a0, -1093
; RV64IZBB-NEXT:  slli a0, a0, 16
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_50394234880:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 188
; RV64IZBS-NEXT:  addiw a0, a0, -1093
; RV64IZBS-NEXT:  slli a0, a0, 16
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_50394234880:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 188
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1093
; RV64IXTHEADBB-NEXT:  slli a0, a0, 16
; RV64IXTHEADBB-NEXT:  ret
ret
i64 50394234880
}

define i64 @imm_12900936431479() {
; RV64I-LABEL: imm_12900936431479:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 192239
; RV64I-NEXT:  slli a0, a0, 2
; RV64I-NEXT:  addi a0, a0, -1093
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1911

```

```

; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_12900936431479:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768956
; RV64IZBA-NEXT:  addi a0, a0, -1093
; RV64IZBA-NEXT:  slli.uw a0, a0, 12
; RV64IZBA-NEXT:  addi a0, a0, 1911
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_12900936431479:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 192239
; RV64IZBB-NEXT:  slli a0, a0, 2
; RV64IZBB-NEXT:  addi a0, a0, -1093
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1911
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_12900936431479:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 192239
; RV64IZBS-NEXT:  slli a0, a0, 2
; RV64IZBS-NEXT:  addi a0, a0, -1093
; RV64IZBS-NEXT:
;               slli a0, a0, 12
; RV64IZBS-NEXT:  addi a0, a0, 1911
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_12900936431479:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 192239
; RV64IXTHEADBB-NEXT:  slli a0, a0, 2
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1093
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1911
; RV64IXTHEADBB-NEXT:  ret
ret i64 12900936431479
}

```

```

define i64 @imm_12900918536874() {
; RV64I-LABEL: imm_12900918536874:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 384477
; RV64I-NEXT:  addiw a0, a0, 1365
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1365
; RV64I-NEXT:  slli a0, a0, 1

```

```

; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_12900918536874:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768955
; RV64IZBA-NEXT:  addi a0, a0, -1365
; RV64IZBA-NEXT:  slli.uw a0, a0, 12
; RV64IZBA-NEXT:  addi a0, a0, -1366
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_12900918536874:
;
RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 384477
; RV64IZBB-NEXT:  addiw a0, a0, 1365
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1365
; RV64IZBB-NEXT:  slli a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_12900918536874:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 384477
; RV64IZBS-NEXT:  addiw a0, a0, 1365
; RV64IZBS-NEXT:  slli a0, a0, 12
; RV64IZBS-NEXT:  addi a0, a0, 1365
; RV64IZBS-NEXT:  slli a0, a0, 1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_12900918536874:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 384477
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 1365
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1365
; RV64IXTHEADBB-NEXT:  slli a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 12900918536874
}

define i64 @imm_12900925247761() {
; RV64I-LABEL: imm_12900925247761:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 384478
; RV64I-NEXT:  addiw
a0, a0, -1911
; RV64I-NEXT:  slli a0, a0, 13
; RV64I-NEXT:  addi a0, a0, -2048

```



```

; RV64I-NEXT:  addi a0, a0, -1775
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_12900925247761:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768955
; RV64IZBA-NEXT:  addi a0, a0, 273
; RV64IZBA-NEXT:  slli.uw a0, a0, 12
; RV64IZBA-NEXT:  addi a0, a0, 273
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_12900925247761:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 384478
; RV64IZBB-NEXT:  addiw a0, a0, -1911
; RV64IZBB-NEXT:  slli a0, a0, 13
; RV64IZBB-NEXT:  addi a0, a0, -2048
; RV64IZBB-NEXT:  addi a0, a0, -1775
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_12900925247761:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 384478
; RV64IZBS-NEXT:  addiw a0, a0, -1911
; RV64IZBS-NEXT:  slli a0, a0, 13
; RV64IZBS-NEXT:  addi a0, a0, -2048
; RV64IZBS-NEXT:  addi a0, a0, -1775
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_12900925247761:
; RV64IXTHEADBB:
;   # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 384478
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1911
; RV64IXTHEADBB-NEXT:  slli a0, a0, 13
; RV64IXTHEADBB-NEXT:  addi a0, a0, -2048
; RV64IXTHEADBB-NEXT:  addi a0, a0, -1775
; RV64IXTHEADBB-NEXT:  ret
ret i64 12900925247761
}

```

```

define i64 @imm_7158272001() {
; RV64I-LABEL: imm_7158272001:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 427
; RV64I-NEXT:  addiw a0, a0, -1367
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1

```

```

; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_7158272001:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 349525
; RV64IZBA-NEXT:  sh2add a0, a0, a0
; RV64IZBA-NEXT:  addi a0, a0, 1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_7158272001:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 427
; RV64IZBB-NEXT:  addiw a0, a0, -1367
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_7158272001:
; RV64IZBS:
;   # %bb.0:
; RV64IZBS-NEXT:  lui a0, 427
; RV64IZBS-NEXT:  addiw a0, a0, -1367
; RV64IZBS-NEXT:  slli a0, a0, 12
; RV64IZBS-NEXT:  addi a0, a0, 1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_7158272001:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 427
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1367
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 7158272001 ; 0x0000_0001_aaaa_9001
}

```

```

define i64 @imm_12884889601() {
; RV64I-LABEL: imm_12884889601:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a0, 768
; RV64I-NEXT:  addiw a0, a0, -3
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_12884889601:
; RV64IZBA:  # %bb.0:
; RV64IZBA-NEXT:  lui a0, 349525

```

```

; RV64IZBA-NEXT: sh3add a0, a0, a0
; RV64IZBA-NEXT: addi a0, a0, 1
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: imm_12884889601:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:
    lui a0, 768
; RV64IZBB-NEXT: addiw a0, a0, -3
; RV64IZBB-NEXT: slli a0, a0, 12
; RV64IZBB-NEXT: addi a0, a0, 1
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: imm_12884889601:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: lui a0, 768
; RV64IZBS-NEXT: addiw a0, a0, -3
; RV64IZBS-NEXT: slli a0, a0, 12
; RV64IZBS-NEXT: addi a0, a0, 1
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: imm_12884889601:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT: lui a0, 768
; RV64IXTHEADBB-NEXT: addiw a0, a0, -3
; RV64IXTHEADBB-NEXT: slli a0, a0, 12
; RV64IXTHEADBB-NEXT: addi a0, a0, 1
; RV64IXTHEADBB-NEXT: ret
ret i64 12884889601 ; 0x0000_0002_ffff_d001
}

```

```

define i64 @imm_neg_3435982847() {
; RV64I-LABEL: imm_neg_3435982847:
; RV64I:    # %bb.0:
; RV64I-NEXT: lui a0, 1048371
; RV64I-NEXT: addiw a0, a0, 817
; RV64I-NEXT: slli a0, a0, 12
; RV64I-NEXT: addi a0, a0, 1
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: imm_neg_3435982847:
; RV64IZBA:
    # %bb.0:
; RV64IZBA-NEXT: lui a0, 768955
; RV64IZBA-NEXT: sh1add a0, a0, a0
; RV64IZBA-NEXT: addi a0, a0, 1
; RV64IZBA-NEXT: ret
;

```

```

; RV64IZBB-LABEL: imm_neg_3435982847:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1048371
; RV64IZBB-NEXT:  addiw a0, a0, 817
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_3435982847:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 734001
; RV64IZBS-NEXT:  addiw a0, a0, 1
; RV64IZBS-NEXT:  bclri a0, a0, 31
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_3435982847:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1048371
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 817
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 -3435982847 ; 0xffff_ffff_3333_1001
}

```

```

define i64 @imm_neg_5726842879() {
; RV64I-LABEL: imm_neg_5726842879:
; RV64I:    # %bb.0:
; RV64I-NEXT:
    lui a0, 1048235
; RV64I-NEXT:  addiw a0, a0, -1419
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_5726842879:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768945
; RV64IZBA-NEXT:  sh2add a0, a0, a0
; RV64IZBA-NEXT:  addi a0, a0, 1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_5726842879:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1048235
; RV64IZBB-NEXT:  addiw a0, a0, -1419
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1

```

```

; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_5726842879:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 698997
; RV64IZBS-NEXT:  addiw a0, a0, 1
; RV64IZBS-NEXT:  bclri a0, a0, 32
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm_neg_5726842879:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1048235
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1419
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:
    addi a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 -5726842879 ; 0xffff_fffe_aaa7_5001
}

```

```

define i64 @imm_neg_10307948543() {
; RV64I-LABEL: imm_neg_10307948543:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 1047962
; RV64I-NEXT:  addiw a0, a0, -1645
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm_neg_10307948543:
; RV64IZBA:      # %bb.0:
; RV64IZBA-NEXT:  lui a0, 768955
; RV64IZBA-NEXT:  sh3add a0, a0, a0
; RV64IZBA-NEXT:  addi a0, a0, 1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm_neg_10307948543:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui a0, 1047962
; RV64IZBB-NEXT:  addiw a0, a0, -1645
; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  addi a0, a0, 1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm_neg_10307948543:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 629139
; RV64IZBS-NEXT:  addiw a0, a0, 1

```

```

; RV64IZBS-NEXT:  bclri a0, a0, 33
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL:
imm_neg_10307948543:
; RV64IXTHEADBB:   # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1047962
; RV64IXTHEADBB-NEXT:  addiw a0, a0, -1645
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:  addi a0, a0, 1
; RV64IXTHEADBB-NEXT:  ret
ret i64 -10307948543 ; 0xffff_fffd_9999_3001
}

```

```

define i64 @li_ropi_1() {
; RV64I-LABEL: li_ropi_1:
; RV64I:   # %bb.0:
; RV64I-NEXT:  li a0, -17
; RV64I-NEXT:  slli a0, a0, 43
; RV64I-NEXT:  addi a0, a0, -1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: li_ropi_1:
; RV64IZBA:   # %bb.0:
; RV64IZBA-NEXT:  li a0, -17
; RV64IZBA-NEXT:  slli a0, a0, 43
; RV64IZBA-NEXT:  addi a0, a0, -1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: li_ropi_1:
; RV64IZBB:   # %bb.0:
; RV64IZBB-NEXT:  li a0, -18
; RV64IZBB-NEXT:  rori a0, a0, 21
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: li_ropi_1:
; RV64IZBS:   # %bb.0:
; RV64IZBS-NEXT:  li a0, -17
; RV64IZBS-NEXT:  slli a0, a0, 43
; RV64IZBS-NEXT:  addi a0, a0,
-1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: li_ropi_1:
; RV64IXTHEADBB:   # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, -18
; RV64IXTHEADBB-NEXT:  th.srri a0, a0, 21
; RV64IXTHEADBB-NEXT:  ret

```

```

ret i64 -149533581377537
}

define i64 @li_ropi_2() {
; RV64I-LABEL: li_ropi_2:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a0, -5
; RV64I-NEXT: slli a0, a0, 60
; RV64I-NEXT: addi a0, a0, -6
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: li_ropi_2:
; RV64IZBA:   # %bb.0:
; RV64IZBA-NEXT: li a0, -5
; RV64IZBA-NEXT: slli a0, a0, 60
; RV64IZBA-NEXT: addi a0, a0, -6
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: li_ropi_2:
; RV64IZBB:   # %bb.0:
; RV64IZBB-NEXT: li a0, -86
; RV64IZBB-NEXT: rori a0, a0, 4
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: li_ropi_2:
; RV64IZBS:   # %bb.0:
; RV64IZBS-NEXT: li a0, -5
; RV64IZBS-NEXT: slli a0, a0, 60
; RV64IZBS-NEXT: addi a0, a0, -6
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: li_ropi_2:
; RV64IXTHEADBB:
;   # %bb.0:
; RV64IXTHEADBB-NEXT: li a0, -86
; RV64IXTHEADBB-NEXT: th.srri a0, a0, 4
; RV64IXTHEADBB-NEXT: ret
ret i64 -5764607523034234886
}

```

```

define i64 @li_ropi_3() {
; RV64I-LABEL: li_ropi_3:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a0, -17
; RV64I-NEXT: slli a0, a0, 27
; RV64I-NEXT: addi a0, a0, -1
; RV64I-NEXT: ret
;

```

```

; RV64IZBA-LABEL: li_ropi_3:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: li a0, -17
; RV64IZBA-NEXT: slli a0, a0, 27
; RV64IZBA-NEXT: addi a0, a0, -1
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: li_ropi_3:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: li a0, -18
; RV64IZBB-NEXT: rori a0, a0, 37
; RV64IZBB-NEXT: ret
;
; RV64IZBS-LABEL: li_ropi_3:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT: li a0, -17
; RV64IZBS-NEXT: slli a0, a0, 27
; RV64IZBS-NEXT: addi a0, a0, -1
; RV64IZBS-NEXT: ret
;
; RV64IXTHEADBB-LABEL: li_ropi_3:
; RV64IXTHEADBB:    # %bb.0:
; RV64IXTHEADBB-NEXT: li a0, -18
; RV64IXTHEADBB-NEXT: th.srri a0,
a0, 37
; RV64IXTHEADBB-NEXT: ret
ret i64 -2281701377
}

```

; This used to assert when compiled with Zba.

```

define i64 @PR54812() {
; RV64I-LABEL: PR54812:
; RV64I:    # %bb.0:
; RV64I-NEXT: lui a0, 1048447
; RV64I-NEXT: addiw a0, a0, 1407
; RV64I-NEXT: slli a0, a0, 12
; RV64I-NEXT: ret
;
; RV64IZBA-LABEL: PR54812:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT: lui a0, 872917
; RV64IZBA-NEXT: sh1add a0, a0, a0
; RV64IZBA-NEXT: ret
;
; RV64IZBB-LABEL: PR54812:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT: lui a0, 1048447
; RV64IZBB-NEXT: addiw a0, a0, 1407

```



```

; RV64IZBB-NEXT:  slli a0, a0, 12
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: PR54812:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 1045887
; RV64IZBS-NEXT:  bclri a0, a0, 31
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: PR54812:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 1048447
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 1407
; RV64IXTHEADBB-NEXT:  slli a0, a0, 12
; RV64IXTHEADBB-NEXT:
    ret
ret i64 -2158497792;
}

```

```

define signext i32 @pos_2048() nounwind {
; RV64I-LABEL: pos_2048:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, 1
; RV64I-NEXT:  slli a0, a0, 11
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: pos_2048:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  li a0, 1
; RV64IZBA-NEXT:  slli a0, a0, 11
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: pos_2048:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  li a0, 1
; RV64IZBB-NEXT:  slli a0, a0, 11
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: pos_2048:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  bseti a0, zero, 11
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: pos_2048:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  li a0, 1
; RV64IXTHEADBB-NEXT:  slli a0, a0, 11
; RV64IXTHEADBB-NEXT:  ret

```

```

ret i32 2048
}

define i64 @imm64_same_lo_hi() nounwind {
; RV64I-LABEL: imm64_same_lo_hi:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a0, 65793
; RV64I-NEXT:  addiw a0, a0, 16
; RV64I-NEXT:
; slli a1, a0, 32
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_same_lo_hi:
; RV64IZBA:    # %bb.0:
; RV64IZBA-NEXT:  lui a0, 65793
; RV64IZBA-NEXT:  addiw a0, a0, 16
; RV64IZBA-NEXT:  slli a1, a0, 32
; RV64IZBA-NEXT:  add a0, a0, a1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_same_lo_hi:
; RV64IZBB:    # %bb.0:
; RV64IZBB-NEXT:  lui a0, 65793
; RV64IZBB-NEXT:  addiw a0, a0, 16
; RV64IZBB-NEXT:  slli a1, a0, 32
; RV64IZBB-NEXT:  add a0, a0, a1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_same_lo_hi:
; RV64IZBS:    # %bb.0:
; RV64IZBS-NEXT:  lui a0, 65793
; RV64IZBS-NEXT:  addiw a0, a0, 16
; RV64IZBS-NEXT:  slli a1, a0, 32
; RV64IZBS-NEXT:  add a0, a0, a1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_same_lo_hi:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 65793
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 16
; RV64IXTHEADBB-NEXT:  slli a1, a0, 32
; RV64IXTHEADBB-NEXT:  add a0, a0, a1
;
; RV64IXTHEADBB-NEXT:  ret
ret i64 1157442765409226768 ; 0x0101010101010101
}

```

```

; Same as above with optsize. Make sure we use constant pool on RV64
define i64 @imm64_same_lo_hi_optsize() nounwind optsize {
; RV64-NOPOOL-LABEL: imm64_same_lo_hi_optsize:
; RV64-NOPOOL:      # %bb.0:
; RV64-NOPOOL-NEXT:  lui a0, 65793
; RV64-NOPOOL-NEXT:  addiw a0, a0, 16
; RV64-NOPOOL-NEXT:  slli a1, a0, 32
; RV64-NOPOOL-NEXT:  add a0, a0, a1
; RV64-NOPOOL-NEXT:  ret
;
; RV64I-POOL-LABEL: imm64_same_lo_hi_optsize:
; RV64I-POOL:      # %bb.0:
; RV64I-POOL-NEXT:  lui a0, %hi(.LCPI64_0)
; RV64I-POOL-NEXT:  ld a0, %lo(.LCPI64_0)(a0)
; RV64I-POOL-NEXT:  ret
;
; RV64IZBA-LABEL: imm64_same_lo_hi_optsize:
; RV64IZBA:      # %bb.0:
; RV64IZBA-NEXT:  lui a0, 65793
; RV64IZBA-NEXT:  addiw a0, a0, 16
; RV64IZBA-NEXT:  slli a1, a0, 32
; RV64IZBA-NEXT:  add a0, a0, a1
; RV64IZBA-NEXT:  ret
;
; RV64IZBB-LABEL: imm64_same_lo_hi_optsize:
; RV64IZBB:      # %bb.0:
; RV64IZBB-NEXT:  lui
a0, 65793
; RV64IZBB-NEXT:  addiw a0, a0, 16
; RV64IZBB-NEXT:  slli a1, a0, 32
; RV64IZBB-NEXT:  add a0, a0, a1
; RV64IZBB-NEXT:  ret
;
; RV64IZBS-LABEL: imm64_same_lo_hi_optsize:
; RV64IZBS:      # %bb.0:
; RV64IZBS-NEXT:  lui a0, 65793
; RV64IZBS-NEXT:  addiw a0, a0, 16
; RV64IZBS-NEXT:  slli a1, a0, 32
; RV64IZBS-NEXT:  add a0, a0, a1
; RV64IZBS-NEXT:  ret
;
; RV64IXTHEADBB-LABEL: imm64_same_lo_hi_optsize:
; RV64IXTHEADBB:  # %bb.0:
; RV64IXTHEADBB-NEXT:  lui a0, 65793
; RV64IXTHEADBB-NEXT:  addiw a0, a0, 16
; RV64IXTHEADBB-NEXT:  slli a1, a0, 32
; RV64IXTHEADBB-NEXT:  add a0, a0, a1
; RV64IXTHEADBB-NEXT:  ret

```

```
ret i64 1157442765409226768 ; 0x0101010101010101
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64I %s
```

; Check indexed and unindexed, sext, zext and anyext loads

```
define void @lb(ptr %a, ptr %b) nounwind {
; RV64I-LABEL: lb:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lb a2, 1(a0)
; RV64I-NEXT:  lbu zero, 0(a0)
; RV64I-NEXT:  sw a2, 0(a1)
; RV64I-NEXT:  ret
%1 = getelementptr i8, ptr %a, i32 1
%2 = load i8, ptr %1
%3 = sext i8 %2 to i32
; the unused load will produce an anyext for selection
%4 = load volatile i8, ptr %a
store i32 %3, ptr %b
ret void
}
```

```
define void @lbu(ptr %a, ptr %b) nounwind {
; RV64I-LABEL: lbu:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lbu a0, 1(a0)
; RV64I-NEXT:  sw a0, 0(a1)
; RV64I-NEXT:  ret
%1 = getelementptr i8, ptr %a, i32 1
%2 = load i8, ptr %1
%3 = zext i8 %2 to i32
store i32 %3, ptr %b
ret void
}
```

```
define void @lh(ptr
%a, ptr %b) nounwind {
; RV64I-LABEL: lh:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lh a2, 2(a0)
; RV64I-NEXT:  lh zero, 0(a0)
; RV64I-NEXT:  sw a2, 0(a1)
; RV64I-NEXT:  ret
%1 = getelementptr i16, ptr %a, i32 1
%2 = load i16, ptr %1
%3 = sext i16 %2 to i32
```

```

; the unused load will produce an anyext for selection
%4 = load volatile i16, ptr %a
store i32 %3, ptr %b
ret void
}

```

```

define void @lhu(ptr %a, ptr %b) nounwind {
; RV64I-LABEL: lhu:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lhu a0, 2(a0)
; RV64I-NEXT:  sw a0, 0(a1)
; RV64I-NEXT:  ret
%1 = getelementptr i16, ptr %a, i32 1
%2 = load i16, ptr %1
%3 = zext i16 %2 to i32
store i32 %3, ptr %b
ret void
}

```

```

define void @lw(ptr %a, ptr %b) nounwind {
; RV64I-LABEL: lw:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lw a2, 4(a0)
; RV64I-NEXT:  lw zero, 0(a0)
; RV64I-NEXT:  sd a2, 0(a1)
; RV64I-NEXT:  ret
%1 = getelementptr i32, ptr %a, i64 1
%2 = load i32, ptr %1
%3 = sext i32 %2 to i64
; the unused load
will produce an anyext for selection
%4 = load volatile i32, ptr %a
store i64 %3, ptr %b
ret void
}

```

```

define void @lwu(ptr %a, ptr %b) nounwind {
; RV64I-LABEL: lwu:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lwu a0, 4(a0)
; RV64I-NEXT:  sd a0, 0(a1)
; RV64I-NEXT:  ret
%1 = getelementptr i32, ptr %a, i64 1
%2 = load i32, ptr %1
%3 = zext i32 %2 to i64
store i64 %3, ptr %b
ret void
}

```

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*/
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mcpu=skylake-avx512 -mattr=prefer-256-bit | FileCheck %s
--check-prefixes=CHECK,CHECK-SKX
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mcpu=skylake-avx512 -mattr=prefer-256-bit,avx512vbmi |
FileCheck %s --check-prefixes=CHECK,CHECK-SKX,CHECK-SKX-VBMI
; Make sure CPUs default to prefer-256-bit. avx512vnni isn't interesting as it just adds an isel peephole for
vpmaddwd+vpadd
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mcpu=skylake-avx512 | FileCheck %s --check-
prefixes=CHECK,CHECK-AVX512
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mattr=-avx512vnni -mcpu=cascadelake | FileCheck %s --
check-prefixes=CHECK,CHECK-AVX512
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mattr=-avx512vnni -mcpu=cooperlake | FileCheck %s --
check-prefixes=CHECK,CHECK-AVX512
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mcpu=cannonlake | FileCheck %s --check-
prefixes=CHECK,CHECK-VBMI
;
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mattr=-avx512vnni -mcpu=icelake-client | FileCheck %s --
check-prefixes=CHECK,CHECK-VBMI
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mattr=-avx512vnni -mcpu=icelake-server | FileCheck %s --
check-prefixes=CHECK,CHECK-VBMI

```

```
; RUN: llc < %s -mtriple=x86_64-unknown-unknown -mattr=-avx512vnni -mcpu=tigerlake | FileCheck %s --check-  
prefixes=CHECK,CHECK-VBMMI
```

; This file primarily contains tests for specific places in X86ISelLowering.cpp that needed be made aware of the  
legalizer not allowing 512-bit vectors due to prefer-256-bit even though AVX512 is enabled.

```
define dso_local void @add256(<16 x i32>* %a, <16 x i32>* %b, <16 x i32>* %c) "min-legal-vector-  
width"="256" {  
; CHECK-LABEL: add256:  
; CHECK:      # %bb.0:  
; CHECK-NEXT: vmovdqa (%rdi), %ymm0  
; CHECK-NEXT: vmovdqa 32(%rdi), %ymm1  
; CHECK-NEXT: vpaddd 32(%rsi), %ymm1, %ymm1  
; CHECK-NEXT: vpaddd (%rsi), %ymm0, %ymm0  
; CHECK-NEXT: vmovdqa %ymm0, (%rdx)  
; CHECK-NEXT:  
    vmovdqa %ymm1, 32(%rdx)  
; CHECK-NEXT: vzeroupper  
; CHECK-NEXT: retq  
%d = load <16 x i32>, <16 x i32>* %a  
%e = load <16 x i32>, <16 x i32>* %b  
%f = add <16 x i32> %d, %e  
store <16 x i32> %f, <16 x i32>* %c  
ret void  
}
```

```
define dso_local void @add512(<16 x i32>* %a, <16 x i32>* %b, <16 x i32>* %c) "min-legal-vector-  
width"="512" {  
; CHECK-LABEL: add512:  
; CHECK:      # %bb.0:  
; CHECK-NEXT: vmovdqa64 (%rdi), %zmm0  
; CHECK-NEXT: vpaddd (%rsi), %zmm0, %zmm0  
; CHECK-NEXT: vmovdqa64 %zmm0, (%rdx)  
; CHECK-NEXT: vzeroupper  
; CHECK-NEXT: retq  
%d = load <16 x i32>, <16 x i32>* %a  
%e = load <16 x i32>, <16 x i32>* %b  
%f = add <16 x i32> %d, %e  
store <16 x i32> %f, <16 x i32>* %c  
ret void  
}
```

```
define dso_local void @avg_v64i8_256(<64 x i8>* %a, <64 x i8>* %b) "min-legal-vector-width"="256" {  
; CHECK-LABEL: avg_v64i8_256:  
; CHECK:      # %bb.0:  
; CHECK-NEXT: vmovdqa (%rsi), %ymm0  
; CHECK-NEXT: vmovdqa 32(%rsi), %ymm1  
; CHECK-NEXT: vpavgb (%rdi),
```



```
%ymm0, %ymm0  
; CHECK-NEXT:    vpavgb 32(%rdi), %ymm1, %ymm1  
; CHECK-NEXT:    vmovdqu %ymm1, (%rax)  
; CHECK-NEXT:    vmovdqu %ymm0, (%rax)  
; CHECK-NEXT:    vzeroupper  
; CHECK-NEXT:    retq  
  
%1 = load <64 x i8>, <64 x i8>* %a  
%2 = load <64 x i8>, <64 x i8>* %b  
%3 = zext <64 x i8> %1 to <64 x i32>  
%4 = zext <64 x i8> %2 to <64 x i32>  
  
%5 = add nuw nsw <64 x i32> %3, <i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1,  
i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1,  
i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1,>  
%6 = add nuw nsw <64 x i32> %5, %4  
%7 = lshr <64 x i32> %6, <i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1, i32 1,  
i32 1, i32 1>  
%8 = trunc <64 x i32> %7 to <64 x i8>  
store <64 x i8> %8, <64 x i8>* undef, align 4  
ret void  
}
```

```

%8 = trunc <64 x i32> %7 to <64 x i8>
store <64 x i8> %8, <64 x i8>* undef,
align 4
ret void
}

```

```

define dso_local void @pmaddwd_32_256(<32 x i16>* %APtr, <32 x i16>* %BPtr, <16 x i32>* %CPtr) "min-
legal-vector-width"="256" {
; CHECK-LABEL: pmaddwd_32_256:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vmovdqa (%rdi), %ymm0
; CHECK-NEXT:  vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT:  vpmaddwd 32(%rsi), %ymm1, %ymm1
; CHECK-NEXT:  vpmaddwd (%rsi), %ymm0, %ymm0
; CHECK-NEXT:  vmovdqa %ymm0, (%rdx)
; CHECK-NEXT:  vmovdqa %ymm1, 32(%rdx)
; CHECK-NEXT:  vzeroupper
; CHECK-NEXT:  retq
    %A = load <32 x i16>, <32 x i16>* %APtr
    %B = load <32 x i16>, <32 x i16>* %BPtr
    %a = sext <32 x i16> %A to <32 x i32>
    %b = sext <32 x i16> %B to <32 x i32>
    %m = mul nsw <32 x i32> %a, %b
    %odd = shufflevector <32 x i32> %m, <32 x i32> undef, <16 x i32> <i32 0, i32 2, i32 4, i32 6, i32 8, i32 10, i32
12, i32 14, i32 16, i32 18, i32 20, i32 22, i32 24, i32 26, i32 28, i32 30>
    %even = shufflevector <32 x i32> %m, <32 x i32> undef, <16 x i32> <i32 1, i32 3, i32 5, i32
7, i32 9, i32 11, i32 13, i32 15, i32 17, i32 19, i32 21, i32 23, i32 25, i32 27, i32 29, i32 31>
    %ret = add <16 x i32> %odd, %even
    store <16 x i32> %ret, <16 x i32>* %CPtr
    ret void
}

```

```

define dso_local void @pmaddwd_32_512(<32 x i16>* %APtr, <32 x i16>* %BPtr, <16 x i32>* %CPtr) "min-
legal-vector-width"="512" {
; CHECK-LABEL: pmaddwd_32_512:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vmovdqa64 (%rdi), %zmm0
; CHECK-NEXT:  vpmaddwd (%rsi), %zmm0, %zmm0
; CHECK-NEXT:  vmovdqa64 %zmm0, (%rdx)
; CHECK-NEXT:  vzeroupper
; CHECK-NEXT:  retq
    %A = load <32 x i16>, <32 x i16>* %APtr
    %B = load <32 x i16>, <32 x i16>* %BPtr
    %a = sext <32 x i16> %A to <32 x i32>
    %b = sext <32 x i16> %B to <32 x i32>
    %m = mul nsw <32 x i32> %a, %b
    %odd = shufflevector <32 x i32> %m, <32 x i32> undef, <16 x i32> <i32 0, i32 2, i32 4, i32 6, i32 8, i32 10, i32
12, i32 14, i32 16, i32 18, i32 20, i32 22, i32 24, i32 26, i32 28, i32 30>

```

```

    %even = shufflevector <32 x i32> %m, <32 x i32>
undef, <16 x i32> <i32 1, i32 3, i32 5, i32 7, i32 9, i32 11, i32 13, i32 15, i32 17, i32 19, i32 21, i32 23, i32 25, i32
27, i32 29, i32 31>
    %ret = add <16 x i32> %odd, %even
    store <16 x i32> %ret, <16 x i32>* %CPtr
    ret void
}

define dso_local void @psubus_64i8_max_256(<64 x i8>* %xptr, <64 x i8>* %yptr, <64 x i8>* %zptr) "min-legal-
vector-width"="256" {
; CHECK-LABEL: psubus_64i8_max_256:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT: vpsubusb 32(%rsi), %ymm1, %ymm1
; CHECK-NEXT: vpsubusb (%rsi), %ymm0, %ymm0
; CHECK-NEXT: vmovdqa %ymm0, (%rdx)
; CHECK-NEXT: vmovdqa %ymm1, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
    %x = load <64 x i8>, <64 x i8>* %xptr
    %y = load <64 x i8>, <64 x i8>* %yptr
    %cmp = icmp ult <64 x i8> %x, %y
    %max = select <64 x i1> %cmp, <64 x i8> %y, <64 x i8> %x
    %res = sub <64 x i8> %max, %y
    store <64 x i8> %res, <64 x i8>* %zptr
    ret void
}

define
dso_local void @psubus_64i8_max_512(<64 x i8>* %xptr, <64 x i8>* %yptr, <64 x i8>* %zptr) "min-legal-
vector-width"="512" {
; CHECK-LABEL: psubus_64i8_max_512:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa64 (%rdi), %zmm0
; CHECK-NEXT: vpsubusb (%rsi), %zmm0, %zmm0
; CHECK-NEXT: vmovdqa64 %zmm0, (%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
    %x = load <64 x i8>, <64 x i8>* %xptr
    %y = load <64 x i8>, <64 x i8>* %yptr
    %cmp = icmp ult <64 x i8> %x, %y
    %max = select <64 x i1> %cmp, <64 x i8> %y, <64 x i8> %x
    %res = sub <64 x i8> %max, %y
    store <64 x i8> %res, <64 x i8>* %zptr
    ret void
}

```

```

define dso_local i32 @_Z9test_charPcS_i_256(i8* nocapture readonly, i8* nocapture readonly, i32) "min-legal-
vector-width"="256" {
; CHECK-SKX-LABEL: _Z9test_charPcS_i_256:
; CHECK-SKX:      # %bb.0: # %entry
; CHECK-SKX-NEXT:  movl %edx, %eax
; CHECK-SKX-NEXT:  vpxor %xmm0, %xmm0, %xmm0
; CHECK-SKX-NEXT:  xorl %ecx, %ecx
; CHECK-SKX-NEXT:  vpxor %xmm1, %xmm1, %xmm1
;
; CHECK-SKX-NEXT:  vpxor %xmm2, %xmm2, %xmm2
; CHECK-SKX-NEXT:  .p2align 4, 0x90
; CHECK-SKX-NEXT:  .LBB8_1: # %vector.body
; CHECK-SKX-NEXT:  # =>This Inner Loop Header: Depth=1
; CHECK-SKX-NEXT:  vpmovsxbw 16(%rdi,%rcx), %ymm3
; CHECK-SKX-NEXT:  vpmovsxbw (%rdi,%rcx), %ymm4
; CHECK-SKX-NEXT:  vpmovsxbw 16(%rsi,%rcx), %ymm5
; CHECK-SKX-NEXT:  vpmaddwd %ymm3, %ymm5, %ymm3
; CHECK-SKX-NEXT:  vpadd %ymm2, %ymm3, %ymm2
; CHECK-SKX-NEXT:  vpmovsxbw (%rsi,%rcx), %ymm3
; CHECK-SKX-NEXT:  vpmaddwd %ymm4, %ymm3, %ymm3
; CHECK-SKX-NEXT:  vpadd %ymm1, %ymm3, %ymm1
; CHECK-SKX-NEXT:  addq $32, %rcx
; CHECK-SKX-NEXT:  cmpq %rcx, %rax
; CHECK-SKX-NEXT:  jne .LBB8_1
; CHECK-SKX-NEXT:  # %bb.2: # %middle.block
; CHECK-SKX-NEXT:  vpadd %ymm0, %ymm1, %ymm1
; CHECK-SKX-NEXT:  vpadd %ymm0, %ymm2, %ymm0
; CHECK-SKX-NEXT:  vpadd %ymm0, %ymm1, %ymm0
; CHECK-SKX-NEXT:  vextracti128 $1, %ymm0, %xmm1
; CHECK-SKX-NEXT:  vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT:
;     vpsltd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-SKX-NEXT:  vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT:  vpsrlq $32, %xmm0, %xmm1
; CHECK-SKX-NEXT:  vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT:  vmovd %xmm0, %eax
; CHECK-SKX-NEXT:  vzeroupper
; CHECK-SKX-NEXT:  retq
;
; CHECK-AVX512-LABEL: _Z9test_charPcS_i_256:
; CHECK-AVX512:    # %bb.0: # %entry
; CHECK-AVX512-NEXT:  movl %edx, %eax
; CHECK-AVX512-NEXT:  vpxor %xmm0, %xmm0, %xmm0
; CHECK-AVX512-NEXT:  xorl %ecx, %ecx
; CHECK-AVX512-NEXT:  vpxor %xmm1, %xmm1, %xmm1
; CHECK-AVX512-NEXT:  vpxor %xmm2, %xmm2, %xmm2
; CHECK-AVX512-NEXT:  .p2align 4, 0x90
; CHECK-AVX512-NEXT:  .LBB8_1: # %vector.body

```

```

; CHECK-AVX512-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-AVX512-NEXT: vpmovsxbw 16(%rdi,%rcx), %ymm3
; CHECK-AVX512-NEXT: vpmovsxbw (%rdi,%rcx), %ymm4
; CHECK-AVX512-NEXT: vpmovsxbw 16(%rsi,%rcx), %ymm5
; CHECK-AVX512-NEXT: vpmaddwd %ymm3, %ymm5, %ymm3
; CHECK-AVX512-NEXT: vpaddd %ymm2, %ymm3,
%ymm2
; CHECK-AVX512-NEXT: vpmovsxbw (%rsi,%rcx), %ymm3
; CHECK-AVX512-NEXT: vpmaddwd %ymm4, %ymm3, %ymm3
; CHECK-AVX512-NEXT: vpaddd %ymm1, %ymm3, %ymm1
; CHECK-AVX512-NEXT: addq $32, %rcx
; CHECK-AVX512-NEXT: cmpq %rcx, %rax
; CHECK-AVX512-NEXT: jne .LBB8_1
; CHECK-AVX512-NEXT: # %bb.2: # %middle.block
; CHECK-AVX512-NEXT: vpaddd %ymm0, %ymm1, %ymm1
; CHECK-AVX512-NEXT: vpaddd %ymm0, %ymm2, %ymm0
; CHECK-AVX512-NEXT: vpaddd %ymm0, %ymm1, %ymm0
; CHECK-AVX512-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpslufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpsrlq $32, %xmm0, %xmm1
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vmovd %xmm0, %eax
; CHECK-AVX512-NEXT: vzeroupper
; CHECK-AVX512-NEXT: retq
;
; CHECK-VBMI-LABEL: _Z9test_charPcS_i_256:
; CHECK-VBMI: # %bb.0: # %entry
; CHECK-VBMI-NEXT:
movl %edx, %eax
; CHECK-VBMI-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-VBMI-NEXT: xorl %ecx, %ecx
; CHECK-VBMI-NEXT: vpxor %xmm1, %xmm1, %xmm1
; CHECK-VBMI-NEXT: vpxor %xmm2, %xmm2, %xmm2
; CHECK-VBMI-NEXT: .p2align 4, 0x90
; CHECK-VBMI-NEXT: .LBB8_1: # %vector.body
; CHECK-VBMI-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-VBMI-NEXT: vpmovsxbw 16(%rdi,%rcx), %ymm3
; CHECK-VBMI-NEXT: vpmovsxbw (%rdi,%rcx), %ymm4
; CHECK-VBMI-NEXT: vpmovsxbw 16(%rsi,%rcx), %ymm5
; CHECK-VBMI-NEXT: vpmaddwd %ymm3, %ymm5, %ymm3
; CHECK-VBMI-NEXT: vpaddd %ymm2, %ymm3, %ymm2
; CHECK-VBMI-NEXT: vpmovsxbw (%rsi,%rcx), %ymm3
; CHECK-VBMI-NEXT: vpmaddwd %ymm4, %ymm3, %ymm3
; CHECK-VBMI-NEXT: vpaddd %ymm1, %ymm3, %ymm1
; CHECK-VBMI-NEXT: addq $32, %rcx
; CHECK-VBMI-NEXT: cmpq %rcx, %rax

```

```
; CHECK-VBMI-NEXT: jne .LBB8_1
; CHECK-VBMI-NEXT: # %bb.2: # %middle.block
; CHECK-VBMI-NEXT: vpaddd %ymm0, %ymm1, %ymm1
; CHECK-VBMI-NEXT: vpaddd %ymm0, %ymm2,
%ymm0
; CHECK-VBMI-NEXT: vpaddd %ymm0, %ymm1, %ymm0
; CHECK-VBMI-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vpslufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vpslufd {{.*#+}} xmm1 = xmm0[1,1,1,1]
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vmovd %xmm0, %eax
; CHECK-VBMI-NEXT: vzeroupper
; CHECK-VBMI-NEXT: retq
```

entry:

```
%3 = zext i32 %2 to i64
```

```
br label %vector.body
```

vector.body:

```
%index = phi i64 [ %index.next, %vector.body ], [ 0, %entry ]
%vec.phi = phi <32 x i32> [ %11, %vector.body ], [ zeroinitializer, %entry ]
%4 = getelementptr inbounds i8, i8* %0, i64 %index
%5 = bitcast i8* %4 to <32 x i8>*
%wide.load = load <32 x i8>, <32 x i8>* %5, align 1
%6 = sext <32 x i8> %wide.load to <32 x i32>
%7 = getelementptr inbounds i8, i8* %1, i64 %index
%8 = bitcast i8* %7 to <32 x i8>*
%wide.load14 = load <32 x
i8>, <32 x i8>* %8, align 1
%9 = sext <32 x i8> %wide.load14 to <32 x i32>
%10 = mul nsw <32 x i32> %9, %6
%11 = add nsw <32 x i32> %10, %vec.phi
%index.next = add i64 %index, 32
%12 = icmp eq i64 %index.next, %3
br i1 %12, label %middle.block, label %vector.body
```

middle.block:

```
%rdx.shuf1 = shufflevector <32 x i32> %11, <32 x i32> undef, <32 x i32> <i32 16, i32 17, i32 18, i32 19, i32 20,
i32 21, i32 22, i32 23, i32 24, i32 25, i32 26, i32 27, i32 28, i32 29, i32 30, i32 31, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef, i32 undef, i32 undef>
%bin.rdx1 = add <32 x i32> %11, %rdx.shuf1
%rdx.shuf = shufflevector <32 x i32> %bin.rdx1, <32 x i32> undef, <32 x i32> <i32 8, i32 9, i32 10, i32 11, i32
12, i32 13, i32 14, i32 15, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef>
```



```

; CHECK-SKX-NEXT: vpsrlq $32, %xmm0, %xmm1
; CHECK-SKX-NEXT: vpaddq %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT:
    vmovd %xmm0, %eax
; CHECK-SKX-NEXT: vzeroupper
; CHECK-SKX-NEXT: retq
;
; CHECK-AVX512-LABEL: _Z9test_charPcS_i_512:
; CHECK-AVX512:    # %bb.0: # %entry
; CHECK-AVX512-NEXT: movl %edx, %eax
; CHECK-AVX512-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-AVX512-NEXT: xorl %ecx, %ecx
; CHECK-AVX512-NEXT: vpxor %xmm1, %xmm1, %xmm1
; CHECK-AVX512-NEXT: .p2align 4, 0x90
; CHECK-AVX512-NEXT: .LBB9_1: # %vector.body
; CHECK-AVX512-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-AVX512-NEXT: vpmovsxbw (%rdi,%rcx), %zmm2
; CHECK-AVX512-NEXT: vpmovsxbw (%rsi,%rcx), %zmm3
; CHECK-AVX512-NEXT: vpmaddwd %zmm2, %zmm3, %zmm2
; CHECK-AVX512-NEXT: vpaddq %zmm1, %zmm2, %zmm1
; CHECK-AVX512-NEXT: addq $32, %rcx
; CHECK-AVX512-NEXT: cmpq %rcx, %rax
; CHECK-AVX512-NEXT: jne .LBB9_1
; CHECK-AVX512-NEXT: # %bb.2: # %middle.block
; CHECK-AVX512-NEXT: vpaddq %zmm0, %zmm1, %zmm0
; CHECK-AVX512-NEXT: vextracti64x4 $1, %zmm0, %ymm1
; CHECK-AVX512-NEXT: vpaddq
    %zmm1, %zmm0, %zmm0
; CHECK-AVX512-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-AVX512-NEXT: vpaddq %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpshufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-AVX512-NEXT: vpaddq %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpsrlq $32, %xmm0, %xmm1
; CHECK-AVX512-NEXT: vpaddq %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vmovd %xmm0, %eax
; CHECK-AVX512-NEXT: vzeroupper
; CHECK-AVX512-NEXT: retq
;
; CHECK-VBMI-LABEL: _Z9test_charPcS_i_512:
; CHECK-VBMI:    # %bb.0: # %entry
; CHECK-VBMI-NEXT: movl %edx, %eax
; CHECK-VBMI-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-VBMI-NEXT: xorl %ecx, %ecx
; CHECK-VBMI-NEXT: vpxor %xmm1, %xmm1, %xmm1
; CHECK-VBMI-NEXT: .p2align 4, 0x90
; CHECK-VBMI-NEXT: .LBB9_1: # %vector.body
; CHECK-VBMI-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-VBMI-NEXT: vpmovsxbw (%rdi,%rcx), %zmm2

```



```

; CHECK-VBMI-NEXT: vpmovsxbw (%rsi,%rcx), %zmm3
; CHECK-VBMI-NEXT: vpmaddwd %zmm2, %zmm3, %zmm2
;
CHECK-VBMI-NEXT: vpaddd %zmm1, %zmm2, %zmm1
; CHECK-VBMI-NEXT: addq $32, %rcx
; CHECK-VBMI-NEXT: cmpq %rcx, %rax
; CHECK-VBMI-NEXT: jne .LBB9_1
; CHECK-VBMI-NEXT: # %bb.2: # %middle.block
; CHECK-VBMI-NEXT: vpaddd %zmm0, %zmm1, %zmm0
; CHECK-VBMI-NEXT: vextracti64x4 $1, %zmm0, %ymm1
; CHECK-VBMI-NEXT: vpaddd %zmm1, %zmm0, %zmm0
; CHECK-VBMI-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vpshufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vpshufd {{.*#+}} xmm1 = xmm0[1,1,1,1]
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vmovd %xmm0, %eax
; CHECK-VBMI-NEXT: vzeroupper
; CHECK-VBMI-NEXT: retq
entry:
%3 = zext i32 %2 to i64
br label %vector.body

```

vector.body:

```

%index = phi i64 [ %index.next, %vector.body ], [ 0, %entry ]
%vec.phi = phi <32 x i32> [ %11, %vector.body ], [ zeroinitializer, %entry ]
%4 = getelementptr
inbounds i8, i8* %0, i64 %index
%5 = bitcast i8* %4 to <32 x i8>*
%wide.load = load <32 x i8>, <32 x i8>* %5, align 1
%6 = sext <32 x i8> %wide.load to <32 x i32>
%7 = getelementptr inbounds i8, i8* %1, i64 %index
%8 = bitcast i8* %7 to <32 x i8>*
%wide.load14 = load <32 x i8>, <32 x i8>* %8, align 1
%9 = sext <32 x i8> %wide.load14 to <32 x i32>
%10 = mul nsw <32 x i32> %9, %6
%11 = add nsw <32 x i32> %10, %vec.phi
%index.next = add i64 %index, 32
%12 = icmp eq i64 %index.next, %3
br i1 %12, label %middle.block, label %vector.body

```

middle.block:

```

%rdx.shuf1 = shufflevector <32 x i32> %11, <32 x i32> undef, <32 x i32> <i32 16, i32 17, i32 18, i32 19, i32 20,
i32 21, i32 22, i32 23, i32 24, i32 25, i32 26, i32 27, i32 28, i32 29, i32 30, i32 31, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx1 = add <32 x i32> %11, %rdx.shuf1

```

```

%rdx.shuf = shufflevector <32 x i32> %bin.rdx1, <32 x i32> undef, <32 x i32> <i32 8, i32 9, i32 10, i32 11, i32
12, i32 13, i32 14, i32 15, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx = add <32 x i32> %bin.rdx1, %rdx.shuf
%rdx.shuf15 = shufflevector <32 x i32> %bin.rdx, <32 x i32> undef, <32 x i32> <i32 4, i32 5, i32 6, i32 7, i32
undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx32 = add <32 x i32> %bin.rdx, %rdx.shuf15
%rdx.shuf17 = shufflevector <32 x i32> %bin.rdx32, <32 x i32> undef,
<32 x i32> <i32 2, i32 3, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef>
%bin.rdx18 = add <32 x i32> %bin.rdx32, %rdx.shuf17
%rdx.shuf19 = shufflevector <32 x i32> %bin.rdx18, <32 x i32> undef, <32 x i32> <i32 1, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32
undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef,
i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx20 = add <32 x i32> %bin.rdx18, %rdx.shuf19
%13 = extractelement <32 x i32> %bin.rdx20, i32 0
ret i32 %13
}

```

```

@a = dso_local global [1024 x i8]
zeroinitializer, align 16
@b = dso_local global [1024 x i8] zeroinitializer, align 16

```

```

define dso_local i32 @sad_16i8_256() "min-legal-vector-width"="256" {
; CHECK-SKX-LABEL: sad_16i8_256:
; CHECK-SKX:      # %bb.0: # %entry
; CHECK-SKX-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-SKX-NEXT: movq $-1024, %rax # imm = 0xFC00
; CHECK-SKX-NEXT: vpxor %xmm1, %xmm1, %xmm1
; CHECK-SKX-NEXT: .p2align 4, 0x90
; CHECK-SKX-NEXT: .LBB10_1: # %vector.body
; CHECK-SKX-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-SKX-NEXT: vmovdqu a+1024(%rax), %xmm2
; CHECK-SKX-NEXT: vpsadbw b+1024(%rax), %xmm2, %xmm2
; CHECK-SKX-NEXT: vpadd %ymm1, %ymm2, %ymm1
; CHECK-SKX-NEXT: addq $4, %rax
; CHECK-SKX-NEXT: jne .LBB10_1
; CHECK-SKX-NEXT: # %bb.2: # %middle.block
; CHECK-SKX-NEXT: vpadd %ymm0, %ymm1, %ymm0
; CHECK-SKX-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-SKX-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT: vpsltd {{.*#+}} xmm1 = xmm0[2,3,2,3]

```

```

; CHECK-SKX-NEXT:
    vpaddd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT:  vpsrlq $32, %xmm0, %xmm1
; CHECK-SKX-NEXT:  vpaddd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT:  vmovd %xmm0, %eax
; CHECK-SKX-NEXT:  vzeroupper
; CHECK-SKX-NEXT:  retq
;
; CHECK-AVX512-LABEL: sad_16i8_256:
; CHECK-AVX512:    # %bb.0: # %entry
; CHECK-AVX512-NEXT:  vpxor %xmm0, %xmm0, %xmm0
; CHECK-AVX512-NEXT:  movq $-1024, %rax # imm = 0xFC00
; CHECK-AVX512-NEXT:  vpxor %xmm1, %xmm1, %xmm1
; CHECK-AVX512-NEXT:  .p2align 4, 0x90
; CHECK-AVX512-NEXT: .LBB10_1: # %vector.body
; CHECK-AVX512-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-AVX512-NEXT: vmovdqu a+1024(%rax), %xmm2
; CHECK-AVX512-NEXT: vpsadbw b+1024(%rax), %xmm2, %xmm2
; CHECK-AVX512-NEXT: vpaddd %ymm1, %ymm2, %ymm1
; CHECK-AVX512-NEXT: addq $4, %rax
; CHECK-AVX512-NEXT: jne .LBB10_1
; CHECK-AVX512-NEXT: # %bb.2: # %middle.block
; CHECK-AVX512-NEXT: vpaddd %ymm0, %ymm1, %ymm0
; CHECK-AVX512-NEXT: vextracti128 $1, %ymm0, %xmm1
;
CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpshufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpsrlq $32, %xmm0, %xmm1
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vmovd %xmm0, %eax
; CHECK-AVX512-NEXT: vzeroupper
; CHECK-AVX512-NEXT: retq
;
; CHECK-VBMI-LABEL: sad_16i8_256:
; CHECK-VBMI:    # %bb.0: # %entry
; CHECK-VBMI-NEXT:  vpxor %xmm0, %xmm0, %xmm0
; CHECK-VBMI-NEXT:  movq $-1024, %rax # imm = 0xFC00
; CHECK-VBMI-NEXT:  vpxor %xmm1, %xmm1, %xmm1
; CHECK-VBMI-NEXT:  .p2align 4, 0x90
; CHECK-VBMI-NEXT: .LBB10_1: # %vector.body
; CHECK-VBMI-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-VBMI-NEXT: vmovdqu a+1024(%rax), %xmm2
; CHECK-VBMI-NEXT: vpsadbw b+1024(%rax), %xmm2, %xmm2
; CHECK-VBMI-NEXT: vpaddd %ymm1, %ymm2, %ymm1
; CHECK-VBMI-NEXT: addq $4, %rax
; CHECK-VBMI-NEXT: jne .LBB10_1
; CHECK-VBMI-NEXT: # %bb.2: # %middle.block

```

```

;
CHECK-VBMI-NEXT:  vpaddd %ymm0, %ymm1, %ymm0
; CHECK-VBMI-NEXT:  vextracti128 $1, %ymm0, %xmm1
; CHECK-VBMI-NEXT:  vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT:  vpshufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-VBMI-NEXT:  vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT:  vpshufd {{.*#+}} xmm1 = xmm0[1,1,1,1]
; CHECK-VBMI-NEXT:  vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT:  vmovd %xmm0, %eax
; CHECK-VBMI-NEXT:  vzeroupper
; CHECK-VBMI-NEXT:  retq
entry:
br label %vector.body

vector.body:
%index = phi i64 [ 0, %entry ], [ %index.next, %vector.body ]
%vec.phi = phi <16 x i32> [ zeroinitializer, %entry ], [ %10, %vector.body ]
%0 = getelementptr inbounds [1024 x i8], [1024 x i8]* @a, i64 0, i64 %index
%1 = bitcast i8* %0 to <16 x i8>*
%wide.load = load <16 x i8>, <16 x i8>* %1, align 4
%2 = zext <16 x i8> %wide.load to <16 x i32>
%3 = getelementptr inbounds [1024 x i8], [1024 x i8]* @b, i64 0, i64 %index
%4 = bitcast i8* %3 to <16 x i8>*
%wide.load1
= load <16 x i8>, <16 x i8>* %4, align 4
%5 = zext <16 x i8> %wide.load1 to <16 x i32>
%6 = sub nsw <16 x i32> %2, %5
%7 = icmp sgt <16 x i32> %6, <i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1>
%8 = sub nsw <16 x i32> zeroinitializer, %6
%9 = select <16 x i1> %7, <16 x i32> %6, <16 x i32> %8
%10 = add nsw <16 x i32> %9, %vec.phi
%index.next = add i64 %index, 4
%11 = icmp eq i64 %index.next, 1024
br i1 %11, label %middle.block, label %vector.body

middle.block:
%rdx.shuf = shufflevector <16 x i32> %10, <16 x i32> undef, <16 x i32> <i32 8, i32 9, i32 10, i32 11, i32 12, i32 13, i32 14, i32 15, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx = add <16 x i32> %10, %rdx.shuf
%rdx.shuf2 = shufflevector <16 x i32> %bin.rdx, <16 x i32> undef, <16 x i32> <i32 4, i32 5, i32 6, i32 7, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx2 = add <16 x i32> %bin.rdx, %rdx.shuf2
%rdx.shuf3 = shufflevector <16 x i32> %bin.rdx2, <16 x i32> undef, <16 x i32> <i32 2, i32 3, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx3 = add <16 x i32> %bin.rdx2, %rdx.shuf3

```

```

%rdx.shuf4 = shufflevector <16 x i32> %bin.rdx3, <16 x i32> undef, <16 x i32> <i32 1, i32 undef, i32 undef, i32
undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx4 = add <16 x i32> %bin.rdx3, %rdx.shuf4
%12 = extractelement <16 x i32> %bin.rdx4, i32 0
ret i32 %12
}

```

```

define dso_local i32 @sad_16i8_512() "min-legal-vector-width"="512" {
; CHECK-SKX-LABEL: sad_16i8_512:
; CHECK-SKX:      # %bb.0: # %entry
; CHECK-SKX-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-SKX-NEXT:
    movq $-1024, %rax # imm = 0xFC00
; CHECK-SKX-NEXT: .p2align 4, 0x90
; CHECK-SKX-NEXT: .LBB11_1: # %vector.body
; CHECK-SKX-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-SKX-NEXT: vmovdqu a+1024(%rax), %xmm1
; CHECK-SKX-NEXT: vpsadbw b+1024(%rax), %xmm1, %xmm1
; CHECK-SKX-NEXT: vpadd %zmm0, %zmm1, %zmm0
; CHECK-SKX-NEXT: addq $4, %rax
; CHECK-SKX-NEXT: jne .LBB11_1
; CHECK-SKX-NEXT: # %bb.2: # %middle.block
; CHECK-SKX-NEXT: vextracti64x4 $1, %zmm0, %ymm1
; CHECK-SKX-NEXT: vpadd %zmm1, %zmm0, %zmm0
; CHECK-SKX-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-SKX-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT: vpsltd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-SKX-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT: vpsrlq $32, %xmm0, %xmm1
; CHECK-SKX-NEXT: vpadd %xmm1, %xmm0, %xmm0
; CHECK-SKX-NEXT: vmovd %xmm0, %eax
; CHECK-SKX-NEXT: vzeroupper
; CHECK-SKX-NEXT: retq
;
; CHECK-AVX512-LABEL: sad_16i8_512:
; CHECK-AVX512:
    # %bb.0: # %entry
; CHECK-AVX512-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-AVX512-NEXT: movq $-1024, %rax # imm = 0xFC00
; CHECK-AVX512-NEXT: .p2align 4, 0x90
; CHECK-AVX512-NEXT: .LBB11_1: # %vector.body
; CHECK-AVX512-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-AVX512-NEXT: vmovdqu a+1024(%rax), %xmm1
; CHECK-AVX512-NEXT: vpsadbw b+1024(%rax), %xmm1, %xmm1
; CHECK-AVX512-NEXT: vpadd %zmm0, %zmm1, %zmm0
; CHECK-AVX512-NEXT: addq $4, %rax
; CHECK-AVX512-NEXT: jne .LBB11_1

```

```

; CHECK-AVX512-NEXT: # %bb.2: # %middle.block
; CHECK-AVX512-NEXT: vextracti64x4 $1, %zmm0, %ymm1
; CHECK-AVX512-NEXT: vpaddd %zmm1, %zmm0, %zmm0
; CHECK-AVX512-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpshufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT: vpsrlq $32, %xmm0, %xmm1
; CHECK-AVX512-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-AVX512-NEXT:
    vmovd %xmm0, %eax
; CHECK-AVX512-NEXT: vzeroupper
; CHECK-AVX512-NEXT: retq
;
; CHECK-VBMI-LABEL: sad_16i8_512:
; CHECK-VBMI: # %bb.0: # %entry
; CHECK-VBMI-NEXT: vpxor %xmm0, %xmm0, %xmm0
; CHECK-VBMI-NEXT: movq $-1024, %rax # imm = 0xFC00
; CHECK-VBMI-NEXT: .p2align 4, 0x90
; CHECK-VBMI-NEXT: .LBB11_1: # %vector.body
; CHECK-VBMI-NEXT: # =>This Inner Loop Header: Depth=1
; CHECK-VBMI-NEXT: vmovdqu a+1024(%rax), %xmm1
; CHECK-VBMI-NEXT: vpsadbw b+1024(%rax), %xmm1, %xmm1
; CHECK-VBMI-NEXT: vpaddd %zmm0, %zmm1, %zmm0
; CHECK-VBMI-NEXT: addq $4, %rax
; CHECK-VBMI-NEXT: jne .LBB11_1
; CHECK-VBMI-NEXT: # %bb.2: # %middle.block
; CHECK-VBMI-NEXT: vextracti64x4 $1, %zmm0, %ymm1
; CHECK-VBMI-NEXT: vpaddd %zmm1, %zmm0, %zmm0
; CHECK-VBMI-NEXT: vextracti128 $1, %ymm0, %xmm1
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vpshufd {{.*#+}} xmm1 = xmm0[2,3,2,3]
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT:
    vpshufd {{.*#+}} xmm1 = xmm0[1,1,1,1]
; CHECK-VBMI-NEXT: vpaddd %xmm1, %xmm0, %xmm0
; CHECK-VBMI-NEXT: vmovd %xmm0, %eax
; CHECK-VBMI-NEXT: vzeroupper
; CHECK-VBMI-NEXT: retq
entry:
br label %vector.body

vector.body:
%index = phi i64 [ 0, %entry ], [ %index.next, %vector.body ]
%vec.phi = phi <16 x i32> [ zeroinitializer, %entry ], [ %10, %vector.body ]
%0 = getelementptr inbounds [1024 x i8], [1024 x i8]* @a, i64 0, i64 %index
%1 = bitcast i8* %0 to <16 x i8>*
%wide.load = load <16 x i8>, <16 x i8>* %1, align 4

```

```

%2 = zext <16 x i8> %wide.load to <16 x i32>
%3 = getelementptr inbounds [1024 x i8], [1024 x i8]* @b, i64 0, i64 %index
%4 = bitcast i8* %3 to <16 x i8>*
%wide.load1 = load <16 x i8>, <16 x i8>* %4, align 4
%5 = zext <16 x i8> %wide.load1 to <16 x i32>
%6 = sub nsw <16 x i32> %2, %5
%7 = icmp sgt <16 x i32> %6, <i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1, i32 -1>
br i1 %7, label %middle.block, label %vector.body

```

middle.block:

```

%rdx.shuf = shufflevector <16 x i32> %10, <16 x i32> undef, <16 x i32> <i32 8, i32 9, i32 10, i32 11, i32 12, i32 13, i32 14, i32 15, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx = add <16 x i32> %10, %rdx.shuf
%rdx.shuf2 = shufflevector <16 x i32> %bin.rdx, <16 x i32> undef, <16 x i32> <i32 4, i32 5, i32 6, i32 7, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx2 = add <16 x i32> %bin.rdx, %rdx.shuf2
%rdx.shuf3 = shufflevector <16 x i32> %bin.rdx2, <16 x i32> undef, <16 x i32> <i32 2, i32 3, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx3 = add <16 x i32> %bin.rdx2, %rdx.shuf3
%rdx.shuf4 = shufflevector <16 x i32> %bin.rdx3, <16 x i32> undef, <16 x i32> <i32 1, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef, i32 undef>
%bin.rdx4 = add <16 x i32> %bin.rdx3, %rdx.shuf4
%12 = extractelement <16 x i32> %bin.rdx4, i32 0
ret i32 %12
}

```

```

define dso_local void @sbto16f32_256(<16 x i16> %a, <16 x float>* %res) "min-legal-vector-width"="256" {
; CHECK-LABEL: sbto16f32_256:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpmovw2m %ymm0, %k0
; CHECK-NEXT:  kshiftrw $8, %k0, %k1
; CHECK-NEXT:  vpmovm2d %k1, %ymm0
; CHECK-NEXT:  vcvtqd2ps %ymm0, %ymm0
; CHECK-NEXT:  vpmovm2d %k0, %ymm1
; CHECK-NEXT:  vcvtqd2ps %ymm1, %ymm1
; CHECK-NEXT:  vmovaps %ymm1, (%rdi)
; CHECK-NEXT:  vmovaps %ymm0, 32(%rdi)
; CHECK-NEXT:

```

```

    vzeroupper
; CHECK-NEXT:    retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = sitofp <16 x i1> %mask to <16 x float>
store <16 x float> %1, <16 x float>* %res
ret void
}

define dso_local void @sbto16f32_512(<16 x i16> %a, <16 x float>* %res) "min-legal-vector-width"="512" {
; CHECK-LABEL: sbto16f32_512:
; CHECK:        # %bb.0:
; CHECK-NEXT:    vpmovw2m %ymm0, %k0
; CHECK-NEXT:    vpmovm2d %k0, %zmm0
; CHECK-NEXT:    vcvtdq2ps %zmm0, %zmm0
; CHECK-NEXT:    vmovaps %zmm0, (%rdi)
; CHECK-NEXT:    vzeroupper
; CHECK-NEXT:    retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = sitofp <16 x i1> %mask to <16 x float>
store <16 x float> %1, <16 x float>* %res
ret void
}

define dso_local void @sbto16f64_256(<16 x i16> %a, <16 x double>* %res) "min-legal-vector-width"="256" {
; CHECK-LABEL: sbto16f64_256:
; CHECK:        # %bb.0:
; CHECK-NEXT:    vpmovw2m %ymm0, %k0
; CHECK-NEXT:    kshiftrw $8, %k0, %k1
; CHECK-NEXT:    vpmovm2d %k1, %ymm0
; CHECK-NEXT:
    vcvtdq2pd %xmm0, %ymm1
; CHECK-NEXT:    vextracti128 $1, %ymm0, %xmm0
; CHECK-NEXT:    vcvtdq2pd %xmm0, %ymm0
; CHECK-NEXT:    vpmovm2d %k0, %ymm2
; CHECK-NEXT:    vcvtdq2pd %xmm2, %ymm3
; CHECK-NEXT:    vextracti128 $1, %ymm2, %xmm2
; CHECK-NEXT:    vcvtdq2pd %xmm2, %ymm2
; CHECK-NEXT:    vmovaps %ymm2, 32(%rdi)
; CHECK-NEXT:    vmovaps %ymm3, (%rdi)
; CHECK-NEXT:    vmovaps %ymm0, 96(%rdi)
; CHECK-NEXT:    vmovaps %ymm1, 64(%rdi)
; CHECK-NEXT:    vzeroupper
; CHECK-NEXT:    retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = sitofp <16 x i1> %mask to <16 x double>
store <16 x double> %1, <16 x double>* %res
ret void
}

```



```

define dso_local void @sbto16f64_512(<16 x i16> %a, <16 x double>* %res) "min-legal-vector-width"="512" {
; CHECK-LABEL: sbto16f64_512:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpmovw2m %ymm0, %k0
; CHECK-NEXT:  vpmovm2d %k0, %zmm0
; CHECK-NEXT:  vcvtdq2pd %ymm0, %zmm1
; CHECK-NEXT:  vextracti64x4 $1, %zmm0, %ymm0
; CHECK-NEXT:  vcvtdq2pd
               %ymm0, %zmm0
; CHECK-NEXT:  vmovaps %zmm0, 64(%rdi)
; CHECK-NEXT:  vmovaps %zmm1, (%rdi)
; CHECK-NEXT:  vzeroupper
; CHECK-NEXT:  retq
               %mask = icmp slt <16 x i16> %a, zeroinitializer
               %1 = sitofp <16 x i1> %mask to <16 x double>
               store <16 x double> %1, <16 x double>* %res
               ret void
}

```

```

define dso_local void @ubto16f32_256(<16 x i16> %a, <16 x float>* %res) "min-legal-vector-width"="256" {
; CHECK-LABEL: ubto16f32_256:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpmovw2m %ymm0, %k0
; CHECK-NEXT:  kshiftrw $8, %k0, %k1
; CHECK-NEXT:  vpmovm2d %k1, %ymm0
; CHECK-NEXT:  vpsrld $31, %ymm0, %ymm0
; CHECK-NEXT:  vcvtdq2ps %ymm0, %ymm0
; CHECK-NEXT:  vpmovm2d %k0, %ymm1
; CHECK-NEXT:  vpsrld $31, %ymm1, %ymm1
; CHECK-NEXT:  vcvtdq2ps %ymm1, %ymm1
; CHECK-NEXT:  vmovaps %ymm1, (%rdi)
; CHECK-NEXT:  vmovaps %ymm0, 32(%rdi)
; CHECK-NEXT:  vzeroupper
; CHECK-NEXT:  retq
               %mask = icmp slt <16 x i16> %a, zeroinitializer
               %1 = uitofp <16 x i1> %mask to <16 x float>
               store <16 x float> %1, <16 x float>* %res
               ret void
}

```

```

define dso_local void @ubto16f32_512(<16 x i16> %a, <16 x float>* %res) "min-legal-vector-width"="512" {
; CHECK-LABEL: ubto16f32_512:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpmovw2m %ymm0, %k0
; CHECK-NEXT:  vpmovm2d %k0, %zmm0
; CHECK-NEXT:  vpsrld $31, %zmm0, %zmm0
; CHECK-NEXT:  vcvtdq2ps %zmm0, %zmm0

```

```

; CHECK-NEXT: vmovaps %zmm0, (%rdi)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = uitofp <16 x i1> %mask to <16 x float>
store <16 x float> %1, <16 x float>* %res
ret void
}

define dso_local void @ubto16f64_256(<16 x i16> %a, <16 x double>* %res) "min-legal-vector-width"="256" {
; CHECK-LABEL: ubto16f64_256:
; CHECK:      # %bb.0:
; CHECK-NEXT: vpmovw2m %ymm0, %k0
; CHECK-NEXT: kshiftrw $8, %k0, %k1
; CHECK-NEXT: vpmovm2d %k1, %ymm0
; CHECK-NEXT: vpsrld $31, %ymm0, %ymm0
; CHECK-NEXT: vcvtdq2pd %xmm0, %ymm1
; CHECK-NEXT: vextracti128
$1, %ymm0, %xmm0
; CHECK-NEXT: vcvtdq2pd %xmm0, %ymm0
; CHECK-NEXT: vpmovm2d %k0, %ymm2
; CHECK-NEXT: vpsrld $31, %ymm2, %ymm2
; CHECK-NEXT: vcvtdq2pd %xmm2, %ymm3
; CHECK-NEXT: vextracti128 $1, %ymm2, %xmm2
; CHECK-NEXT: vcvtdq2pd %xmm2, %ymm2
; CHECK-NEXT: vmovaps %ymm2, 32(%rdi)
; CHECK-NEXT: vmovaps %ymm3, (%rdi)
; CHECK-NEXT: vmovaps %ymm0, 96(%rdi)
; CHECK-NEXT: vmovaps %ymm1, 64(%rdi)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = uitofp <16 x i1> %mask to <16 x double>
store <16 x double> %1, <16 x double>* %res
ret void
}

define dso_local void @ubto16f64_512(<16 x i16> %a, <16 x double>* %res) "min-legal-vector-width"="512" {
; CHECK-LABEL: ubto16f64_512:
; CHECK:      # %bb.0:
; CHECK-NEXT: vpmovw2m %ymm0, %k0
; CHECK-NEXT: vpmovm2d %k0, %zmm0
; CHECK-NEXT: vpsrld $31, %zmm0, %zmm0
; CHECK-NEXT: vcvtdq2pd %ymm0, %zmm1
; CHECK-NEXT: vextracti64x4 $1, %zmm0, %ymm0
; CHECK-NEXT:
vcvtdq2pd %ymm0, %zmm0
; CHECK-NEXT: vmovaps %zmm0, 64(%rdi)

```

```

; CHECK-NEXT: vmovaps %zmm1, (%rdi)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%mask = icmp slt <16 x i16> %a, zeroinitializer
%1 = uitofp <16 x i1> %mask to <16 x double>
store <16 x double> %1, <16 x double>* %res
ret void
}

define <16 x i16> @test_16f32toub_256(<16 x float>* %ptr, <16 x i16> %passthru) "min-legal-vector-
width"="256" {
; CHECK-LABEL: test_16f32toub_256:
; CHECK:      # %bb.0:
; CHECK-NEXT: vcvttps2dq (%rdi), %ymm1
; CHECK-NEXT: vpslld $31, %ymm1, %ymm1
; CHECK-NEXT: vpmovd2m %ymm1, %k0
; CHECK-NEXT: vcvttps2dq 32(%rdi), %ymm1
; CHECK-NEXT: vpslld $31, %ymm1, %ymm1
; CHECK-NEXT: vpmovd2m %ymm1, %k1
; CHECK-NEXT: kunpckbw %k0, %k1, %k1
; CHECK-NEXT: vmovdqu16 %ymm0, %ymm0 {%k1} {z}
; CHECK-NEXT: retq
%a = load <16 x float>, <16 x float>* %ptr
%mask = fptoui <16 x float> %a to <16 x i1>
%select = select <16 x i1> %mask, <16 x i16> %passthru,
<16 x i16> zeroinitializer
ret <16 x i16> %select
}

define <16 x i16> @test_16f32toub_512(<16 x float>* %ptr, <16 x i16> %passthru) "min-legal-vector-
width"="512" {
; CHECK-LABEL: test_16f32toub_512:
; CHECK:      # %bb.0:
; CHECK-NEXT: vcvttps2dq (%rdi), %zmm1
; CHECK-NEXT: vpslld $31, %zmm1, %zmm1
; CHECK-NEXT: vpmovd2m %zmm1, %k1
; CHECK-NEXT: vmovdqu16 %ymm0, %ymm0 {%k1} {z}
; CHECK-NEXT: retq
%a = load <16 x float>, <16 x float>* %ptr
%mask = fptoui <16 x float> %a to <16 x i1>
%select = select <16 x i1> %mask, <16 x i16> %passthru, <16 x i16> zeroinitializer
ret <16 x i16> %select
}

define <16 x i16> @test_16f32tosb_256(<16 x float>* %ptr, <16 x i16> %passthru) "min-legal-vector-
width"="256" {
; CHECK-LABEL: test_16f32tosb_256:
; CHECK:      # %bb.0:

```

```
; CHECK-NEXT: vcvttps2dq (%rdi), %ymm1
; CHECK-NEXT: vpmovd2m %ymm1, %k0
; CHECK-NEXT: vcvttps2dq 32(%rdi), %ymm1
; CHECK-NEXT: vpmovd2m %ymm1, %k1
; CHECK-NEXT: kunpckbw %k0, %k1, %k1
; CHECK-NEXT:
    vmovdqu16 %ymm0, %ymm0 {%k1} {z}
; CHECK-NEXT: retq
%a = load <16 x float>, <16 x float>* %ptr
%mask = fptosi <16 x float> %a to <16 x i1>
%select = select <16 x i1> %mask, <16 x i16> %passthru, <16 x i16> zeroinitializer
ret <16 x i16> %select
}
```

```
define <16 x i16> @test_16f32tosb_512(<16 x float>* %ptr, <16 x i16> %passthru) "min-legal-vector-
width"="512" {
```

```
; CHECK-LABEL: test_16f32tosb_512:
; CHECK:    # %bb.0:
; CHECK-NEXT: vcvttps2dq (%rdi), %zmm1
; CHECK-NEXT: vpmovd2m %zmm1, %k1
; CHECK-NEXT: vmovdqu16 %ymm0, %ymm0 {%k1} {z}
; CHECK-NEXT: retq
%a = load <16 x float>, <16 x float>* %ptr
%mask = fptosi <16 x float> %a to <16 x i1>
%select = select <16 x i1> %mask, <16 x i16> %passthru, <16 x i16> zeroinitializer
ret <16 x i16> %select
}
```

```
define dso_local void @mul256(<64 x i8>* %a, <64 x i8>* %b, <64 x i8>* %c) "min-legal-vector-width"="256" {
```

```
; CHECK-SKX-VBMI-LABEL: mul256:
; CHECK-SKX-VBMI:    # %bb.0:
; CHECK-SKX-VBMI-NEXT: vmovdqa
    (%rdi), %ymm0
; CHECK-SKX-VBMI-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-SKX-VBMI-NEXT: vmovdqa (%rsi), %ymm2
; CHECK-SKX-VBMI-NEXT: vmovdqa 32(%rsi), %ymm3
; CHECK-SKX-VBMI-NEXT: vpunpckhbw {{.*#+}} ymm4 =
    ymm3[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-SKX-VBMI-NEXT: vpunpckhbw {{.*#+}} ymm5 =
    ymm1[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-SKX-VBMI-NEXT: vpmullw %ymm4, %ymm5, %ymm4
; CHECK-SKX-VBMI-NEXT: vpunpcklbw {{.*#+}} ymm3 =
    ymm3[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-SKX-VBMI-NEXT: vpunpcklbw {{.*#+}} ymm1 =
    ymm1[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-SKX-VBMI-NEXT: vpmullw %ymm3, %ymm1, %ymm1
; CHECK-SKX-VBMI-NEXT: vmovdqa {{.*#+}} ymm3 =
    [0,2,4,6,8,10,12,14,32,34,36,38,40,42,44,46,16,18,20,22,24,26,28,30,48,50,52,54,56,58,60,62]
```

```

;
CHECK-SKX-VBMI-NEXT: vpermt2b %ymm4, %ymm3, %ymm1
; CHECK-SKX-VBMI-NEXT: vpunpckhbw {{.*#+}} ymm4 =
ymm2[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-SKX-VBMI-NEXT: vpunpckhbw {{.*#+}} ymm5 =
ymm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-SKX-VBMI-NEXT: vpmullw %ymm4, %ymm5, %ymm4
; CHECK-SKX-VBMI-NEXT: vpunpcklbw {{.*#+}} ymm2 =
ymm2[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-SKX-VBMI-NEXT: vpunpcklbw {{.*#+}} ymm0 =
ymm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-SKX-VBMI-NEXT: vpmullw %ymm2, %ymm0, %ymm0
; CHECK-SKX-VBMI-NEXT: vpermt2b %ymm4, %ymm3, %ymm0
; CHECK-SKX-VBMI-NEXT: vmovdqa %ymm0, (%rdx)
; CHECK-SKX-VBMI-NEXT: vmovdqa %ymm1, 32(%rdx)
; CHECK-SKX-VBMI-NEXT: vzeroupper
; CHECK-SKX-VBMI-NEXT: retq
;
; CHECK-AVX512-LABEL: mul256:
; CHECK-AVX512:
# %bb.0:
; CHECK-AVX512-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-AVX512-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-AVX512-NEXT: vmovdqa (%rsi), %ymm2
; CHECK-AVX512-NEXT: vmovdqa 32(%rsi), %ymm3
; CHECK-AVX512-NEXT: vpunpckhbw {{.*#+}} ymm4 =
ymm3[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-AVX512-NEXT: vpunpckhbw {{.*#+}} ymm5 =
ymm1[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-AVX512-NEXT: vpmullw %ymm4, %ymm5, %ymm4
; CHECK-AVX512-NEXT: vpbroadcastw {{.*#+}} ymm5 =
[255,255,255,255,255,255,255,255,255,255,255,255,255,255,255,255]
; CHECK-AVX512-NEXT: vpand %ymm5, %ymm4, %ymm4
; CHECK-AVX512-NEXT: vpunpcklbw {{.*#+}} ymm3 =
ymm3[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-AVX512-NEXT: vpunpcklbw {{.*#+}} ymm1 =
ymm1[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
;
CHECK-AVX512-NEXT: vpmullw %ymm3, %ymm1, %ymm1
; CHECK-AVX512-NEXT: vpand %ymm5, %ymm1, %ymm1
; CHECK-AVX512-NEXT: vpackuswb %ymm4, %ymm1, %ymm1
; CHECK-AVX512-NEXT: vpunpckhbw {{.*#+}} ymm3 =
ymm2[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-AVX512-NEXT: vpunpckhbw {{.*#+}} ymm4 =
ymm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-AVX512-NEXT: vpmullw %ymm3, %ymm4, %ymm3
; CHECK-AVX512-NEXT: vpand %ymm5, %ymm3, %ymm3
; CHECK-AVX512-NEXT: vpunpcklbw {{.*#+}} ymm2 =

```

```

ymm2[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-AVX512-NEXT:  vpunpcklbw {{.*#+}} ymm0 =
ymm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-AVX512-NEXT:  vpmullw %ymm2, %ymm0, %ymm0
; CHECK-AVX512-NEXT:  vpand %ymm5, %ymm0, %ymm0
; CHECK-AVX512-NEXT:  vpackuswb %ymm3, %ymm0, %ymm0
; CHECK-AVX512-NEXT:
    vmovdqa %ymm0, (%rdx)
; CHECK-AVX512-NEXT:  vmovdqa %ymm1, 32(%rdx)
; CHECK-AVX512-NEXT:  vzeroupper
; CHECK-AVX512-NEXT:  retq
;
; CHECK-VBMI-LABEL: mul256:
; CHECK-VBMI:        # %bb.0:
; CHECK-VBMI-NEXT:  vmovdqa (%rdi), %ymm0
; CHECK-VBMI-NEXT:  vmovdqa 32(%rdi), %ymm1
; CHECK-VBMI-NEXT:  vmovdqa (%rsi), %ymm2
; CHECK-VBMI-NEXT:  vmovdqa 32(%rsi), %ymm3
; CHECK-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm4 =
ymm3[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm5 =
ymm1[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-VBMI-NEXT:  vpmullw %ymm4, %ymm5, %ymm4
; CHECK-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm3 =
ymm3[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm1 =
ymm1[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
;
    CHECK-VBMI-NEXT:  vpmullw %ymm3, %ymm1, %ymm1
; CHECK-VBMI-NEXT:  vmovdqa {{.*#+}} ymm3 =
[0,2,4,6,8,10,12,14,32,34,36,38,40,42,44,46,16,18,20,22,24,26,28,30,48,50,52,54,56,58,60,62]
; CHECK-VBMI-NEXT:  vpermt2b %ymm4, %ymm3, %ymm1
; CHECK-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm4 =
ymm2[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-VBMI-NEXT:  vpunpckhbw {{.*#+}} ymm5 =
ymm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-VBMI-NEXT:  vpmullw %ymm4, %ymm5, %ymm4
; CHECK-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm2 =
ymm2[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-VBMI-NEXT:  vpunpcklbw {{.*#+}} ymm0 =
ymm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-VBMI-NEXT:  vpmullw %ymm2, %ymm0, %ymm0
; CHECK-VBMI-NEXT:  vpermt2b %ymm4, %ymm3, %ymm0
; CHECK-VBMI-NEXT:  vmovdqa %ymm0, (%rdx)
;
    CHECK-VBMI-NEXT:  vmovdqa %ymm1, 32(%rdx)
; CHECK-VBMI-NEXT:  vzeroupper
; CHECK-VBMI-NEXT:  retq

```

```

%d = load <64 x i8>, <64 x i8>* %a
%e = load <64 x i8>, <64 x i8>* %b
%f = mul <64 x i8> %d, %e
store <64 x i8> %f, <64 x i8>* %c
ret void
}

```

```

define dso_local void @mul512(<64 x i8>* %a, <64 x i8>* %b, <64 x i8>* %c) "min-legal-vector-width"="512" {
; CHECK-SKX-VBMI-LABEL: mul512:
; CHECK-SKX-VBMI:      # %bb.0:
; CHECK-SKX-VBMI-NEXT:  vmovdqa64 (%rdi), %zmm0
; CHECK-SKX-VBMI-NEXT:  vmovdqa64 (%rsi), %zmm1
; CHECK-SKX-VBMI-NEXT:  vpunpckhbw {{.*#+}} zmm2 =
zmm1[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31,40,40,41,41,4
2,42,43,43,44,44,45,45,46,46,47,47,56,56,57,57,58,58,59,59,60,60,61,61,62,62,63,63]
; CHECK-SKX-VBMI-NEXT:  vpunpckhbw {{.*#+}} zmm3 =
zmm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31,40,40,41,41,4
2,42,43,43,44,44,45,45,46,46,47,47,56,56,57,57,58,58,59,59,60,60,61,61,62,62,63,63]
;
; CHECK-SKX-VBMI-NEXT:  vpmullw %zmm2, %zmm3, %zmm2
; CHECK-SKX-VBMI-NEXT:  vpunpcklbw {{.*#+}} zmm1 =
zmm1[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23,32,32,33,33,34,34,35,35,36,3
6,37,37,38,38,39,39,48,48,49,49,50,50,51,51,52,52,53,53,54,54,55,55]
; CHECK-SKX-VBMI-NEXT:  vpunpcklbw {{.*#+}} zmm0 =
zmm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23,32,32,33,33,34,34,35,35,36,3
6,37,37,38,38,39,39,48,48,49,49,50,50,51,51,52,52,53,53,54,54,55,55]
; CHECK-SKX-VBMI-NEXT:  vpmullw %zmm1, %zmm0, %zmm0
; CHECK-SKX-VBMI-NEXT:  vmovdqa64 {{.*#+}} zmm1 =
[0,2,4,6,8,10,12,14,64,66,68,70,72,74,76,78,16,18,20,22,24,26,28,30,80,82,84,86,88,90,92,94,32,34,36,38,40,42,44,
46,96,98,100,102,104,106,108,110,48,50,52,54,56,58,60,62,112,114,116,118,120,122,124,126]
; CHECK-SKX-VBMI-NEXT:  vpermi2b %zmm2, %zmm0, %zmm1
; CHECK-SKX-VBMI-NEXT:  vmovdqa64 %zmm1, (%rdx)
; CHECK-SKX-VBMI-NEXT:  vzeroupper
;
; CHECK-SKX-VBMI-NEXT:  retq
;
; CHECK-AVX512-LABEL: mul512:
; CHECK-AVX512:      # %bb.0:
; CHECK-AVX512-NEXT:  vmovdqa64 (%rdi), %zmm0
; CHECK-AVX512-NEXT:  vmovdqa64 (%rsi), %zmm1
; CHECK-AVX512-NEXT:  vpunpckhbw {{.*#+}} zmm2 =
zmm1[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31,40,40,41,41,4
2,42,43,43,44,44,45,45,46,46,47,47,56,56,57,57,58,58,59,59,60,60,61,61,62,62,63,63]
; CHECK-AVX512-NEXT:  vpunpckhbw {{.*#+}} zmm3 =
zmm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31,40,40,41,41,4
2,42,43,43,44,44,45,45,46,46,47,47,56,56,57,57,58,58,59,59,60,60,61,61,62,62,63,63]
; CHECK-AVX512-NEXT:  vpmullw %zmm2, %zmm3, %zmm2
; CHECK-AVX512-NEXT:  vpbroadcastw {{.*#+}} zmm3 =

```





```
ret void
}
```

; This threw an assertion at one point.

```
define <4 x i32> @mload_v4i32(<4 x i32> %trigger, <4 x i32>* %addr, <4 x i32> %dst) "min-legal-vector-
width"="256" {
; CHECK-LABEL: mload_v4i32:
; CHECK:      # %bb.0:
; CHECK-NEXT: vptestnmd %xmm0, %xmm0, %k1
; CHECK-NEXT: vpblendmd (%rdi), %xmm1, %xmm0 {%k1}
; CHECK-NEXT: retq
%mask = icmp eq <4 x i32> %trigger, zeroinitializer
%res = call <4 x i32> @llvm.masked.load.v4i32.p0v4i32(<4 x i32>* %addr, i32 4, <4 x i1> %mask, <4 x i32>
%dst)
ret <4 x i32> %res
}
declare <4 x i32>
@llvm.masked.load.v4i32.p0v4i32(<4 x i32>*, i32, <4 x i1>, <4 x i32>)
```

```
define <16 x i32> @trunc_v16i64_v16i32(<16 x i64>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v16i64_v16i32:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT: vmovdqa 64(%rdi), %ymm2
; CHECK-NEXT: vmovdqa 96(%rdi), %ymm3
; CHECK-NEXT: vpmovqd %ymm0, %xmm0
; CHECK-NEXT: vpmovqd %ymm1, %xmm1
; CHECK-NEXT: vinserti128 $1, %xmm1, %ymm0, %ymm0
; CHECK-NEXT: vpmovqd %ymm2, %xmm1
; CHECK-NEXT: vpmovqd %ymm3, %xmm2
; CHECK-NEXT: vinserti128 $1, %xmm2, %ymm1, %ymm1
; CHECK-NEXT: retq
%a = load <16 x i64>, <16 x i64>* %x
%b = trunc <16 x i64> %a to <16 x i32>
ret <16 x i32> %b
}
```

```
define <16 x i8> @trunc_v16i64_v16i8(<16 x i64>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v16i64_v16i8:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rdi),
%ymm1
; CHECK-NEXT: vmovdqa 64(%rdi), %ymm2
; CHECK-NEXT: vmovdqa 96(%rdi), %ymm3
; CHECK-NEXT: vpmovqb %ymm3, %xmm3
; CHECK-NEXT: vpmovqb %ymm2, %xmm2
```

```

; CHECK-NEXT: vpunpckldq {{.*#+}} xmm2 = xmm2[0],xmm3[0],xmm2[1],xmm3[1]
; CHECK-NEXT: vpmovqb %ymm1, %xmm1
; CHECK-NEXT: vpmovqb %ymm0, %xmm0
; CHECK-NEXT: vpunpckldq {{.*#+}} xmm0 = xmm0[0],xmm1[0],xmm0[1],xmm1[1]
; CHECK-NEXT: vpunpckldq {{.*#+}} xmm0 = xmm0[0],xmm2[0]
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = load <16 x i64>, <16 x i64>* %x
%b = trunc <16 x i64> %a to <16 x i8>
ret <16 x i8> %b
}

```

```

define <16 x i8> @trunc_v16i32_v16i8(<16 x i32>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v16i32_v16i8:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT: vpmovdb %ymm1, %xmm1
; CHECK-NEXT: vpmovdb %ymm0, %xmm0
; CHECK-NEXT: vpunpckldq {{.*#+}} xmm0 = xmm0[0],xmm1[0]
; CHECK-NEXT: vzeroupper
;
CHECK-NEXT: retq
%a = load <16 x i32>, <16 x i32>* %x
%b = trunc <16 x i32> %a to <16 x i8>
ret <16 x i8> %b
}

```

```

define <8 x i8> @trunc_v8i64_v8i8(<8 x i64>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v8i64_v8i8:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rdi), %ymm1
; CHECK-NEXT: vpmovqb %ymm1, %xmm1
; CHECK-NEXT: vpmovqb %ymm0, %xmm0
; CHECK-NEXT: vpunpckldq {{.*#+}} xmm0 = xmm0[0],xmm1[0],xmm0[1],xmm1[1]
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = load <8 x i64>, <8 x i64>* %x
%b = trunc <8 x i64> %a to <8 x i8>
ret <8 x i8> %b
}

```

```

define <8 x i16> @trunc_v8i64_v8i16(<8 x i64>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v8i64_v8i16:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vmovdqa 32(%rdi), %ymm1

```

```

; CHECK-NEXT: vpmovqw %ymm1, %xmm1
; CHECK-NEXT: vpmovqw %ymm0, %xmm0
; CHECK-NEXT: vpunpcklqdq {{.*#+}} xmm0
= xmm0[0],xmm1[0]
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = load <8 x i64>, <8 x i64>* %x
%b = trunc <8 x i64> %a to <8 x i16>
ret <8 x i16> %b
}

define <8 x i32> @trunc_v8i64_v8i32_zeroes(<8 x i64>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v8i64_v8i32_zeroes:
; CHECK:      # %bb.0:
; CHECK-NEXT: vpsrlq $48, 32(%rdi), %ymm0
; CHECK-NEXT: vpsrlq $48, (%rdi), %ymm1
; CHECK-NEXT: vpackusdw %ymm0, %ymm1, %ymm0
; CHECK-NEXT: vpermq {{.*#+}} ymm0 = ymm0[0,2,1,3]
; CHECK-NEXT: retq
%a = load <8 x i64>, <8 x i64>* %x
%b = lshr <8 x i64> %a, <i64 48, i64 48, i64 48, i64 48, i64 48, i64 48, i64 48, i64 48>
%c = trunc <8 x i64> %b to <8 x i32>
ret <8 x i32> %c
}

define <16 x i16> @trunc_v16i32_v16i16_zeroes(<16 x i32>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_v16i32_v16i16_zeroes:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm1
; CHECK-NEXT: vmovdqa {{.*#+}} ymm0 = [1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31]
;
CHECK-NEXT: vpermi2w 32(%rdi), %ymm1, %ymm0
; CHECK-NEXT: retq
%a = load <16 x i32>, <16 x i32>* %x
%b = lshr <16 x i32> %a, <i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16>
%c = trunc <16 x i32> %b to <16 x i16>
ret <16 x i16> %c
}

define <32 x i8> @trunc_v32i16_v32i8_zeroes(<32 x i16>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-SKX-VBMI-LABEL: trunc_v32i16_v32i8_zeroes:
; CHECK-SKX-VBMI:      # %bb.0:
; CHECK-SKX-VBMI-NEXT: vmovdqa (%rdi), %ymm1
; CHECK-SKX-VBMI-NEXT: vmovdqa {{.*#+}} ymm0 =
[1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39,41,43,45,47,49,51,53,55,57,59,61,63]
; CHECK-SKX-VBMI-NEXT: vpermi2b 32(%rdi), %ymm1, %ymm0
; CHECK-SKX-VBMI-NEXT: retq

```

```

;
; CHECK-AVX512-LABEL: trunc_v32i16_v32i8_zeroes:
; CHECK-AVX512:    # %bb.0:
; CHECK-AVX512-NEXT:  vpsrlw $8, 32(%rdi), %ymm0
; CHECK-AVX512-NEXT:  vpsrlw $8, (%rdi),
    %ymm1
; CHECK-AVX512-NEXT:  vpackuswb %ymm0, %ymm1, %ymm0
; CHECK-AVX512-NEXT:  vpermq {{.*#+}} ymm0 = ymm0[0,2,1,3]
; CHECK-AVX512-NEXT:  retq
;
; CHECK-VBMI-LABEL: trunc_v32i16_v32i8_zeroes:
; CHECK-VBMI:    # %bb.0:
; CHECK-VBMI-NEXT:  vmovdqa (%rdi), %ymm1
; CHECK-VBMI-NEXT:  vmovdqa {{.*#+}} ymm0 =
[1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39,41,43,45,47,49,51,53,55,57,59,61,63]
; CHECK-VBMI-NEXT:  vperm2b 32(%rdi), %ymm1, %ymm0
; CHECK-VBMI-NEXT:  retq
%a = load <32 x i16>, <32 x i16>* %x
%b = lshr <32 x i16> %a, <i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8>
%c = trunc <32 x i16> %b to <32 x i8>
ret <32 x i8> %c
}

```

```

define <8 x i32> @trunc_v8i64_v8i32_sign(<8 x i64>* %x) nounwind "min-legal-vector-width"="256" {

```

```

; CHECK-LABEL: trunc_v8i64_v8i32_sign:
; CHECK:
# %bb.0:
; CHECK-NEXT:  vpsraq $48, 32(%rdi), %ymm0
; CHECK-NEXT:  vpsraq $48, (%rdi), %ymm1
; CHECK-NEXT:  vpackssdw %ymm0, %ymm1, %ymm0
; CHECK-NEXT:  vpermq {{.*#+}} ymm0 = ymm0[0,2,1,3]
; CHECK-NEXT:  retq
%a = load <8 x i64>, <8 x i64>* %x
%b = ashr <8 x i64> %a, <i64 48, i64 48, i64 48, i64 48, i64 48, i64 48, i64 48, i64 48>
%c = trunc <8 x i64> %b to <8 x i32>
ret <8 x i32> %c
}

```

```

define <16 x i16> @trunc_v16i32_v16i16_sign(<16 x i32>* %x) nounwind "min-legal-vector-width"="256" {

```

```

; CHECK-LABEL: trunc_v16i32_v16i16_sign:
; CHECK:    # %bb.0:
; CHECK-NEXT:  vmovdqa (%rdi), %ymm1
; CHECK-NEXT:  vmovdqa {{.*#+}} ymm0 = [1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31]
; CHECK-NEXT:  vperm2w 32(%rdi), %ymm1, %ymm0
; CHECK-NEXT:  retq
%a = load <16 x i32>, <16 x i32>* %x
%b = ashr <16 x i32> %a, <i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16, i32 16>

```

```
16, i32 16, i32 16, i32 16, i32 16>
%c = trunc <16 x i32> %b to <16
x i16>
ret <16 x i16> %c
}
```

```

define <32 x i8> @trunc_v32i16_v32i8_sign(<32 x i16>* %x) nounwind "min-legal-vector-width"="256" {
; CHECK-SKX-VBMI-LABEL: trunc_v32i16_v32i8_sign:
; CHECK-SKX-VBMI:      # %bb.0:
; CHECK-SKX-VBMI-NEXT:  vmovdqa (%rdi), %ymm1
; CHECK-SKX-VBMI-NEXT:  vmovdqa {{.*#+}} ymm0 =
[1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39,41,43,45,47,49,51,53,55,57,59,61,63]
; CHECK-SKX-VBMI-NEXT:  vperm2b 32(%rdi), %ymm1, %ymm0
; CHECK-SKX-VBMI-NEXT:  retq
;
; CHECK-AVX512-LABEL: trunc_v32i16_v32i8_sign:
; CHECK-AVX512:      # %bb.0:
; CHECK-AVX512-NEXT:  vpsrlw $8, 32(%rdi), %ymm0
; CHECK-AVX512-NEXT:  vpsrlw $8, (%rdi), %ymm1
; CHECK-AVX512-NEXT:  vpackuswb %ymm0, %ymm1, %ymm0
; CHECK-AVX512-NEXT:  vpermq {{.*#+}} ymm0 = ymm0[0,2,1,3]
; CHECK-AVX512-NEXT:  retq
;
; CHECK-VBMI-LABEL: trunc_v32i16_v32i8_sign:
; CHECK-VBMI:      # %bb.0:
; CHECK-VBMI-NEXT:  vmovdqa (%rdi), %ymm1
; CHECK-VBMI-NEXT:  vmovdqa {{.*#+}} ymm0 =
[1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39,41,43,45,47,49,51,53,55,57,59,61,63]
;
CHECK-VBMI-NEXT:  vperm2b 32(%rdi), %ymm1, %ymm0
; CHECK-VBMI-NEXT:  retq
%a = load <32 x i16>, <32 x i16>* %x
%b = ashr <32 x i16> %a, <i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8, i16 8>
%c = trunc <32 x i16> %b to <32 x i8>
ret <32 x i8> %c
}

```

```
define dso_local void @zext_v16i8_v16i64(<16 x i8> %x, <16 x i64>* %y) nounwind "min-legal-vector-
width"="256" {
; CHECK-LABEL: zext_v16i8_v16i64:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpmovzxbw {{.*#+}} ymm1 =
xmm0[0],zero,xmm0[1],zero,xmm0[2],zero,xmm0[3],zero,xmm0[4],zero,xmm0[5],zero,xmm0[6],zero,xmm0[7],zer
o,xmm0[8],zero,xmm0[9],zero,xmm0[10],zero,xmm0[11],zero,xmm0[12],zero,xmm0[13],zero,xmm0[14],zero,xm
m0[15],zero
; CHECK-NEXT:  vpshufd {{.*#+}} xmm2 = xmm1[2,3,2,3]
; CHECK-NEXT:
```

```

    vpmovzxwq {{.*#+}} ymm2 =
xmm2[0],zero,zero,zero,xmm2[1],zero,zero,zero,xmm2[2],zero,zero,zero,xmm2[3],zero,zero,zero
; CHECK-NEXT:    vextracti128 $1, %ymm1, %xmm1
; CHECK-NEXT:    vpshufd {{.*#+}} xmm3 = xmm1[2,3,2,3]
; CHECK-NEXT:    vpmovzxwq {{.*#+}} ymm3 =
xmm3[0],zero,zero,zero,xmm3[1],zero,zero,zero,xmm3[2],zero,zero,zero,xmm3[3],zero,zero,zero
; CHECK-NEXT:    vpmovzxwq {{.*#+}} ymm1 =
xmm1[0],zero,zero,zero,xmm1[1],zero,zero,zero,xmm1[2],zero,zero,zero,xmm1[3],zero,zero,zero
; CHECK-NEXT:    vpmovzxbq {{.*#+}} ymm0 =
xmm0[0],zero,zero,zero,zero,zero,zero,zero,xmm0[1],zero,zero,zero,zero,zero,zero,zero,xmm0[2],zero,zero,zero,zer
o,zero,zero,zero,xmm0[3],zero,zero,zero,zero,zero,zero,zero
; CHECK-NEXT:    vmovdqa %ymm0, (%rdi)
; CHECK-NEXT:    vmovdqa %ymm1, 64(%rdi)
; CHECK-NEXT:    vmovdqa %ymm3, 96(%rdi)
; CHECK-NEXT:    vmovdqa %ymm2, 32(%rdi)
; CHECK-NEXT:    vzeroupper
; CHECK-NEXT:    retq
%a = zext <16 x i8> %x to <16 x i64>
store <16 x i64> %a, <16 x i64>*
%y
ret void
}

```

```

define dso_local void @sext_v16i8_v16i64(<16 x i8> %x, <16 x i64>* %y) nounwind "min-legal-vector-
width"="256" {
; CHECK-LABEL: sext_v16i8_v16i64:
; CHECK:      # %bb.0:
; CHECK-NEXT: vpmovsxbw %xmm0, %ymm1
; CHECK-NEXT: vpshufd {{.*#+}} xmm2 = xmm1[2,3,2,3]
; CHECK-NEXT: vpmovswwq %xmm2, %ymm2
; CHECK-NEXT: vextracti128 $1, %ymm1, %xmm1
; CHECK-NEXT: vpshufd {{.*#+}} xmm3 = xmm1[2,3,2,3]
; CHECK-NEXT: vpmovswwq %xmm3, %ymm3
; CHECK-NEXT: vpmovswwq %xmm1, %ymm1
; CHECK-NEXT: vpmovsxbq %xmm0, %ymm0
; CHECK-NEXT: vmovdqa %ymm0, (%rdi)
; CHECK-NEXT: vmovdqa %ymm1, 64(%rdi)
; CHECK-NEXT: vmovdqa %ymm3, 96(%rdi)
; CHECK-NEXT: vmovdqa %ymm2, 32(%rdi)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = sext <16 x i8> %x to <16 x i64>
store <16 x i64> %a, <16 x i64>* %y
ret void
}

```

```

define dso_local void @vselect_split_v8i16_setcc(<8 x i16> %s, <8 x i16> %t, <8 x i64>* %p, <8 x i64>* %q, <8
x i64>* %r) "min-legal-vector-width"="256"

```

```

{
; CHECK-LABEL: vselect_split_v8i16_setcc:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rsi), %ymm2
; CHECK-NEXT: vmovdqa 32(%rsi), %ymm3
; CHECK-NEXT: vpcmpeqw %xmm1, %xmm0, %k1
; CHECK-NEXT: kshiftrb $4, %k1, %k2
; CHECK-NEXT: vmovdqa64 32(%rdi), %ymm3 {%k2}
; CHECK-NEXT: vmovdqa64 (%rdi), %ymm2 {%k1}
; CHECK-NEXT: vmovdqa %ymm2, (%rdx)
; CHECK-NEXT: vmovdqa %ymm3, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <8 x i64>, <8 x i64>* %p
%y = load <8 x i64>, <8 x i64>* %q
%a = icmp eq <8 x i16> %s, %t
%b = select <8 x i1> %a, <8 x i64> %x, <8 x i64> %y
store <8 x i64> %b, <8 x i64>* %r
ret void
}

```

```

define dso_local void @vselect_split_v8i32_setcc(<8 x i32> %s, <8 x i32> %t, <8 x i64>* %p, <8 x i64>* %q, <8
x i64>* %r) "min-legal-vector-width"="256" {
; CHECK-LABEL: vselect_split_v8i32_setcc:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rsi), %ymm2
; CHECK-NEXT: vmovdqa 32(%rsi), %ymm3
; CHECK-NEXT: vpcmpeqd %ymm1,
%ymm0, %k1
; CHECK-NEXT: kshiftrb $4, %k1, %k2
; CHECK-NEXT: vmovdqa64 32(%rdi), %ymm3 {%k2}
; CHECK-NEXT: vmovdqa64 (%rdi), %ymm2 {%k1}
; CHECK-NEXT: vmovdqa %ymm2, (%rdx)
; CHECK-NEXT: vmovdqa %ymm3, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <8 x i64>, <8 x i64>* %p
%y = load <8 x i64>, <8 x i64>* %q
%a = icmp eq <8 x i32> %s, %t
%b = select <8 x i1> %a, <8 x i64> %x, <8 x i64> %y
store <8 x i64> %b, <8 x i64>* %r
ret void
}

```

```

define dso_local void @vselect_split_v16i8_setcc(<16 x i8> %s, <16 x i8> %t, <16 x i32>* %p, <16 x i32>* %q,
<16 x i32>* %r) "min-legal-vector-width"="256" {
; CHECK-LABEL: vselect_split_v16i8_setcc:
; CHECK:      # %bb.0:

```

```

; CHECK-NEXT: vmovdqa (%rsi), %ymm2
; CHECK-NEXT: vmovdqa 32(%rsi), %ymm3
; CHECK-NEXT: vpcmpeqb %xmm1, %xmm0, %k1
; CHECK-NEXT: kshiftrw $8, %k1, %k2
; CHECK-NEXT: vmovdqa32 32(%rdi), %ymm3 {%k2}
; CHECK-NEXT: vmovdqa32 (%rdi), %ymm2 {%k1}
; CHECK-NEXT: vmovdqa %ymm2,
(%rdx)
; CHECK-NEXT: vmovdqa %ymm3, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <16 x i32>, <16 x i32>* %p
%y = load <16 x i32>, <16 x i32>* %q
%a = icmp eq <16 x i8> %s, %t
%b = select <16 x i1> %a, <16 x i32> %x, <16 x i32> %y
store <16 x i32> %b, <16 x i32>* %r
ret void
}

```

```

define dso_local void @vselect_split_v16i16_setcc(<16 x i16> %s, <16 x i16> %t, <16 x i32>* %p, <16 x i32>*
%q, <16 x i32>* %r) "min-legal-vector-width"="256" {
; CHECK-LABEL: vselect_split_v16i16_setcc:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rsi), %ymm2
; CHECK-NEXT: vmovdqa 32(%rsi), %ymm3
; CHECK-NEXT: vpcmpeqw %ymm1, %ymm0, %k1
; CHECK-NEXT: kshiftrw $8, %k1, %k2
; CHECK-NEXT: vmovdqa32 32(%rdi), %ymm3 {%k2}
; CHECK-NEXT: vmovdqa32 (%rdi), %ymm2 {%k1}
; CHECK-NEXT: vmovdqa %ymm2, (%rdx)
; CHECK-NEXT: vmovdqa %ymm3, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <16 x i32>, <16 x i32>* %p
%y = load <16 x i32>,
<16 x i32>* %q
%a = icmp eq <16 x i16> %s, %t
%b = select <16 x i1> %a, <16 x i32> %x, <16 x i32> %y
store <16 x i32> %b, <16 x i32>* %r
ret void
}

```

```

define <16 x i8> @trunc_packus_v16i32_v16i8(<16 x i32>* %p) "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_packus_v16i32_v16i8:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vpackusdw 32(%rdi), %ymm0, %ymm0
; CHECK-NEXT: vpermq { {.*,#+} } ymm0 = ymm0[0,2,1,3]

```



```

; CHECK-NEXT: vpmovuswb %ymm0, %xmm0
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = load <16 x i32>, <16 x i32>* %p
%b = icmp slt <16 x i32> %a, <i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255>
%c = select <16 x i1> %b, <16 x i32> %a, <16 x i32> <i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255>
%d = icmp sgt <16 x i32> %c, zeroinitializer
%e = select <16 x i1> %d, <16 x i32> %c, <16 x i32> zeroinitializer
%f = trunc <16 x i32> %e to <16 x i8>
ret <16 x i8> %f
}

```

```

define dso_local void @trunc_packus_v16i32_v16i8_store(<16 x i32>* %p, <16 x i8>* %q) "min-legal-vector-width"="256" {
; CHECK-LABEL: trunc_packus_v16i32_v16i8_store:
; CHECK:      # %bb.0:
; CHECK-NEXT: vmovdqa (%rdi), %ymm0
; CHECK-NEXT: vpackusdw 32(%rdi), %ymm0, %ymm0
; CHECK-NEXT: vpermq { {. *#+} } ymm0 = ymm0[0,2,1,3]
; CHECK-NEXT: vpmovuswb %ymm0, (%rsi)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%a = load <16 x i32>, <16 x i32>* %p
%b = icmp slt <16 x i32> %a, <i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255>
%c = select <16 x i1> %b, <16 x i32> %a, <16 x i32> <i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255, i32 255>
%d = icmp sgt <16 x i32> %c, zeroinitializer
%e = select <16 x i1> %d, <16 x i32> %c, <16 x i32> zeroinitializer
%f = trunc <16 x i32> %e to <16 x i8>
store <16 x i8> %f, <16 x i8>* %q
ret void
}

```

```

define <64 x i1> @v64i1_argument_return(<64 x i1> %x) "min-legal-vector-width"="256" {
; CHECK-LABEL: v64i1_argument_return:
; CHECK:      # %bb.0:
; CHECK-NEXT: retq
ret <64 x i1> %x
}

```

```

define dso_local void @v64i1_shuffle(<64 x i8>* %x, <64 x i8>* %y) "min-legal-vector-width"="256" {
; CHECK-LABEL: v64i1_shuffle:
; CHECK:      # %bb.0: # %entry
; CHECK-NEXT: vmovdqa (%rdi), %ymm1

```

```

; CHECK-NEXT: vmovdqa 32(%rdi), %ymm0
; CHECK-NEXT: vptestnmb %ymm1, %ymm1, %k0
; CHECK-NEXT: kshiftrd $1, %k0, %k1
; CHECK-NEXT: kshiftrlq $63, %k0, %k2
; CHECK-NEXT: kshiftrq $62, %k2, %k2
; CHECK-NEXT: kshiftrlq $63, %k1, %k1
; CHECK-NEXT: kshiftrq $63, %k1, %k1
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-5, %rax
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1,
%k1
; CHECK-NEXT: kshiftrd $3, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $61, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-9, %rax
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $2, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $60, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-17, %rax
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $5, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $59, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-33, %rax
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $4, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $58, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-65, %rax
; CHECK-NEXT: kmovq %rax, %k2
;
CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $7, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $57, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-129, %rax
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1

```

```

; CHECK-NEXT: kshiftrd $6, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $56, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-257, %rax # imm = 0xFEFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $9, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $55, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-513, %rax # imm = 0xFDFD
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $8, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $54, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
;
CHECK-NEXT: movq $-1025, %rax # imm = 0xFBFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $11, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $53, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-2049, %rax # imm = 0xF7FF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $10, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $52, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-4097, %rax # imm = 0xEFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $13, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $51, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-8193, %rax # imm = 0xDFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $12, %k0, %k2
; CHECK-NEXT:
    kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $50, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1

```

```

; CHECK-NEXT:  movq $-16385, %rax # imm = 0xBFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $15, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $49, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-32769, %rax # imm = 0xFFFF7FFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $14, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $48, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-65537, %rax # imm = 0xFFFFFFFFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $17, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $47, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-131073, %rax # imm = 0xFFFFDFFF
;
CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $16, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $46, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-262145, %rax # imm = 0xFFFFBFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $19, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $45, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-524289, %rax # imm = 0xFFF7FFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $18, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2
; CHECK-NEXT:  kshiftrq $44, %k2, %k2
; CHECK-NEXT:  korq %k2, %k1, %k1
; CHECK-NEXT:  movq $-1048577, %rax # imm = 0xFFEFFFFF
; CHECK-NEXT:  kmovq %rax, %k2
; CHECK-NEXT:  kandq %k2, %k1, %k1
; CHECK-NEXT:  kshiftrd $21, %k0, %k2
; CHECK-NEXT:  kshiftrlq $63, %k2, %k2

```

```

; CHECK-NEXT:
    kshiftrq $43, %k2, %k2
; CHECK-NEXT:    korq %k2, %k1, %k1
; CHECK-NEXT:    movq $-2097153, %rax # imm = 0xFFDFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k1, %k1
; CHECK-NEXT:    kshiftrd $20, %k0, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $42, %k2, %k2
; CHECK-NEXT:    korq %k2, %k1, %k1
; CHECK-NEXT:    movq $-4194305, %rax # imm = 0xFFBFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k1, %k1
; CHECK-NEXT:    kshiftrd $23, %k0, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $41, %k2, %k2
; CHECK-NEXT:    korq %k2, %k1, %k1
; CHECK-NEXT:    movq $-8388609, %rax # imm = 0xFF7FFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k1, %k1
; CHECK-NEXT:    kshiftrd $22, %k0, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $40, %k2, %k2
; CHECK-NEXT:    korq %k2, %k1, %k1
; CHECK-NEXT:    movq $-16777217, %rax # imm = 0xFEFFFFFF
; CHECK-NEXT:    kmovq
    %rax, %k2
; CHECK-NEXT:    kandq %k2, %k1, %k1
; CHECK-NEXT:    kshiftrd $25, %k0, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $39, %k2, %k2
; CHECK-NEXT:    korq %k2, %k1, %k1
; CHECK-NEXT:    movq $-33554433, %rax # imm = 0xFDFFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k1, %k1
; CHECK-NEXT:    kshiftrd $24, %k0, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $38, %k2, %k2
; CHECK-NEXT:    korq %k2, %k1, %k1
; CHECK-NEXT:    movq $-67108865, %rax # imm = 0xFBFFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k1, %k1
; CHECK-NEXT:    kshiftrd $27, %k0, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $37, %k2, %k2
; CHECK-NEXT:    korq %k2, %k1, %k1
; CHECK-NEXT:    movq $-134217729, %rax # imm = 0xF7FFFFFF
; CHECK-NEXT:    kmovq %rax, %k2

```

```

; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $26, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq
$36, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-268435457, %rax # imm = 0xFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $29, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $35, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-536870913, %rax # imm = 0xDFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $28, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $34, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movq $-1073741825, %rax # imm = 0xBFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k1
; CHECK-NEXT: kshiftrd $31, %k0, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $33, %k2, %k2
; CHECK-NEXT: korq %k2, %k1, %k1
; CHECK-NEXT: movabsq $-2147483649, %rax # imm = 0xFFFFFFFF7FFFFFFF
; CHECK-NEXT:
kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k1, %k2
; CHECK-NEXT: vptestnmb %ymm0, %ymm0, %k1
; CHECK-NEXT: kshiftrd $30, %k0, %k0
; CHECK-NEXT: kshiftrlq $63, %k0, %k0
; CHECK-NEXT: kshiftrq $32, %k0, %k0
; CHECK-NEXT: korq %k0, %k2, %k0
; CHECK-NEXT: movabsq $-4294967297, %rax # imm = 0xFFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $1, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $31, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-8589934593, %rax # imm = 0xFFFFFFFFDFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrlq $63, %k1, %k2
; CHECK-NEXT: kshiftrq $30, %k2, %k2

```

```

; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-17179869185, %rax # imm = 0xFFFFFFFFBFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $3, %k1, %k2
; CHECK-NEXT:
    kshiftlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $29, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-34359738369, %rax # imm = 0xFFFFFFFF7FFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $2, %k1, %k2
; CHECK-NEXT: kshiftlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $28, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-68719476737, %rax # imm = 0xFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $5, %k1, %k2
; CHECK-NEXT: kshiftlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $27, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-137438953473, %rax # imm = 0xFFFFFFFFDFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $4, %k1, %k2
; CHECK-NEXT: kshiftlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $26, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
;
CHECK-NEXT: movabsq $-274877906945, %rax # imm = 0xFFFFFFFFBFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $7, %k1, %k2
; CHECK-NEXT: kshiftlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $25, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-549755813889, %rax # imm = 0xFFFFFFFF7FFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $6, %k1, %k2
; CHECK-NEXT: kshiftlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $24, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-1099511627777, %rax # imm = 0xFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0

```

```

; CHECK-NEXT: kshiftrd $9, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $23, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-2199023255553, %rax # imm = 0xFFFFFDFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
;
CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $8, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $22, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-4398046511105, %rax # imm = 0xFFFFFBFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $11, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $21, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-8796093022209, %rax # imm = 0xFFFFF7FFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $10, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $20, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-17592186044417, %rax # imm = 0xFFFFFEFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $13, %k1, %k2
; CHECK-NEXT: kshiftrlq
$63, %k2, %k2
; CHECK-NEXT: kshiftrq $19, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-35184372088833, %rax # imm = 0xFFFFDFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $12, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $18, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-70368744177665, %rax # imm = 0xFFFFBFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $15, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $17, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0

```



```

; CHECK-NEXT: movabsq $-140737488355329, %rax # imm = 0xFFFF7FFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $14, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $16, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT:
    movabsq $-281474976710657, %rax # imm = 0xFFFEFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $17, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $15, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-562949953421313, %rax # imm = 0xFFFDFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $16, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $14, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-1125899906842625, %rax # imm = 0xFFFBFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $19, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $13, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-2251799813685249, %rax # imm = 0xFFF7FFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq
    %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $18, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $12, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-4503599627370497, %rax # imm = 0xFFEFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $21, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $11, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-9007199254740993, %rax # imm = 0xFFDFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $20, %k1, %k2

```

```

; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $10, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-18014398509481985, %rax # imm = 0xFFBFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $23, %k1, %k2
;
CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $9, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-36028797018963969, %rax # imm = 0xFF7FFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $22, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $8, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-72057594037927937, %rax # imm = 0xFEFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $25, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $7, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-144115188075855873, %rax # imm = 0xFDFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $24, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $6, %k2, %k2
; CHECK-NEXT:
korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-288230376151711745, %rax # imm = 0xFBFFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $27, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $5, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-576460752303423489, %rax # imm = 0xF7FFFFFFFFFFFFFFF
; CHECK-NEXT: kmovq %rax, %k2
; CHECK-NEXT: kandq %k2, %k0, %k0
; CHECK-NEXT: kshiftrd $26, %k1, %k2
; CHECK-NEXT: kshiftrlq $63, %k2, %k2
; CHECK-NEXT: kshiftrq $4, %k2, %k2
; CHECK-NEXT: korq %k2, %k0, %k0
; CHECK-NEXT: movabsq $-1152921504606846977, %rax # imm = 0xEEFFFFFFFFFFFFFFF

```

```

; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k0, %k0
; CHECK-NEXT:    kshiftrd $29, %k1, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $3, %k2, %k2
; CHECK-NEXT:    korq %k2, %k0, %k0
; CHECK-NEXT:    movabsq $-2305843009213693953, %rax # imm =
0xDFFFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k0, %k0
; CHECK-NEXT:    kshiftrd $28, %k1, %k2
; CHECK-NEXT:    kshiftrlq $63, %k2, %k2
; CHECK-NEXT:    kshiftrq $2, %k2, %k2
; CHECK-NEXT:    korq %k2, %k0, %k0
; CHECK-NEXT:    movabsq $-4611686018427387905, %rax # imm = 0xBFFFFFFF
; CHECK-NEXT:    kmovq %rax, %k2
; CHECK-NEXT:    kandq %k2, %k0, %k0
; CHECK-NEXT:    kshiftrd $31, %k1, %k2
; CHECK-NEXT:    kshiftrlq $62, %k2, %k2
; CHECK-NEXT:    korq %k2, %k0, %k0
; CHECK-NEXT:    kshiftrd $30, %k1, %k1
; CHECK-NEXT:    kshiftrlq $1, %k0, %k0
; CHECK-NEXT:    kshiftrq $1, %k0, %k0
; CHECK-NEXT:    kshiftrlq $63, %k1, %k1
; CHECK-NEXT:    korq %k1, %k0, %k1
; CHECK-NEXT:    vmovdqu8 %ymm1, (%rsi) {%k1}
; CHECK-NEXT:    kshiftrq $32, %k1, %k1
; CHECK-NEXT:    vmovdqu8 %ymm0, 32(%rsi) {%k1}
; CHECK-NEXT:    vzeroupper
; CHECK-NEXT:    retq
entry:
    %a = load <64 x i8>, <64 x i8>* %x
    %b = icmp eq <64 x i8> %a, zeroinitializer
    %shuf = shufflevector
    <64 x i1> %b, <64 x i1> undef, <64 x i32> <i32 1, i32 0, i32 3, i32 2, i32 5, i32 4, i32 7, i32 6, i32 9, i32 8, i32 11,
i32 10, i32 13, i32 12, i32 15, i32 14, i32 17, i32 16, i32 19, i32 18, i32 21, i32 20, i32 23, i32 22, i32 25, i32 24, i32
27, i32 26, i32 29, i32 28, i32 31, i32 30, i32 33, i32 32, i32 35, i32 34, i32 37, i32 36, i32 39, i32 38, i32 41, i32 40,
i32 43, i32 42, i32 45, i32 44, i32 47, i32 46, i32 49, i32 48, i32 51, i32 50, i32 53, i32 52, i32 55, i32 54, i32 57, i32
56, i32 59, i32 58, i32 61, i32 60, i32 63, i32 62>
    call void @llvm.masked.store.v64i8.p0v64i8(<64 x i8> %a, <64 x i8>* %y, i32 1, <64 x i1> %shuf)
    ret void
}
declare void @llvm.masked.store.v64i8.p0v64i8(<64 x i8>, <64 x i8>*, i32, <64 x i1>)

@mem64_dst = dso_local global i64 0, align 8
@mem64_src = dso_local global i64 0, align 8
define dso_local i32 @v64i1_inline_asm() "min-legal-vector-width"="256" {
; CHECK-LABEL: v64i1_inline_asm:

```

```

; CHECK:      # %bb.0:
; CHECK-NEXT:  kmovq mem64_src(%rip),
               %k0
; CHECK-NEXT:  #APP
; CHECK-NEXT:  #NO_APP
; CHECK-NEXT:  kmovq %k0, mem64_dst(%rip)
; CHECK-NEXT:  movl -{[0-9]+}}(%rsp), %eax
; CHECK-NEXT:  retq
%1 = alloca i32, align 4
%2 = load i64, i64* @mem64_src, align 8
%3 = call i64 @asm "", "=k,k,~{dirflag},~{fpsr},~{flags}"(i64 %2)
store i64 %3, i64* @mem64_dst, align 8
%4 = load i32, i32* %1, align 4
ret i32 %4
}

```

```

define dso_local void @cmp_v8i64_sext(<8 x i64>* %xptr, <8 x i64>* %yptr, <8 x i64>* %zptr) "min-legal-
vector-width"="256" {

```

```

; CHECK-LABEL: cmp_v8i64_sext:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vmovdqa (%rsi), %ymm0
; CHECK-NEXT:  vmovdqa 32(%rsi), %ymm1
; CHECK-NEXT:  vpcmpgtq 32(%rdi), %ymm1, %ymm1
; CHECK-NEXT:  vpcmpgtq (%rdi), %ymm0, %ymm0
; CHECK-NEXT:  vmovdqa %ymm0, (%rdx)
; CHECK-NEXT:  vmovdqa %ymm1, 32(%rdx)
; CHECK-NEXT:  vzeroupper
; CHECK-NEXT:  retq
%x = load <8 x i64>, <8 x i64>* %xptr
%y = load <8 x i64>, <8 x i64>* %yptr
%cmp = icmp slt <8 x i64> %x, %y
%ext
= sext <8 x i1> %cmp to <8 x i64>
store <8 x i64> %ext, <8 x i64>* %zptr
ret void
}

```

```

define dso_local void @cmp_v8i64_zext(<8 x i64>* %xptr, <8 x i64>* %yptr, <8 x i64>* %zptr) "min-legal-
vector-width"="256" {

```

```

; CHECK-LABEL: cmp_v8i64_zext:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vmovdqa (%rsi), %ymm0
; CHECK-NEXT:  vmovdqa 32(%rsi), %ymm1
; CHECK-NEXT:  vpcmpgtq 32(%rdi), %ymm1, %ymm1
; CHECK-NEXT:  vpcmpgtq (%rdi), %ymm0, %ymm0
; CHECK-NEXT:  vpsrlq $63, %ymm1, %ymm1
; CHECK-NEXT:  vpsrlq $63, %ymm0, %ymm0
; CHECK-NEXT:  vmovdqa %ymm0, (%rdx)

```

```

; CHECK-NEXT: vmovdqa %ymm1, 32(%rdx)
; CHECK-NEXT: vzeroupper
; CHECK-NEXT: retq
%x = load <8 x i64>, <8 x i64>* %xptra
%y = load <8 x i64>, <8 x i64>* %yptra
%cmp = icmp slt <8 x i64> %x, %y
%ext = zext <8 x i1> %cmp to <8 x i64>
store <8 x i64> %ext, <8 x i64>* %zptr
ret void
}

define <16 x i8> @var_rotate_v16i8(<16 x i8> %a, <16 x i8> %b) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: var_rotate_v16i8:
;
CHECK:    # %bb.0:
; CHECK-NEXT: vpandd {{\.?LCPI[0-9]+_[0-9]+}}(%rip){1to4}, %xmm1, %xmm1
; CHECK-NEXT: vpxor %xmm2, %xmm2, %xmm2
; CHECK-NEXT: vpunpckhbw {{\.*#+}} %xmm2 =
xmm1[8],xmm2[8],xmm1[9],xmm2[9],xmm1[10],xmm2[10],xmm1[11],xmm2[11],xmm1[12],xmm2[12],xmm1[13],
xmm2[13],xmm1[14],xmm2[14],xmm1[15],xmm2[15]
; CHECK-NEXT: vpunpckhbw {{\.*#+}} %xmm3 = xmm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15]
; CHECK-NEXT: vpsllvw %xmm2, %xmm3, %xmm2
; CHECK-NEXT: vpsrlw $8, %xmm2, %xmm2
; CHECK-NEXT: vpunpcklbw {{\.*#+}} %xmm0 = xmm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7]
; CHECK-NEXT: vpmovzxbw {{\.*#+}} %xmm1 =
xmm1[0],zero,xmm1[1],zero,xmm1[2],zero,xmm1[3],zero,xmm1[4],zero,xmm1[5],zero,xmm1[6],zero,xmm1[7],zero
; CHECK-NEXT: vpsllvw %xmm1, %xmm0, %xmm0
; CHECK-NEXT: vpsrlw $8, %xmm0, %xmm0
; CHECK-NEXT: vpackuswb %xmm2, %xmm0, %xmm0
; CHECK-NEXT: retq
%b8 = sub <16 x i8> <i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8, i8 8>, %b
%shl = shl <16 x i8> %a, %b8
%lshr = lshr <16 x i8> %a, %b8
%or = or <16 x i8> %shl, %lshr
ret <16 x i8> %or
}

define <32 x i8> @var_rotate_v32i8(<32 x i8> %a, <32 x i8> %b) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: var_rotate_v32i8:
; CHECK:    # %bb.0:
; CHECK-NEXT: vpandd {{\.?LCPI[0-9]+_[0-9]+}}(%rip){1to8}, %ymm1, %ymm1
; CHECK-NEXT: vpxor %ymm2, %ymm2, %ymm2
; CHECK-NEXT: vpunpckhbw {{\.*#+}} %ymm3 =
ymm1[8],ymm2[8],ymm1[9],ymm2[9],ymm1[10],ymm2[10],ymm1[11],ymm2[11],ymm1[12],ymm2[12],ymm1[13],ymm2[13],ymm1[14],ymm2[14],ymm1[15],ymm2[15],ymm1[16],ymm2[16],ymm1[17],ymm2[17],ymm1[18],ymm2[18],ymm1[19],ymm2[19],ymm1[20],ymm2[20],ymm1[21],ymm2[21],ymm1[22],ymm2[22],ymm1[23],ymm2[23],ymm1[24],ymm2[24],ymm1[25],ymm2[25],ymm1[26],ymm2[26],ymm1[27],ymm2[27],ymm1[28],ymm2[28],ymm1[29],ymm2[29],ymm1[30],ymm2[30],ymm1[31],ymm2[31],ymm1[32],ymm2[32]

```

[illegible]

```

define <32 x i8> @constant_rotate_v32i8(<32 x i8> %a) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: constant_rotate_v32i8:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpunpckhbw {{.*#+}} ymm1 =
ymm0[8,8,9,9,10,10,11,11,12,12,13,13,14,14,15,15,24,24,25,25,26,26,27,27,28,28,29,29,30,30,31,31]
; CHECK-NEXT:  vpsllvw {{\.?LCPI[0-9]+\_[0-9]+\}}(%rip), %ymm1, %ymm1
; CHECK-NEXT:  vpsrlw $8, %ymm1, %ymm1
; CHECK-NEXT:  vpunpcklbw {{.*#+}} ymm0 =
ymm0[0,0,1,1,2,2,3,3,4,4,5,5,6,6,7,7,16,16,17,17,18,18,19,19,20,20,21,21,22,22,23,23]
; CHECK-NEXT:  vpsllvw {{\.?LCPI[0-9]+\_[0-9]+\}}(%rip), %ymm0, %ymm0
; CHECK-NEXT:  vpsrlw $8, %ymm0, %ymm0
; CHECK-NEXT:  vpackuswb %ymm1, %ymm0, %ymm0
; CHECK-NEXT:  retq
%shl = shl <32 x i8> %a, <i8 0, i8 1, i8 2, i8 3, i8 4, i8 5, i8 6, i8 7, i8 8, i8 7, i8 6, i8 5, i8 4, i8 3, i8 2, i8 1, i8 0, i8
1, i8 2, i8 3, i8 4, i8 5, i8 6, i8 7, i8
8, i8 7, i8 6, i8 5, i8 4, i8 3, i8 2, i8 1>
%lshr = lshr <32 x i8> %a, <i8 8, i8 7, i8 6, i8 5, i8 4, i8 3, i8 2, i8 1, i8 0, i8 1, i8 2, i8 3, i8 4, i8 5, i8 6, i8 7, i8 8,
i8 7, i8 6, i8 5, i8 4, i8 3, i8 2, i8 1, i8 0, i8 1, i8 2, i8 3, i8 4, i8 5, i8 6, i8 7>
%or = or <32 x i8> %shl, %lshr
ret <32 x i8> %or
}

```

```

define <32 x i8> @splatconstant_rotate_v32i8(<32 x i8> %a) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: splatconstant_rotate_v32i8:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpsllw $4, %ymm0, %ymm1
; CHECK-NEXT:  vpsrlw $4, %ymm0, %ymm0
; CHECK-NEXT:  vpternlogd $216, {{\.?LCPI[0-9]+\_[0-9]+\}}(%rip){1to8}, %ymm1, %ymm0
; CHECK-NEXT:  retq
%shl = shl <32 x i8> %a, <i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8
4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4>
%lshr = lshr <32 x i8> %a, <i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8
4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4>
%or = or <32 x i8> %shl, %lshr
ret <32 x i8> %or
}

```

```

define <32 x i8> @splatconstant_rotate_mask_v32i8(<32 x i8> %a) nounwind "min-legal-vector-width"="256" {
; CHECK-LABEL: splatconstant_rotate_mask_v32i8:
; CHECK:      # %bb.0:
; CHECK-NEXT:  vpsllw $4, %ymm0, %ymm1
; CHECK-NEXT:  vpsrlw $4, %ymm0, %ymm0
; CHECK-NEXT:  vpternlogd $216, {{\.?LCPI[0-9]+\_[0-9]+\}}(%rip){1to8}, %ymm1, %ymm0
; CHECK-NEXT:  vpandd {{\.?LCPI[0-9]+\_[0-9]+\}}(%rip){1to8}, %ymm0, %ymm0
; CHECK-NEXT:  retq
%shl = shl <32 x i8> %a, <i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8
4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4, i8 4>

```

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```
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64I
; RUN: llc -mtriple=riscv64 -mattr=+zbs -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64ZBS
```

## Open Source Used In Debug-container elpaso 3048



```

; RV64I-LABEL: bclr_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclr_i32:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  andi a1, a1, 31
; RV64ZBS-NEXT:  bclr a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%and = and i32 %b, 31
%shl = shl nuw i32 1, %and
%neg = xor i32 %shl, -1
%and1 = and i32 %neg, %a
ret i32 %and1
}

```

```

define signext i32 @bclr_i32_no_mask(i32 signext %a,
i32 signext %b) nounwind {

```

```

; RV64I-LABEL: bclr_i32_no_mask:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclr_i32_no_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bclr a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%shl = shl i32 1, %b
%neg = xor i32 %shl, -1
%and1 = and i32 %neg, %a
ret i32 %and1
}

```

```

define signext i32 @bclr_i32_load(ptr %p, i32 signext %b) nounwind {

```

```

; RV64I-LABEL: bclr_i32_load:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1

```

```

; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclr_i32_load:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  lw a0, 0(a0)
; RV64ZBS-NEXT:  bclr a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%a = load i32, ptr %p
%shl = shl i32 1, %b
%neg
= xor i32 %shl, -1
%and1 = and i32 %neg, %a
ret i32 %and1
}

```

```

define i64 @bclr_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: bclr_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sll a1, a2, a1
; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclr_i64:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bclr a0, a0, a1
; RV64ZBS-NEXT:  ret
%and = and i64 %b, 63
%shl = shl nuw i64 1, %and
%neg = xor i64 %shl, -1
%and1 = and i64 %neg, %a
ret i64 %and1
}

```

```

define i64 @bclr_i64_no_mask(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: bclr_i64_no_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sll a1, a2, a1
; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclr_i64_no_mask:

```

```

; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bclr a0, a0, a1
; RV64ZBS-NEXT:  ret
%shl = shl i64 1, %b
%neg = xor i64 %shl, -1
%and1 = and i64 %neg, %a
ret i64
%and1
}

```

```

define signext i32 @bset_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: bset_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bset_i32:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  andi a1, a1, 31
; RV64ZBS-NEXT:  bset a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%and = and i32 %b, 31
%shl = shl nuw i32 1, %and
%or = or i32 %shl, %a
ret i32 %or
}

```

```

define signext i32 @bset_i32_no_mask(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: bset_i32_no_mask:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bset_i32_no_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bset a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%shl = shl i32 1, %b
%or = or i32 %shl, %a
ret i32 %or
}

```

```

define signext i32
@bset_i32_load(ptr %p, i32 signext %b) nounwind {
; RV64I-LABEL: bset_i32_load:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bset_i32_load:
; RV64ZBS:     # %bb.0:
; RV64ZBS-NEXT: lw a0, 0(a0)
; RV64ZBS-NEXT: bset a0, a0, a1
; RV64ZBS-NEXT: sext.w a0, a0
; RV64ZBS-NEXT: ret
%a = load i32, ptr %p
%shl = shl i32 1, %b
%or = or i32 %shl, %a
ret i32 %or
}

```

; We can use bsetw for  $1 \ll x$  by setting the first source to zero.

```

define signext i32 @bset_i32_zero(i32 signext %a) nounwind {
; RV64I-LABEL: bset_i32_zero:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  sllw a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bset_i32_zero:
; RV64ZBS:     # %bb.0:
; RV64ZBS-NEXT: bset a0, zero, a0
; RV64ZBS-NEXT: sext.w a0, a0
; RV64ZBS-NEXT: ret
%shl = shl i32 1, %a
ret i32 %shl
}

```

```

define i64 @bset_i64(i64 %a,
i64 %b) nounwind {
; RV64I-LABEL: bset_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sll a1, a2, a1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;

```

```

; RV64ZBS-LABEL: bset_i64:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bset a0, a0, a1
; RV64ZBS-NEXT:  ret
%conv = and i64 %b, 63
%shl = shl nuw i64 1, %conv
%or = or i64 %shl, %a
ret i64 %or
}

```

```

define i64 @bset_i64_no_mask(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: bset_i64_no_mask:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sll a1, a2, a1
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bset_i64_no_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bset a0, a0, a1
; RV64ZBS-NEXT:  ret
%shl = shl i64 1, %b
%or = or i64 %shl, %a
ret i64 %or
}

```

; We can use bsetw for  $1 \ll x$  by setting the first source to zero.

```

define signext i64 @bset_i64_zero(i64 signext %a) nounwind {
; RV64I-LABEL: bset_i64_zero:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li
a1, 1
; RV64I-NEXT:  sll a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bset_i64_zero:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bset a0, zero, a0
; RV64ZBS-NEXT:  ret
%shl = shl i64 1, %a
ret i64 %shl
}

```

```

define signext i32 @binv_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: binv_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 1

```

```

; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  xor a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binv_i32:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  andi a1, a1, 31
; RV64ZBS-NEXT:  binv a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%and = and i32 %b, 31
%shl = shl nuw i32 1, %and
%xor = xor i32 %shl, %a
ret i32 %xor
}

define signext i32 @binv_i32_no_mask(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: binv_i32_no_mask:
; RV64I:        # %bb.0:
; RV64I-NEXT:   li a2, 1
; RV64I-NEXT:   sllw a1, a2, a1
; RV64I-NEXT:   xor a0, a1, a0
; RV64I-NEXT:   ret
;
; RV64ZBS-LABEL: binv_i32_no_mask:
;
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  binv a0, a0, a1
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%shl = shl i32 1, %b
%xor = xor i32 %shl, %a
ret i32 %xor
}

define signext i32 @binv_i32_load(ptr %p, i32 signext %b) nounwind {
; RV64I-LABEL: binv_i32_load:
; RV64I:        # %bb.0:
; RV64I-NEXT:   lw a0, 0(a0)
; RV64I-NEXT:   li a2, 1
; RV64I-NEXT:   sllw a1, a2, a1
; RV64I-NEXT:   xor a0, a1, a0
; RV64I-NEXT:   ret
;
; RV64ZBS-LABEL: binv_i32_load:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  lw a0, 0(a0)
; RV64ZBS-NEXT:  binv a0, a0, a1

```

```

; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%a = load i32, ptr %p
%shl = shl i32 1, %b
%xor = xor i32 %shl, %a
ret i32 %xor
}

define i64 @binv_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: binv_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sll a1, a2, a1
; RV64I-NEXT:  xor a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binv_i64:
; RV64ZBS:    # %bb.0:
;
RV64ZBS-NEXT:  binv a0, a0, a1
; RV64ZBS-NEXT:  ret
%conv = and i64 %b, 63
%shl = shl nuw i64 1, %conv
%xor = xor i64 %shl, %a
ret i64 %xor
}

define i64 @binv_i64_no_mask(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: binv_i64_no_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  sll a1, a2, a1
; RV64I-NEXT:  xor a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binv_i64_no_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  binv a0, a0, a1
; RV64ZBS-NEXT:  ret
%shl = shl nuw i64 1, %b
%xor = xor i64 %shl, %a
ret i64 %xor
}

define signext i32 @bext_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: bext_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a0, a0, a1

```

```

; RV64I-NEXT:  andi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bext_i32:
; RV64ZBS:     # %bb.0:
; RV64ZBS-NEXT:  andi a1, a1, 31
; RV64ZBS-NEXT:  bext a0, a0, a1
; RV64ZBS-NEXT:  ret
%and = and i32 %b, 31
%shr = lshr i32 %a, %and
%and1 = and i32
%shr, 1
ret i32 %and1
}

define signext i32 @bext_i32_no_mask(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: bext_i32_no_mask:
; RV64I:        # %bb.0:
; RV64I-NEXT:   srlw a0, a0, a1
; RV64I-NEXT:   andi a0, a0, 1
; RV64I-NEXT:   ret
;
; RV64ZBS-LABEL: bext_i32_no_mask:
; RV64ZBS:     # %bb.0:
; RV64ZBS-NEXT:  bext a0, a0, a1
; RV64ZBS-NEXT:  ret
%shr = lshr i32 %a, %b
%and1 = and i32 %shr, 1
ret i32 %and1
}

; This gets previous converted to (i1 (truncate (srl X, Y))). Make sure we are
; able to use bext.
define void @bext_i32_trunc(i32 signext %0, i32 signext %1) {
; RV64I-LABEL: bext_i32_trunc:
; RV64I:        # %bb.0:
; RV64I-NEXT:   srlw a0, a0, a1
; RV64I-NEXT:   andi a0, a0, 1
; RV64I-NEXT:   beqz a0, .LBB19_2
; RV64I-NEXT:   # %bb.1:
; RV64I-NEXT:   ret
; RV64I-NEXT:   .LBB19_2:
; RV64I-NEXT:   tail bar
;
; RV64ZBS-LABEL: bext_i32_trunc:
; RV64ZBS:     # %bb.0:
; RV64ZBS-NEXT:  bext a0, a0, a1
; RV64ZBS-NEXT:  beqz a0, .LBB19_2

```



```

; RV64ZBS-NEXT:
    # %bb.1:
; RV64ZBS-NEXT:  ret
; RV64ZBS-NEXT: .LBB19_2:
; RV64ZBS-NEXT:  tail bar
    %3 = shl i32 1, %1
    %4 = and i32 %3, %0
    %5 = icmp eq i32 %4, 0
    br i1 %5, label %6, label %7

6:                                     ; preds = %2
    tail call void @bar()
    br label %7

7:                                     ; preds = %6, %2
    ret void
}

declare void @bar()

define i64 @bext_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: bext_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srl a0, a0, a1
; RV64I-NEXT:  andi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bext_i64:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bext a0, a0, a1
; RV64ZBS-NEXT:  ret
    %conv = and i64 %b, 63
    %shr = lshr i64 %a, %conv
    %and1 = and i64 %shr, 1
    ret i64 %and1
}

define i64 @bext_i64_no_mask(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: bext_i64_no_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srl a0, a0, a1
; RV64I-NEXT:  andi a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL:
    bext_i64_no_mask:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bext a0, a0, a1

```

```

; RV64ZBS-NEXT:  ret
%shr = lshr i64 %a, %b
%and1 = and i64 %shr, 1
ret i64 %and1
}

define signext i32 @bexti_i32(i32 signext %a) nounwind {
; RV64I-LABEL: bexti_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 58
; RV64I-NEXT:  srli a0, a0, 63
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bexti_i32:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bexti a0, a0, 5
; RV64ZBS-NEXT:  ret
%shr = lshr i32 %a, 5
%and = and i32 %shr, 1
ret i32 %and
}

define i64 @bexti_i64(i64 %a) nounwind {
; RV64I-LABEL: bexti_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 58
; RV64I-NEXT:  srli a0, a0, 63
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bexti_i64:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bexti a0, a0, 5
; RV64ZBS-NEXT:  ret
%shr = lshr i64 %a, 5
%and = and i64 %shr, 1
ret i64 %and
}

define signext i32 @bexti_i32_cmp(i32 signext %a) nounwind {
; CHECK-LABEL: bexti_i32_cmp:
;
CHECK:      # %bb.0:
; CHECK-NEXT:  andi a0, a0, 32
; CHECK-NEXT:  snez a0, a0
; CHECK-NEXT:  ret
%and = and i32 %a, 32
%cmp = icmp ne i32 %and, 0
%zext = zext i1 %cmp to i32

```

```

ret i32 %zext
}

define i64 @bexti_i64_cmp(i64 %a) nounwind {
; RV64I-LABEL: bexti_i64_cmp:
; RV64I:      # %bb.0:
; RV64I-NEXT: slli a0, a0, 58
; RV64I-NEXT: srli a0, a0, 63
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bexti_i64_cmp:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bexti a0, a0, 5
; RV64ZBS-NEXT: ret
%and = and i64 %a, 32
%cmp = icmp ne i64 %and, 0
%zext = zext i1 %cmp to i64
ret i64 %zext
}

define signext i32 @bclri_i32_10(i32 signext %a) nounwind {
; CHECK-LABEL: bclri_i32_10:
; CHECK:      # %bb.0:
; CHECK-NEXT: andi a0, a0, -1025
; CHECK-NEXT: ret
%and = and i32 %a, -1025
ret i32 %and
}

define signext i32 @bclri_i32_11(i32 signext %a) nounwind {
; RV64I-LABEL: bclri_i32_11:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a1, 1048575
; RV64I-NEXT: addiw a1,
a1, 2047
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bclri_i32_11:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bclri a0, a0, 11
; RV64ZBS-NEXT: ret
%and = and i32 %a, -2049
ret i32 %and
}

define signext i32 @bclri_i32_30(i32 signext %a) nounwind {
; RV64I-LABEL: bclri_i32_30:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 786432
; RV64I-NEXT:  addiw a1, a1, -1
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i32_30:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 30
; RV64ZBS-NEXT:  ret
%and = and i32 %a, -1073741825
ret i32 %and
}

```

```

define signext i32 @bclri_i32_31(i32 signext %a) nounwind {
; RV64I-LABEL: bclri_i32_31:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 33
; RV64I-NEXT:  srli a0, a0, 33
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i32_31:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 31
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%and = and i32 %a,
-2147483649
ret i32 %and
}

```

```

define i64 @bclri_i64_10(i64 %a) nounwind {
; CHECK-LABEL: bclri_i64_10:
; CHECK:    # %bb.0:
; CHECK-NEXT:  andi a0, a0, -1025
; CHECK-NEXT:  ret
%and = and i64 %a, -1025
ret i64 %and
}

```

```

define i64 @bclri_i64_11(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_11:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 1048575
; RV64I-NEXT:  addiw a1, a1, 2047
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
;

```

```
; RV64ZBS-LABEL: bclri_i64_11:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 11
; RV64ZBS-NEXT:  ret
%and = and i64 %a, -2049
ret i64 %and
}
```

```
define i64 @bclri_i64_30(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_30:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 786432
; RV64I-NEXT:  addiw a1, a1, -1
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i64_30:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 30
; RV64ZBS-NEXT:  ret
%and = and i64 %a, -1073741825
ret i64 %and
}
```

```
define
i64 @bclri_i64_31(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_31:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 524288
; RV64I-NEXT:  addi a1, a1, -1
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i64_31:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 31
; RV64ZBS-NEXT:  ret
%and = and i64 %a, -2147483649
ret i64 %and
}
```

```
define i64 @bclri_i64_62(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_62:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  slli a1, a1, 62
; RV64I-NEXT:  addi a1, a1, -1
; RV64I-NEXT:  and a0, a0, a1
```

```

; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i64_62:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 62
; RV64ZBS-NEXT:  ret
%and = and i64 %a, -4611686018427387905
ret i64 %and
}

```

```

define i64 @bclri_i64_63(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_63:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 1
; RV64I-NEXT:  srli a0, a0, 1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL:
bclri_i64_63:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 63
; RV64ZBS-NEXT:  ret
%and = and i64 %a, -9223372036854775809
ret i64 %and
}

```

```

define i64 @bclri_i64_large0(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_large0:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 1044480
; RV64I-NEXT:  addiw a1, a1, -256
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i64_large0:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  andi a0, a0, -256
; RV64ZBS-NEXT:  bclri a0, a0, 24
; RV64ZBS-NEXT:  ret
%and = and i64 %a, -16777472
ret i64 %and
}

```

```

define i64 @bclri_i64_large1(i64 %a) nounwind {
; RV64I-LABEL: bclri_i64_large1:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 1044464
; RV64I-NEXT:  addiw a1, a1, -1

```

```

; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bclri_i64_large1:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bclri a0, a0, 16
; RV64ZBS-NEXT:  bclri a0, a0, 24
; RV64ZBS-NEXT:  ret
%and = and i64 %a,
-16842753
ret i64 %and
}

```

```

define signext i32 @bseti_i32_10(i32 signext %a) nounwind {
; CHECK-LABEL: bseti_i32_10:
; CHECK:      # %bb.0:
; CHECK-NEXT:  ori a0, a0, 1024
; CHECK-NEXT:  ret
%or = or i32 %a, 1024
ret i32 %or
}

```

```

define signext i32 @bseti_i32_11(i32 signext %a) nounwind {
; RV64I-LABEL: bseti_i32_11:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  slliw a1, a1, 11
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i32_11:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 11
; RV64ZBS-NEXT:  ret
%or = or i32 %a, 2048
ret i32 %or
}

```

```

define signext i32 @bseti_i32_30(i32 signext %a) nounwind {
; RV64I-LABEL: bseti_i32_30:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 262144
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i32_30:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 30

```

```

; RV64ZBS-NEXT:  ret
%or = or i32 %a, 1073741824
ret i32 %or
}

define signext i32
@bseti_i32_31(i32 signext %a) nounwind {
; RV64I-LABEL: bseti_i32_31:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 524288
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i32_31:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 31
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%or = or i32 %a, 2147483648
ret i32 %or
}

define i64 @bseti_i64_10(i64 %a) nounwind {
; CHECK-LABEL: bseti_i64_10:
; CHECK:      # %bb.0:
; CHECK-NEXT:  ori a0, a0, 1024
; CHECK-NEXT:  ret
%or = or i64 %a, 1024
ret i64 %or
}

define i64 @bseti_i64_11(i64 %a) nounwind {
; RV64I-LABEL: bseti_i64_11:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  slli a1, a1, 11
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i64_11:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 11
; RV64ZBS-NEXT:  ret
%or = or i64 %a, 2048
ret i64 %or
}

define i64 @bseti_i64_30(i64 %a) nounwind {

```



```

; RV64I-LABEL: bseti_i64_30:
;
RV64I:    # %bb.0:
; RV64I-NEXT: lui a1, 262144
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bseti_i64_30:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bseti a0, a0, 30
; RV64ZBS-NEXT: ret
%or = or i64 %a, 1073741824
ret i64 %or
}

define i64 @bseti_i64_31(i64 %a) nounwind {
; RV64I-LABEL: bseti_i64_31:
; RV64I:    # %bb.0:
; RV64I-NEXT: li a1, 1
; RV64I-NEXT: slli a1, a1, 31
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bseti_i64_31:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bseti a0, a0, 31
; RV64ZBS-NEXT: ret
%or = or i64 %a, 2147483648
ret i64 %or
}

define i64 @bseti_i64_62(i64 %a) nounwind {
; RV64I-LABEL: bseti_i64_62:
; RV64I:    # %bb.0:
; RV64I-NEXT: li a1, 1
; RV64I-NEXT: slli a1, a1, 62
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: bseti_i64_62:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bseti a0, a0, 62
; RV64ZBS-NEXT: ret
%or = or i64 %a,
4611686018427387904
ret i64 %or
}

```

```

define i64 @bseti_i64_63(i64 %a) nounwind {
; RV64I-LABEL: bseti_i64_63:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  slli a1, a1, 63
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bseti_i64_63:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bseti a0, a0, 63
; RV64ZBS-NEXT:  ret
%or = or i64 %a, 9223372036854775808
ret i64 %or
}

```

```

define signext i32 @binvi_i32_10(i32 signext %a) nounwind {
; CHECK-LABEL: binvi_i32_10:
; CHECK:      # %bb.0:
; CHECK-NEXT:  xori a0, a0, 1024
; CHECK-NEXT:  ret
%xor = xor i32 %a, 1024
ret i32 %xor
}

```

```

define signext i32 @binvi_i32_11(i32 signext %a) nounwind {
; RV64I-LABEL: binvi_i32_11:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  slliw a1, a1, 11
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binvi_i32_11:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  binvi a0, a0, 11
; RV64ZBS-NEXT:  ret
%xor = xor i32 %a,
2048
ret i32 %xor
}

```

```

define signext i32 @binvi_i32_30(i32 signext %a) nounwind {
; RV64I-LABEL: binvi_i32_30:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 262144
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret

```

```

;
; RV64ZBS-LABEL: binvi_i32_30:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  binvi a0, a0, 30
; RV64ZBS-NEXT:  ret
%xor = xor i32 %a, 1073741824
ret i32 %xor
}

```

```

define signext i32 @binvi_i32_31(i32 signext %a) nounwind {
; RV64I-LABEL: binvi_i32_31:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 524288
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binvi_i32_31:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  binvi a0, a0, 31
; RV64ZBS-NEXT:  sext.w a0, a0
; RV64ZBS-NEXT:  ret
%xor = xor i32 %a, 2147483648
ret i32 %xor
}

```

```

define i64 @binvi_i64_10(i64 %a) nounwind {
; CHECK-LABEL: binvi_i64_10:
; CHECK:    # %bb.0:
; CHECK-NEXT:  xori a0, a0, 1024
; CHECK-NEXT:  ret
%xor = xor i64 %a, 1024
ret i64 %xor
}

```

```

define i64 @binvi_i64_11(i64
%a) nounwind {
; RV64I-LABEL: binvi_i64_11:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  slli a1, a1, 11
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: binvi_i64_11:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT:  binvi a0, a0, 11
; RV64ZBS-NEXT:  ret
%xor = xor i64 %a, 2048

```

```

ret i64 %xor
}

define i64 @binvi_i64_30(i64 %a) nounwind {
; RV64I-LABEL: binvi_i64_30:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a1, 262144
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: binvi_i64_30:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: binvi a0, a0, 30
; RV64ZBS-NEXT: ret
%xor = xor i64 %a, 1073741824
ret i64 %xor
}

```

```

define i64 @binvi_i64_31(i64 %a) nounwind {
; RV64I-LABEL: binvi_i64_31:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a1, 1
; RV64I-NEXT: slli a1, a1, 31
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: binvi_i64_31:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: binvi
a0, a0, 31
; RV64ZBS-NEXT: ret
%xor = xor i64 %a, 2147483648
ret i64 %xor
}

```

```

define i64 @binvi_i64_62(i64 %a) nounwind {
; RV64I-LABEL: binvi_i64_62:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a1, 1
; RV64I-NEXT: slli a1, a1, 62
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: binvi_i64_62:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: binvi a0, a0, 62
; RV64ZBS-NEXT: ret
%xor = xor i64 %a, 4611686018427387904

```

```

ret i64 %xor
}

define i64 @binvi_i64_63(i64 %a) nounwind {
; RV64I-LABEL: binvi_i64_63:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a1, -1
; RV64I-NEXT: slli a1, a1, 63
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: binvi_i64_63:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: binvi a0, a0, 63
; RV64ZBS-NEXT: ret
%xor = xor i64 %a, 9223372036854775808
ret i64 %xor
}

define i64 @xor_i64_large(i64 %a) nounwind {
; RV64I-LABEL: xor_i64_large:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a1, 1
; RV64I-NEXT: slli
a1, a1, 32
; RV64I-NEXT: addi a1, a1, 1
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: xor_i64_large:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: binvi a0, a0, 0
; RV64ZBS-NEXT: binvi a0, a0, 32
; RV64ZBS-NEXT: ret
%xor = xor i64 %a, 4294967297
ret i64 %xor
}

define i64 @xor_i64_4099(i64 %a) nounwind {
; RV64I-LABEL: xor_i64_4099:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a1, 1
; RV64I-NEXT: addiw a1, a1, 3
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: xor_i64_4099:
; RV64ZBS:    # %bb.0:

```

```
; RV64ZBS-NEXT: xori a0, a0, 3
; RV64ZBS-NEXT: binvi a0, a0, 12
; RV64ZBS-NEXT: ret
%xor = xor i64 %a, 4099
ret i64 %xor
}
```

```
define i64 @xor_i64_96(i64 %a) nounwind {
; CHECK-LABEL: xor_i64_96:
; CHECK:      # %bb.0:
; CHECK-NEXT: xori a0, a0, 96
; CHECK-NEXT: ret
%xor = xor i64 %a, 96
ret i64 %xor
}
```

```
define i64 @or_i64_large(i64 %a) nounwind {
; RV64I-LABEL: or_i64_large:
; RV64I:      # %bb.0:
; RV64I-NEXT:
    li a1, 1
; RV64I-NEXT: slli a1, a1, 32
; RV64I-NEXT: addi a1, a1, 1
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: or_i64_large:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: bseti a0, a0, 0
; RV64ZBS-NEXT: bseti a0, a0, 32
; RV64ZBS-NEXT: ret
%or = or i64 %a, 4294967297
ret i64 %or
}
```

```
define i64 @xor_i64_66901(i64 %a) nounwind {
; RV64I-LABEL: xor_i64_66901:
; RV64I:      # %bb.0:
; RV64I-NEXT: lui a1, 16
; RV64I-NEXT: addiw a1, a1, 1365
; RV64I-NEXT: xor a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBS-LABEL: xor_i64_66901:
; RV64ZBS:    # %bb.0:
; RV64ZBS-NEXT: xori a0, a0, 1365
; RV64ZBS-NEXT: binvi a0, a0, 16
; RV64ZBS-NEXT: ret
}
```

```

%xor = xor i64 %a, 66901
ret i64 %xor
}

define i64 @or_i64_4099(i64 %a) nounwind {
; RV64I-LABEL: or_i64_4099:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 1
; RV64I-NEXT:  addiw a1, a1, 3
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: or_i64_4099:
; RV64ZBS:
;   # %bb.0:
; RV64ZBS-NEXT:  ori a0, a0, 3
; RV64ZBS-NEXT:  bseti a0, a0, 12
; RV64ZBS-NEXT:  ret
%or = or i64 %a, 4099
ret i64 %or
}

define i64 @or_i64_96(i64 %a) nounwind {
; CHECK-LABEL: or_i64_96:
; CHECK:      # %bb.0:
; CHECK-NEXT:  ori a0, a0, 96
; CHECK-NEXT:  ret
%or = or i64 %a, 96
ret i64 %or
}

define i64 @or_i64_66901(i64 %a) nounwind {
; RV64I-LABEL: or_i64_66901:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a1, 16
; RV64I-NEXT:  addiw a1, a1, 1365
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: or_i64_66901:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  ori a0, a0, 1365
; RV64ZBS-NEXT:  bseti a0, a0, 16
; RV64ZBS-NEXT:  ret
%or = or i64 %a, 66901
ret i64 %or
}

```

```

define signext i32 @bset_trailing_ones_i32_mask(i32 signext %a) nounwind {
; RV64I-LABEL: bset_trailing_ones_i32_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  sllw a0, a1, a0
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
;
RV64ZBS-LABEL: bset_trailing_ones_i32_mask:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  andi a0, a0, 31
; RV64ZBS-NEXT:  bset a0, zero, a0
; RV64ZBS-NEXT:  addiw a0, a0, -1
; RV64ZBS-NEXT:  ret
%and = and i32 %a, 31
%shift = shl nsw i32 -1, %and
%not = xor i32 %shift, -1
ret i32 %not
}

define signext i32 @bset_trailing_ones_i32_no_mask(i32 signext %a) nounwind {
; RV64I-LABEL: bset_trailing_ones_i32_no_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  sllw a0, a1, a0
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
;
RV64ZBS-LABEL: bset_trailing_ones_i32_no_mask:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bset a0, zero, a0
; RV64ZBS-NEXT:  addiw a0, a0, -1
; RV64ZBS-NEXT:  ret
%shift = shl nsw i32 -1, %a
%not = xor i32 %shift, -1
ret i32 %not
}

define signext i64 @bset_trailing_ones_i64_mask(i64 signext %a) nounwind {
; RV64I-LABEL: bset_trailing_ones_i64_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  sll
a0, a1, a0
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
;

```



```

; RV64ZBS-LABEL: bset_trailing_ones_i64_mask:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bset a0, zero, a0
; RV64ZBS-NEXT:  addi a0, a0, -1
; RV64ZBS-NEXT:  ret
%and = and i64 %a, 63
%shift = shl nsw i64 -1, %and
%not = xor i64 %shift, -1
ret i64 %not
}

define signext i64 @bset_trailing_ones_i64_no_mask(i64 signext %a) nounwind {
; RV64I-LABEL: bset_trailing_ones_i64_no_mask:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  sll a0, a1, a0
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
; RV64ZBS-LABEL: bset_trailing_ones_i64_no_mask:
; RV64ZBS:      # %bb.0:
; RV64ZBS-NEXT:  bset a0, zero, a0
; RV64ZBS-NEXT:  addi a0, a0, -1
; RV64ZBS-NEXT:  ret
%shift = shl nsw i64 -1, %a
%not = xor i64 %shift, -1
ret i64 %not
}

```

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```
; RUN: opt -passes=consthoist -S -o - %s | FileCheck %s
target datalayout = "e-m:e-p:32:32-i64:64-v128:64:128-a:0:32-n32-S64"
target triple = "thumbv6m-none--musleabi"
```

```
; Check that for i8 type, the maximum legal offset is 31.
; Also check that an constant used as value to be stored rather than
; pointer in a store instruction is hoisted.
; CHECK: foo_i8
; CHECK-DAG: %[[C1:const[0-9]?]] = bitcast i32 805874720 to i32
; CHECK-DAG: %[[C2:const[0-9]?]] = bitcast i32 805874688 to i32
; CHECK-DAG: %[[C3:const[0-9]?]] = bitcast i32 805873720 to i32
; CHECK-DAG: %[[C4:const[0-9]?]] = bitcast i32 805873688 to i32
; CHECK: %0 = inttoptr i32 %[[C2]] to ptr
; CHECK-NEXT: %1 = load volatile i8, ptr %0
; CHECK-NEXT: %[[M1:const_mat[0-9]?]] = add i32 %[[C2]], 4
; CHECK-NEXT: %2 = inttoptr i32 %[[M1]] to ptr
; CHECK-NEXT: %3 = load volatile i8, ptr %2
; CHECK-NEXT: %[[M2:const_mat[0-9]?]] = add i32 %[[C2]], 31
; CHECK-NEXT: %4 = inttoptr i32 %[[M2]] to ptr
; CHECK-NEXT: %5 = load volatile
i8, ptr %4
; CHECK-NEXT: %6 = inttoptr i32 %[[C1]] to ptr
; CHECK-NEXT: %7 = load volatile i8, ptr %6
; CHECK-NEXT: %[[M3:const_mat[0-9]?]] = add i32 %[[C1]], 7
; CHECK-NEXT: %8 = inttoptr i32 %[[M3]] to ptr
; CHECK-NEXT: %9 = load volatile i8, ptr %8
; CHECK-NEXT: %10 = inttoptr i32 %[[C4]] to ptr
; CHECK-NEXT: store i8 %9, ptr %10
; CHECK-NEXT: %[[M4:const_mat[0-9]?]] = add i32 %[[C4]], 31
; CHECK-NEXT: %11 = inttoptr i32 %[[M4]] to ptr
; CHECK-NEXT: store i8 %7, ptr %11
; CHECK-NEXT: %12 = inttoptr i32 %[[C3]] to ptr
; CHECK-NEXT: store i8 %5, ptr %12
```

```
; CHECK-NEXT: %[[M5:const_mat[0-9]?]] = add i32 %[[C3]], 7
; CHECK-NEXT: %13 = inttoptr i32 %[[M5]] to ptr
; CHECK-NEXT: store i8 %3, ptr %13
; CHECK-NEXT: %[[M6:const_mat[0-9]?]] = add i32 %[[C1]], 80
; CHECK-NEXT: %14 = inttoptr i32 %[[M6]] to ptr
; CHECK-NEXT: store ptr %14, ptr @goo
```

```
@goo = global ptr undef
```

```
define void @foo_i8() {
entry:
  %0 = load volatile i8, ptr inttoptr (i32 805874688 to ptr)
  %1 = load volatile
i8, ptr inttoptr (i32 805874692 to ptr)
  %2 = load volatile i8, ptr inttoptr (i32 805874719 to ptr)
  %3 = load volatile i8, ptr inttoptr (i32 805874720 to ptr)
  %4 = load volatile i8, ptr inttoptr (i32 805874727 to ptr)
  store i8 %4, ptr inttoptr(i32 805873688 to ptr)
  store i8 %3, ptr inttoptr(i32 805873719 to ptr)
  store i8 %2, ptr inttoptr(i32 805873720 to ptr)
  store i8 %1, ptr inttoptr(i32 805873727 to ptr)
  store ptr inttoptr(i32 805874800 to ptr), ptr @goo
  ret void
}
```

```
; Check that for i16 type, the maximum legal offset is 62.
; CHECK: foo_i16
; CHECK-DAG: %[[C1:const[0-9]?]] = bitcast i32 805874752 to i32
; CHECK-DAG: %[[C2:const[0-9]?]] = bitcast i32 805874688 to i32
; CHECK: %0 = inttoptr i32 %[[C2]] to ptr
; CHECK-NEXT: %1 = load volatile i16, ptr %0, align 2
; CHECK-NEXT: %[[M1:const_mat[0-9]?]] = add i32 %[[C2]], 4
; CHECK-NEXT: %2 = inttoptr i32 %[[M1]] to ptr
; CHECK-NEXT: %3 = load volatile i16, ptr %2, align 2
; CHECK-NEXT: %[[M2:const_mat[0-9]?]] = add
i32 %[[C2]], 32
; CHECK-NEXT: %4 = inttoptr i32 %[[M2]] to ptr
; CHECK-NEXT: %5 = load volatile i16, ptr %4, align 2
; CHECK-NEXT: %[[M3:const_mat[0-9]?]] = add i32 %[[C2]], 62
; CHECK-NEXT: %6 = inttoptr i32 %[[M3]] to ptr
; CHECK-NEXT: %7 = load volatile i16, ptr %6, align 2
; CHECK-NEXT: %8 = inttoptr i32 %[[C1]] to ptr
; CHECK-NEXT: %9 = load volatile i16, ptr %8, align 2
; CHECK-NEXT: %[[M4:const_mat[0-9]?]] = add i32 %[[C1]], 22
; CHECK-NEXT: %10 = inttoptr i32 %[[M4]] to ptr
; CHECK-NEXT: %11 = load volatile i16, ptr %10, align 2
```

```
define void @foo_i16() {
```

```

entry:
%0 = load volatile i16, ptr inttoptr (i32 805874688 to ptr), align 2
%1 = load volatile i16, ptr inttoptr (i32 805874692 to ptr), align 2
%2 = load volatile i16, ptr inttoptr (i32 805874720 to ptr), align 2
%3 = load volatile i16, ptr inttoptr (i32 805874750 to ptr), align 2
%4 = load volatile i16, ptr inttoptr (i32 805874752 to ptr), align 2
%5 = load volatile i16, ptr inttoptr (i32 805874774 to ptr), align
2
ret void
}

; Check that for i32 type, the maximum legal offset is 124.
; CHECK: foo_i32
; CHECK-DAG: %[[C1:const[0-9]?]] = bitcast i32 805874816 to i32
; CHECK-DAG: %[[C2:const[0-9]?]] = bitcast i32 805874688 to i32
; CHECK: %0 = inttoptr i32 %[[C2]] to ptr
; CHECK-NEXT: %1 = load volatile i32, ptr %0, align 4
; CHECK-NEXT: %[[M1:const_mat[0-9]?]] = add i32 %[[C2]], 4
; CHECK-NEXT: %2 = inttoptr i32 %[[M1]] to ptr
; CHECK-NEXT: %3 = load volatile i32, ptr %2, align 4
; CHECK-NEXT: %[[M2:const_mat[0-9]?]] = add i32 %[[C2]], 124
; CHECK-NEXT: %4 = inttoptr i32 %[[M2]] to ptr
; CHECK-NEXT: %5 = load volatile i32, ptr %4, align 4
; CHECK-NEXT: %6 = inttoptr i32 %[[C1]] to ptr
; CHECK-NEXT: %7 = load volatile i32, ptr %6, align 4
; CHECK-NEXT: %[[M3:const_mat[0-9]?]] = add i32 %[[C1]], 8
; CHECK-NEXT: %8 = inttoptr i32 %[[M3]] to ptr
; CHECK-NEXT: %9 = load volatile i32, ptr %8, align 4
; CHECK-NEXT: %[[M4:const_mat[0-9]?]] = add i32 %[[C1]], 12
; CHECK-NEXT: %10 = inttoptr
i32 %[[M4]] to ptr
; CHECK-NEXT: %11 = load volatile i32, ptr %10, align 4

define void @foo_i32() {
entry:
%0 = load volatile i32, ptr inttoptr (i32 805874688 to ptr), align 4
%1 = load volatile i32, ptr inttoptr (i32 805874692 to ptr), align 4
%2 = load volatile i32, ptr inttoptr (i32 805874812 to ptr), align 4
%3 = load volatile i32, ptr inttoptr (i32 805874816 to ptr), align 4
%4 = load volatile i32, ptr inttoptr (i32 805874824 to ptr), align 4
%5 = load volatile i32, ptr inttoptr (i32 805874828 to ptr), align 4
ret void
}

; RUN: llc -march=hexagon < %s
; REQUIRES: asserts

; The two loads based on %struct.0, loading two different data types
; cause LSR to assume type "void" for the memory type. This would then

```



; cause an assert in isLegalAddressingMode. Make sure we no longer crash.

target triple = "hexagon"

%struct.0 = type { ptr, i8, %union.anon.0 }

%union.anon.0 = type { ptr }

define hidden fastcc void @fred() unnamed\_addr #0 {

entry:

br i1 undef, label %while.end, label %while.body.lr.ph

while.body.lr.ph: ; preds = %entry

br label %while.body

while.body: ; preds = %exit.2, %while.body.lr.ph

%lsr.iv = phi ptr [ %cgep22, %exit.2 ], [ undef, %while.body.lr.ph ]

switch i32 undef, label %exit [

i32 1, label %sw.bb.i

i32 2, label %sw.bb3.i

]

sw.bb.i: ; preds = %while.body

unreachable

sw.bb3.i: ; preds = %while.body

unreachable

exit:

; preds = %while.body

switch i32 undef, label %exit.2 [

i32 1, label %sw.bb.i17

i32 2, label %sw.bb3.i20

]

sw.bb.i17: ; preds = %exit

%0 = load i32, ptr %lsr.iv, align 4

unreachable

sw.bb3.i20: ; preds = %exit

%1 = load ptr, ptr %lsr.iv, align 4

unreachable

exit.2: ; preds = %exit

%cgep22 = getelementptr %struct.0, ptr %lsr.iv, i32 1

br label %while.body

while.end: ; preds = %entry

ret void

```
}
```

```
attributes #0 = { nounwind optsize "target-cpu"="hexagonv55" }  
; NOTE: Assertions have been autogenerated by utils/update_test_checks.py UTC_ARGS: --include-generated-funcs  
; RUN: opt -S -passes=verify,iroutliner -ir-outlining-no-cost < %s | FileCheck %s  
; FIXME: Disabled run-line after running into some turbulence with debuginfo-iterators  
; run: opt -S -passes=verify,iroutliner -ir-outlining-no-cost < %s --try-experimental-debuginfo-iterators | FileCheck %s
```

```
; This test checks that debug info is recognized as able to be extracted along  
; with the other instructions, but is not included in the consolidated function.
```

```
define void @function1() !dbg !6 {  
entry:  
  %a = alloca i32, align 4, !dbg !17  
  call void @llvm.dbg.value(metadata ptr %a, metadata !9, metadata !DIExpression()), !dbg !17  
  %b = alloca i32, align 4, !dbg !18  
  call void @llvm.dbg.value(metadata ptr %b, metadata !11, metadata !DIExpression()), !dbg !18  
  %c = alloca i32, align 4, !dbg !19  
  call void @llvm.dbg.value(metadata ptr %c, metadata !12, metadata !DIExpression()), !dbg !19  
  
  store i32 2, ptr %a, align 4, !dbg !20  
  store i32 3, ptr %b, align 4, !dbg !21  
  store i32 4, ptr %c, align 4, !dbg !22  
  %al = load i32, ptr %a, align 4, !dbg !23  
  call void @llvm.dbg.value(metadata i32 %al, metadata !13, metadata !DIExpression()), !dbg !23  
  %bl = load i32, ptr %b, align 4, !dbg !24  
  call void @llvm.dbg.value(metadata i32 %bl, metadata !15, metadata !DIExpression()), !dbg !24  
  %cl = load i32, ptr %c, align 4, !dbg !25  
  call void @llvm.dbg.value(metadata i32 %cl, metadata !16, metadata !DIExpression()), !dbg !25  
  ret void, !dbg !26  
}
```

```
define void @function2() !dbg !27 {  
entry:  
  %a = alloca i32, align 4, !dbg !35  
  call void @llvm.dbg.value(metadata ptr %a, metadata !29, metadata !DIExpression()), !dbg !35  
  %b = alloca i32, align 4, !dbg !36  
  call void @llvm.dbg.value(metadata ptr %b, metadata !30, metadata !DIExpression()), !dbg !36  
  %c = alloca i32, align 4, !dbg !37  
  call void @llvm.dbg.value(metadata ptr %c, metadata !31, metadata !DIExpression()), !dbg !37  
  
  store i32 2, ptr %a, align 4, !dbg !38  
  store i32 3, ptr %b, align 4, !dbg !39  
  store i32 4, ptr %c, align 4, !dbg !40  
  %al = load i32, ptr %a, align 4, !dbg !41  
  call void @llvm.dbg.value(metadata i32 %al, metadata !32, metadata !DIExpression()), !dbg !41
```

```

%bl = load i32, ptr %b, align 4, !dbg !42
call void @llvm.dbg.value(metadata i32 %bl, metadata !33, metadata !DIExpression()), !dbg !42
%cl = load i32, ptr %c, align 4, !dbg !43
call void @llvm.dbg.value(metadata i32 %cl, metadata !34, metadata !DIExpression()), !dbg !43
ret void, !dbg !44
}

```

```

; Function Attrs: nounwind readnone speculatable willreturn
declare void @llvm.dbg.value(metadata, metadata, metadata) #0

```

```

attributes #0 = { nounwind readnone speculatable willreturn }

```

```

!llvm.dbg.cu = !{!0}
!llvm.debugify = !{!3, !4}
!llvm.module.flags = !{!5}

```

```

!0 = distinct !DICompileUnit(language: DW_LANG_C, file: !1, producer: "debugify", isOptimized: true,
runtimeVersion: 0, emissionKind: FullDebug, enums: !2)
!1 = !DIFile(filename:
"legal-debug.ll", directory: "/")
!2 = !{}
!3 = !{i32 20}
!4 = !{i32 12}
!5 = !{i32 2, !"Debug Info Version", i32 3}
!6 = distinct !DISubprogram(name: "function1", linkageName: "function1", scope: null, file: !1, line: 1, type: !7,
scopeLine: 1, spFlags: DISPFlagDefinition | DISPFlagOptimized, unit: !0, retainedNodes: !8)
!7 = !DISubroutineType(types: !2)
!8 = !{!9, !11, !12, !13, !15, !16}
!9 = !DILocalVariable(name: "1", scope: !6, file: !1, line: 1, type: !10)
!10 = !DIBasicType(name: "ty64", size: 64, encoding: DW_ATE_unsigned)
!11 = !DILocalVariable(name: "2", scope: !6, file: !1, line: 2, type: !10)
!12 = !DILocalVariable(name: "3", scope: !6, file: !1, line: 3, type: !10)
!13 = !DILocalVariable(name: "4", scope: !6, file: !1, line: 7, type: !14)
!14 = !DIBasicType(name: "ty32", size: 32, encoding: DW_ATE_unsigned)
!15 = !DILocalVariable(name: "5", scope: !6, file: !1, line: 8, type: !14)
!16 = !DILocalVariable(name: "6", scope: !6, file: !1, line: 9, type: !14)
!17
= !DILocation(line: 1, column: 1, scope: !6)
!18 = !DILocation(line: 2, column: 1, scope: !6)
!19 = !DILocation(line: 3, column: 1, scope: !6)
!20 = !DILocation(line: 4, column: 1, scope: !6)
!21 = !DILocation(line: 5, column: 1, scope: !6)
!22 = !DILocation(line: 6, column: 1, scope: !6)
!23 = !DILocation(line: 7, column: 1, scope: !6)
!24 = !DILocation(line: 8, column: 1, scope: !6)
!25 = !DILocation(line: 9, column: 1, scope: !6)
!26 = !DILocation(line: 10, column: 1, scope: !6)

```

```

!27 = distinct !DISubprogram(name: "function2", linkageName: "function2", scope: null, file: !1, line: 11, type: !7,
scopeLine: 11, spFlags: DISPFlagDefinition | DISPFlagOptimized, unit: !0, retainedNodes: !28)
!28 = !{!29, !30, !31, !32, !33, !34}
!29 = !DILocalVariable(name: "7", scope: !27, file: !1, line: 11, type: !10)
!30 = !DILocalVariable(name: "8", scope: !27, file: !1, line: 12, type: !10)
!31 = !DILocalVariable(name: "9", scope: !27, file: !1, line: 13, type: !10)
!32 = !DILocalVariable(name: "10",
scope: !27, file: !1, line: 17, type: !14)
!33 = !DILocalVariable(name: "11", scope: !27, file: !1, line: 18, type: !14)
!34 = !DILocalVariable(name: "12", scope: !27, file: !1, line: 19, type: !14)
!35 = !DILocation(line: 11, column: 1, scope: !27)
!36 = !DILocation(line: 12, column: 1, scope: !27)
!37 = !DILocation(line: 13, column: 1, scope: !27)
!38 = !DILocation(line: 14, column: 1, scope: !27)
!39 = !DILocation(line: 15, column: 1, scope: !27)
!40 = !DILocation(line: 16, column: 1, scope: !27)
!41 = !DILocation(line: 17, column: 1, scope: !27)
!42 = !DILocation(line: 18, column: 1, scope: !27)
!43 = !DILocation(line: 19, column: 1, scope: !27)
!44 = !DILocation(line: 20, column: 1, scope: !27)
; CHECK-LABEL: @function1(
; CHECK-NEXT: entry:
; CHECK-NEXT: [[A:%.*]] = alloca i32, align 4, !dbg [[DBG17:![0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[A]], metadata [[META9:![0-9]+]], metadata
!DIExpression()), !dbg [[DBG17]]
; CHECK-NEXT: [[B:%.*]] = alloca
i32, align 4, !dbg [[DBG18:![0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[B]], metadata [[META11:![0-9]+]], metadata
!DIExpression()), !dbg [[DBG18]]
; CHECK-NEXT: [[C:%.*]] = alloca i32, align 4, !dbg [[DBG19:![0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[C]], metadata [[META12:![0-9]+]], metadata
!DIExpression()), !dbg [[DBG19]]
; CHECK-NEXT: call void @outlined_ir_func_0(ptr [[A]], ptr [[B]], ptr [[C]]), !dbg [[DBG20:![0-9]+]]
; CHECK-NEXT: ret void, !dbg [[DBG21:![0-9]+]]
;
;
; CHECK-LABEL: @function2(
; CHECK-NEXT: entry:
; CHECK-NEXT: [[A:%.*]] = alloca i32, align 4, !dbg [[DBG30:![0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[A]], metadata [[META24:![0-9]+]], metadata
!DIExpression()), !dbg [[DBG30]]
; CHECK-NEXT: [[B:%.*]] = alloca i32, align 4, !dbg [[DBG31:![0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[B]], metadata [[META25:![0-9]+]], metadata
!DIExpression()), !dbg [[DBG31]]
;
CHECK-NEXT: [[C:%.*]] = alloca i32, align 4, !dbg [[DBG32:![0-9]+]]
; CHECK-NEXT: call void @llvm.dbg.value(metadata ptr [[C]], metadata [[META26:![0-9]+]], metadata
!DIExpression()), !dbg [[DBG32]]

```

```
; CHECK-NEXT: call void @outlined_ir_func_0(ptr [[A]], ptr [[B]], ptr [[C]]), !dbg [[DBG33:![0-9]+]]
; CHECK-NEXT: ret void, !dbg [[DBG34:![0-9]+]]
;
;
; CHECK: @outlined_ir_func_0(ptr [[TMP0:%.*]], ptr [[TMP1:%.*]], ptr [[TMP2:%.*]])
; CHECK: entry_to_outline:
; CHECK-NEXT: store i32 2, ptr [[TMP0]], align 4
; CHECK-NEXT: store i32 3, ptr [[TMP1]], align 4
; CHECK-NEXT: store i32 4, ptr [[TMP2]], align 4
; CHECK-NEXT: [[AL:%.*]] = load i32, ptr [[TMP0]], align 4
; CHECK-NEXT: [[BL:%.*]] = load i32, ptr [[TMP1]], align 4
; CHECK-NEXT: [[CL:%.*]] = load i32, ptr [[TMP2]], align 4
; CHECK-NEXT: br label [[ENTRY_AFTER_OUTLINE_EXITSTUB:%.*]]
;
; RUN: opt < %s -passes=argpromotion -S | FileCheck %s
```

```
; CHECK-LABEL: define i32 @foo() #0 {
; CHECK-NEXT:   %.val = load <32 x half>, ptr undef, align 4
; CHECK-NEXT:   call void @bar(<32 x half> %.val)
; CHECK-NEXT:   ret i32 0
; CHECK-NEXT: }

; CHECK-LABEL: define internal void @bar(<32 x half> %.0.val) #0 {
; CHECK-NEXT:   ret void
; CHECK-NEXT: }
```

```
; CHECK: attributes #0 = { uwtable "min-legal-vector-width"="512" }
```

```
define i32 @foo() #0 {
  call void @bar(ptr undef)
  ret i32 0
}
```

```
define internal void @bar(ptr) #0 {
  %2 = load <32 x half>, ptr %0, align 4
  ret void
}
```

```
attributes #0 = { uwtable "min-legal-vector-width"="0" }
```

```
=====
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```
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -mattr=+m -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64I
; RUN: llc -mtriple=riscv64 -mattr=+m,+zba -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-
prefixes=CHECK,RV64ZBA,RV64ZBANOZBB
; RUN: llc -mtriple=riscv64 -mattr=+m,+zba,+zbb -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64ZBA,RV64ZBAZBB
```

```
define i64 @slliuw(i64 %a) nounwind {
; RV64I-LABEL: slliuw:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 31
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: slliuw:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 1
; RV64ZBA-NEXT:  ret
%conv1 = shl i64 %a, 1
%shl = and i64 %conv1, 8589934590
ret i64 %shl
}
```

```
define i128 @slliuw_2(i32 signext %0, ptr %1) {
; RV64I-LABEL:
slliuw_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 28
; RV64I-NEXT:  add a1, a1, a0
; RV64I-NEXT:  ld a0, 0(a1)
; RV64I-NEXT:  ld a1, 8(a1)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: slliuw_2:
; RV64ZBA:      # %bb.0:
```

```

; RV64ZBA-NEXT:  slli.uw a0, a0, 4
; RV64ZBA-NEXT:  add a1, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a1)
; RV64ZBA-NEXT:  ld a1, 8(a1)
; RV64ZBA-NEXT:  ret
%3 = zext i32 %0 to i64
%4 = getelementptr inbounds i128, ptr %1, i64 %3
%5 = load i128, ptr %4
ret i128 %5
}

```

```

define i128 @slliuw_3(i32 signext %0, ptr %1) {
; RV64I-LABEL: slliuw_3:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 28
; RV64I-NEXT:  add a1, a1, a0
; RV64I-NEXT:  ld a0, 0(a1)
; RV64I-NEXT:  ld a1, 8(a1)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: slliuw_3:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  addi a0, a0, 1
; RV64ZBA-NEXT:  slli.uw a0, a0, 4
; RV64ZBA-NEXT:
    add a1, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a1)
; RV64ZBA-NEXT:  ld a1, 8(a1)
; RV64ZBA-NEXT:  ret
%add = add i32 %0, 1
%3 = zext i32 %add to i64
%4 = getelementptr inbounds i128, ptr %1, i64 %3
%5 = load i128, ptr %4
ret i128 %5
}

```

```

define i64 @adduw(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: adduw:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 32
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: adduw:
; RV64ZBA:      # %bb.0:

```

```

; RV64ZBA-NEXT:  add.uw a0, a1, a0
; RV64ZBA-NEXT:  ret
%and = and i64 %b, 4294967295
%add = add i64 %and, %a
ret i64 %add
}

define signext i8 @adduw_2(i32 signext %0, ptr %1) {
; RV64I-LABEL: adduw_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lb a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: adduw_2:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  add.uw a0, a0, a1
; RV64ZBA-NEXT:
    lb a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = zext i32 %0 to i64
%4 = getelementptr inbounds i8, ptr %1, i64 %3
%5 = load i8, ptr %4
ret i8 %5
}

define signext i8 @adduw_3(i32 signext %0, ptr %1) {
; RV64I-LABEL: adduw_3:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lb a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: adduw_3:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  addi a0, a0, 1
; RV64ZBA-NEXT:  add.uw a0, a0, a1
; RV64ZBA-NEXT:  lb a0, 0(a0)
; RV64ZBA-NEXT:  ret
%add = add i32 %0, 1
%3 = zext i32 %add to i64
%4 = getelementptr inbounds i8, ptr %1, i64 %3
%5 = load i8, ptr %4

```

```
ret i8 %5
}
```

```
define i64 @zextw_i64(i64 %a) nounwind {
; RV64I-LABEL: zextw_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: slli a0, a0, 32
; RV64I-NEXT: srli a0, a0, 32
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: zextw_i64:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:
    zext.w a0, a0
; RV64ZBA-NEXT: ret
    %and = and i64 %a, 4294967295
    ret i64 %and
}
```

; This makes sure targetShrinkDemandedConstant changes the and immediate to  
; allow zext.w or slli+srli.

```
define i64 @zextw_demandedbits_i64(i64 %0) {
; RV64I-LABEL: zextw_demandedbits_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: ori a0, a0, 1
; RV64I-NEXT: slli a0, a0, 32
; RV64I-NEXT: srli a0, a0, 32
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: zextw_demandedbits_i64:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT: ori a0, a0, 1
; RV64ZBA-NEXT: zext.w a0, a0
; RV64ZBA-NEXT: ret
    %2 = and i64 %0, 4294967294
    %3 = or i64 %2, 1
    ret i64 %3
}
```

```
define signext i16 @sh1add(i64 %0, ptr %1) {
; RV64I-LABEL: sh1add:
; RV64I:      # %bb.0:
; RV64I-NEXT: slli a0, a0, 1
; RV64I-NEXT: add a0, a1, a0
; RV64I-NEXT: lh a0, 0(a0)
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: sh1add:
```

```

; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh1add a0, a0, a1
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:
    ret
%3 = getelementptr inbounds i16, ptr %1, i64 %0
%4 = load i16, ptr %3
ret i16 %4
}

```

```

define signext i32 @sh2add(i64 %0, ptr %1) {
; RV64I-LABEL: sh2add:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 2
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh2add:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh2add a0, a0, a1
; RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = getelementptr inbounds i32, ptr %1, i64 %0
%4 = load i32, ptr %3
ret i32 %4
}

```

```

define i64 @sh3add(i64 %0, ptr %1) {
; RV64I-LABEL: sh3add:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 3
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh3add:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a1
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = getelementptr inbounds i64, ptr %1, i64 %0
%4 = load i64, ptr %3
ret i64 %4
}

```

```

define signext i16 @sh1adduw(i32

```



```

signext %0, ptr %1) {
; RV64I-LABEL: sh1adduw:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 31
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lh a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh1adduw:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh1add.uw a0, a0, a1
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = zext i32 %0 to i64
%4 = getelementptr inbounds i16, ptr %1, i64 %3
%5 = load i16, ptr %4
ret i16 %5
}

define i64 @sh1adduw_2(i64 %0, i64 %1) {
; RV64I-LABEL: sh1adduw_2:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 31
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh1adduw_2:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh1add.uw a0, a0, a1
; RV64ZBA-NEXT:  ret
%3 = shl i64 %0, 1
%4 = and i64 %3, 8589934590
%5 = add i64 %4, %1
ret i64 %5
}

define signext i32 @sh2adduw(i32 signext %0, ptr %1) {
; RV64I-LABEL: sh2adduw:
; RV64I:
;   # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 30
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;

```

```

; RV64ZBA-LABEL: sh2adduw:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add.uw a0, a0, a1
; RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = zext i32 %0 to i64
%4 = getelementptr inbounds i32, ptr %1, i64 %3
%5 = load i32, ptr %4
ret i32 %5
}

```

```

define i64 @sh2adduw_2(i64 %0, i64 %1) {
; RV64I-LABEL: sh2adduw_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 30
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh2adduw_2:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add.uw a0, a0, a1
; RV64ZBA-NEXT:  ret
%3 = shl i64 %0, 2
%4 = and i64 %3, 17179869180
%5 = add i64 %4, %1
ret i64 %5
}

```

```

define i64 @sh3adduw(i32 signext %0, ptr %1) {
; RV64I-LABEL: sh3adduw:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:
; RV64I-NEXT:  srli a0, a0, 29
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh3adduw:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add.uw a0, a0, a1
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = zext i32 %0 to i64
%4 = getelementptr inbounds i64, ptr %1, i64 %3
%5 = load i64, ptr %4
ret i64 %5

```

```
}
```

```
define i64 @sh3adduw_2(i64 %0, i64 %1) {  
; RV64I-LABEL: sh3adduw_2:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: slli a0, a0, 32  
; RV64I-NEXT: srli a0, a0, 29  
; RV64I-NEXT: add a0, a0, a1  
; RV64I-NEXT: ret  
;  
; RV64ZBA-LABEL: sh3adduw_2:  
; RV64ZBA:      # %bb.0:  
; RV64ZBA-NEXT: sh3add.uw a0, a0, a1  
; RV64ZBA-NEXT: ret  
%3 = shl i64 %0, 3  
%4 = and i64 %3, 34359738360  
%5 = add i64 %4, %1  
ret i64 %5  
}
```

; Type legalization inserts a sext\_inreg after the first add. That add will be  
; selected as sh2add which does not sign extend. SimplifyDemandedBits is unable  
; to remove the sext\_inreg because it has multiple uses.

The ashr will use the

; sext\_inreg to become sraiw. This leaves the sext\_inreg only used by the shl.

; If the shl is selected as sllw, we don't need the sext\_inreg.

```
define i64 @sh2add_extra_sext(i32 %x, i32 %y, i32 %z) {
```

```
; RV64I-LABEL: sh2add_extra_sext:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: slli a0, a0, 2  
; RV64I-NEXT: add a0, a0, a1  
; RV64I-NEXT: sllw a1, a2, a0  
; RV64I-NEXT: sraiw a0, a0, 2  
; RV64I-NEXT: mul a0, a1, a0  
; RV64I-NEXT: ret  
;  
; RV64ZBA-LABEL: sh2add_extra_sext:  
; RV64ZBA:      # %bb.0:  
; RV64ZBA-NEXT: sh2add a0, a0, a1  
; RV64ZBA-NEXT: sllw a1, a2, a0  
; RV64ZBA-NEXT: sraiw a0, a0, 2  
; RV64ZBA-NEXT: mul a0, a1, a0  
; RV64ZBA-NEXT: ret  
%a = shl i32 %x, 2  
%b = add i32 %a, %y  
%c = shl i32 %z, %b  
%d = ashr i32 %b, 2  
%e = sext i32 %c to i64
```

```

%f = sext i32 %d to i64
%g = mul i64 %e, %f
ret i64 %g
}

```

```

define i64 @addmul6(i64 %a, i64 %b) {
; RV64I-LABEL: addmul6:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 6
; RV64I-NEXT:  mul
a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul6:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  sh1add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 6
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @addmul10(i64 %a, i64 %b) {
; RV64I-LABEL: addmul10:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 10
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul10:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add a0, a0, a0
; RV64ZBA-NEXT:  sh1add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 10
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @addmul12(i64 %a, i64 %b) {
; RV64I-LABEL: addmul12:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 12
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1

```

```

; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul12:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  sh2add
a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 12
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @addmul18(i64 %a, i64 %b) {
; RV64I-LABEL: addmul18:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 18
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul18:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  sh1add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 18
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @addmul20(i64 %a, i64 %b) {
; RV64I-LABEL: addmul20:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 20
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul20:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add a0, a0, a0
; RV64ZBA-NEXT:  sh2add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 20
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @addmul24(i64 %a, i64 %b) {
; RV64I-LABEL: addmul24:
; RV64I:
;   # %bb.0:
; RV64I-NEXT:  li a2, 24
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul24:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  sh3add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 24
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @addmul36(i64 %a, i64 %b) {
; RV64I-LABEL: addmul36:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 36
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul36:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  sh2add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 36
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @addmul40(i64 %a, i64 %b) {
; RV64I-LABEL: addmul40:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a2, 40
; RV64I-NEXT:  mul a0, a0, a2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addmul40:
; RV64ZBA:    # %bb.0:

```

```

;
RV64ZBA-NEXT: sh2add a0, a0, a0
; RV64ZBA-NEXT: sh3add a0, a0, a1
; RV64ZBA-NEXT: ret
%c = mul i64 %a, 40
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @addmul72(i64 %a, i64 %b) {
; RV64I-LABEL: addmul72:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a2, 72
; RV64I-NEXT: mul a0, a0, a2
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: addmul72:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT: sh3add a0, a0, a0
; RV64ZBA-NEXT: sh3add a0, a0, a1
; RV64ZBA-NEXT: ret
%c = mul i64 %a, 72
%d = add i64 %c, %b
ret i64 %d
}

```

```

define i64 @mul96(i64 %a) {
; RV64I-LABEL: mul96:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a1, 96
; RV64I-NEXT: mul a0, a0, a1
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: mul96:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT: sh1add a0, a0, a0
; RV64ZBA-NEXT: slli a0, a0, 5
; RV64ZBA-NEXT: ret
%c = mul i64 %a, 96
ret i64 %c
}

```

```

define i64 @mul160(i64 %a) {
; RV64I-LABEL: mul160:
; RV64I:      # %bb.0:
; RV64I-NEXT:

```

```

    li a1, 160
; RV64I-NEXT:    mul a0, a0, a1
; RV64I-NEXT:    ret
;
; RV64ZBA-LABEL: mul160:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add a0, a0, a0
; RV64ZBA-NEXT:  slli a0, a0, 5
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 160
ret i64 %c
}

define i64 @mul288(i64 %a) {
; RV64I-LABEL: mul288:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 288
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul288:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  slli a0, a0, 5
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 288
ret i64 %c
}

define i64 @zext_mul96(i32 signext %a) {
; RV64I-LABEL: zext_mul96:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 3
; RV64I-NEXT:  slli a1, a1, 37
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  mulhu a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: zext_mul96:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 5
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  ret
%b = zext
i32 %a to i64
%c = mul i64 %b, 96
ret i64 %c
}

```



```

define i64 @zext_mul160(i32 signext %a) {
; RV64I-LABEL: zext_mul160:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  slli a1, a1, 37
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  mulhu a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: zext_mul160:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 5
; RV64ZBA-NEXT:  sh2add a0, a0, a0
; RV64ZBA-NEXT:  ret
%b = zext i32 %a to i64
%c = mul i64 %b, 160
ret i64 %c
}

```

```

define i64 @zext_mul288(i32 signext %a) {
; RV64I-LABEL: zext_mul288:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 9
; RV64I-NEXT:  slli a1, a1, 37
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  mulhu a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: zext_mul288:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 5
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  ret
%b = zext i32 %a to i64
%c = mul i64 %b, 288
ret i64 %c
}

```

; We can't use slli.uw becaues  
the shift amount is more than 31.  
; FIXME: The zext.w is unneeded.

```

define i64 @zext_mul12884901888(i32 signext %a) {
; RV64I-LABEL: zext_mul12884901888:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  li a1, 3

```

```

; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: zext_mul12884901888:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  andi a0, a0, -1
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  slli a0, a0, 32
; RV64ZBA-NEXT:  ret
%b = zext i32 %a to i64
%c = mul i64 %b, 12884901888
ret i64 %c
}

```

; We can't use slli.uw becaues the shift amount is more than 31.

; FIXME: The zext.w is unneeded.

```
define i64 @zext_mul21474836480(i32 signext %a) {
```

```
; RV64I-LABEL: zext_mul21474836480:
```

```
; RV64I:      # %bb.0:
```

```
; RV64I-NEXT:  slli a0, a0, 32
```

```
; RV64I-NEXT:  srli a0, a0, 32
```

```
; RV64I-NEXT:  li a1, 5
```

```
; RV64I-NEXT:  slli a1, a1, 32
```

```
; RV64I-NEXT:  mul a0, a0, a1
```

```
; RV64I-NEXT:
```

```
    ret
```

```
;
```

```
; RV64ZBA-LABEL: zext_mul21474836480:
```

```
; RV64ZBA:      # %bb.0:
```

```
; RV64ZBA-NEXT:  andi a0, a0, -1
```

```
; RV64ZBA-NEXT:  sh2add a0, a0, a0
```

```
; RV64ZBA-NEXT:  slli a0, a0, 32
```

```
; RV64ZBA-NEXT:  ret
```

```
%b = zext i32 %a to i64
```

```
%c = mul i64 %b, 21474836480
```

```
ret i64 %c
```

```
}
```

; We can't use slli.uw becaues the shift amount is more than 31.

; FIXME: The zext.w is unneeded.

```
define i64 @zext_mul38654705664(i32 signext %a) {
```

```
; RV64I-LABEL: zext_mul38654705664:
```

```
; RV64I:      # %bb.0:
```

```
; RV64I-NEXT:  slli a0, a0, 32
```

```
; RV64I-NEXT:  srli a0, a0, 32
```

```
; RV64I-NEXT:  li a1, 9
```

```
; RV64I-NEXT:  slli a1, a1, 32
```

```

; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: zext_mul38654705664:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  andi a0, a0, -1
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  slli a0, a0, 32
; RV64ZBA-NEXT:  ret
%b = zext i32 %a to i64
%c = mul i64 %b, 38654705664
ret i64 %c
}

```

```

define i64 @sh1add_imm(i64 %0) {
; CHECK-LABEL: sh1add_imm:
;
CHECK:      # %bb.0:
; CHECK-NEXT:  slli a0, a0, 1
; CHECK-NEXT:  addi a0, a0, 5
; CHECK-NEXT:  ret
%a = shl i64 %0, 1
%b = add i64 %a, 5
ret i64 %b
}

```

```

define i64 @sh2add_imm(i64 %0) {
; CHECK-LABEL: sh2add_imm:
; CHECK:      # %bb.0:
; CHECK-NEXT:  slli a0, a0, 2
; CHECK-NEXT:  addi a0, a0, -6
; CHECK-NEXT:  ret
%a = shl i64 %0, 2
%b = add i64 %a, -6
ret i64 %b
}

```

```

define i64 @sh3add_imm(i64 %0) {
; CHECK-LABEL: sh3add_imm:
; CHECK:      # %bb.0:
; CHECK-NEXT:  slli a0, a0, 3
; CHECK-NEXT:  addi a0, a0, 7
; CHECK-NEXT:  ret
%a = shl i64 %0, 3
%b = add i64 %a, 7
ret i64 %b
}

```

```

define i64 @sh1adduw_imm(i32 signext %0) {
; RV64I-LABEL: sh1adduw_imm:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 31
; RV64I-NEXT:  addi a0, a0, 11
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh1adduw_imm:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 1
; RV64ZBA-NEXT:  addi a0, a0, 11
; RV64ZBA-NEXT:  ret
%a =
zext i32 %0 to i64
%b = shl i64 %a, 1
%c = add i64 %b, 11
ret i64 %c
}

```

```

define i64 @sh2adduw_imm(i32 signext %0) {
; RV64I-LABEL: sh2adduw_imm:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 30
; RV64I-NEXT:  addi a0, a0, -12
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh2adduw_imm:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 2
; RV64ZBA-NEXT:  addi a0, a0, -12
; RV64ZBA-NEXT:  ret
%a = zext i32 %0 to i64
%b = shl i64 %a, 2
%c = add i64 %b, -12
ret i64 %c
}

```

```

define i64 @sh3adduw_imm(i32 signext %0) {
; RV64I-LABEL: sh3adduw_imm:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 29
; RV64I-NEXT:  addi a0, a0, 13
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh3adduw_imm:

```

```

; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  slli.uw a0, a0, 3
; RV64ZBA-NEXT:  addi a0, a0, 13
; RV64ZBA-NEXT:  ret
%a = zext i32 %0 to i64
%b = shl i64 %a, 3
%c = add i64 %b, 13
ret i64 %c
}

define i64 @adduw_imm(i32 signext %0) nounwind {
; RV64I-LABEL: adduw_imm:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  addi a0, a0, 5
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: adduw_imm:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  zext.w a0, a0
; RV64ZBA-NEXT:  addi a0, a0, 5
; RV64ZBA-NEXT:  ret
%a = zext i32 %0 to i64
%b = add i64 %a, 5
ret i64 %b
}

define i64 @mul258(i64 %a) {
; CHECK-LABEL: mul258:
; CHECK:    # %bb.0:
; CHECK-NEXT:  li a1, 258
; CHECK-NEXT:  mul a0, a0, a1
; CHECK-NEXT:  ret
%c = mul i64 %a, 258
ret i64 %c
}

define i64 @mul260(i64 %a) {
; CHECK-LABEL: mul260:
; CHECK:    # %bb.0:
; CHECK-NEXT:  li a1, 260
; CHECK-NEXT:  mul a0, a0, a1
; CHECK-NEXT:  ret
%c = mul i64 %a, 260
ret i64 %c
}

```

```

define i64 @mul264(i64 %a) {
; CHECK-LABEL: mul264:
; CHECK:      # %bb.0:
; CHECK-NEXT:  li a1, 264
; CHECK-NEXT:  mul a0, a0, a1
; CHECK-NEXT:  ret
%c = mul i64 %a, 264
ret i64
%c
}

```

```

define i64 @imm_zextw() nounwind {
; RV64I-LABEL: imm_zextw:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a0, 1
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  addi a0, a0, -2
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: imm_zextw:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  li a0, -2
; RV64ZBA-NEXT:  zext.w a0, a0
; RV64ZBA-NEXT:  ret
ret i64 4294967294 ; -2 in 32 bits.
}

```

```

define i64 @mul11(i64 %a) {
; RV64I-LABEL: mul11:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 11
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul11:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh2add a1, a0, a0
; RV64ZBA-NEXT:  sh1add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 11
ret i64 %c
}

```

```

define i64 @mul19(i64 %a) {
; RV64I-LABEL: mul19:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 19

```

```

; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul19:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add a1, a0, a0
; RV64ZBA-NEXT:  sh1add a0,
a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 19
ret i64 %c
}

```

```

define i64 @mul13(i64 %a) {
; RV64I-LABEL: mul13:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 13
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul13:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh1add a1, a0, a0
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 13
ret i64 %c
}

```

```

define i64 @mul21(i64 %a) {
; RV64I-LABEL: mul21:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 21
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul21:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add a1, a0, a0
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 21
ret i64 %c
}

```

```

define i64 @mul37(i64 %a) {
; RV64I-LABEL: mul37:
; RV64I:      # %bb.0:

```

```

; RV64I-NEXT:  li a1, 37
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul37:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add a1, a0, a0
; RV64ZBA-NEXT:
    sh2add a0, a1, a0
; RV64ZBA-NEXT:  ret
    %c = mul i64 %a, 37
    ret i64 %c
}

```

```

define i64 @mul25(i64 %a) {
; RV64I-LABEL: mul25:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 25
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul25:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh1add a1, a0, a0
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ret
    %c = mul i64 %a, 25
    ret i64 %c
}

```

```

define i64 @mul41(i64 %a) {
; RV64I-LABEL: mul41:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 41
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul41:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add a1, a0, a0
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ret
    %c = mul i64 %a, 41
    ret i64 %c
}

```

```

define i64 @mul73(i64 %a) {
; RV64I-LABEL: mul73:

```



```

; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 73
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul73:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh3add
a1, a0, a0
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 73
ret i64 %c
}

```

```

define i64 @mul27(i64 %a) {
; RV64I-LABEL: mul27:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 27
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul27:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  sh1add a0, a0, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 27
ret i64 %c
}

```

```

define i64 @mul45(i64 %a) {
; RV64I-LABEL: mul45:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 45
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul45:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  sh2add a0, a0, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 45
ret i64 %c
}

```

```

define i64 @mul81(i64 %a) {

```

```

; RV64I-LABEL: mul81:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 81
; RV64I-NEXT:  mul a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul81:
; RV64ZBA:    # %bb.0:
;
RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  sh3add a0, a0, a0
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 81
ret i64 %c
}

```

```

define i64 @mul4098(i64 %a) {
; RV64I-LABEL: mul4098:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a1, a0, 1
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul4098:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  slli a1, a0, 12
; RV64ZBA-NEXT:  sh1add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 4098
ret i64 %c
}

```

```

define i64 @mul4100(i64 %a) {
; RV64I-LABEL: mul4100:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a1, a0, 2
; RV64I-NEXT:  slli a0, a0, 12
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: mul4100:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  slli a1, a0, 12
; RV64ZBA-NEXT:  sh2add a0, a0, a1
; RV64ZBA-NEXT:  ret
%c = mul i64 %a, 4100
ret i64 %c

```

```
}
```

```
define i64 @mul4104(i64 %a) {  
; RV64I-LABEL: mul4104:  
; RV64I:    # %bb.0:  
; RV64I-NEXT:  
    slli a1, a0, 3  
; RV64I-NEXT:  slli a0, a0, 12  
; RV64I-NEXT:  add a0, a0, a1  
; RV64I-NEXT:  ret  
;  
; RV64ZBA-LABEL: mul4104:  
; RV64ZBA:    # %bb.0:  
; RV64ZBA-NEXT:  slli a1, a0, 12  
; RV64ZBA-NEXT:  sh3add a0, a0, a1  
; RV64ZBA-NEXT:  ret  
    %c = mul i64 %a, 4104  
    ret i64 %c  
}
```

```
define signext i32 @mulw192(i32 signext %a) {  
; CHECK-LABEL: mulw192:  
; CHECK:    # %bb.0:  
; CHECK-NEXT:  li a1, 192  
; CHECK-NEXT:  mulw a0, a0, a1  
; CHECK-NEXT:  ret  
    %c = mul i32 %a, 192  
    ret i32 %c  
}
```

```
define signext i32 @mulw320(i32 signext %a) {  
; CHECK-LABEL: mulw320:  
; CHECK:    # %bb.0:  
; CHECK-NEXT:  li a1, 320  
; CHECK-NEXT:  mulw a0, a0, a1  
; CHECK-NEXT:  ret  
    %c = mul i32 %a, 320  
    ret i32 %c  
}
```

```
define signext i32 @mulw576(i32 signext %a) {  
; CHECK-LABEL: mulw576:  
; CHECK:    # %bb.0:  
; CHECK-NEXT:  li a1, 576  
; CHECK-NEXT:  mulw a0, a0, a1  
; CHECK-NEXT:  ret  
    %c = mul i32 %a, 576  
    ret i32 %c  
}
```

```
}
```

```
define i64 @add4104(i64 %a) {  
; RV64I-LABEL: add4104:  
; RV64I:  
    # %bb.0:  
; RV64I-NEXT:    lui a1, 1  
; RV64I-NEXT:    addiw a1, a1, 8  
; RV64I-NEXT:    add a0, a0, a1  
; RV64I-NEXT:    ret  
;  
; RV64ZBA-LABEL: add4104:  
; RV64ZBA:      # %bb.0:  
; RV64ZBA-NEXT:    li a1, 1026  
; RV64ZBA-NEXT:    sh2add a0, a1, a0  
; RV64ZBA-NEXT:    ret  
    %c = add i64 %a, 4104  
    ret i64 %c  
}
```

```
define i64 @add8208(i64 %a) {  
; RV64I-LABEL: add8208:  
; RV64I:      # %bb.0:  
; RV64I-NEXT:    lui a1, 2  
; RV64I-NEXT:    addiw a1, a1, 16  
; RV64I-NEXT:    add a0, a0, a1  
; RV64I-NEXT:    ret  
;  
; RV64ZBA-LABEL: add8208:  
; RV64ZBA:      # %bb.0:  
; RV64ZBA-NEXT:    li a1, 1026  
; RV64ZBA-NEXT:    sh3add a0, a1, a0  
; RV64ZBA-NEXT:    ret  
    %c = add i64 %a, 8208  
    ret i64 %c  
}
```

; Make sure we prefer LUI for the 8192 instead of using sh3add.

```
define signext i32 @add8192_i32(i32 signext %a) {  
; CHECK-LABEL: add8192_i32:  
; CHECK:      # %bb.0:  
; CHECK-NEXT:    lui a1, 2  
; CHECK-NEXT:    addw a0, a0, a1  
; CHECK-NEXT:    ret  
    %c = add i32 %a, 8192  
    ret i32 %c  
}
```

```

; Make sure we prefer LUI
; for the 8192 instead of using sh3add.
define i64 @add8192(i64 %a) {
; CHECK-LABEL: add8192:
; CHECK:      # %bb.0:
; CHECK-NEXT:  lui a1, 2
; CHECK-NEXT:  add a0, a0, a1
; CHECK-NEXT:  ret
%c = add i64 %a, 8192
ret i64 %c
}

define signext i32 @addshl32_5_6(i32 signext %a, i32 signext %b) {
; RV64I-LABEL: addshl32_5_6:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 5
; RV64I-NEXT:  slli a1, a1, 6
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addshl32_5_6:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT: sh1add a0, a1, a0
; RV64ZBA-NEXT: slliw a0, a0, 5
; RV64ZBA-NEXT: ret
%c = shl i32 %a, 5
%d = shl i32 %b, 6
%e = add i32 %c, %d
ret i32 %e
}

define i64 @addshl64_5_6(i64 %a, i64 %b) {
; RV64I-LABEL: addshl64_5_6:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 5
; RV64I-NEXT:  slli a1, a1, 6
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addshl64_5_6:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:
; sh1add a0, a1, a0
; RV64ZBA-NEXT: slli a0, a0, 5
; RV64ZBA-NEXT: ret
%c = shl i64 %a, 5
%d = shl i64 %b, 6
%e = add i64 %c, %d

```

```

ret i64 %e
}

define signext i32 @addshl32_5_7(i32 signext %a, i32 signext %b) {
; RV64I-LABEL: addshl32_5_7:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 5
; RV64I-NEXT:  slli a1, a1, 7
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addshl32_5_7:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  slliw a0, a0, 5
; RV64ZBA-NEXT:  ret
%c = shl i32 %a, 5
%d = shl i32 %b, 7
%e = add i32 %c, %d
ret i32 %e
}

define i64 @addshl64_5_7(i64 %a, i64 %b) {
; RV64I-LABEL: addshl64_5_7:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 5
; RV64I-NEXT:  slli a1, a1, 7
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addshl64_5_7:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  slli a0, a0, 5
; RV64ZBA-NEXT:  ret
%c
= shl i64 %a, 5
%d = shl i64 %b, 7
%e = add i64 %c, %d
ret i64 %e
}

define signext i32 @addshl32_5_8(i32 signext %a, i32 signext %b) {
; RV64I-LABEL: addshl32_5_8:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 5
; RV64I-NEXT:  slli a1, a1, 8
; RV64I-NEXT:  addw a0, a0, a1

```

```

; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: addshl32_5_8:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  slliw a0, a0, 5
; RV64ZBA-NEXT:  ret
%c = shl i32 %a, 5
%d = shl i32 %b, 8
%e = add i32 %c, %d
ret i32 %e
}

```

```

define i64 @addshl64_5_8(i64 %a, i64 %b) {
; RV64I-LABEL: addshl64_5_8:
; RV64I:        # %bb.0:
; RV64I-NEXT:   slli a0, a0, 5
; RV64I-NEXT:   slli a1, a1, 8
; RV64I-NEXT:   add a0, a0, a1
; RV64I-NEXT:   ret
;
; RV64ZBA-LABEL: addshl64_5_8:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  slli a0, a0, 5
; RV64ZBA-NEXT:  ret
%c = shl i64 %a, 5
%d = shl i64 %b, 8
%e = add i64 %c, %d
ret i64 %e
}

```

```

; Make
sure we use sext.h+slli+srli for Zba+Zbb.
; FIXME: The RV64I and Zba only cases can be done with only 3 shifts.

```

```

define zeroext i32 @sext_ashr_zext_i8(i8 %a) nounwind {

```

```

; RV64I-LABEL: sext_ashr_zext_i8:
; RV64I:        # %bb.0:
; RV64I-NEXT:   slli a0, a0, 24
; RV64I-NEXT:   sraiw a0, a0, 31
; RV64I-NEXT:   slli a0, a0, 32
; RV64I-NEXT:   srli a0, a0, 32
; RV64I-NEXT:   ret
;
; RV64ZBANOZBB-LABEL: sext_ashr_zext_i8:
; RV64ZBANOZBB: # %bb.0:
; RV64ZBANOZBB-NEXT: slli a0, a0, 24
; RV64ZBANOZBB-NEXT: sraiw a0, a0, 31

```

```

; RV64ZBANOBZBB-NEXT:  zext.w a0, a0
; RV64ZBANOBZBB-NEXT:  ret
;
; RV64ZBAZBB-LABEL: sext_ashr_zext_i8:
; RV64ZBAZBB:          # %bb.0:
; RV64ZBAZBB-NEXT:    sext.b a0, a0
; RV64ZBAZBB-NEXT:    srai.w a0, a0, 9
; RV64ZBAZBB-NEXT:    zext.w a0, a0
; RV64ZBAZBB-NEXT:    ret
%ext = sext i8 %a to i32
%1 = ashr i32 %ext, 9
ret i32 %1
}

; Make sure we use sext.h+slli+srli for Zba+Zbb.
; FIXME: The RV64I and Zba only cases can be done with only 3 shifts.
define
zeroext i32 @sext_ashr_zext_i16(i16 %a) nounwind {
; RV64I-LABEL: sext_ashr_zext_i16:
; RV64I:          # %bb.0:
; RV64I-NEXT:    slli a0, a0, 16
; RV64I-NEXT:    srai.w a0, a0, 25
; RV64I-NEXT:    slli a0, a0, 32
; RV64I-NEXT:    srli a0, a0, 32
; RV64I-NEXT:    ret
;
; RV64ZBANOBZBB-LABEL: sext_ashr_zext_i16:
; RV64ZBANOBZBB:  # %bb.0:
; RV64ZBANOBZBB-NEXT:  slli a0, a0, 16
; RV64ZBANOBZBB-NEXT:  srai.w a0, a0, 25
; RV64ZBANOBZBB-NEXT:  zext.w a0, a0
; RV64ZBANOBZBB-NEXT:  ret
;
; RV64ZBAZBB-LABEL: sext_ashr_zext_i16:
; RV64ZBAZBB:      # %bb.0:
; RV64ZBAZBB-NEXT:  slli a0, a0, 48
; RV64ZBAZBB-NEXT:  srai a0, a0, 57
; RV64ZBAZBB-NEXT:  zext.w a0, a0
; RV64ZBAZBB-NEXT:  ret
%ext = sext i16 %a to i32
%1 = ashr i32 %ext, 9
ret i32 %1
}

; This the IR you get from InstCombine if take the difference of 2 pointers and
; cast is to unsigned before using as an index.
define signext i16 @sh1adduw_ptrdiff(i64 %diff, ptr %baseptr) {
; RV64I-LABEL: sh1adduw_ptrdiff:

```



```

; RV64I:
    # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  slli a2, a2, 33
; RV64I-NEXT:  addi a2, a2, -2
; RV64I-NEXT:  and a0, a0, a2
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lh a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh1adduw_ptrdiff:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srli a0, a0, 1
; RV64ZBA-NEXT:  sh1add.uw a0, a0, a1
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:  ret
%ptrdiff = lshr exact i64 %diff, 1
%cast = and i64 %ptrdiff, 4294967295
%ptr = getelementptr inbounds i16, ptr %baseptr, i64 %cast
%res = load i16, ptr %ptr
ret i16 %res
}

define signext i32 @sh2adduw_ptrdiff(i64 %diff, ptr %baseptr) {
; RV64I-LABEL: sh2adduw_ptrdiff:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  slli a2, a2, 34
; RV64I-NEXT:  addi a2, a2, -4
; RV64I-NEXT:  and a0, a0, a2
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh2adduw_ptrdiff:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:
    srli a0, a0, 2
; RV64ZBA-NEXT:  sh2add.uw a0, a0, a1
; RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%ptrdiff = lshr exact i64 %diff, 2
%cast = and i64 %ptrdiff, 4294967295
%ptr = getelementptr inbounds i32, ptr %baseptr, i64 %cast
%res = load i32, ptr %ptr
ret i32 %res
}

```

```

define i64 @sh3adduw_ptrdiff(i64 %diff, ptr %baseptr) {
; RV64I-LABEL: sh3adduw_ptrdiff:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a2, 1
; RV64I-NEXT:  slli a2, a2, 35
; RV64I-NEXT:  addi a2, a2, -8
; RV64I-NEXT:  and a0, a0, a2
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: sh3adduw_ptrdiff:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srli a0, a0, 3
; RV64ZBA-NEXT:  sh3add.uw a0, a0, a1
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%ptrdiff = lshr exact i64 %diff, 3
%cast = and i64 %ptrdiff, 4294967295
%ptr = getelementptr inbounds i64, ptr %baseptr, i64 %cast
%res = load i64, ptr %ptr
ret i64 %res
}

```

```

define signext
i16 @srlw_1_sh1add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srlw_1_sh1add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a1, a1, 1
; RV64I-NEXT:  slli a1, a1, 1
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lh a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srlw_1_sh1add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srlw a1, a1, 1
; RV64ZBA-NEXT:  sh1add a0, a1, a0
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 1
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i16, ptr %0, i64 %4
%6 = load i16, ptr %5, align 2
ret i16 %6
}

```

```

define i128 @slliuw_ptrdiff(i64 %diff, ptr %baseptr) {

```

```

; RV64I-LABEL: slliuw_ptrdiff:
; RV64I:      # %bb.0:
; RV64I-NEXT: li a2, 1
; RV64I-NEXT: slli a2, a2, 36
; RV64I-NEXT: addi a2, a2, -16
; RV64I-NEXT: and a0, a0, a2
; RV64I-NEXT: add a1, a1, a0
; RV64I-NEXT: ld a0, 0(a1)
; RV64I-NEXT: ld a1, 8(a1)
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: slliuw_ptrdiff:
; RV64ZBA:      # %bb.0:
;
RV64ZBA-NEXT: srli a0, a0, 4
; RV64ZBA-NEXT: slli.uw a0, a0, 4
; RV64ZBA-NEXT: add a1, a1, a0
; RV64ZBA-NEXT: ld a0, 0(a1)
; RV64ZBA-NEXT: ld a1, 8(a1)
; RV64ZBA-NEXT: ret
%ptrdiff = lshr exact i64 %diff, 4
%cast = and i64 %ptrdiff, 4294967295
%ptr = getelementptr inbounds i128, ptr %baseptr, i64 %cast
%res = load i128, ptr %ptr
ret i128 %res
}

```

```

define signext i32 @srliw_2_sh2add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srliw_2_sh2add:
; RV64I:      # %bb.0:
; RV64I-NEXT: srliw a1, a1, 2
; RV64I-NEXT: slli a1, a1, 2
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: lw a0, 0(a0)
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: srliw_2_sh2add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT: srliw a1, a1, 2
; RV64ZBA-NEXT: sh2add a0, a1, a0
; RV64ZBA-NEXT: lw a0, 0(a0)
; RV64ZBA-NEXT: ret
%3 = lshr i32 %1, 2
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i32, ptr %0, i64 %4
%6 = load i32, ptr %5, align 4
ret i32 %6
}

```

```

define i64 @srlw_3_sh3add(ptr
    %0, i32 signext %1) {
; RV64I-LABEL: srlw_3_sh3add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a1, a1, 3
; RV64I-NEXT:  slli a1, a1, 3
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srlw_3_sh3add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srlw a1, a1, 3
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 3
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i64, ptr %0, i64 %4
%6 = load i64, ptr %5, align 8
ret i64 %6
}

define signext i32 @srlw_1_sh2add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srlw_1_sh2add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a1, a1, 1
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 30
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srlw_1_sh2add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srlw a1, a1, 1
; RV64ZBA-NEXT:  sh2add a0, a1, a0
;
RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 1
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i32, ptr %0, i64 %4
%6 = load i32, ptr %5, align 4
ret i32 %6
}

```

```

define i64 @srliw_1_sh3add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srliw_1_sh3add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a1, 1
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 29
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srliw_1_sh3add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srliw a1, a1, 1
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 1
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i64, ptr %0, i64 %4
%6 = load i64, ptr %5, align 8
ret i64 %6
}

```

```

define i64 @srliw_2_sh3add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srliw_2_sh3add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a1, 2
; RV64I-NEXT:  slli a1, a1, 32
;
; RV64I-NEXT:  srli a1, a1, 29
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srliw_2_sh3add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srliw a1, a1, 2
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 2
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i64, ptr %0, i64 %4
%6 = load i64, ptr %5, align 8
ret i64 %6
}

```

```

define signext i16 @srliw_2_sh1add(ptr %0, i32 signext %1) {

```

```

; RV64I-LABEL: srlw_2_sh1add:
; RV64I:    # %bb.0:
; RV64I-NEXT:  srlw a1, a1, 2
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 31
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lh a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srlw_2_sh1add:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  srlw a1, a1, 2
; RV64ZBA-NEXT:  sh1add a0, a1, a0
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 2
%4 = zext i32 %3 to i64
%5 = getelementptr
inbounds i16, ptr %0, i64 %4
%6 = load i16, ptr %5, align 2
ret i16 %6
}

define signext i32 @srlw_3_sh2add(ptr %0, i32 signext %1) {
; RV64I-LABEL: srlw_3_sh2add:
; RV64I:    # %bb.0:
; RV64I-NEXT:  srlw a1, a1, 3
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 30
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srlw_3_sh2add:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  srlw a1, a1, 3
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i32 %1, 3
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i32, ptr %0, i64 %4
%6 = load i32, ptr %5, align 4
ret i32 %6
}

define i64 @srlw_4_sh3add(ptr %0, i32 signext %1) {

```

```

; RV64I-LABEL: srlw_4_sh3add:
; RV64I:      # %bb.0:
; RV64I-NEXT: srlw a1, a1, 4
; RV64I-NEXT: slli a1, a1, 32
; RV64I-NEXT: srli a1, a1, 29
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: ld a0, 0(a0)
; RV64I-NEXT:
    ret
;
; RV64ZBA-LABEL: srlw_4_sh3add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT: srlw a1, a1, 4
; RV64ZBA-NEXT: sh3add a0, a1, a0
; RV64ZBA-NEXT: ld a0, 0(a0)
; RV64ZBA-NEXT: ret
%3 = lshr i32 %1, 4
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i64, ptr %0, i64 %4
%6 = load i64, ptr %5, align 8
ret i64 %6
}

```

```

define signext i32 @srli_1_sh2add(ptr %0, i64 %1) {
; RV64I-LABEL: srli_1_sh2add:
; RV64I:      # %bb.0:
; RV64I-NEXT: slli a1, a1, 1
; RV64I-NEXT: andi a1, a1, -4
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: lw a0, 0(a0)
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: srli_1_sh2add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT: srli a1, a1, 1
; RV64ZBA-NEXT: sh2add a0, a1, a0
; RV64ZBA-NEXT: lw a0, 0(a0)
; RV64ZBA-NEXT: ret
%3 = lshr i64 %1, 1
%4 = getelementptr inbounds i32, ptr %0, i64 %3
%5 = load i32, ptr %4, align 4
ret i32 %5
}

```

```

define i64 @srli_2_sh3add(ptr %0, i64 %1) {
; RV64I-LABEL: srli_2_sh3add:
; RV64I:      # %bb.0:
;

```

```

RV64I-NEXT:  slli a1, a1, 1
; RV64I-NEXT:  andi a1, a1, -8
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srli_2_sh3add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srli a1, a1, 2
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i64 %1, 2
%4 = getelementptr inbounds i64, ptr %0, i64 %3
%5 = load i64, ptr %4, align 8
ret i64 %5
}

define signext i16 @srli_2_sh1add(ptr %0, i64 %1) {
; RV64I-LABEL: srli_2_sh1add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srli a1, a1, 1
; RV64I-NEXT:  andi a1, a1, -2
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lh a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: srli_2_sh1add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  srli a1, a1, 2
; RV64ZBA-NEXT:  sh1add a0, a1, a0
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = lshr i64 %1, 2
%4 = getelementptr inbounds i16, ptr %0, i64 %3
%5 = load i16, ptr %4, align
2
ret i16 %5
}

define signext i32 @srli_3_sh2add(ptr %0, i64 %1) {
; RV64I-LABEL: srli_3_sh2add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srli a1, a1, 1
; RV64I-NEXT:  andi a1, a1, -4
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret

```



```

;
; RV64ZBA-LABEL: srli_3_sh2add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT: srli a1, a1, 3
; RV64ZBA-NEXT: sh2add a0, a1, a0
; RV64ZBA-NEXT: lw a0, 0(a0)
; RV64ZBA-NEXT: ret
%3 = lshr i64 %1, 3
%4 = getelementptr inbounds i32, ptr %0, i64 %3
%5 = load i32, ptr %4, align 4
ret i32 %5
}

```

```

define i64 @srli_4_sh3add(ptr %0, i64 %1) {
; RV64I-LABEL: srli_4_sh3add:
; RV64I:      # %bb.0:
; RV64I-NEXT: srli a1, a1, 1
; RV64I-NEXT: andi a1, a1, -8
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: ld a0, 0(a0)
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: srli_4_sh3add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT: srli a1, a1, 4
; RV64ZBA-NEXT: sh3add a0, a1, a0
; RV64ZBA-NEXT: ld a0, 0(a0)
; RV64ZBA-NEXT:
ret
%3 = lshr i64 %1, 4
%4 = getelementptr inbounds i64, ptr %0, i64 %3
%5 = load i64, ptr %4, align 8
ret i64 %5
}

```

```

define signext i16 @shl_2_sh1add(ptr %0, i32 signext %1) {
; RV64I-LABEL: shl_2_sh1add:
; RV64I:      # %bb.0:
; RV64I-NEXT: slli a1, a1, 2
; RV64I-NEXT: slli a1, a1, 32
; RV64I-NEXT: srli a1, a1, 31
; RV64I-NEXT: add a0, a0, a1
; RV64I-NEXT: lh a0, 0(a0)
; RV64I-NEXT: ret
;
; RV64ZBA-LABEL: shl_2_sh1add:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT: slli a1, a1, 2

```

```

; RV64ZBA-NEXT:  zext.w a1, a1
; RV64ZBA-NEXT:  sh1add a0, a1, a0
; RV64ZBA-NEXT:  lh a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = shl i32 %1, 2
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i16, ptr %0, i64 %4
%6 = load i16, ptr %5, align 2
ret i16 %6
}

```

```

define signext i32 @shl_16_sh2add(ptr %0, i32 signext %1) {
; RV64I-LABEL: shl_16_sh2add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a1, a1, 16
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 30
;
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lw a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: shl_16_sh2add:
; RV64ZBA:    # %bb.0:
; RV64ZBA-NEXT:  slli a1, a1, 16
; RV64ZBA-NEXT:  zext.w a1, a1
; RV64ZBA-NEXT:  sh2add a0, a1, a0
; RV64ZBA-NEXT:  lw a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = shl i32 %1, 16
%4 = zext i32 %3 to i64
%5 = getelementptr inbounds i32, ptr %0, i64 %4
%6 = load i32, ptr %5, align 4
ret i32 %6
}

```

```

define i64 @shl_31_sh3add(ptr %0, i32 signext %1) {
; RV64I-LABEL: shl_31_sh3add:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a1, a1, 31
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 29
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, 0(a0)
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: shl_31_sh3add:
; RV64ZBA:    # %bb.0:

```

```

; RV64ZBA-NEXT:  slli a1, a1, 31
; RV64ZBA-NEXT:  zext.w a1, a1
; RV64ZBA-NEXT:  sh3add a0, a1, a0
; RV64ZBA-NEXT:  ld a0, 0(a0)
; RV64ZBA-NEXT:  ret
%3 = shl i32 %1, 31
%4 = zext i32 %3
to i64
%5 = getelementptr inbounds i64, ptr %0, i64 %4
%6 = load i64, ptr %5, align 8
ret i64 %6
}

```

```

define i64 @pack_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: pack_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: pack_i64:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli a1, a1, 32
; RV64ZBA-NEXT:  add.uw a0, a0, a1
; RV64ZBA-NEXT:  ret
%shl = and i64 %a, 4294967295
%shl1 = shl i64 %b, 32
%or = or i64 %shl1, %shl
ret i64 %or
}

```

```

define i64 @pack_i64_2(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: pack_i64_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: pack_i64_2:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  slli a1, a1, 32
; RV64ZBA-NEXT:  add.uw a0, a0,
a1
; RV64ZBA-NEXT:  ret

```

```

%zexta = zext i32 %a to i64
%zextb = zext i32 %b to i64
%shl1 = shl i64 %zextb, 32
%or = or i64 %shl1, %zexta
ret i64 %or
}

```

```

define i64 @pack_i64_3(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: pack_i64_3:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  addi a1, a1, 1
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBA-LABEL: pack_i64_3:
; RV64ZBA:      # %bb.0:
; RV64ZBA-NEXT:  addi a0, a0, 1
; RV64ZBA-NEXT:  addi a1, a1, 1
; RV64ZBA-NEXT:  slli a1, a1, 32
; RV64ZBA-NEXT:  add.uw a0, a0, a1
; RV64ZBA-NEXT:  ret
%adda = add i32 %a, 1
%addb = add i32 %b, 1
%zexta = zext i32 %adda to i64
%zextb = zext i32 %addb to i64
%shl1 = shl i64 %zextb, 32
%or = or i64 %shl1, %zexta
ret i64 %or
}

```

=====

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```
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py  
; RUN: llc -mtriple=riscv64 -mattr=+zbb -verify-machineinstrs < %s \  
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBB
```

```
declare i32 @llvm.riscv.orc.b.i32(i32)
```

```
define signext i32 @orc32(i32 signext %a) nounwind {  
; RV64ZBB-LABEL: orc32:  
; RV64ZBB:      # %bb.0:  
; RV64ZBB-NEXT:  orc.b a0, a0
```

```
; RV64ZBB-NEXT:  sext.w a0, a0
; RV64ZBB-NEXT:  ret
%tmp = call i32 @llvm.riscv.orc.b.i32(i32 %a)
ret i32 %tmp
}
```

```
define zeroext i32 @orc32_zext(i32 zeroext %a) nounwind {
; RV64ZBB-LABEL: orc32_zext:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  orc.b a0, a0
; RV64ZBB-NEXT:  ret
%tmp = call i32 @llvm.riscv.orc.b.i32(i32 %a)
ret i32 %tmp
}
```

; Second and+or is redundant with the first, make sure we remove them.

```
define signext i32 @orc32_knownbits(i32 signext %a) nounwind {
; RV64ZBB-LABEL: orc32_knownbits:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  lui a1, 1044480
; RV64ZBB-NEXT:
    and a0, a0, a1
; RV64ZBB-NEXT:  lui a1, 2048
; RV64ZBB-NEXT:  addi a1, a1, 1
; RV64ZBB-NEXT:  or a0, a0, a1
; RV64ZBB-NEXT:  orc.b a0, a0
; RV64ZBB-NEXT:  sext.w a0, a0
; RV64ZBB-NEXT:  ret
%tmp = and i32 %a, 4278190080 ; 0xFF000000
%tmp2 = or i32 %tmp, 8388609 ; 0x800001
%tmp3 = call i32 @llvm.riscv.orc.b.i32(i32 %tmp2)
%tmp4 = and i32 %tmp3, 4278190080 ; 0xFF000000
%tmp5 = or i32 %tmp4, 16711935 ; 0xFF00FF
ret i32 %tmp5
}
```

```
declare i64 @llvm.riscv.orc.b.i64(i64)
```

```
define i64 @orc64(i64 %a) nounwind {
; RV64ZBB-LABEL: orc64:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  orc.b a0, a0
; RV64ZBB-NEXT:  ret
%tmp = call i64 @llvm.riscv.orc.b.i64(i64 %a)
ret i64 %tmp
}
```

; Second and+or is redundant with the first, make sure we remove them.

```

define i64 @orcb64_knownbits(i64 %a) nounwind {
; RV64ZBB-LABEL: orcb64_knownbits:
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT: lui a1, 65535
; RV64ZBB-NEXT: slli a1, a1, 12
; RV64ZBB-NEXT: and a0, a0, a1
;
; RV64ZBB-NEXT: lui a1, 256
; RV64ZBB-NEXT: addiw a1, a1, 8
; RV64ZBB-NEXT: slli a2, a1, 42
; RV64ZBB-NEXT: add a1, a1, a2
; RV64ZBB-NEXT: or a0, a0, a1
; RV64ZBB-NEXT: orc.b a0, a0
; RV64ZBB-NEXT: ret
%tmp = and i64 %a, 1099494850560 ; 0x000000ffff000000
%tmp2 = or i64 %tmp, 4611721202800525320 ; 0x4000200000100008
%tmp3 = call i64 @llvm.riscv.orc.b.i64(i64 %tmp2)
%tmp4 = and i64 %tmp3, 1099494850560 ; 0x000000ffff000000
%tmp5 = or i64 %tmp4, 18374966855153418495 ; 0xff00ff0000ff00ff
ret i64 %tmp5
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -mattr=+zbc -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBC

```

```

declare i64 @llvm.riscv.clmulr.i64(i64 %a, i64 %b)

```

```

define i64 @clmul64r(i64 %a, i64 %b) nounwind {
; RV64ZBC-LABEL: clmul64r:
; RV64ZBC:      # %bb.0:
; RV64ZBC-NEXT: clmulr a0, a0, a1
; RV64ZBC-NEXT: ret
%tmp = call i64 @llvm.riscv.clmulr.i64(i64 %a, i64 %b)
ret i64 %tmp
}

```

```

declare i32 @llvm.riscv.clmulr.i32(i32 %a, i32 %b)

```

```

define signext i32 @clmul32r(i32 signext %a, i32 signext %b) nounwind {
; RV64ZBC-LABEL: clmul32r:
; RV64ZBC:      # %bb.0:
; RV64ZBC-NEXT: slli a1, a1, 32
; RV64ZBC-NEXT: slli a0, a0, 32
; RV64ZBC-NEXT: clmulr a0, a0, a1
; RV64ZBC-NEXT: srai a0, a0, 32
; RV64ZBC-NEXT: ret
%tmp = call i32 @llvm.riscv.clmulr.i32(i32 %a, i32 %b)
ret i32 %tmp

```

```

}

; FIXME: We could avoid the slli instructions by using clmul+srli+sext.w
; since
; the inputs are zero extended.
define signext i32 @clmul32r_zext(i32 zeroext %a, i32 zeroext %b) nounwind {
; RV64ZBC-LABEL: clmul32r_zext:
; RV64ZBC:      # %bb.0:
; RV64ZBC-NEXT: slli a1, a1, 32
; RV64ZBC-NEXT: slli a0, a0, 32
; RV64ZBC-NEXT: clmulr a0, a0, a1
; RV64ZBC-NEXT: srar a0, a0, 32
; RV64ZBC-NEXT: ret
    %tmp = call i32 @llvm.riscv.clmulr.i32(i32 %a, i32 %b)
    ret i32 %tmp
}

; RUN: opt %s -passes=inline -S | FileCheck %s

define internal void @innerSmall() "min-legal-vector-width"="128" {
    ret void
}

define internal void @innerLarge() "min-legal-vector-width"="512" {
    ret void
}

define internal void @innerNoAttribute() {
    ret void
}

; We should not add an attribute during inlining. No attribute means unknown.
; Inlining doesn't change the fact that we don't know anything about this
; function.
define void @outerNoAttribute() {
    call void @innerLarge()
    ret void
}

define void @outerConflictingAttributeSmall() "min-legal-vector-width"="128" {
    call void @innerLarge()
    ret void
}

define void @outerConflictingAttributeLarge() "min-legal-vector-width"="512" {
    call void @innerSmall()
    ret void
}

```

```

; We should remove the attribute after inlining since the callee's
; vector width requirements are unknown.
define void @outerAttribute() "min-legal-vector-width"="128" {
  call void @innerNoAttribute()
  ret void
}

; CHECK: define void @outerNoAttribute()
{
; CHECK: define void @outerConflictingAttributeSmall() #0
; CHECK: define void @outerConflictingAttributeLarge() #0
; CHECK: define void @outerAttribute() {
; CHECK: attributes #0 = { "min-legal-vector-width"="512" }
; RUN: opt -mtriple=aarch64-linux-gnu -mattr=+sve -passes=sanitize-masked-mem-intrin -S < %s | FileCheck %s

; Testing that masked scatters operating on scalable vectors that are
; packed in SVE registers are not scalarized.

; CHECK-LABEL: @masked_scatter_nxv4i32(
; CHECK: call void @llvm.masked.scatter.nxv4i32
define void @masked_scatter_nxv4i32(<vscale x 4 x i32> %data, <vscale x 4 x ptr> %ptrs, <vscale x 4 x i1>
%mask) {
  call void @llvm.masked.scatter.nxv4i32(<vscale x 4 x i32> %data, <vscale x 4 x ptr> %ptrs, i32 0, <vscale x 4 x
i1> %mask)
  ret void
}

; Testing that masked scatters operating on scalable vectors of FP
; data that is packed in SVE registers are not scalarized.

; CHECK-LABEL: @masked_scatter_nxv2f64(
; CHECK: call void @llvm.masked.scatter.nxv2f64
define void @masked_scatter_nxv2f64(<vscale x 2 x double> %data, <vscale x 2 x ptr> %ptrs, <vscale x 2 x i1>
%mask) {
  call void @llvm.masked.scatter.nxv2f64(<vscale x 2 x double> %data, <vscale x 2 x ptr> %ptrs,
i32 0, <vscale x 2 x i1> %mask)
  ret void
}

; Testing that masked scatters operating on scalable vectors of FP
; data that is unpacked in SVE registers are not scalarized.

; CHECK-LABEL: @masked_scatter_nxv2f16(
; CHECK: call void @llvm.masked.scatter.nxv2f16
define void @masked_scatter_nxv2f16(<vscale x 2 x half> %data, <vscale x 2 x ptr> %ptrs, <vscale x 2 x i1>
%mask) {
  call void @llvm.masked.scatter.nxv2f16(<vscale x 2 x half> %data, <vscale x 2 x ptr> %ptrs, i32 0, <vscale x 2 x
i1> %mask)

```

```

ret void
}

; Testing that masked scatters operating on 64-bit fixed vectors are
; scalarized because NEON doesn't have support for masked scatter
; instructions.

; CHECK-LABEL: @masked_scatter_v2f32(
; CHECK-NOT: @llvm.masked.scatter.v2f32(
define void @masked_scatter_v2f32(<2 x float> %data, <2 x ptr> %ptrs, <2 x i1> %masks) {
    call void @llvm.masked.scatter.v2f32(<2 x float> %data, <2 x ptr> %ptrs, i32 0, <2 x i1> %masks)
    ret void
}

; Testing that masked scatters operating on 128-bit
; fixed vectors are
; scalarized because NEON doesn't have support for masked scatter
; instructions and because we are not targeting fixed width SVE.

; CHECK-LABEL: @masked_scatter_v4i32(
; CHECK-NOT: @llvm.masked.scatter.v4i32(
define void @masked_scatter_v4i32(<4 x i32> %data, <4 x ptr> %ptrs, <4 x i1> %masks) {
    call void @llvm.masked.scatter.v4i32(<4 x i32> %data, <4 x ptr> %ptrs, i32 0, <4 x i1> %masks)
    ret void
}

declare void @llvm.masked.scatter.nxv4i32(<vscale x 4 x i32> %data, <vscale x 4 x ptr> %ptrs, i32 %align,
<vscale x 4 x i1> %masks)
declare void @llvm.masked.scatter.nxv2f64(<vscale x 2 x double> %data, <vscale x 2 x ptr> %ptrs, i32 %align,
<vscale x 2 x i1> %masks)
declare void @llvm.masked.scatter.nxv2f16(<vscale x 2 x half> %data, <vscale x 2 x ptr> %ptrs, i32 %align,
<vscale x 2 x i1> %masks)
declare void @llvm.masked.scatter.v2f32(<2 x float> %data, <2 x ptr> %ptrs, i32 %align, <2 x i1> %masks)
declare void @llvm.masked.scatter.v4i32(<4 x i32> %data, <4 x
ptr> %ptrs, i32 %align, <4 x i1> %masks)
//===-- ObjectContainerBSDArchive.h -----*- C++ -*-===//
//
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//
//===-----==//

#ifndef
LLDB_SOURCE_PLUGINS_OBJECTCONTAINER_BSD_ARCHIVE_OBJECTCONTAINERBSDARCHIVE_H
#define
LLDB_SOURCE_PLUGINS_OBJECTCONTAINER_BSD_ARCHIVE_OBJECTCONTAINERBSDARCHIVE_H

```



```

#include "lldb/Core/UniqueCStringMap.h"
#include "lldb/Symbol/ObjectContainer.h"
#include "lldb/Utility/ArchSpec.h"
#include "lldb/Utility/ConstString.h"
#include "lldb/Utility/FileSpec.h"

#include "llvm/Object/Archive.h"
#include "llvm/Support/Chrono.h"
#include "llvm/Support/Path.h"

#include <map>
#include <memory>
#include <mutex>

enum class ArchiveType { Invalid, Archive, ThinArchive };

class ObjectContainerBSDArchive : public lldb_private::ObjectContainer
{
public:
    ObjectContainerBSDArchive(const lldb::ModuleSP &module_sp,
                             lldb::DataBufferSP &data_sp,
                             lldb::offset_t data_offset,
                             const lldb_private::FileSpec *file,
                             lldb::offset_t offset, lldb::offset_t length,
                             ArchiveType archive_type);

    ~ObjectContainerBSDArchive() override;

    // Static Functions
    static void Initialize();

    static void Terminate();

    static llvm::StringRef GetPluginNameStatic() { return "bsd-archive"; }

    static llvm::StringRef GetPluginDescriptionStatic() {
        return "BSD Archive object container reader.";
    }

    static lldb_private::ObjectContainer *
    CreateInstance(const lldb::ModuleSP &module_sp, lldb::DataBufferSP &data_sp,
                  lldb::offset_t data_offset, const lldb_private::FileSpec *file,
                  lldb::offset_t offset, lldb::offset_t length);

    static size_t GetModuleSpecifications(const
    lldb_private::FileSpec &file,
                                         lldb::DataBufferSP &data_sp,
                                         lldb::offset_t data_offset,

```

```

        lldb::offset_t file_offset,
        lldb::offset_t length,
        lldb_private::ModuleSpecList &specs);

static ArchiveType MagicBytesMatch(const lldb_private::DataExtractor &data);

// Member Functions
bool ParseHeader() override;

size_t GetNumObjects() const override {
    if (m_archive_sp)
        return m_archive_sp->GetNumObjects();
    return 0;
}

lldb::ObjectFileSP GetObjectFile(const lldb_private::FileSpec *file) override;

// PluginInterface protocol
llvm::StringRef GetPluginName() override { return GetPluginNameStatic(); }

protected:
struct Object {
    Object();

    void Clear();

    lldb::offset_t ExtractFromThin(const lldb_private::DataExtractor &data,

        lldb::offset_t offset,
        llvm::StringRef stringTable);

    lldb::offset_t Extract(const lldb_private::DataExtractor &data,
        lldb::offset_t offset);
    /// Object name in the archive.
    lldb_private::ConstString ar_name;

    /// Object modification time in the archive.
    uint32_t modification_time = 0;

    /// Object size in bytes in the archive.
    uint32_t size = 0;

    /// File offset in bytes from the beginning of the file of the object data.
    lldb::offset_t file_offset = 0;

    /// Length of the object data.
    lldb::offset_t file_size = 0;

```

```

void Dump() const;
};

class Archive {
public:
    typedef std::shared_ptr<Archive> shared_ptr;
    typedef std::multimap<lldb_private::FileSpec, shared_ptr> Map;

    Archive(const lldb_private::ArchSpec &arch,
            const llvm::sys::TimePoint<> &mod_time, lldb::offset_t file_offset,
            lldb_private::DataExtractor &data, ArchiveType archive_type);

    ~Archive();

    static Map &GetArchiveCache();

    static std::recursive_mutex &GetArchiveCacheMutex();

    static Archive::shared_ptr FindCachedArchive(
        const lldb_private::FileSpec &file, const lldb_private::ArchSpec &arch,
        const llvm::sys::TimePoint<> &mod_time, lldb::offset_t file_offset);

    static Archive::shared_ptr ParseAndCacheArchiveForFile(
        const lldb_private::FileSpec &file, const lldb_private::ArchSpec &arch,
        const llvm::sys::TimePoint<> &mod_time, lldb::offset_t file_offset,
        lldb_private::DataExtractor &data, ArchiveType archive_type);

    size_t GetNumObjects() const { return m_objects.size(); }

    const Object *GetObjectAtIndex(size_t idx) {
        if (idx < m_objects.size())
            return &m_objects[idx];
        return nullptr;
    }

    size_t ParseObjects();

    Object *FindObject(lldb_private::ConstString object_name,
        const llvm::sys::TimePoint<> &object_mod_time);

    lldb::offset_t
    GetFileOffset() const { return m_file_offset; }

    const llvm::sys::TimePoint<> &GetModificationTime() {
        return m_modification_time;
    }

    const lldb_private::ArchSpec &GetArchitecture() const { return m_arch; }

```

```

void SetArchitecture(const lldb_private::ArchSpec &arch) { m_arch = arch; }

bool HasNoExternalReferences() const;

lldb_private::DataExtractor &GetData() { return m_data; }

ArchiveType GetArchiveType() { return m_archive_type; }

protected:
    typedef lldb_private::UniqueCStringMap<uint32_t> ObjectNameToIndexMap;
    // Member Variables
    lldb_private::ArchSpec m_arch;
    llvm::sys::TimePoint<> m_modification_time;
    lldb::offset_t m_file_offset;
    std::vector<Object> m_objects;
    ObjectNameToIndexMap m_object_name_to_index_map;
    lldb_private::DataExtractor m_data; ///< The data for this object container
                                     ///

```

```
    call sub()
!$omp end parallel
```

```
end
```

```
subroutine lastprivate()
class(*), allocatable, save :: x
```

!PORTABILITY: If a polymorphic variable with allocatable attribute 'x' is in LASTPRIVATE clause, the behavior is unspecified

```
!$omp do lastprivate(x)
do i = 1, 10
    call sub()
enddo
!$omp end do
```

```
end
```

```
subroutine copyin()
class(*), allocatable, save :: x
!$omp threadprivate(x)
```

!PORTABILITY: If a polymorphic variable with allocatable attribute 'x' is in COPYIN clause, the behavior is unspecified

```
!$omp parallel copyin(x)
    call sub()
!$omp end parallel
```

```
end
```

```
subroutine copyprivate()
class(*), allocatable, save :: x
!$omp threadprivate(x)
```

```
!$omp single
    call sub()
```

!PORTABILITY: If a polymorphic variable with allocatable attribute 'x' is in COPYPRIVATE clause, the behavior is unspecified

```
!$omp end single copyprivate(x)
```

```
end
```

```
=====
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```

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```
static_library("BSD-Archive") {
  output_name = "lldbPluginObjectContainerBSDArchive"
  configs += [ "../llvm/utils/gn/build:lldb_code" ]
  deps = [
    "../lldb/source/Core",
    "../lldb/source/Host",
    "../lldb/source/Symbol",
    "../llvm/lib/Support",
  ]
  sources = [ "ObjectContainerBSDArchive.cpp" ]
}
; RUN: opt -mtriple=aarch64-linux-gnu -mattr=+sve -passes=sccp,masked-gather-intrin -S < %s | FileCheck %s

; Testing that masked gathers operating on scalable vectors that are
; packed in SVE registers are not scalarized.

; CHECK-LABEL: @masked_gather_nxv4i32(
; CHECK: call <vscale x 4 x i32> @llvm.masked.gather.nxv4i32
```

```

define <vscale x 4 x i32> @masked_gather_nxv4i32(<vscale x 4 x ptr> %ld, <vscale x 4 x i1> %masks, <vscale x 4 x i32> %passthru) {
    %res = call <vscale x 4 x i32> @llvm.masked.gather.nxv4i32(<vscale x 4 x ptr> %ld, i32 0, <vscale x 4 x i1> %masks, <vscale x 4 x i32> %passthru)
    ret <vscale x 4 x i32> %res
}

```

; Testing that masked gathers operating on scalable vectors of FP data  
; that is packed in SVE registers are not scalarized.

```

; CHECK-LABEL: @masked_gather_nxv2f64(
; CHECK: call <vscale x 2 x double> @llvm.masked.gather.nxv2f64
define <vscale x 2 x double> @masked_gather_nxv2f64(<vscale x 2 x ptr> %ld, <vscale x 2 x i1> %masks, <vscale x 2 x double> %passthru)
{
    %res = call <vscale x 2 x double> @llvm.masked.gather.nxv2f64(<vscale x 2 x ptr> %ld, i32 0, <vscale x 2 x i1> %masks, <vscale x 2 x double> %passthru)
    ret <vscale x 2 x double> %res
}

```

; Testing that masked gathers operating on scalable vectors of FP data  
; that is unpacked in SVE registers are not scalarized.

```

; CHECK-LABEL: @masked_gather_nxv2f16(
; CHECK: call <vscale x 2 x half> @llvm.masked.gather.nxv2f16
define <vscale x 2 x half> @masked_gather_nxv2f16(<vscale x 2 x ptr> %ld, <vscale x 2 x i1> %masks, <vscale x 2 x half> %passthru) {
    %res = call <vscale x 2 x half> @llvm.masked.gather.nxv2f16(<vscale x 2 x ptr> %ld, i32 0, <vscale x 2 x i1> %masks, <vscale x 2 x half> %passthru)
    ret <vscale x 2 x half> %res
}

```

; Testing that masked gathers operating on 64-bit fixed vectors are  
; scalarized because NEON doesn't have support for masked gather  
; instructions.

```

; CHECK-LABEL: @masked_gather_v2f32(
; CHECK-NOT: @llvm.masked.gather.v2f32(
define <2 x float> @masked_gather_v2f32(<2 x ptr> %ld, <2 x i1> %masks, <2 x float> %passthru) {
    %res = call <2 x float> @llvm.masked.gather.v2f32(<2 x ptr> %ld, i32 0, <2 x i1> %masks, <2 x float> %passthru)
    ret <2 x float> %res
}

```

; Testing that masked gathers operating on 128-bit fixed vectors are  
; scalarized because NEON doesn't have support for masked gather  
; instructions and because we are not targeting fixed width SVE.

```
; CHECK-LABEL: @masked_gather_v4i32(
; CHECK-NOT: @llvm.masked.gather.v4i32(
define <4 x i32> @masked_gather_v4i32(<4 x ptr> %ld, <4 x i1> %masks, <4 x i32> %passthru) {
    %res = call <4 x i32> @llvm.masked.gather.v4i32(<4 x ptr> %ld, i32 0, <4 x i1> %masks, <4 x i32> %passthru)
    ret <4 x i32> %res
}

declare <vscale x 4 x i32> @llvm.masked.gather.nxv4i32(<vscale x 4 x ptr> %ptrs, i32 %align, <vscale x 4 x i1>
%.masks, <vscale x 4 x i32> %passthru)
declare <vscale x 2 x double> @llvm.masked.gather.nxv2f64(<vscale x 2 x ptr> %ptrs, i32 %align, <vscale x 2 x
i1> %masks, <vscale x 2 x double>
%passthru)
declare <vscale x 2 x half> @llvm.masked.gather.nxv2f16(<vscale x 2 x ptr> %ptrs, i32 %align, <vscale x 2 x i1>
%.masks, <vscale x 2 x half> %passthru)
declare <2 x float> @llvm.masked.gather.v2f32(<2 x ptr> %ptrs, i32 %align, <2 x i1> %masks, <2 x float>
%passthru)
declare <4 x i32> @llvm.masked.gather.v4i32(<4 x ptr> %ptrs, i32 %align, <4 x i1> %masks, <4 x i32> %passthru)
# RUN: llc -O0 -mtriple=m68k -start-after=prologuepillog -verify-machineinstrs %s -o - | FileCheck %s
```

name: is-pcrel-register-operand-legal

body: |

bb.0.entry:

```
; CHECK: move.l (0,%pc,%a0), (%a1)
```

```
; CHECK: move.l (%a0), (0,%pc,%a1)
```

```
MOV32jk $a1, 0, $a0, implicit-def $ccr
```

```
MOV32kj 0, $a1, $a0, implicit-def $ccr
```

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; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

; RUN: llc < %s -mtriple=x86\_64-linux-android -mattr=+mmx -enable-legalize-types-checking | FileCheck %s

;

; D31946

; Check that we dont end up with the ""LLVM ERROR: Cannot select" error.

; Additionally ensure that the output code actually put fp128 values in SSE registers.

```

declare fp128 @llvm.fabs.f128(fp128)
declare fp128 @llvm.copysign.f128(fp128, fp128)

define fp128 @TestSelect(fp128 %a, fp128 %b) {
; CHECK-LABEL: TestSelect:
; CHECK:      # %bb.0:
; CHECK-NEXT: pushq %rbx
; CHECK-NEXT: .cfi_def_cfa_offset 16
; CHECK-NEXT: subq $32, %rsp
; CHECK-NEXT: .cfi_def_cfa_offset 48
; CHECK-NEXT: .cfi_offset %rbx, -16
; CHECK-NEXT: movaps %xmm1, {[[-0-9]+]}(%r{[sb]})p) # 16-byte Spill
; CHECK-NEXT: movaps %xmm0, (%rsp) # 16-byte Spill
; CHECK-NEXT: callq __gttf2@PLT
; CHECK-NEXT: movl %eax, %ebx
; CHECK-NEXT: movaps (%rsp), %xmm0 # 16-byte Reload
; CHECK-NEXT: movaps {[[-0-9]+]}(%r{[sb]})p),
    %xmm1 # 16-byte Reload
; CHECK-NEXT: callq __subtf3@PLT
; CHECK-NEXT: testl %ebx, %ebx
; CHECK-NEXT: jg .LBB0_2
; CHECK-NEXT: # %bb.1:
; CHECK-NEXT: xorps %xmm0, %xmm0
; CHECK-NEXT: .LBB0_2:
; CHECK-NEXT: addq $32, %rsp
; CHECK-NEXT: .cfi_def_cfa_offset 16
; CHECK-NEXT: popq %rbx
; CHECK-NEXT: .cfi_def_cfa_offset 8
; CHECK-NEXT: retq
    %cmp = fcmp ogt fp128 %a, %b
    %sub = fsub fp128 %a, %b
    %res = select i1 %cmp, fp128 %sub, fp128 0xL00000000000000000000000000000000
    ret fp128 %res
}

define fp128 @TestFabs(fp128 %a) {
; CHECK-LABEL: TestFabs:
; CHECK:      # %bb.0:
; CHECK-NEXT: andps {[.?.LCPI[0-9]+_[0-9]+]}(%rip), %xmm0
; CHECK-NEXT: retq
    %res = call fp128 @llvm.fabs.f128(fp128 %a)
    ret fp128 %res
}

define fp128 @TestCopysign(fp128 %a, fp128 %b) {
; CHECK-LABEL: TestCopysign:
; CHECK:      # %bb.0:

```

```
; CHECK-NEXT: andps {{\.?LCPI[0-9]+_[0-9]+}}(%rip), %xmm1
; CHECK-NEXT: andps {{\.?LCPI[0-9]+_[0-9]+}}(%rip), %xmm0
; CHECK-NEXT:
    orps %xmm1, %xmm0
; CHECK-NEXT: retq
%res = call fp128 @llvm.copysign.f128(fp128 %a, fp128 %b)
ret fp128 %res
}
```

```
define fp128 @TestFneg(fp128 %a) {
; CHECK-LABEL: TestFneg:
; CHECK:      # %bb.0:
; CHECK-NEXT: pushq %rax
; CHECK-NEXT: .cfi_def_cfa_offset 16
; CHECK-NEXT: movaps %xmm0, %xmm1
; CHECK-NEXT: callq __multf3@PLT
; CHECK-NEXT: xorps {{\.?LCPI[0-9]+_[0-9]+}}(%rip), %xmm0
; CHECK-NEXT: popq %rax
; CHECK-NEXT: .cfi_def_cfa_offset 8
; CHECK-NEXT: retq
%mul = fmul fp128 %a, %a
%res = fsub fp128 0xL00000000000000008000000000000000, %mul
ret fp128 %res
}
```

-----

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; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

; RUN: llc -mtriple=riscv64 -mattr=+zbbk -verify-machineinstrs < %s \

; RUN: | FileCheck %s -check-prefix=RV64ZBKB

declare i64 @llvm.riscv.brev8.i64(i64)

define i64 @brev8(i64 %a) nounwind {

; RV64ZBKB-LABEL: brev8:

; RV64ZBKB: # %bb.0:

; RV64ZBKB-NEXT: brev8 a0, a0

; RV64ZBKB-NEXT: ret

%val = call i64 @llvm.riscv.brev8.i64(i64 %a)

ret i64 %val

}

; Test that rev8 is recognized as preserving zero extension.

define zeroext i16 @brev8\_knownbits(i16 zeroext %a) nounwind {

; RV64ZBKB-LABEL: brev8\_knownbits:

; RV64ZBKB: # %bb.0:

; RV64ZBKB-NEXT: brev8 a0, a0

; RV64ZBKB-NEXT: ret

%zext = zext i16 %a to i64

%val = call i64 @llvm.riscv.brev8.i64(i64 %zext)

```

%trunc = trunc i64 %val to i16
ret i16 %trunc
}

declare i64 @llvm.bswap.i64(i64)

define i64 @rev8_i64(i64 %a) {
; RV64ZBKB-LABEL: rev8_i64:
; RV64ZBKB:      # %bb.0:
; RV64ZBKB-NEXT:  rev8 a0, a0
; RV64ZBKB-NEXT:  ret
    %1 = call i64 @llvm.bswap.i64(i64 %a)
ret i64 %1
}

declare i32 @llvm.riscv.brev8.i32(i32)

define signext i32 @brev8_i32(i32 signext %a) nounwind {
; RV64ZBKB-LABEL: brev8_i32:
; RV64ZBKB:      # %bb.0:
; RV64ZBKB-NEXT:  brev8 a0, a0
; RV64ZBKB-NEXT:  sext.w a0, a0
; RV64ZBKB-NEXT:  ret
    %val = call i32 @llvm.riscv.brev8.i32(i32 %a)
ret i32 %val
}

; Test that rev8 is recognized as preserving zero extension.
define zeroext i16 @brev8_i32_knownbits(i16 zeroext %a) nounwind {
; RV64ZBKB-LABEL: brev8_i32_knownbits:
; RV64ZBKB:      # %bb.0:
; RV64ZBKB-NEXT:  brev8 a0, a0
; RV64ZBKB-NEXT:  ret
    %zext = zext i16 %a to i32
    %val = call i32 @llvm.riscv.brev8.i32(i32 %zext)
    %trunc = trunc i32 %val to i16
ret i16 %trunc
}

declare i32 @llvm.bswap.i32(i32)

define signext i32 @rev8_i32(i32 signext %a) {
; RV64ZBKB-LABEL: rev8_i32:
; RV64ZBKB:      # %bb.0:
; RV64ZBKB-NEXT:  rev8 a0, a0
; RV64ZBKB-NEXT:  srai a0, a0, 32
; RV64ZBKB-NEXT:  ret
    %1 = call i32 @llvm.bswap.i32(i32

```

```

%a)
ret i32 %1
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=amdgc -mcpu=fiji < %s | FileCheck -check-prefixes=VI %s

; FIXME: This one should fold to rcp
define half @select_fneg_posk_src_rcp_f16(i32 %c, half %x, half %y) {
; VI-LABEL: select_fneg_posk_src_rcp_f16:
; VI:      ; %bb.0:
; VI-NEXT:  s_waitcnt vmcnt(0) expcnt(0) lgkmcnt(0)
; VI-NEXT:  v_rcp_f16_e64 v1, -v1
; VI-NEXT:  v_mov_b32_e32 v2, 0x4000
; VI-NEXT:  v_cmp_eq_u32_e32 vcc, 0, v0
; VI-NEXT:  v_cndmask_b32_e32 v0, v2, v1, vcc
; VI-NEXT:  s_setpc_b64 s[30:31]
%cmp = icmp eq i32 %c, 0
%rcp = call half @llvm.amdgc.rcp.f16(half %x)
%fneg = fneg half %rcp
%select = select i1 %cmp, half %fneg, half 2.0
ret half %select
}

declare half @llvm.amdgc.rcp.f16(half) #0

attributes #0 = { nocallback nofree nosync nounwind speculatable willreturn memory(none) }
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; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64I
; RUN: llc -mtriple=riscv64 -mattr=+zbb -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64ZBB-ZBKB,RV64ZBB
; RUN: llc -mtriple=riscv64 -mattr=+zbbk -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefixes=CHECK,RV64ZBB-
ZBKB,RV64ZBKB

define signext i32 @andn_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: andn_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  not a1, a1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: andn_i32:
; RV64ZBB-ZBKB:      # %bb.0:
; RV64ZBB-ZBKB-NEXT:  andn a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
%neg = xor i32 %b, -1

```

```

%and = and i32 %neg, %a
ret i32 %and
}

```

```

define i64 @andn_i64(i64 %a, i64
%b) nounwind {
; RV64I-LABEL: andn_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: not a1, a1
; RV64I-NEXT: and a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBB-ZBKB-LABEL: andn_i64:
; RV64ZBB-ZBKB:  # %bb.0:
; RV64ZBB-ZBKB-NEXT: andn a0, a0, a1
; RV64ZBB-ZBKB-NEXT: ret
%neg = xor i64 %b, -1
%and = and i64 %neg, %a
ret i64 %and
}

```

```

define signext i32 @orn_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: orn_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT: not a1, a1
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBB-ZBKB-LABEL: orn_i32:
; RV64ZBB-ZBKB:  # %bb.0:
; RV64ZBB-ZBKB-NEXT: orn a0, a0, a1
; RV64ZBB-ZBKB-NEXT: ret
%neg = xor i32 %b, -1
%or = or i32 %neg, %a
ret i32 %or
}

```

```

define i64 @orn_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: orn_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT: not a1, a1
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ret
;
; RV64ZBB-ZBKB-LABEL: orn_i64:
; RV64ZBB-ZBKB:  # %bb.0:
; RV64ZBB-ZBKB-NEXT:

```

```

    orn a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
    %neg = xor i64 %b, -1
    %or = or i64 %neg, %a
    ret i64 %or
}

define signext i32 @xnor_i32(i32 signext %a, i32 signext %b) nounwind {
; CHECK-LABEL: xnor_i32:
; CHECK:      # %bb.0:
; CHECK-NEXT:  xor a0, a0, a1
; CHECK-NEXT:  not a0, a0
; CHECK-NEXT:  ret
    %neg = xor i32 %a, -1
    %xor = xor i32 %neg, %b
    ret i32 %xor
}

define i64 @xnor_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: xnor_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: xnor_i64:
; RV64ZBB-ZBKB:  # %bb.0:
; RV64ZBB-ZBKB-NEXT:  xnor a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
    %neg = xor i64 %a, -1
    %xor = xor i64 %neg, %b
    ret i64 %xor
}

declare i32 @llvm.fshl.i32(i32, i32, i32)

define signext i32 @rol_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: rol_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  andi a2, a1, -1
; RV64I-NEXT:  sllw a1, a0, a1
; RV64I-NEXT:
    negw a2, a2
; RV64I-NEXT:  srlw a0, a0, a2
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rol_i32:

```



```

; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  rolw a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshl.i32(i32 %a, i32 %a, i32 %b)
ret i32 %1
}

; Similar to rol_i32, but doesn't sign extend the result.
define void @rol_i32_nosext(i32 signext %a, i32 signext %b, ptr %x) nounwind {
; RV64I-LABEL: rol_i32_nosext:
; RV64I:    # %bb.0:
; RV64I-NEXT:  andi a3, a1, -1
; RV64I-NEXT:  sllw a1, a0, a1
; RV64I-NEXT:  negw a3, a3
; RV64I-NEXT:  srlw a0, a0, a3
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:  sw a0, 0(a2)
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rol_i32_nosext:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  rolw a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  sw a0, 0(a2)
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshl.i32(i32 %a, i32 %a, i32 %b)
store i32 %1, ptr %x
ret void
}

define signext
i32 @rol_i32_neg_constant_rhs(i32 signext %a) nounwind {
; RV64I-LABEL: rol_i32_neg_constant_rhs:
; RV64I:    # %bb.0:
; RV64I-NEXT:  andi a1, a0, -1
; RV64I-NEXT:  li a2, -2
; RV64I-NEXT:  sllw a0, a2, a0
; RV64I-NEXT:  negw a1, a1
; RV64I-NEXT:  srlw a1, a2, a1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rol_i32_neg_constant_rhs:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  li a1, -2
; RV64ZBB-ZBKB-NEXT:  rolw a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshl.i32(i32 -2, i32 -2, i32 %a)
ret i32 %1

```

```
}
```

```
declare i64 @llvm.fshl.i64(i64, i64, i64)
```

```
define i64 @rol_i64(i64 %a, i64 %b) nounwind {  
; RV64I-LABEL: rol_i64:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: sll a2, a0, a1  
; RV64I-NEXT: negw a1, a1  
; RV64I-NEXT: srl a0, a0, a1  
; RV64I-NEXT: or a0, a2, a0  
; RV64I-NEXT: ret  
;  
; RV64ZBB-ZBKB-LABEL: rol_i64:  
; RV64ZBB-ZBKB:  # %bb.0:  
; RV64ZBB-ZBKB-NEXT:  rol a0, a0, a1  
; RV64ZBB-ZBKB-NEXT:  
    ret  
%or = tail call i64 @llvm.fshl.i64(i64 %a, i64 %a, i64 %b)  
ret i64 %or  
}
```

```
declare i32 @llvm.fshr.i32(i32, i32, i32)
```

```
define signext i32 @ror_i32(i32 signext %a, i32 signext %b) nounwind {  
; RV64I-LABEL: ror_i32:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: andi a2, a1, -1  
; RV64I-NEXT: srlw a1, a0, a1  
; RV64I-NEXT: negw a2, a2  
; RV64I-NEXT: sllw a0, a0, a2  
; RV64I-NEXT: or a0, a1, a0  
; RV64I-NEXT: ret  
;  
; RV64ZBB-ZBKB-LABEL: ror_i32:  
; RV64ZBB-ZBKB:  # %bb.0:  
; RV64ZBB-ZBKB-NEXT:  rorw a0, a0, a1  
; RV64ZBB-ZBKB-NEXT:  ret  
%1 = tail call i32 @llvm.fshr.i32(i32 %a, i32 %a, i32 %b)  
ret i32 %1  
}
```

; Similar to ror\_i32, but doesn't sign extend the result.

```
define void @ror_i32_nosext(i32 signext %a, i32 signext %b, ptr %x) nounwind {  
; RV64I-LABEL: ror_i32_nosext:  
; RV64I:      # %bb.0:  
; RV64I-NEXT: andi a3, a1, -1  
; RV64I-NEXT: srlw a1, a0, a1
```

```

; RV64I-NEXT:  negw a3, a3
; RV64I-NEXT:  sllw a0, a0, a3
; RV64I-NEXT:  or a0, a1, a0
; RV64I-NEXT:
    sw a0, 0(a2)
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: ror_i32_nosext:
; RV64ZBB-ZBKB:      # %bb.0:
; RV64ZBB-ZBKB-NEXT:  rorw a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  sw a0, 0(a2)
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshr.i32(i32 %a, i32 %a, i32 %b)
store i32 %1, ptr %x
ret void
}

```

```

define signext i32 @ror_i32_neg_constant_rhs(i32 signext %a) nounwind {
; RV64I-LABEL: ror_i32_neg_constant_rhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  andi a1, a0, -1
; RV64I-NEXT:  li a2, -2
; RV64I-NEXT:  srlw a0, a2, a0
; RV64I-NEXT:  negw a1, a1
; RV64I-NEXT:  sllw a1, a2, a1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: ror_i32_neg_constant_rhs:
; RV64ZBB-ZBKB:      # %bb.0:
; RV64ZBB-ZBKB-NEXT:  li a1, -2
; RV64ZBB-ZBKB-NEXT:  rorw a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshr.i32(i32 -2, i32 -2, i32 %a)
ret i32 %1
}

```

```

declare i64 @llvm.fshr.i64(i64, i64, i64)

```

```

define i64 @ror_i64(i64 %a, i64 %b) nounwind {
;
RV64I-LABEL: ror_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srl a2, a0, a1
; RV64I-NEXT:  negw a1, a1
; RV64I-NEXT:  sll a0, a0, a1
; RV64I-NEXT:  or a0, a2, a0
; RV64I-NEXT:  ret

```

```

;
; RV64ZBB-ZBKB-LABEL: ror_i64:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  ror a0, a0, a1
; RV64ZBB-ZBKB-NEXT:  ret
%or = tail call i64 @llvm.fshr.i64(i64 %a, i64 %a, i64 %b)
ret i64 %or
}

define signext i32 @rori_i32_fshl(i32 signext %a) nounwind {
; RV64I-LABEL: rori_i32_fshl:
; RV64I:    # %bb.0:
; RV64I-NEXT:  srlw a1, a0, 1
; RV64I-NEXT:  sllw a0, a0, 31
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i32_fshl:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  roriw a0, a0, 1
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshl.i32(i32 %a, i32 %a, i32 31)
ret i32 %1
}

; Similar to rori_i32_fshl, but doesn't sign extend the result.
define void @rori_i32_fshl_nosext(i32 signext %a, ptr %x) nounwind {
; RV64I-LABEL: rori_i32_fshl_nosext:
;
RV64I:    # %bb.0:
; RV64I-NEXT:  srlw a2, a0, 1
; RV64I-NEXT:  slli a0, a0, 31
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  sw a0, 0(a1)
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i32_fshl_nosext:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  roriw a0, a0, 1
; RV64ZBB-ZBKB-NEXT:  sw a0, 0(a1)
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshl.i32(i32 %a, i32 %a, i32 31)
store i32 %1, ptr %x
ret void
}

define signext i32 @rori_i32_fshr(i32 signext %a) nounwind {
; RV64I-LABEL: rori_i32_fshr:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  slliw a1, a0, 1
; RV64I-NEXT:  srliw a0, a0, 31
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i32_fshr:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  roriw a0, a0, 31
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshr.i32(i32 %a, i32 %a, i32 31)
ret i32 %1
}

```

; Similar to rori\_i32\_fshr, but doesn't sign extend the result.

```

define void @rori_i32_fshr_nosext(i32
  signext %a, ptr %x) nounwind {
; RV64I-LABEL: rori_i32_fshr_nosext:
; RV64I:    # %bb.0:
; RV64I-NEXT:  slli a2, a0, 1
; RV64I-NEXT:  srliw a0, a0, 31
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  sw a0, 0(a1)
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i32_fshr_nosext:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  roriw a0, a0, 31
; RV64ZBB-ZBKB-NEXT:  sw a0, 0(a1)
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i32 @llvm.fshr.i32(i32 %a, i32 %a, i32 31)
store i32 %1, ptr %x
ret void
}

```

; This test is similar to the type legalized version of the fshl/fshr tests, but

; instead of having the same input to both shifts it has different inputs. Make

; sure we don't match it as a roriw.

```

define signext i32 @not_rori_i32(i32 signext %x, i32 signext %y) nounwind {
; CHECK-LABEL: not_rori_i32:
; CHECK:    # %bb.0:
; CHECK-NEXT:  slliw a0, a0, 31
; CHECK-NEXT:  srliw a1, a1, 1
; CHECK-NEXT:  or a0, a0, a1
; CHECK-NEXT:  ret
%a = shl
i32 %x, 31
%b = lshr i32 %y, 1

```

```

%c = or i32 %a, %b
ret i32 %c
}

```

; This is similar to the type legalized roriw pattern, but the and mask is more  
; than 32 bits so the lshr doesn't shift zeroes into the lower 32 bits. Make  
; sure we don't match it to roriw.

```

define i64 @roriw_bug(i64 %x) nounwind {
; CHECK-LABEL: roriw_bug:
; CHECK:      # %bb.0:
; CHECK-NEXT:  slli a1, a0, 31
; CHECK-NEXT:  andi a2, a0, -2
; CHECK-NEXT:  srli a0, a0, 1
; CHECK-NEXT:  or a0, a1, a0
; CHECK-NEXT:  sext.w a0, a0
; CHECK-NEXT:  xor a0, a2, a0
; CHECK-NEXT:  ret
%a = shl i64 %x, 31
%b = and i64 %x, 18446744073709551614
%c = lshr i64 %b, 1
%d = or i64 %a, %c
%e = shl i64 %d, 32
%f = ashr i64 %e, 32
%g = xor i64 %b, %f ; to increase the use count on %b to disable SimplifyDemandedBits.
ret i64 %g
}

```

```

define i64 @rori_i64_fshl(i64 %a) nounwind {
; RV64I-LABEL: rori_i64_fshl:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srli a1, a0, 1
; RV64I-NEXT:  slli a0, a0, 63
; RV64I-NEXT:
; or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i64_fshl:
; RV64ZBB-ZBKB:  # %bb.0:
; RV64ZBB-ZBKB-NEXT:  rori a0, a0, 1
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i64 @llvm.fshl.i64(i64 %a, i64 %a, i64 63)
ret i64 %1
}

```

```

define i64 @rori_i64_fshr(i64 %a) nounwind {
; RV64I-LABEL: rori_i64_fshr:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a1, a0, 1

```

```

; RV64I-NEXT:  srli a0, a0, 63
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: rori_i64_fshr:
; RV64ZBB-ZBKB:      # %bb.0:
; RV64ZBB-ZBKB-NEXT:  rori a0, a0, 63
; RV64ZBB-ZBKB-NEXT:  ret
%1 = tail call i64 @llvm.fshr.i64(i64 %a, i64 %a, i64 63)
ret i64 %1
}

```

```

define signext i32 @not_shl_one_i32(i32 signext %x) {
; RV64I-LABEL: not_shl_one_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  sllw a0, a1, a0
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: not_shl_one_i32:
; RV64ZBB-ZBKB:      # %bb.0:
; RV64ZBB-ZBKB-NEXT:  li a1,
-2
; RV64ZBB-ZBKB-NEXT:  rolw a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  ret
%1 = shl i32 1, %x
%2 = xor i32 %1, -1
ret i32 %2
}

```

```

define i64 @not_shl_one_i64(i64 %x) {
; RV64I-LABEL: not_shl_one_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 1
; RV64I-NEXT:  sll a0, a1, a0
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: not_shl_one_i64:
; RV64ZBB-ZBKB:      # %bb.0:
; RV64ZBB-ZBKB-NEXT:  li a1, -2
; RV64ZBB-ZBKB-NEXT:  rol a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  ret
%1 = shl i64 1, %x
%2 = xor i64 %1, -1
ret i64 %2
}

```

```

define i8 @srli_i8(i8 %a) nounwind {
; CHECK-LABEL: srli_i8:
; CHECK:      # %bb.0:
; CHECK-NEXT:  slli a0, a0, 56
; CHECK-NEXT:  srli a0, a0, 62
; CHECK-NEXT:  ret
%1 = lshr i8 %a, 6
ret i8 %1
}

```

; We could use sext.b+srai, but slli+srai offers more opportunities for  
; compressed instructions.

```

define i8 @srai_i8(i8 %a) nounwind {
; RV64I-LABEL: srai_i8:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:
    sraiw a0, a0, 29
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: srai_i8:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT:  slli a0, a0, 56
; RV64ZBB-NEXT:  srai a0, a0, 61
; RV64ZBB-NEXT:  ret
;
; RV64ZBKB-LABEL: srai_i8:
; RV64ZBKB:    # %bb.0:
; RV64ZBKB-NEXT:  slli a0, a0, 24
; RV64ZBKB-NEXT:  sraiw a0, a0, 29
; RV64ZBKB-NEXT:  ret
%1 = ashr i8 %a, 5
ret i8 %1
}

```

; We could use zext.h+srli, but slli+srli offers more opportunities for  
; compressed instructions.

```

define i16 @srli_i16(i16 %a) nounwind {
; CHECK-LABEL: srli_i16:
; CHECK:      # %bb.0:
; CHECK-NEXT:  slli a0, a0, 48
; CHECK-NEXT:  srli a0, a0, 54
; CHECK-NEXT:  ret
%1 = lshr i16 %a, 6
ret i16 %1
}

```



```

; We could use sext.h+srai, but slli+srai offers more opportunities for
; compressed instructions.
define i16 @srai_i16(i16 %a) nounwind {
; RV64I-LABEL: srai_i16:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a0, a0, 25
; RV64I-NEXT:  ret
;
; RV64ZBB-LABEL: srai_i16:
;
; RV64ZBB:      # %bb.0:
; RV64ZBB-NEXT:  slli a0, a0, 48
; RV64ZBB-NEXT:  srai a0, a0, 57
; RV64ZBB-NEXT:  ret
;
; RV64ZBKB-LABEL: srai_i16:
; RV64ZBKB:      # %bb.0:
; RV64ZBKB-NEXT:  slli a0, a0, 16
; RV64ZBKB-NEXT:  sraiw a0, a0, 25
; RV64ZBKB-NEXT:  ret
%1 = ashr i16 %a, 9
ret i16 %1
}

define i1 @andn_seqz_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: andn_seqz_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  seqz a0, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: andn_seqz_i32:
; RV64ZBB-ZBKB:      # %bb.0:
; RV64ZBB-ZBKB-NEXT:  andn a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  seqz a0, a0
; RV64ZBB-ZBKB-NEXT:  ret
%and = and i32 %a, %b
%cmpeq = icmp eq i32 %and, %b
ret i1 %cmpeq
}

define i1 @andn_seqz_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: andn_seqz_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  xor a0, a0, a1

```

```

; RV64I-NEXT:  seqz a0, a0
; RV64I-NEXT:
    ret
;
; RV64ZBB-ZBKB-LABEL: andn_seqz_i64:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  andn a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  seqz a0, a0
; RV64ZBB-ZBKB-NEXT:  ret
%and = and i64 %a, %b
%cmpeq = icmp eq i64 %and, %b
ret i1 %cmpeq
}

define i1 @andn_snez_i32(i32 signext %a, i32 signext %b) nounwind {
; RV64I-LABEL: andn_snez_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  snez a0, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: andn_snez_i32:
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  andn a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  snez a0, a0
; RV64ZBB-ZBKB-NEXT:  ret
%and = and i32 %a, %b
%cmpeq = icmp ne i32 %and, %b
ret i1 %cmpeq
}

define i1 @andn_snez_i64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: andn_snez_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  snez a0, a0
; RV64I-NEXT:  ret
;
; RV64ZBB-ZBKB-LABEL: andn_snez_i64:
;
; RV64ZBB-ZBKB:    # %bb.0:
; RV64ZBB-ZBKB-NEXT:  andn a0, a1, a0
; RV64ZBB-ZBKB-NEXT:  snez a0, a0
; RV64ZBB-ZBKB-NEXT:  ret
%and = and i64 %a, %b
%cmpeq = icmp ne i64 %and, %b

```

```

ret i1 %cmpeq
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64I %s
; RUN: llc -mtriple=riscv64 -mattr=+m -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64IM %s

```

```

define i32 @urem(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: urem:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 32
; RV64I-NEXT:  call __umoddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: urem:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  remuw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = urem i32 %a, %b
ret i32 %1
}

```

```

define i32 @urem_constant_lhs(i32 %a) nounwind {
;
; RV64I-LABEL: urem_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a1, a0, 32
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  call __umoddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: urem_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  remuw a0, a1, a0

```

```

; RV64IM-NEXT:  ret
%1 = urem i32 10, %a
ret i32 %1
}

define i32 @srem(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: srem:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  sext.w a1, a1
; RV64I-NEXT:  call __moddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:
    remw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = srem i32 %a, %b
ret i32 %1
}

define i32 @srem_pow2(i32 %a) nounwind {
; RV64I-LABEL: srem_pow2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  srliw a1, a1, 29
; RV64I-NEXT:  add a1, a0, a1
; RV64I-NEXT:  andi a1, a1, -8
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem_pow2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  sraiw a1, a0, 31
; RV64IM-NEXT:  srliw a1, a1, 29
; RV64IM-NEXT:  add a1, a0, a1
; RV64IM-NEXT:  andi a1, a1, -8
; RV64IM-NEXT:  subw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = srem i32 %a, 8
ret i32 %1
}

```

```

define i32 @srem_pow2_2(i32 %a) nounwind {
; RV64I-LABEL: srem_pow2_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  srliw a1, a1, 16
; RV64I-NEXT:  add a1, a0, a1
; RV64I-NEXT:  lui a2, 1048560
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem_pow2_2:
; RV64IM:
;   # %bb.0:
; RV64IM-NEXT:  sraiw a1, a0, 31
; RV64IM-NEXT:  srliw a1, a1, 16
; RV64IM-NEXT:  add a1, a0, a1
; RV64IM-NEXT:  lui a2, 1048560
; RV64IM-NEXT:  and a1, a1, a2
; RV64IM-NEXT:  subw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = srem i32 %a, 65536
ret i32 %1
}

define i32 @srem_constant_lhs(i32 %a) nounwind {
; RV64I-LABEL: srem_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sext.w a1, a0
; RV64I-NEXT:  li a0, -10
; RV64I-NEXT:  call __moddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, -10
; RV64IM-NEXT:  remw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = srem i32 -10, %a
ret i32 %1
}

define i64 @urem64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: urem64:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  tail __umoddi3
;
; RV64IM-LABEL:
urem64:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  remu a0, a0, a1
; RV64IM-NEXT:  ret
%1 = urem i64 %a, %b
ret i64 %1
}

define i64 @urem64_constant_lhs(i64 %a) nounwind {
; RV64I-LABEL: urem64_constant_lhs:
; RV64I:    # %bb.0:
; RV64I-NEXT:  mv a1, a0
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  tail __umoddi3
;
; RV64IM-LABEL: urem64_constant_lhs:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  remu a0, a1, a0
; RV64IM-NEXT:  ret
%1 = urem i64 10, %a
ret i64 %1
}

define i64 @srem64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: srem64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  tail __moddi3
;
; RV64IM-LABEL: srem64:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  rem a0, a0, a1
; RV64IM-NEXT:  ret
%1 = srem i64 %a, %b
ret i64 %1
}

define i64 @srem64_constant_lhs(i64 %a) nounwind {
; RV64I-LABEL: srem64_constant_lhs:
; RV64I:    # %bb.0:
; RV64I-NEXT:  mv a1, a0
; RV64I-NEXT:  li a0, -10
; RV64I-NEXT:  tail __moddi3
;

```

```

; RV64IM-LABEL: srem64_constant_lhs:
;
RV64IM:    # %bb.0:
; RV64IM-NEXT:  li a1, -10
; RV64IM-NEXT:  rem a0, a1, a0
; RV64IM-NEXT:  ret
%1 = srem i64 -10, %a
ret i64 %1
}

define i8 @urem8(i8 %a, i8 %b) nounwind {
; RV64I-LABEL: urem8:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  andi a0, a0, 255
; RV64I-NEXT:  andi a1, a1, 255
; RV64I-NEXT:  call __umoddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: urem8:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  andi a1, a1, 255
; RV64IM-NEXT:  andi a0, a0, 255
; RV64IM-NEXT:  remuw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = urem i8 %a, %b
ret i8 %1
}

define i8 @urem8_constant_lhs(i8 %a) nounwind {
; RV64I-LABEL: urem8_constant_lhs:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  andi a1, a0, 255
; RV64I-NEXT:
    li a0, 10
; RV64I-NEXT:  call __umoddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: urem8_constant_lhs:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  andi a0, a0, 255

```

```
; RV64IM-NEXT: li a1, 10
; RV64IM-NEXT: remuw a0, a1, a0
; RV64IM-NEXT: ret
%1 = urem i8 10, %a
ret i8 %1
}
```

```
define i8 @srem8(i8 %a, i8 %b) nounwind {
; RV64I-LABEL: srem8:
; RV64I:    # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: slli a1, a1, 24
; RV64I-NEXT: sraiw a1, a1, 24
; RV64I-NEXT: slli a0, a0, 24
; RV64I-NEXT: sraiw a0, a0, 24
; RV64I-NEXT: call __moddi3
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64IM-LABEL: srem8:
; RV64IM:    # %bb.0:
; RV64IM-NEXT: slli a1, a1, 24
; RV64IM-NEXT: sraiw a1, a1, 24
; RV64IM-NEXT: slli a0, a0, 24
; RV64IM-NEXT: sraiw
a0, a0, 24
; RV64IM-NEXT: remw a0, a0, a1
; RV64IM-NEXT: ret
%1 = srem i8 %a, %b
ret i8 %1
}
```

```
define i8 @srem8_constant_lhs(i8 %a) nounwind {
; RV64I-LABEL: srem8_constant_lhs:
; RV64I:    # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: slli a0, a0, 24
; RV64I-NEXT: sraiw a1, a0, 24
; RV64I-NEXT: li a0, -10
; RV64I-NEXT: call __moddi3
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
;
```



```

; RV64IM-LABEL: srem8_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 24
; RV64IM-NEXT:  sraiw a0, a0, 24
; RV64IM-NEXT:  li a1, -10
; RV64IM-NEXT:  remw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = srem i8 -10, %a
ret i8 %1
}

```

```

define i16 @urem16(i16 %a, i16 %b) nounwind {
; RV64I-LABEL: urem16:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  lui a2, 16
; RV64I-NEXT:
    addiw a2, a2, -1
; RV64I-NEXT:  and a0, a0, a2
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  call __umoddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: urem16:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  lui a2, 16
; RV64IM-NEXT:  addi a2, a2, -1
; RV64IM-NEXT:  and a1, a1, a2
; RV64IM-NEXT:  and a0, a0, a2
; RV64IM-NEXT:  remuw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = urem i16 %a, %b
ret i16 %1
}

```

```

define i16 @urem16_constant_lhs(i16 %a) nounwind {
; RV64I-LABEL: urem16_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a1, a0, 48
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  call __umoddi3

```

```

; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64IM-LABEL: urem16_constant_lhs:
; RV64IM:    # %bb.0:
;
RV64IM-NEXT: slli a0, a0, 48
; RV64IM-NEXT: srli a0, a0, 48
; RV64IM-NEXT: li a1, 10
; RV64IM-NEXT: remuw a0, a1, a0
; RV64IM-NEXT: ret
%1 = urem i16 10, %a
ret i16 %1
}

```

```

define i16 @srem16(i16 %a, i16 %b) nounwind {
; RV64I-LABEL: srem16:
; RV64I:    # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: slli a1, a1, 16
; RV64I-NEXT: sraiw a1, a1, 16
; RV64I-NEXT: slli a0, a0, 16
; RV64I-NEXT: sraiw a0, a0, 16
; RV64I-NEXT: call __moddi3
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64IM-LABEL: srem16:
; RV64IM:    # %bb.0:
; RV64IM-NEXT: slli a1, a1, 16
; RV64IM-NEXT: sraiw a1, a1, 16
; RV64IM-NEXT: slli a0, a0, 16
; RV64IM-NEXT: sraiw a0, a0, 16
; RV64IM-NEXT: remw a0, a0, a1
; RV64IM-NEXT: ret
%1 = srem i16 %a, %b
ret i16 %1
}

```

```

define i16 @srem16_constant_lhs(i16 %a) nounwind {
; RV64I-LABEL: srem16_constant_lhs:
;
RV64I:    # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill

```

```

; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a1, a0, 16
; RV64I-NEXT:  li a0, -10
; RV64I-NEXT:  call __moddi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: srem16_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 16
; RV64IM-NEXT:  sraiw a0, a0, 16
; RV64IM-NEXT:  li a1, -10
; RV64IM-NEXT:  remw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = srem i16 -10, %a
ret i16 %1
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=aarch64-apple-ios %s -o - | FileCheck %s

```

```

define <16 x double> @test_sitofp_fixed(<16 x i32> %in) {

```

```

; CHECK-LABEL: test_sitofp_fixed:
; CHECK:      ; %bb.0:
; CHECK-NEXT:  sshll2.2d v4, v0, #0
; CHECK-NEXT:  sshll.2d v0, v0, #0
; CHECK-NEXT:  sshll2.2d v5, v1, #0
; CHECK-NEXT:  sshll.2d v6, v1, #0
; CHECK-NEXT:  sshll.2d v7, v2, #0
; CHECK-NEXT:  sshll2.2d v16, v2, #0
; CHECK-NEXT:  sshll2.2d v17, v3, #0
; CHECK-NEXT:  sshll.2d v18, v3, #0
; CHECK-NEXT:  scvtf.2d v1, v4, #6
; CHECK-NEXT:  scvtf.2d v0, v0, #6
; CHECK-NEXT:  scvtf.2d v3, v5, #6
; CHECK-NEXT:  scvtf.2d v2, v6, #6
; CHECK-NEXT:  scvtf.2d v4, v7, #6
; CHECK-NEXT:  scvtf.2d v5, v16, #6
; CHECK-NEXT:  scvtf.2d v7, v17, #6
; CHECK-NEXT:  scvtf.2d v6, v18, #6
; CHECK-NEXT:  ret

```

```

%flt = sitofp <16 x i32> %in to <16 x double>
%res = fdiv <16 x double> %flt, <double 64.0, double 64.0, double 64.0,
double 64.0, double 64.0, double 64.0, double 64.0, double 64.0, double
64.0, double 64.0, double 64.0, double 64.0, double 64.0>
ret <16 x double> %res
}

```

```

; This one is small enough to satisfy isSimple, but still illegally large.
define <4 x double> @test_sitofp_fixed_shortish(<4 x i64> %in) {
; CHECK-LABEL: test_sitofp_fixed_shortish:
; CHECK:      ; %bb.0:
; CHECK-NEXT:  scvtf.2d v0, v0, #6
; CHECK-NEXT:  scvtf.2d v1, v1, #6
; CHECK-NEXT:  ret

%flt = sitofp <4 x i64> %in to <4 x double>
%res = fdiv <4 x double> %flt, <double 64.0, double 64.0, double 64.0, double 64.0>
ret <4 x double> %res
}
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64I

```

```

; These tests are each targeted at a particular RISC-V ALU instruction. Most
; other files in this folder exercise LLVM IR instructions that don't directly
; match a RISC-V instruction.

```

```

; Register-immediate instructions.

```

```

define i32 @addi(i32 %a) nounwind {
; RV64I-LABEL: addi:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addiw a0, a0, 1
; RV64I-NEXT:  ret
%1 = add i32 %a, 1
ret i32 %1
}

```

```

define i32 @slti(i32 %a) nounwind {
; RV64I-LABEL: slti:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  slti a0, a0, 2
; RV64I-NEXT:  ret
%1 = icmp slt i32 %a, 2
%2 = zext i1 %1 to i32
ret i32 %2
}

```

```

define i32 @sltiu(i32 %a) nounwind {
; RV64I-LABEL: sltiu:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sext.w a0, a0

```

```

; RV64I-NEXT:  sltiu a0, a0, 3
; RV64I-NEXT:
    ret
%1 = icmp ult i32 %a, 3
%2 = zext i1 %1 to i32
ret i32 %2
}

define i32 @xori(i32 %a) nounwind {
; RV64I-LABEL: xori:
; RV64I:      # %bb.0:
; RV64I-NEXT:  xori a0, a0, 4
; RV64I-NEXT:  ret
%1 = xor i32 %a, 4
ret i32 %1
}

define i32 @ori(i32 %a) nounwind {
; RV64I-LABEL: ori:
; RV64I:      # %bb.0:
; RV64I-NEXT:  ori a0, a0, 5
; RV64I-NEXT:  ret
%1 = or i32 %a, 5
ret i32 %1
}

define i32 @andi(i32 %a) nounwind {
; RV64I-LABEL: andi:
; RV64I:      # %bb.0:
; RV64I-NEXT:  andi a0, a0, 6
; RV64I-NEXT:  ret
%1 = and i32 %a, 6
ret i32 %1
}

define i32 @slli(i32 %a) nounwind {
; RV64I-LABEL: slli:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slliw a0, a0, 7
; RV64I-NEXT:  ret
%1 = shl i32 %a, 7
ret i32 %1
}

define i32 @srli(i32 %a) nounwind {
; RV64I-LABEL: srli:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a0, a0, 8

```

```

; RV64I-NEXT:  ret
%1 = lshr i32 %a, 8
ret i32 %1
}

define i32 @srai(i32 %a) nounwind {
; RV64I-LABEL: srai:
; RV64I:
# %bb.0:
; RV64I-NEXT:  sraiw a0, a0, 9
; RV64I-NEXT:  ret
%1 = ashr i32 %a, 9
ret i32 %1
}

; Register-register instructions

define i32 @add(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: add:
; RV64I:  # %bb.0:
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  ret
%1 = add i32 %a, %b
ret i32 %1
}

define i32 @sub(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: sub:
; RV64I:  # %bb.0:
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  ret
%1 = sub i32 %a, %b
ret i32 %1
}

define i32 @sub_negative_constant_lhs(i32 %a) nounwind {
; RV64I-LABEL: sub_negative_constant_lhs:
; RV64I:  # %bb.0:
; RV64I-NEXT:  li a1, -2
; RV64I-NEXT:  subw a0, a1, a0
; RV64I-NEXT:  ret
%1 = sub i32 -2, %a
ret i32 %1
}

define i32 @sll(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: sll:
; RV64I:  # %bb.0:

```

```
; RV64I-NEXT:  sllw a0, a0, a1
; RV64I-NEXT:  ret
%1 = shl i32 %a, %b
ret i32 %1
}
```

; Make sure we don't emit instructions to zero extend the shift amount to i64.

```
define
i32 @sll_shamt_zext(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: sll_shamt_zext:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a1, a1, 1
; RV64I-NEXT:  sllw a0, a0, a1
; RV64I-NEXT:  ret
%shamt = add i32 %b, 1
%1 = shl i32 %a, %shamt
ret i32 %1
}
```

```
define i32 @sll_negative_constant_lhs(i32 %a) nounwind {
; RV64I-LABEL: sll_negative_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  sllw a0, a1, a0
; RV64I-NEXT:  ret
%1 = shl i32 -1, %a
ret i32 %1
}
```

```
define i32 @slt(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: slt:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sext.w a1, a1
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  slt a0, a0, a1
; RV64I-NEXT:  ret
%1 = icmp slt i32 %a, %b
%2 = zext i1 %1 to i32
ret i32 %2
}
```

```
define i32 @sltu(i32 %a, i32 %b) nounwind {
;
; RV64I-LABEL: sltu:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sext.w a1, a1
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  sltu a0, a0, a1
```

```
; RV64I-NEXT:  ret
%1 = icmp ult i32 %a,
%b
%2 = zext i1 %1 to i32
ret i32 %2
}
```

```
define i32 @xor(i32 %a, i32 %b) nounwind {
;
; RV64I-LABEL: xor:
; RV64I:      # %bb.0:
; RV64I-NEXT:  xor a0, a0, a1
; RV64I-NEXT:  ret
%1 = xor i32 %a, %b
ret i32 %1
}
```

```
define i32 @srl(i32 %a, i32 %b) nounwind {
;
; RV64I-LABEL: srl:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a0, a0, a1
; RV64I-NEXT:  ret
%1 = lshr i32 %a, %b
ret i32 %1
}
```

; Make sure we don't emit instructions to zero extend the shift amount to i64.

```
define i32 @srl_shamt_zext(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: srl_shamt_zext:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a1, a1, 1
; RV64I-NEXT:  srlw a0, a0, a1
; RV64I-NEXT:  ret
%shamt = add i32 %b, 1
%1 = lshr i32 %a, %shamt
ret i32 %1
}
```

```
define i32 @srl_negative_constant_lhs(i32 %a) nounwind {
;
; RV64I-LABEL: srl_negative_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, -1
; RV64I-NEXT:  srlw a0, a1, a0
; RV64I-NEXT:  ret
%1 = lshr i32 -1, %a
ret i32 %1
}
```



```
}
```

```
define
```

```
  i32 @sra(i32 %a, i32 %b) nounwind {
```

```
  ;
```

```
  ; RV64I-LABEL: sra:
```

```
  ; RV64I:      # %bb.0:
```

```
  ; RV64I-NEXT:  sraw a0, a0, a1
```

```
  ; RV64I-NEXT:  ret
```

```
    %1 = ashr i32 %a, %b
```

```
    ret i32 %1
```

```
}
```

```
; Make sure we don't emit instructions to zero extend the shift amount to i64.
```

```
define i32 @sra_shamt_zext(i32 %a, i32 %b) nounwind {
```

```
  ; RV64I-LABEL: sra_shamt_zext:
```

```
  ; RV64I:      # %bb.0:
```

```
  ; RV64I-NEXT:  addi a1, a1, 1
```

```
  ; RV64I-NEXT:  sraw a0, a0, a1
```

```
  ; RV64I-NEXT:  ret
```

```
    %shamt = add i32 %b, 1
```

```
    %1 = ashr i32 %a, %shamt
```

```
    ret i32 %1
```

```
}
```

```
define i32 @sra_negative_constant_lhs(i32 %a) nounwind {
```

```
  ;
```

```
  ; RV64I-LABEL: sra_negative_constant_lhs:
```

```
  ; RV64I:      # %bb.0:
```

```
  ; RV64I-NEXT:  lui a1, 524288
```

```
  ; RV64I-NEXT:  sraw a0, a1, a0
```

```
  ; RV64I-NEXT:  ret
```

```
    %1 = ashr i32 2147483648, %a
```

```
    ret i32 %1
```

```
}
```

```
define i32 @or(i32 %a, i32 %b) nounwind {
```

```
  ;
```

```
  ; RV64I-LABEL: or:
```

```
  ; RV64I:      # %bb.0:
```

```
  ; RV64I-NEXT:  or a0, a0, a1
```

```
  ; RV64I-NEXT:  ret
```

```
    %1 = or i32 %a, %b
```

```
    ret i32 %1
```

```
}
```

```
define i32 @and(i32 %a, i32 %b) nounwind {
```

```
  ;
```

```

; RV64I-LABEL:
and:
; RV64I:    # %bb.0:
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  ret
%1 = and i32 %a, %b
ret i32 %1
}
; NOTE: Assertions have been autogenerated by utils/update_test_checks.py UTC_ARGS: --include-generated-funcs
; RUN: opt -S -passes=verify,iroutliner -ir-outlining-no-cost < %s | FileCheck %s

```

; This test checks that we do outline indirect calls when it is not specified  
; that we should not.

```

declare void @f1(ptr, ptr);
declare void @f2(ptr, ptr);

```

```

define void @function1(ptr %func) {
entry:
%a = alloca i32, align 4
%b = alloca i32, align 4
%c = alloca i32, align 4
store i32 2, ptr %a, align 4
store i32 3, ptr %b, align 4
store i32 4, ptr %c, align 4
call void %func()
%al = load i32, ptr %a
%bl = load i32, ptr %b
%cl = load i32, ptr %c
ret void
}

```

```

define void @function2(ptr %func) {
entry:
%a = alloca i32, align 4
%b = alloca i32, align 4
%c = alloca i32, align 4
store i32 2, ptr %a, align 4
store i32 3, ptr %b, align 4
store i32 4, ptr %c, align 4
call void %func()
%al = load i32, ptr %a
%bl = load i32, ptr %b
%cl = load i32, ptr %c
ret void
}
;

```

```

CHECK-LABEL: @function1(
; CHECK-NEXT: entry:
; CHECK-NEXT: [[A:%.*]] = alloca i32, align 4
; CHECK-NEXT: [[B:%.*]] = alloca i32, align 4
; CHECK-NEXT: [[C:%.*]] = alloca i32, align 4
; CHECK-NEXT: call void @outlined_ir_func_0(ptr [[A]], ptr [[B]], ptr [[C]], ptr [[FUNC:%.*]])
; CHECK-NEXT: ret void
;
;
; CHECK-LABEL: @function2(
; CHECK-NEXT: entry:
; CHECK-NEXT: [[A:%.*]] = alloca i32, align 4
; CHECK-NEXT: [[B:%.*]] = alloca i32, align 4
; CHECK-NEXT: [[C:%.*]] = alloca i32, align 4
; CHECK-NEXT: call void @outlined_ir_func_0(ptr [[A]], ptr [[B]], ptr [[C]], ptr [[FUNC:%.*]])
; CHECK-NEXT: ret void
;
;
; CHECK-LABEL: define internal void @outlined_ir_func_0(
; CHECK-NEXT: newFuncRoot:
; CHECK-NEXT: br label [[ENTRY_TO_OUTLINE:%.*]]
; CHECK: entry_to_outline:
; CHECK-NEXT: store i32 2, ptr [[TMP0:%.*]], align 4
; CHECK-NEXT: store i32 3, ptr [[TMP1:%.*]], align 4
; CHECK-NEXT: store i32 4, ptr [[TMP2:%.*]], align 4
; CHECK-NEXT:
; CHECK-NEXT: call void [[TMP3:%.*]]()
; CHECK-NEXT: [[AL:%.*]] = load i32, ptr [[TMP0]], align 4
; CHECK-NEXT: [[BL:%.*]] = load i32, ptr [[TMP1]], align 4
; CHECK-NEXT: [[CL:%.*]] = load i32, ptr [[TMP2]], align 4
; CHECK-NEXT: br label [[ENTRY_AFTER_OUTLINE_EXITSTUB:%.*]]
; CHECK: entry_after_outline.exitStub:
; CHECK-NEXT: ret void
;
;
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64I
; RUN: llc -mtriple=riscv64 -mattr=+xtheadbb -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64XTHEADBB

```

```

declare i32 @llvm.ctlz.i32(i32, i1)

```

```

define signext i32 @ctlz_i32(i32 signext %a) nounwind {
; RV64I-LABEL: ctlz_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT: beqz a0, .LBB0_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: addi sp, sp, -16

```

```

; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 2
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 8
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 16
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT:
    not a0, a0
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 24
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
; RV64I-NEXT: .LBB0_2:
; RV64I-NEXT: li a0, 32
; RV64I-NEXT: ret
;
; RV64XTHEADBB-LABEL: ctlz_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT: th.extu a0, a0, 31, 0
; RV64XTHEADBB-NEXT: th.ff1 a0,
a0
; RV64XTHEADBB-NEXT: addi a0, a0, -32
; RV64XTHEADBB-NEXT: ret
%1 = call i32 @llvm.ctlz.i32(i32 %a, i1 false)

```

```

ret i32 %1
}

define signext i32 @log2_i32(i32 signext %a) nounwind {
; RV64I-LABEL: log2_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT: beqz a0, .LBB1_2
; RV64I-NEXT: # %bb.1: # %cond.false
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 2
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 8
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 16
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: not a0, a0
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT: lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT:
and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 24
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: j .LBB1_3
; RV64I-NEXT: .LBB1_2:
; RV64I-NEXT: li a0, 32
; RV64I-NEXT: .LBB1_3: # %cond.end

```

```

; RV64I-NEXT:  li a1, 31
; RV64I-NEXT:  subw a0, a1, a0
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: log2_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  th.extu a0, a0, 31, 0
; RV64XTHEADBB-NEXT:  th.ff1 a0, a0
; RV64XTHEADBB-NEXT:  addi a0, a0, -32
; RV64XTHEADBB-NEXT:  li a1, 31
; RV64XTHEADBB-NEXT:  subw a0, a1, a0
; RV64XTHEADBB-NEXT:  ret
%1 = call i32 @llvmctlz.i32(i32
%a, i1 false)
%2 = sub i32 31, %1
ret i32 %2
}

define signext i32 @log2_ceil_i32(i32 signext %a) nounwind {
; RV64I-LABEL: log2_ceil_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:  addiw a0, a0, -1
; RV64I-NEXT:  li s0, 32
; RV64I-NEXT:  li a1, 32
; RV64I-NEXT:  beqz a0, .LBB2_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 4
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srliw a1, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  srliw a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addi a2, a2, 1365
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:
    lui a1, 209715
; RV64I-NEXT:  addi a1, a1, 819

```

```

; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a1, a0, 24
; RV64I-NEXT: .LBB2_2: # %cond.end
; RV64I-NEXT: subw a0, s0, a1
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64XTHEADBB-LABEL: log2_ceil_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT: addi a0, a0, -1
; RV64XTHEADBB-NEXT: slli a0, a0, 32
; RV64XTHEADBB-NEXT: srli a0, a0, 32
; RV64XTHEADBB-NEXT: th.ff1 a0, a0
; RV64XTHEADBB-NEXT: addi a0, a0, -32
; RV64XTHEADBB-NEXT:
    li a1, 32
; RV64XTHEADBB-NEXT: subw a0, a1, a0
; RV64XTHEADBB-NEXT: ret
%1 = sub i32 %a, 1
%2 = call i32 @llvmctlz.i32(i32 %1, i1 false)
%3 = sub i32 32, %2
ret i32 %3
}

define signext i32 @findLastSet_i32(i32 signext %a) nounwind {
; RV64I-LABEL: findLastSet_i32:
; RV64I:    # %bb.0:
; RV64I-NEXT: addi sp, sp, -16
; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT: mv s0, a0
; RV64I-NEXT: srliw a0, a0, 1
; RV64I-NEXT: or a0, s0, a0
; RV64I-NEXT: srliw a1, a0, 2
; RV64I-NEXT: or a0, a0, a1

```

```

; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 8
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: srliw a1, a0, 16
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: not a0, a0
; RV64I-NEXT: srliw a1, a0, 1
; RV64I-NEXT: lui a2, 349525
; RV64I-NEXT: addi a2, a2, 1365
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: subw a0, a0, a1
; RV64I-NEXT:
    lui a1, 209715
; RV64I-NEXT: addi a1, a1, 819
; RV64I-NEXT: and a2, a0, a1
; RV64I-NEXT: srliw a0, a0, 2
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: add a0, a2, a0
; RV64I-NEXT: srliw a1, a0, 4
; RV64I-NEXT: addw a0, a0, a1
; RV64I-NEXT: lui a1, 61681
; RV64I-NEXT: addiw a1, a1, -241
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 4112
; RV64I-NEXT: addiw a1, a1, 257
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 24
; RV64I-NEXT: xori a0, a0, 31
; RV64I-NEXT: snez a1, s0
; RV64I-NEXT: addiw a1, a1, -1
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64XTHEADBB-LABEL: findLastSet_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT: th.extu a1, a0, 31, 0
; RV64XTHEADBB-NEXT: th.ff1 a1, a1
; RV64XTHEADBB-NEXT: addiw a1, a1, -32
; RV64XTHEADBB-NEXT: xori a1, a1,
31
; RV64XTHEADBB-NEXT: snez a0, a0
; RV64XTHEADBB-NEXT: addiw a0, a0, -1
; RV64XTHEADBB-NEXT: or a0, a0, a1
; RV64XTHEADBB-NEXT: ret

```



```

%1 = call i32 @llvm.ctlz.i32(i32 %a, i1 true)
%2 = xor i32 31, %1
%3 = icmp eq i32 %a, 0
%4 = select i1 %3, i32 -1, i32 %2
ret i32 %4
}

```

```

define i32 @ctlz_lshr_i32(i32 signext %a) {
; RV64I-LABEL: ctlz_lshr_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a0, a0, 1
; RV64I-NEXT:  beqz a0, .LBB4_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  .cfi_def_cfa_offset 16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  .cfi_offset ra, -8
; RV64I-NEXT:  srlw a1, a0, 1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srlw a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srlw a1, a0, 4
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srlw a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srlw a1, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  not
a0, a0
; RV64I-NEXT:  srlw a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addi a2, a2, 1365
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  subw a0, a0, a1
; RV64I-NEXT:  lui a1, 209715
; RV64I-NEXT:  addi a1, a1, 819
; RV64I-NEXT:  and a2, a0, a1
; RV64I-NEXT:  srlw a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srlw a1, a0, 4
; RV64I-NEXT:  addw a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  call __muldi3

```

```

; RV64I-NEXT:  srlw a0, a0, 24
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
; RV64I-NEXT:  .LBB4_2:
; RV64I-NEXT:  li a0, 32
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: ctlz_lshr_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  srlw a0, a0, 1
; RV64XTHEADBB-NEXT:  th.ff1 a0, a0
; RV64XTHEADBB-NEXT:
    addi a0, a0, -32
; RV64XTHEADBB-NEXT:  ret
%1 = lshr i32 %a, 1
%2 = call i32 @llvm.ctlz.i32(i32 %1, i1 false)
ret i32 %2
}

```

```
declare i64 @llvm.ctlz.i64(i64, i1)
```

```

define i64 @ctlz_i64(i64 %a) nounwind {
; RV64I-LABEL: ctlz_i64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  beqz a0, .LBB5_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  srli a1, a0, 1
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 4
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 8
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 16
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  srli a1, a0, 32
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  not a0, a0
; RV64I-NEXT:  srli a1, a0, 1
; RV64I-NEXT:  lui a2, 349525
; RV64I-NEXT:  addiw a2, a2, 1365
; RV64I-NEXT:  slli a3, a2, 32
; RV64I-NEXT:  add a2, a2,

```

```

a3
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  sub a0, a0, a1
; RV64I-NEXT:  lui a1, 209715
; RV64I-NEXT:  addiw a1, a1, 819
; RV64I-NEXT:  slli a2, a1, 32
; RV64I-NEXT:  add a1, a1, a2
; RV64I-NEXT:  and a2, a0, a1
; RV64I-NEXT:  srli a0, a0, 2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  add a0, a2, a0
; RV64I-NEXT:  srli a1, a0, 4
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  lui a1, 61681
; RV64I-NEXT:  addiw a1, a1, -241
; RV64I-NEXT:  slli a2, a1, 32
; RV64I-NEXT:  add a1, a1, a2
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 4112
; RV64I-NEXT:  addiw a1, a1, 257
; RV64I-NEXT:  slli a2, a1, 32
; RV64I-NEXT:  add a1, a1, a2
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srli a0, a0, 56
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
; RV64I-NEXT:  .LBB5_2:
; RV64I-NEXT:  li a0, 64
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: ctlz_i64:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:
    th.ff1 a0, a0
; RV64XTHEADBB-NEXT:  ret
%1 = call i64 @llvm.ctlz.i64(i64 %a, i1 false)
ret i64 %1
}

```

```

declare i32 @llvm.cttz.i32(i32, i1)

```

```

define signext i32 @cttz_i32(i32 signext %a) nounwind {
; RV64I-LABEL: cttz_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  beqz a0, .LBB6_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16

```

```

; RV64I-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT: negw a1, a0
; RV64I-NEXT: and a0, a0, a1
; RV64I-NEXT: lui a1, 30667
; RV64I-NEXT: addiw a1, a1, 1329
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 27
; RV64I-NEXT: lui a1, %hi(.LCPI6_0)
; RV64I-NEXT: addi a1, a1, %lo(.LCPI6_0)
; RV64I-NEXT: add a0, a1, a0
; RV64I-NEXT: lbu a0, 0(a0)
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
; RV64I-NEXT: .LBB6_2:
; RV64I-NEXT: li a0, 32
; RV64I-NEXT: ret
;
; RV64XTHEADBB-LABEL: cttz_i32:
; RV64XTHEADBB:    #
%bb.0:
; RV64XTHEADBB-NEXT: beqz a0, .LBB6_2
; RV64XTHEADBB-NEXT: # %bb.1: # %cond.false
; RV64XTHEADBB-NEXT: addi sp, sp, -16
; RV64XTHEADBB-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT: negw a1, a0
; RV64XTHEADBB-NEXT: and a0, a0, a1
; RV64XTHEADBB-NEXT: lui a1, 30667
; RV64XTHEADBB-NEXT: addiw a1, a1, 1329
; RV64XTHEADBB-NEXT: call __muldi3
; RV64XTHEADBB-NEXT: srliw a0, a0, 27
; RV64XTHEADBB-NEXT: lui a1, %hi(.LCPI6_0)
; RV64XTHEADBB-NEXT: addi a1, a1, %lo(.LCPI6_0)
; RV64XTHEADBB-NEXT: add a0, a1, a0
; RV64XTHEADBB-NEXT: lbu a0, 0(a0)
; RV64XTHEADBB-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT: addi sp, sp, 16
; RV64XTHEADBB-NEXT: ret
; RV64XTHEADBB-NEXT: .LBB6_2:
; RV64XTHEADBB-NEXT: li a0, 32
; RV64XTHEADBB-NEXT: ret
; RV64ZBB-LABEL: cttz_i32:
; RV64ZBB:    # %bb.0:
; RV64ZBB-NEXT: ctw a0, a0
; RV64ZBB-NEXT: ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 false)
ret i32 %1
}

```

```

define
  signext i32 @cttz_zero_undef_i32(i32 signext %a) nounwind {
; RV64I-LABEL: cttz_zero_undef_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  negw a1, a0
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, 30667
; RV64I-NEXT:  addiw a1, a1, 1329
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srliw a0, a0, 27
; RV64I-NEXT:  lui a1, %hi(.LCPI7_0)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI7_0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: cttz_zero_undef_i32:
; RV64XTHEADBB:  # %bb.0:
; RV64XTHEADBB-NEXT:  addi sp, sp, -16
; RV64XTHEADBB-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT:  negw a1, a0
; RV64XTHEADBB-NEXT:  and a0, a0, a1
; RV64XTHEADBB-NEXT:  lui a1, 30667
; RV64XTHEADBB-NEXT:  addiw a1, a1, 1329
; RV64XTHEADBB-NEXT:
;   call __muldi3
; RV64XTHEADBB-NEXT:  srliw a0, a0, 27
; RV64XTHEADBB-NEXT:  lui a1, %hi(.LCPI7_0)
; RV64XTHEADBB-NEXT:  addi a1, a1, %lo(.LCPI7_0)
; RV64XTHEADBB-NEXT:  add a0, a1, a0
; RV64XTHEADBB-NEXT:  lbu a0, 0(a0)
; RV64XTHEADBB-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT:  addi sp, sp, 16
; RV64XTHEADBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)
ret i32 %1
}

```

```

define signext i32 @findFirstSet_i32(i32 signext %a) nounwind {
; RV64I-LABEL: findFirstSet_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill

```

```

; RV64I-NEXT: sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT: mv s0, a0
; RV64I-NEXT: negw a0, a0
; RV64I-NEXT: and a0, s0, a0
; RV64I-NEXT: lui a1, 30667
; RV64I-NEXT: addiw a1, a1, 1329
; RV64I-NEXT: call __muldi3
; RV64I-NEXT: srliw a0, a0, 27
; RV64I-NEXT: lui a1, %hi(.LCPI8_0)
; RV64I-NEXT: addi a1, a1, %lo(.LCPI8_0)
; RV64I-NEXT:
    add a0, a1, a0
; RV64I-NEXT: lbu a0, 0(a0)
; RV64I-NEXT: snez a1, s0
; RV64I-NEXT: addi a1, a1, -1
; RV64I-NEXT: or a0, a1, a0
; RV64I-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT: ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT: addi sp, sp, 16
; RV64I-NEXT: ret
;
; RV64XTHEADBB-LABEL: findFirstSet_i32:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT: addi sp, sp, -16
; RV64XTHEADBB-NEXT: sd ra, 8(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT: sd s0, 0(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT: mv s0, a0
; RV64XTHEADBB-NEXT: negw a0, a0
; RV64XTHEADBB-NEXT: and a0, s0, a0
; RV64XTHEADBB-NEXT: lui a1, 30667
; RV64XTHEADBB-NEXT: addiw a1, a1, 1329
; RV64XTHEADBB-NEXT: call __muldi3
; RV64XTHEADBB-NEXT: srliw a0, a0, 27
; RV64XTHEADBB-NEXT: lui a1, %hi(.LCPI8_0)
; RV64XTHEADBB-NEXT: addi a1, a1, %lo(.LCPI8_0)
; RV64XTHEADBB-NEXT: add a0, a1, a0
; RV64XTHEADBB-NEXT: lbu a0, 0(a0)
; RV64XTHEADBB-NEXT:
    snez a1, s0
; RV64XTHEADBB-NEXT: addi a1, a1, -1
; RV64XTHEADBB-NEXT: or a0, a1, a0
; RV64XTHEADBB-NEXT: ld ra, 8(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT: ld s0, 0(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT: addi sp, sp, 16
; RV64XTHEADBB-NEXT: ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)
%2 = icmp eq i32 %a, 0
%3 = select i1 %2, i32 -1, i32 %1

```

```
ret i32 %3
}
```

```
define signext i32 @ffs_i32(i32 signext %a) nounwind {
; RV64I-LABEL: ffs_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64I-NEXT:  mv s0, a0
; RV64I-NEXT:  negw a0, a0
; RV64I-NEXT:  and a0, s0, a0
; RV64I-NEXT:  lui a1, 30667
; RV64I-NEXT:  addiw a1, a1, 1329
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srliw a0, a0, 27
; RV64I-NEXT:  lui a1, %hi(.LCPI9_0)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI9_0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:
    lbu a0, 0(a0)
; RV64I-NEXT:  addi a0, a0, 1
; RV64I-NEXT:  seqz a1, s0
; RV64I-NEXT:  addi a1, a1, -1
; RV64I-NEXT:  and a0, a1, a0
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  ld s0, 0(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: ffs_i32:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:  addi sp, sp, -16
; RV64XTHEADBB-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT:  sd s0, 0(sp) # 8-byte Folded Spill
; RV64XTHEADBB-NEXT:  mv s0, a0
; RV64XTHEADBB-NEXT:  negw a0, a0
; RV64XTHEADBB-NEXT:  and a0, s0, a0
; RV64XTHEADBB-NEXT:  lui a1, 30667
; RV64XTHEADBB-NEXT:  addiw a1, a1, 1329
; RV64XTHEADBB-NEXT:  call __muldi3
; RV64XTHEADBB-NEXT:  srliw a0, a0, 27
; RV64XTHEADBB-NEXT:  lui a1, %hi(.LCPI9_0)
; RV64XTHEADBB-NEXT:  addi a1, a1, %lo(.LCPI9_0)
; RV64XTHEADBB-NEXT:  add a0, a1, a0
;
;
```

```

RV64XTHEADBB-NEXT:  lbu a0, 0(a0)
; RV64XTHEADBB-NEXT:  addi a0, a0, 1
; RV64XTHEADBB-NEXT:  seqz a1, s0
; RV64XTHEADBB-NEXT:  addi a1, a1, -1
; RV64XTHEADBB-NEXT:  and a0, a1, a0
; RV64XTHEADBB-NEXT:  slli a0, a0, 32
; RV64XTHEADBB-NEXT:  srli a0, a0, 32
; RV64XTHEADBB-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT:  ld s0, 0(sp) # 8-byte Folded Reload
; RV64XTHEADBB-NEXT:  addi sp, sp, 16
; RV64XTHEADBB-NEXT:  ret
%1 = call i32 @llvm.cttz.i32(i32 %a, i1 true)
%2 = add i32 %1, 1
%3 = icmp eq i32 %a, 0
%4 = select i1 %3, i32 0, i32 %2
ret i32 %4
}

```

```

declare i64 @llvm.cttz.i64(i64, i1)

```

```

define i64 @cttz_i64(i64 %a) nounwind {
; RV64I-LABEL: cttz_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  beqz a0, .LBB10_2
; RV64I-NEXT:  # %bb.1: # %cond.false
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  neg a1, a0
; RV64I-NEXT:  and a0, a0, a1
; RV64I-NEXT:  lui a1, %hi(.LCPI10_0)
; RV64I-NEXT:
    ld a1, %lo(.LCPI10_0)(a1)
; RV64I-NEXT:  call __muldi3
; RV64I-NEXT:  srli a0, a0, 58
; RV64I-NEXT:  lui a1, %hi(.LCPI10_1)
; RV64I-NEXT:  addi a1, a1, %lo(.LCPI10_1)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  lbu a0, 0(a0)
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
; RV64I-NEXT: .LBB10_2:
; RV64I-NEXT:  li a0, 64
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: cttz_i64:
; RV64XTHEADBB:  # %bb.0:
; RV64XTHEADBB-NEXT:  beqz a0, .LBB10_2

```



```

; RV64XTHEADBB-NEXT: # %bb.1: # %cond.false
; RV64XTHEADBB-NEXT:  addi a1, a0, -1
; RV64XTHEADBB-NEXT:  not a0, a0
; RV64XTHEADBB-NEXT:  and a0, a0, a1
; RV64XTHEADBB-NEXT:  th.ff1 a0, a0
; RV64XTHEADBB-NEXT:  li a1, 64
; RV64XTHEADBB-NEXT:  sub a0, a1, a0
; RV64XTHEADBB-NEXT:  ret
; RV64XTHEADBB-NEXT: .LBB10_2:
; RV64XTHEADBB-NEXT:  li a0, 64
; RV64XTHEADBB-NEXT:  ret
%1 = call i64 @llvm.cttz.i64(i64 %a, i1 false)
ret i64 %1
}

```

```

define signext
i32 @sextb_i32(i32 signext %a) nounwind {
; RV64I-LABEL: sextb_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 56
; RV64I-NEXT:  srai a0, a0, 56
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: sextb_i32:
; RV64XTHEADBB:  # %bb.0:
; RV64XTHEADBB-NEXT:  th.ext a0, a0, 7, 0
; RV64XTHEADBB-NEXT:  ret
%shl = shl i32 %a, 24
%shr = ashr exact i32 %shl, 24
ret i32 %shr
}

```

```

define i64 @sextb_i64(i64 %a) nounwind {
; RV64I-LABEL: sextb_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 56
; RV64I-NEXT:  srai a0, a0, 56
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: sextb_i64:
; RV64XTHEADBB:  # %bb.0:
; RV64XTHEADBB-NEXT:  th.ext a0, a0, 7, 0
; RV64XTHEADBB-NEXT:  ret
%shl = shl i64 %a, 56
%shr = ashr exact i64 %shl, 56
ret i64 %shr
}

```

```

define signext i32 @sexth_i32(i32 signext %a) nounwind {
; RV64I-LABEL: sexth_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srai a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL:
sexth_i32:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:  th.ext a0, a0, 15, 0
; RV64XTHEADBB-NEXT:  ret
%shl = shl i32 %a, 16
%shr = ashr exact i32 %shl, 16
ret i32 %shr
}

```

```

define signext i32 @no_sexth_i32(i32 signext %a) nounwind {
; RV64I-LABEL: no_sexth_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 17
; RV64I-NEXT:  sraiw a0, a0, 16
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: no_sexth_i32:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:  slli a0, a0, 17
; RV64XTHEADBB-NEXT:  sraiw a0, a0, 16
; RV64XTHEADBB-NEXT:  ret
%shl = shl i32 %a, 17
%shr = ashr exact i32 %shl, 16
ret i32 %shr
}

```

```

define i64 @sexth_i64(i64 %a) nounwind {
; RV64I-LABEL: sexth_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srai a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: sexth_i64:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:  th.ext a0, a0, 15, 0
; RV64XTHEADBB-NEXT:  ret
%shl = shl i64 %a, 48
%shr = ashr

```

```

exact i64 %shl, 48
ret i64 %shr
}

```

```

define i64 @no_s sixth_i64(i64 %a) nounwind {
; RV64I-LABEL: no_s sixth_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 49
; RV64I-NEXT:  srai a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: no_s sixth_i64:
; RV64XTHEADBB:  # %bb.0:
; RV64XTHEADBB-NEXT:  slli a0, a0, 49
; RV64XTHEADBB-NEXT:  srai a0, a0, 48
; RV64XTHEADBB-NEXT:  ret
%shl = shl i64 %a, 49
%shr = ashr exact i64 %shl, 48
ret i64 %shr
}

```

```

define i32 @z sixth_i32(i32 %a) nounwind {
; RV64I-LABEL: z sixth_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: z sixth_i32:
; RV64XTHEADBB:  # %bb.0:
; RV64XTHEADBB-NEXT:  th.extu a0, a0, 15, 0
; RV64XTHEADBB-NEXT:  ret
%and = and i32 %a, 65535
ret i32 %and
}

```

```

define i64 @z sixth_i64(i64 %a) nounwind {
; RV64I-LABEL: z sixth_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:
ret
;
; RV64XTHEADBB-LABEL: z sixth_i64:
; RV64XTHEADBB:  # %bb.0:
; RV64XTHEADBB-NEXT:  th.extu a0, a0, 15, 0
; RV64XTHEADBB-NEXT:  ret

```

```

%and = and i64 %a, 65535
ret i64 %and
}

define i64 @zext_bf_i64(i64 %a) nounwind {
; RV64I-LABEL: zext_bf_i64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 47
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: zext_bf_i64:
; RV64XTHEADBB:  # %bb.0:
; RV64XTHEADBB-NEXT:  th.extu a0, a0, 16, 1
; RV64XTHEADBB-NEXT:  ret
%1 = lshr i64 %a, 1
%and = and i64 %1, 65535
ret i64 %and
}

define i64 @zext_i64_srliw(i64 %a) nounwind {
; RV64I-LABEL: zext_i64_srliw:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a0, a0, 16
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: zext_i64_srliw:
; RV64XTHEADBB:  # %bb.0:
; RV64XTHEADBB-NEXT:  srliw a0, a0, 16
; RV64XTHEADBB-NEXT:  ret
%1 = lshr i64 %a, 16
%and = and i64 %1, 65535
ret i64 %and
}

declare i32 @llvm.bswap.i32(i32)

define signext
i32 @bswap_i32(i32 signext %a) nounwind {
; RV64I-LABEL: bswap_i32:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a1, a0, 8
; RV64I-NEXT:  lui a2, 16
; RV64I-NEXT:  addiw a2, a2, -256
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  srliw a3, a0, 24
; RV64I-NEXT:  or a1, a1, a3
; RV64I-NEXT:  and a2, a0, a2

```

```

; RV64I-NEXT:  slliw a2, a2, 8
; RV64I-NEXT:  slliw a0, a0, 24
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  or a0, a0, a1
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: bswap_i32:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:  th.rev w a0, a0
; RV64XTHEADBB-NEXT:  ret
%1 = tail call i32 @llvm.bswap.i32(i32 %a)
ret i32 %1
}

; Similar to bswap_i32 but the result is not sign extended.
define void @bswap_i32_nosext(i32 signext %a, ptr %x) nounwind {
; RV64I-LABEL: bswap_i32_nosext:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srlw a2, a0, 8
; RV64I-NEXT:  lui a3, 16
; RV64I-NEXT:  addi a3, a3, -256
; RV64I-NEXT:  and a2, a2, a3
; RV64I-NEXT:  srlw
a4, a0, 24
; RV64I-NEXT:  or a2, a2, a4
; RV64I-NEXT:  and a3, a0, a3
; RV64I-NEXT:  slli a3, a3, 8
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:  or a0, a0, a3
; RV64I-NEXT:  or a0, a0, a2
; RV64I-NEXT:  sw a0, 0(a1)
; RV64I-NEXT:  ret
;
; RV64XTHEADBB-LABEL: bswap_i32_nosext:
; RV64XTHEADBB:      # %bb.0:
; RV64XTHEADBB-NEXT:  th.rev w a0, a0
; RV64XTHEADBB-NEXT:  sw a0, 0(a1)
; RV64XTHEADBB-NEXT:  ret
%1 = tail call i32 @llvm.bswap.i32(i32 %a)
store i32 %1, ptr %x
ret void
}

declare i64 @llvm.bswap.i64(i64)

define i64 @bswap_i64(i64 %a) {
; RV64I-LABEL: bswap_i64:
; RV64I:      # %bb.0:

```

```

; RV64I-NEXT: srli a1, a0, 40
; RV64I-NEXT: lui a2, 16
; RV64I-NEXT: addiw a2, a2, -256
; RV64I-NEXT: and a1, a1, a2
; RV64I-NEXT: srli a3, a0, 56
; RV64I-NEXT: or a1, a1, a3
; RV64I-NEXT: srli a3, a0, 24
; RV64I-NEXT: lui a4, 4080
; RV64I-NEXT: and a3, a3, a4
; RV64I-NEXT: srli a5, a0, 8
; RV64I-NEXT: srliw a5, a5, 24
; RV64I-NEXT: slli
a5, a5, 24
; RV64I-NEXT: or a3, a5, a3
; RV64I-NEXT: or a1, a3, a1
; RV64I-NEXT: and a4, a0, a4
; RV64I-NEXT: slli a4, a4, 24
; RV64I-NEXT: srliw a3, a0, 24
; RV64I-NEXT: slli a3, a3, 32
; RV64I-NEXT: or a3, a4, a3
; RV64I-NEXT: and a2, a0, a2
; RV64I-NEXT: slli a2, a2, 40
; RV64I-NEXT: slli a0, a0, 56
; RV64I-NEXT: or a0, a0, a2
; RV64I-NEXT: or a0, a0, a3
; RV64I-NEXT: or a0, a0, a1
; RV64I-NEXT: ret
;
; RV64XTHEADBB-LABEL: bswap_i64:
; RV64XTHEADBB:    # %bb.0:
; RV64XTHEADBB-NEXT:  th.rev a0, a0
; RV64XTHEADBB-NEXT:  ret
%1 = call i64 @llvm.bswap.i64(i64 %a)
ret i64 %1
}
; RUN: llc < %s -mtriple=s390x-linux-gnu -mcpu=zEC12 -verify-machineinstrs | FileCheck %s
;
; Test that early if conversion produces LOCR with operands of the right
; register classes.

define void @autogen_SD4739(ptr) {
; CHECK-NOT: Expected a GR32Bit register, but got a GRX32Bit register
BB:
%L34 = load i8, ptr %0
%Cmp56 = icmp sgt i8 undef, %L34
br label %CF246

CF246:                                ; preds = %CF246, %BB

```

```
%S1163 = select i1 %Cmp56, i8 %L34, i8 undef
br i1 undef, label %CF246, label %CF248
```

```
CF248:                                ; preds = %CF248, %CF246
store i8 %S1163, ptr %0
br label %CF248
}
```

```
; RUN: llc -march=hexagon -hexagon-hvx-widen=32 < %s | FileCheck %s
```

```
; Truncating a type-to-be-widened to a legal type (v8i8).
```

```
; Check that this compiles successfully.
```

```
; CHECK-LABEL: f0:
```

```
; CHECK: dealloc_return
```

```
target datalayout = "e-m:e-p:32:32:32-a:0-n16:32-i64:64:64-i32:32:32-i16:16:16-i1:8:8-f32:32:32-f64:64:64-
v32:32:32-v64:64:64-v512:512:512-v1024:1024:1024-v2048:2048:2048"
target triple = "hexagon"
```

```
define dlllexport void @f0(ptr %a0) local_unnamed_addr #0 {
b0:
%v0 = load i8, ptr undef, align 1
%v1 = zext i8 %v0 to i16
%v2 = add i16 0, %v1
%v3 = icmp sgt i16 %v2, 1
%v4 = select i1 %v3, i16 %v2, i16 1
%v5 = udiv i16 -32768, %v4
%v6 = zext i16 %v5 to i32
%v7 = insertelement <8 x i32> undef, i32 %v6, i32 0
%v8 = shufflevector <8 x i32> %v7, <8 x i32> undef, <8 x i32> zeroinitializer
%v9 = load <8 x i16>, ptr undef, align 2
%v10 = sext <8 x i16> %v9 to <8 x i32>
%v11 = mul nsw <8 x i32> %v8, %v10
%v12 = add nsw <8 x i32> %v11, <i32 16384, i32 16384, i32 16384,
i32 16384, i32 16384, i32 16384, i32 16384, i32 16384>
%v13 = lshr <8 x i32> %v12, <i32 15, i32 15, i32 15, i32 15, i32 15, i32 15, i32 15, i32 15>
%v14 = trunc <8 x i32> %v13 to <8 x i8>
%v15 = getelementptr inbounds i8, ptr %a0, i32 undef
store <8 x i8> %v14, ptr %v15, align 1
ret void
}
```

```
attributes #0 = { "target-features"="+hvx,+hvx-length128b" }
```

```
; RUN: llc -O3 -mtriple=powerpc-unknown-linux-gnu -mcpu=e500 -mattr=spe < %s | FileCheck %s
```

```
; PowerPC SPE is a rare in-tree target that has the FP_TO_SINT node marked
```

```
; as Legal.
```

```
; Verify that fptosi(42.1) isn't simplified when the rounding mode is
```

```

; unknown.
; Verify that no gross errors happen.
; CHECK-LABEL: @f20
; COMMON: cfdctsiz
define i32 @f20(double %a) strictfp {
entry:
  %result = call i32 @llvm.experimental.constrained.fptosi.i32.f64(double 42.1,
                                metadata !"fpexcept.strict")
                                strictfp
  ret i32 %result
}

```

```

@llvm.fp.env = thread_local global i8 zeroinitializer, section "llvm.metadata"
declare i32 @llvm.experimental.constrained.fptosi.i32.f64(double, metadata)
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```

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```

; NOTE: Assertions have been autogenerated by utils/update_analyze_test_checks.py
; RUN: opt < %s -passes="print<cost-model>" 2>&1 -disable-output -mtriple=x86_64-apple-macosx10.8.0 -
mattr=+avx2 | FileCheck %s --check-prefixes=VEC256,AVX
; RUN: opt < %s -passes="print<cost-model>" 2>&1 -disable-output -mtriple=x86_64-apple-macosx10.8.0 -
mattr=+avx512vl,+prefer-256-bit | FileCheck %s --check-prefixes=VEC256,AVX512VL256
; RUN: opt < %s -passes="print<cost-model>" 2>&1 -disable-output -mtriple=x86_64-apple-macosx10.8.0 -
mattr=+avx512vl,+prefer-256-bit | FileCheck %s --check-prefixes=AVX512VL512
; RUN: opt < %s -passes="print<cost-model>" 2>&1 -disable-output -mtriple=x86_64-apple-macosx10.8.0 -
mattr=+avx512vl,+avx512bw,+avx512dq,+prefer-256-bit | FileCheck %s --check-prefixes=VEC256,SKX256
; RUN: opt < %s -passes="print<cost-model>" 2>&1 -disable-output -mtriple=x86_64-apple-macosx10.8.0 -
mattr=+avx512vl,+avx512bw,+avx512dq,-prefer-256-bit | FileCheck %s --check-prefixes=SKX512

```



```

define
void @zext256() "min-legal-vector-width"="256" {
; AVX-LABEL: 'zext256'
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %A = zext <8 x i16> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %B = zext <8 x i32> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %C = zext <16 x i8> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %D = zext <16 x i16> undef to <16 x
i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %E = zext <32 x i8> undef to <32 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL256-LABEL: 'zext256'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %A = zext <8 x i16> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %B = zext <8 x i32> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost
Model: Found an estimated cost of 2 for instruction: %C = zext <16 x i8> undef to <16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %D = zext <16 x i16> undef to
<16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = zext <32 x i8> undef to
<32 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL512-LABEL: 'zext256'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = zext <8 x i32> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16 x i16> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction:
%E = zext <32 x i8> undef to <32 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX256-LABEL: 'zext256'
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %A = zext <8 x i16> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %B = zext <8 x i32> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %C = zext <16 x i8> undef to <16 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %D = zext <16 x i16> undef to <16 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = zext <32 x i8> undef to <32 x
i16>

```

```

; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX512-LABEL: 'zext256'
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to <8 x i64>
; SKX512-NEXT: Cost Model: Found an estimated
cost of 1 for instruction: %B = zext <8 x i32> undef to <8 x i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to <16 x i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16 x i16> undef to <16 x i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = zext <32 x i8> undef to <32 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
%A = zext <8 x i16> undef to <8 x i64>
%B = zext <8 x i32> undef to <8 x i64>
%C = zext <16 x i8> undef to <16 x i32>
%D = zext <16 x i16> undef to <16 x i32>
%E = zext <32 x i8> undef to <32 x i16>
ret void
}

define void @zext512() "min-legal-vector-width"="512" {
; AVX-LABEL: 'zext512'
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %A = zext <8 x i16> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %B = zext <8 x i32>
undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %C = zext <16 x i8> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %D = zext <16 x i16> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %E = zext <32 x i8> undef to <32 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL256-LABEL: 'zext512'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = zext <8 x i32> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to
<16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16 x i16> undef to
<16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost
of 3 for instruction: %E = zext <32 x i8> undef to <32 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL512-LABEL: 'zext512'

```

```

; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = zext <8 x i32> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16 x i16> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = zext <32 x i8> undef to
<32 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX256-LABEL: 'zext512'
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to <8
x i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = zext <8 x i32> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to <16 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16 x i16> undef to <16 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = zext <32 x i8> undef to <32 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX512-LABEL: 'zext512'
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = zext <8 x i16> undef to <8 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = zext <8 x i32> undef to <8 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = zext <16 x i8> undef to <16 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = zext <16
x i16> undef to <16 x i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = zext <32 x i8> undef to <32 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
%A = zext <8 x i16> undef to <8 x i64>
%B = zext <8 x i32> undef to <8 x i64>
%C = zext <16 x i8> undef to <16 x i32>
%D = zext <16 x i16> undef to <16 x i32>
%E = zext <32 x i8> undef to <32 x i16>
ret void
}

define void @sext256() "min-legal-vector-width"="256" {
; AVX-LABEL: 'sext256'

```

```

; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %A = sext <8 x i8> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %B = sext <8 x i16> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %C = sext <8 x i32> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %D = sext <16 x i8> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found
an estimated cost of 3 for instruction: %E = sext <16 x i16> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %F = sext <32 x i8> undef to <32 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL256-LABEL: 'sext256'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %A = sext <8 x i8> undef to <8
x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %B = sext <8 x i16> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %C = sext <8 x i32> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %D = sext <16 x i8> undef to
<16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = sext <16 x i16> undef to
<16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %F = sext <32 x i8> undef
to <32 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL512-LABEL: 'sext256'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8
x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to
<8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = sext <16 x i16> undef to
<16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %F = sext <32 x i8> undef to
<32 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX256-LABEL: 'sext256'
; SKX256-NEXT: Cost Model: Found an
estimated cost of 2 for instruction: %A = sext <8 x i8> undef to <8 x i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %B = sext <8 x i16> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %C = sext <8 x i32> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %D = sext <16 x i8> undef to <16 x
i32>

```

```

; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = sext <16 x i16> undef to <16 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %F = sext <32 x i8> undef to <32 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX512-LABEL: 'sext256'
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8 x i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to <8 x
i64>
; SKX512-NEXT: Cost
Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to <8 x i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to <16 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = sext <16 x i16> undef to <16 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %F = sext <32 x i8> undef to <32 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
%A = sext <8 x i8> undef to <8 x i64>
%B = sext <8 x i16> undef to <8 x i64>
%C = sext <8 x i32> undef to <8 x i64>
%D = sext <16 x i8> undef to <16 x i32>
%E = sext <16 x i16> undef to <16 x i32>
%F = sext <32 x i8> undef to <32 x i16>
ret void
}

```

```

define void @sext512() "min-legal-vector-width"="512" {
; AVX-LABEL: 'sext512'
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %A = sext <8 x i8> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found
an estimated cost of 4 for instruction: %B = sext <8 x i16> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %C = sext <8 x i32> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %D = sext <16 x i8> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %E = sext <16 x i16> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %F = sext <32 x i8> undef to <32 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL256-LABEL: 'sext512'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8
x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to
<8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to
<8 x i64>
; AVX512VL256-NEXT:

```

Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to <16 x i32>

; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = sext <16 x i16> undef to <16 x i32>

; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %F = sext <32 x i8> undef to <32 x i16>

; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void

;

; AVX512VL512-LABEL: 'sext512'

; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8 x i64>

; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to <8 x i64>

; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to <8 x i64>

; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to <16 x i32>

; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = sext <16 x i16> undef to <16 x i32>

; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %F = sext <32 x i8> undef to <32 x i16>

; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void

;

; SKX256-LABEL: 'sext512'

; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8 x i64>

; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to <8 x i64>

; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to <8 x i64>

; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to <16 x i32>

; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = sext <16 x i16> undef to <16 x i32>

; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %F = sext <32 x i8> undef to <32 x i16>

; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void

;

; SKX512-LABEL: 'sext512'

; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = sext <8 x i8> undef to <8 x i64>

; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %B = sext <8 x i16> undef to <8 x i64>

; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %C = sext <8 x i32> undef to <8 x i64>

; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %D = sext <16 x i8> undef to <16 x i32>

; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %E = sext <16 x i16> undef to <16 x i32>

; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %F = sext <32 x i8> undef to <32 x i16>

```

i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
%A = sext <8 x i8> undef to <8 x i64>
%B = sext <8 x i16> undef to <8 x i64>
%C = sext <8 x i32> undef to <8 x i64>
%D = sext <16 x i8>
undef to <16 x i32>
%E = sext <16 x i16> undef to <16 x i32>
%F = sext <32 x i8> undef to <32 x i16>
ret void
}

define void @trunc256() "min-legal-vector-width"="256" {
; VEC256-LABEL: 'trunc256'
; VEC256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %A = trunc <8 x i64> undef to <8 x
i32>
; VEC256-NEXT: Cost Model: Found an estimated cost of 10 for instruction: %B = trunc <8 x i64> undef to <8 x
i16>
; VEC256-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %C = trunc <8 x i64> undef to <8 x
i8>
; VEC256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %D = trunc <16 x i32> undef to <16 x
i16>
; VEC256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %E = trunc <16 x i32> undef to <16 x
i8>
; VEC256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %F = trunc <32 x i16> undef to <32 x
i8>
; VEC256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; AVX512VL512-LABEL: 'trunc256'
;
AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = trunc <8 x i64> undef to
<8 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %B = trunc <8 x i64> undef to
<8 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %C = trunc <8 x i64> undef to
<8 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %D = trunc <16 x i32> undef
to <16 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %E = trunc <16 x i32> undef to
<16 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %F = trunc <32 x i16> undef to
<32 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
; SKX512-LABEL: 'trunc256'
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %A = trunc <8 x i64> undef to <8 x
i32>

```

```

; SKX512-NEXT: Cost Model: Found an estimated
cost of 2 for instruction: %B = trunc <8 x i64> undef to <8 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %C = trunc <8 x i64> undef to <8 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %D = trunc <16 x i32> undef to <16 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %E = trunc <16 x i32> undef to <16 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %F = trunc <32 x i16> undef to <32 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret void
;
%A = trunc <8 x i64> undef to <8 x i32>
%B = trunc <8 x i64> undef to <8 x i16>
%C = trunc <8 x i64> undef to <8 x i8>
%D = trunc <16 x i32> undef to <16 x i16>
%E = trunc <16 x i32> undef to <16 x i8>
%F = trunc <32 x i16> undef to <32 x i8>
ret void
}

define i32 @zext256_vXi1() "min-legal-vector-width"="256" {
; AVX-LABEL: 'zext256_vXi1'
; AVX-NEXT: Cost Model: Found
an estimated cost of 1 for instruction: %V2i64 = zext <2 x i1> undef to <2 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i64 = zext <4 x i1> undef to <4 x
i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i64 = zext <8 x i1> undef to <8 x
i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i32 = zext <2 x i1> undef to <2 x
i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i32 = zext <4 x i1> undef to <4 x
i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i32 = zext <8 x i1> undef to <8 x
i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i32 = zext <16 x i1> undef to <16 x
i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i16 = zext <2 x i1> undef to <2 x
i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i16 = zext <4 x i1> undef to <4 x
i16>
; AVX-NEXT:
Cost Model: Found an estimated cost of 1 for instruction: %V8i16 = zext <8 x i1> undef to <8 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i16 = zext <16 x i1> undef to <16 x
i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V32i16 = zext <32 x i1> undef to <32 x
i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i8 = zext <2 x i1> undef to <2 x i8>

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; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i8 = zext <4 x i1> undef to <4 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i8 = zext <8 x i1> undef to <8 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i8 = zext <16 x i1> undef to <16 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V32i8 = zext <32 x i1> undef to <32 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V64i8 = zext <64 x i1> undef to <64 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; AVX512VL256-LABEL: 'zext256_vXi1'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = zext <2 x i1> undef to <2 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = zext <4 x i1> undef to <4 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V8i64 = zext <8 x i1> undef to <8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = zext <2 x i1> undef to <2 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = zext <4 x i1> undef to <4 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = zext <8 x i1> undef to <8 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i32 = zext <16 x i1> undef to <16 x i32>
; AVX512VL256-NEXT:
  Cost Model: Found an estimated cost of 5 for instruction: %V2i16 = zext <2 x i1> undef to <2 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V4i16 = zext <4 x i1> undef to <4 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V8i16 = zext <8 x i1> undef to <8 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 12 for instruction: %V16i16 = zext <16 x i1> undef to <16 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 24 for instruction: %V32i16 = zext <32 x i1> undef to <32 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 6 for instruction: %V2i8 = zext <2 x i1> undef to <2 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 6 for instruction: %V4i8 = zext <4 x i1> undef to <4 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 6 for instruction: %V8i8 = zext <8 x i1> undef to <8 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 12 for instruction: %V16i8 = zext <16 x i1> undef to <16 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 25 for instruction: %V32i8 = zext <32 x i1> undef to <32 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 50 for instruction: %V64i8 = zext <64 x i1> undef to <64 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef

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;
; AVX512VL512-LABEL: 'zext256_vXi1'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = zext <2 x i1> undef
to <2 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = zext <4 x i1> undef
to <4 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i64 = zext <8 x i1> undef
to <8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = zext <2 x i1> undef
to <2 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of
2 for instruction: %V4i32 = zext <4 x i1> undef to <4 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = zext <8 x i1> undef
to <8 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = zext <16 x i1>
undef to <16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V2i16 = zext <2 x i1> undef
to <2 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V4i16 = zext <4 x i1> undef
to <4 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i16 = zext <8 x i1> undef
to <8 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i16 = zext <16 x i1>
undef to <16 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 9 for instruction: %V32i16 = zext <32 x i1>
undef to <32 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V2i8
= zext <2 x i1> undef to <2 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V4i8 = zext <4 x i1> undef to
<4 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i8 = zext <8 x i1> undef to
<8 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i8 = zext <16 x i1> undef
to <16 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 9 for instruction: %V32i8 = zext <32 x i1> undef
to <32 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 19 for instruction: %V64i8 = zext <64 x i1>
undef to <64 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX256-LABEL: 'zext256_vXi1'
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = zext <2 x i1> undef to <2 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = zext <4 x i1> undef to <4 x
i64>
;
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i64 = zext <8 x i1> undef to <8 x
i64>

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; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = zext <2 x i1> undef to <2 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = zext <4 x i1> undef to <4 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = zext <8 x i1> undef to <8 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i32 = zext <16 x i1> undef to
<16 x i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i16 = zext <2 x i1> undef to <2 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i16 = zext <4 x i1> undef to <4 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i16 = zext <8 x i1> undef to <8 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction:
%V16i16 = zext <16 x i1> undef to <16 x i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V32i16 = zext <32 x i1> undef to
<32 x i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i8 = zext <2 x i1> undef to <2 x
i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i8 = zext <4 x i1> undef to <4 x
i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i8 = zext <8 x i1> undef to <8 x
i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i8 = zext <16 x i1> undef to <16
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i8 = zext <32 x i1> undef to <32
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V64i8 = zext <64 x i1> undef to <64
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX512-LABEL: 'zext256_vXi1'
; SKX512-NEXT: Cost
Model: Found an estimated cost of 2 for instruction: %V2i64 = zext <2 x i1> undef to <2 x i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = zext <4 x i1> undef to <4 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i64 = zext <8 x i1> undef to <8 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = zext <2 x i1> undef to <2 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = zext <4 x i1> undef to <4 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = zext <8 x i1> undef to <8 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = zext <16 x i1> undef to
<16 x i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i16 = zext <2 x i1> undef to <2 x

```

```

i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i16 = zext
<4 x i1> undef to <4 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i16 = zext <8 x i1> undef to <8 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i16 = zext <16 x i1> undef to
<16 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i16 = zext <32 x i1> undef to
<32 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i8 = zext <2 x i1> undef to <2 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i8 = zext <4 x i1> undef to <4 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i8 = zext <8 x i1> undef to <8 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i8 = zext <16 x i1> undef to <16
x i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i8 = zext <32 x i1> undef to <32
x i8>
; SKX512-NEXT: Cost Model: Found an estimated
cost of 2 for instruction: %V64i8 = zext <64 x i1> undef to <64 x i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
%V2i64 = zext <2 x i1> undef to <2 x i64>
%V4i64 = zext <4 x i1> undef to <4 x i64>
%V8i64 = zext <8 x i1> undef to <8 x i64>

%V2i32 = zext <2 x i1> undef to <2 x i32>
%V4i32 = zext <4 x i1> undef to <4 x i32>
%V8i32 = zext <8 x i1> undef to <8 x i32>
%V16i32 = zext <16 x i1> undef to <16 x i32>

%V2i16 = zext <2 x i1> undef to <2 x i16>
%V4i16 = zext <4 x i1> undef to <4 x i16>
%V8i16 = zext <8 x i1> undef to <8 x i16>
%V16i16 = zext <16 x i1> undef to <16 x i16>
%V32i16 = zext <32 x i1> undef to <32 x i16>

%V2i8 = zext <2 x i1> undef to <2 x i8>
%V4i8 = zext <4 x i1> undef to <4 x i8>
%V8i8 = zext <8 x i1> undef to <8 x i8>
%V16i8 = zext <16 x i1> undef to <16 x i8>
%V32i8 = zext <32 x i1> undef to <32 x i8>
%V64i8 = zext <64 x i1> undef to <64 x i8>

ret i32 undef
}

```

```

define i32 @sext256_vXi1()
    "min-legal-vector-width"="256" {
; AVX-LABEL: 'sext256_vXi1'
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %i64 = sext i1 undef to i64
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = sext <2 x i1> undef to <2 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i64 = sext <4 x i1> undef to <4 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i64 = sext <8 x i1> undef to <8 x i64>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %i32 = sext i1 undef to i32
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = sext <2 x i1> undef to <2 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = sext <4 x i1> undef to <4 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i32 = sext <8 x i1> undef to <8 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost
    of 4 for instruction: %V16i32 = sext <16 x i1> undef to <16 x i32>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %i16 = sext i1 undef to i16
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i16 = sext <2 x i1> undef to <2 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i16 = sext <4 x i1> undef to <4 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i16 = sext <8 x i1> undef to <8 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i16 = sext <16 x i1> undef to <16 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V32i16 = sext <32 x i1> undef to <32 x i16>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %i8 = sext i1 undef to i8
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i8 = sext <2 x i1> undef to <2 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for
    instruction: %V4i8 = sext <4 x i1> undef to <4 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i8 = sext <8 x i1> undef to <8 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i8 = sext <16 x i1> undef to <16 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i8 = sext <32 x i1> undef to <32 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V64i8 = sext <64 x i1> undef to <64 x i8>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; AVX512VL256-LABEL: 'sext256_vXi1'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %i64 = sext i1 undef to i64
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i64 = sext <2 x i1> undef
    to <2 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i64 = sext <4 x i1> undef

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to <4 x i64>
; AVX512VL256-NEXT:
  Cost Model: Found an estimated cost of 3 for instruction: %V8i64 = sext <8 x i1> undef to <8 x i64>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I32 = sext i1 undef to i32
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i32 = sext <2 x i1> undef
to <2 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i32 = sext <4 x i1> undef
to <4 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i32 = sext <8 x i1> undef
to <8 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = sext <16 x i1>
undef to <16 x i32>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I16 = sext i1 undef to i16
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V2i16 = sext <2 x i1> undef
to <2 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 4 for instruction:
  %V4i16 = sext <4 x i1> undef to <4 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V8i16 = sext <8 x i1> undef
to <8 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 10 for instruction: %V16i16 = sext <16 x i1>
undef to <16 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 20 for instruction: %V32i16 = sext <32 x i1>
undef to <32 x i16>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I8 = sext i1 undef to i8
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V2i8 = sext <2 x i1> undef to
<2 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V4i8 = sext <4 x i1> undef to
<4 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 5 for instruction: %V8i8 = sext <8 x i1> undef to
<8 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 10 for instruction: %V16i8 = sext <16 x i1>
undef to <16 x i8>
;
  AVX512VL256-NEXT: Cost Model: Found an estimated cost of 21 for instruction: %V32i8 = sext <32 x i1>
undef to <32 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 42 for instruction: %V64i8 = sext <64 x i1>
undef to <64 x i8>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; AVX512VL512-LABEL: 'sext256_vXi1'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I64 = sext i1 undef to i64
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i64 = sext <2 x i1> undef
to <2 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i64 = sext <4 x i1> undef
to <4 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i64 = sext <8 x i1> undef
to <8 x i64>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I32 = sext i1 undef to i32

```

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; AVX512VL512-NEXT: Cost Model: Found an estimated
cost of 1 for instruction: %V2i32 = sext <2 x i1> undef to <2 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i32 = sext <4 x i1> undef
to <4 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i32 = sext <8 x i1> undef
to <8 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i32 = sext <16 x i1>
undef to <16 x i32>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I16 = sext i1 undef to i16
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i16 = sext <2 x i1> undef
to <2 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i16 = sext <4 x i1> undef
to <4 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i16 = sext <8 x i1> undef
to <8 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V16i16 =
sext <16 x i1> undef to <16 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 7 for instruction: %V32i16 = sext <32 x i1>
undef to <32 x i16>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I8 = sext i1 undef to i8
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i8 = sext <2 x i1> undef to
<2 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i8 = sext <4 x i1> undef to
<4 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i8 = sext <8 x i1> undef to
<8 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V16i8 = sext <16 x i1> undef
to <16 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 7 for instruction: %V32i8 = sext <32 x i1> undef
to <32 x i8>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 15 for instruction: %V64i8 = sext <64 x i1>
undef to <64 x i8>
; AVX512VL512-NEXT:
Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX256-LABEL: 'sext256_vXi1'
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I64 = sext i1 undef to i64
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i64 = sext <2 x i1> undef to <2 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i64 = sext <4 x i1> undef to <4 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i64 = sext <8 x i1> undef to <8 x
i64>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I32 = sext i1 undef to i32
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i32 = sext <2 x i1> undef to <2 x
i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i32 = sext <4 x i1> undef to <4 x
i32>

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```

; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i32 = sext <8 x i1> undef
to <8 x i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = sext <16 x i1> undef to
<16 x i32>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I16 = sext i1 undef to i16
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i16 = sext <2 x i1> undef to <2 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i16 = sext <4 x i1> undef to <4 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i16 = sext <8 x i1> undef to <8 x
i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i16 = sext <16 x i1> undef to
<16 x i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i16 = sext <32 x i1> undef to
<32 x i16>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I8 = sext i1 undef to i8
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i8
= sext <2 x i1> undef to <2 x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i8 = sext <4 x i1> undef to <4 x
i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i8 = sext <8 x i1> undef to <8 x
i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i8 = sext <16 x i1> undef to <16
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V32i8 = sext <32 x i1> undef to <32
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V64i8 = sext <64 x i1> undef to <64
x i8>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX512-LABEL: 'sext256_vXi1'
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I64 = sext i1 undef to i64
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i64 = sext <2 x i1> undef to <2 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated
cost of 1 for instruction: %V4i64 = sext <4 x i1> undef to <4 x i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i64 = sext <8 x i1> undef to <8 x
i64>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I32 = sext i1 undef to i32
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i32 = sext <2 x i1> undef to <2 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i32 = sext <4 x i1> undef to <4 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i32 = sext <8 x i1> undef to <8 x
i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i32 = sext <16 x i1> undef to
<16 x i32>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I16 = sext i1 undef to i16

```



```

; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i16 = sext <2 x i1> undef to <2 x
i16>
; SKX512-NEXT: Cost Model:
Found an estimated cost of 1 for instruction: %V4i16 = sext <4 x i1> undef to <4 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i16 = sext <8 x i1> undef to <8 x
i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i16 = sext <16 x i1> undef to
<16 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V32i16 = sext <32 x i1> undef to
<32 x i16>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %I8 = sext i1 undef to i8
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i8 = sext <2 x i1> undef to <2 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i8 = sext <4 x i1> undef to <4 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i8 = sext <8 x i1> undef to <8 x
i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V16i8 = sext <16 x i1> undef to <16
x i8>
;
SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V32i8 = sext <32 x i1> undef to <32
x i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V64i8 = sext <64 x i1> undef to <64
x i8>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
%I64 = sext i1 undef to i64
%V2i64 = sext <2 x i1> undef to <2 x i64>
%V4i64 = sext <4 x i1> undef to <4 x i64>
%V8i64 = sext <8 x i1> undef to <8 x i64>

%I32 = sext i1 undef to i32
%V2i32 = sext <2 x i1> undef to <2 x i32>
%V4i32 = sext <4 x i1> undef to <4 x i32>
%V8i32 = sext <8 x i1> undef to <8 x i32>
%V16i32 = sext <16 x i1> undef to <16 x i32>

%I16 = sext i1 undef to i16
%V2i16 = sext <2 x i1> undef to <2 x i16>
%V4i16 = sext <4 x i1> undef to <4 x i16>
%V8i16 = sext <8 x i1> undef to <8 x i16>
%V16i16 = sext <16 x i1> undef to <16 x i16>
%V32i16 = sext <32 x i1> undef to <32 x i16>

%I8 = sext i1 undef to i8
%V2i8 = sext <2
x i1> undef to <2 x i8>
%V4i8 = sext <4 x i1> undef to <4 x i8>

```

```

%V8i8 = sext <8 x i1> undef to <8 x i8>
%V16i8 = sext <16 x i1> undef to <16 x i8>
%V32i8 = sext <32 x i1> undef to <32 x i8>
%V64i8 = sext <64 x i1> undef to <64 x i8>

ret i32 undef
}

define i32 @trunc_vXi1() "min-legal-vector-width"="256" {
; AVX-LABEL: 'trunc_vXi1'
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V2i64 = trunc <2 x i64> undef to <2 x
i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V4i64 = trunc <4 x i64> undef to <4 x
i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 9 for instruction: %V8i64 = trunc <8 x i64> undef to <8 x
i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 11 for instruction: %V16i64 = trunc <16 x i64> undef to
<16 x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i64 = trunc <32 x i64> undef to <32
x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i64
= trunc <64 x i64> undef to <64 x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i32 = trunc <2 x i32> undef to <2 x
i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V4i32 = trunc <4 x i32> undef to <4 x
i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = trunc <8 x i32> undef to <8 x
i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V16i32 = trunc <16 x i32> undef to <16
x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i32 = trunc <32 x i32> undef to <32
x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i32 = trunc <64 x i32> undef to <64
x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i16 = trunc <2 x i16> undef to <2 x
i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i16 = trunc <4 x i16> undef to <4 x
i1>
; AVX-NEXT: Cost Model: Found an estimated
cost of 0 for instruction: %V8i16 = trunc <8 x i16> undef to <8 x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i16 = trunc <16 x i16> undef to <16
x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i16 = trunc <32 x i16> undef to <32
x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i16 = trunc <64 x i16> undef to <64
x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V2i8 = trunc <2 x i8> undef to <2 x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V4i8 = trunc <4 x i8> undef to <4 x i1>

```

```

; AVX-NEXT: Cost Model: Found an estimated cost of 1 for instruction: %V8i8 = trunc <8 x i8> undef to <8 x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V16i8 = trunc <16 x i8> undef to <16 x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i8 = trunc <32 x i8> undef to <32 x i1>
; AVX-NEXT:
  Cost Model: Found an estimated cost of 0 for instruction: %V64i8 = trunc <64 x i8> undef to <64 x i1>
; AVX-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; AVX512VL256-LABEL: 'trunc_vXi1'
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = trunc <2 x i64> undef to <2 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = trunc <4 x i64> undef to <4 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 9 for instruction: %V8i64 = trunc <8 x i64> undef to <8 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 11 for instruction: %V16i64 = trunc <16 x i64> undef to <16 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i64 = trunc <32 x i64> undef to <32 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i64 = trunc <64 x i64> undef to <64 x i1>
; AVX512VL256-NEXT: Cost Model:
  Found an estimated cost of 2 for instruction: %V2i32 = trunc <2 x i32> undef to <2 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = trunc <4 x i32> undef to <4 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = trunc <8 x i32> undef to <8 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i32 = trunc <16 x i32> undef to <16 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V32i32 = trunc <32 x i32> undef to <32 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 16 for instruction: %V64i32 = trunc <64 x i32> undef to <64 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i16 = trunc <2 x i16> undef to <2 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i16 = trunc <4 x i16> undef to <4 x i1>
; AVX512VL256-NEXT: Cost Model: Found an
  estimated cost of 3 for instruction: %V8i16 = trunc <8 x i16> undef to <8 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V16i16 = trunc <16 x i16> undef to <16 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 16 for instruction: %V32i16 = trunc <32 x i16> undef to <32 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 32 for instruction: %V64i16 = trunc <64 x i16> undef to <64 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i8 = trunc <2 x i8> undef to <2 x i1>

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; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i8 = trunc <4 x i8> undef
to <4 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i8 = trunc <8 x i8> undef
to <8 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V16i8 = trunc <16 x i8>
undef to <16 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of
0 for instruction: %V32i8 = trunc <32 x i8> undef to <32 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i8 = trunc <64 x i8>
undef to <64 x i1>
; AVX512VL256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; AVX512VL512-LABEL: 'trunc_vXi1'
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = trunc <2 x i64>
undef to <2 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = trunc <4 x i64>
undef to <4 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i64 = trunc <8 x i64>
undef to <8 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 11 for instruction: %V16i64 = trunc <16 x i64>
undef to <16 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i64 = trunc <32 x i64>
undef to <32 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction:
%V64i64 = trunc <64 x i64> undef to <64 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = trunc <2 x i32>
undef to <2 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = trunc <4 x i32>
undef to <4 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = trunc <8 x i32>
undef to <8 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = trunc <16 x i32>
undef to <16 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V32i32 = trunc <32 x i32>
undef to <32 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V64i32 = trunc <64 x i32>
undef to <64 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i16 = trunc <2 x i16>
undef to <2 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction:
%V4i16 = trunc <4 x i16> undef to <4 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i16 = trunc <8 x i16>
undef to <8 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V16i16 = trunc <16 x i16>
undef to <16 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i16 = trunc <32 x i16>
undef to <32 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i16 = trunc <64 x i16>

```

```

undef to <64 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V2i8 = trunc <2 x i8> undef
to <2 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V4i8 = trunc <4 x i8> undef
to <4 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V8i8 = trunc <8 x i8> undef
to <8 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 3 for instruction: %V16i8 = trunc <16 x
i8> undef to <16 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i8 = trunc <32 x i8>
undef to <32 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i8 = trunc <64 x i8>
undef to <64 x i1>
; AVX512VL512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX256-LABEL: 'trunc_vXi1'
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = trunc <2 x i64> undef to <2
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = trunc <4 x i64> undef to <4
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 9 for instruction: %V8i64 = trunc <8 x i64> undef to <8
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 11 for instruction: %V16i64 = trunc <16 x i64> undef to
<16 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i64 = trunc <32 x i64> undef to
<32 x i1>
; SKX256-NEXT:
Cost Model: Found an estimated cost of 0 for instruction: %V64i64 = trunc <64 x i64> undef to <64 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = trunc <2 x i32> undef to <2
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = trunc <4 x i32> undef to <4
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = trunc <8 x i32> undef to <8
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V16i32 = trunc <16 x i32> undef to
<16 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i32 = trunc <32 x i32> undef to
<32 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i32 = trunc <64 x i32> undef to
<64 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i16 = trunc <2 x i16> undef to <2
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction:
%V4i16 = trunc <4 x i16> undef to <4 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i16 = trunc <8 x i16> undef to <8
x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i16 = trunc <16 x i16> undef to
<16 x i1>

```

```

; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V32i16 = trunc <32 x i16> undef to
<32 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 8 for instruction: %V64i16 = trunc <64 x i16> undef to
<64 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i8 = trunc <2 x i8> undef to <2 x
i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i8 = trunc <4 x i8> undef to <4 x
i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i8 = trunc <8 x i8> undef to <8 x
i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i8 = trunc <16 x i8> undef to
<16 x i1>
; SKX256-NEXT:
Cost Model: Found an estimated cost of 2 for instruction: %V32i8 = trunc <32 x i8> undef to <32 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V64i8 = trunc <64 x i8> undef to
<64 x i1>
; SKX256-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef
;
; SKX512-LABEL: 'trunc_vXi1'
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i64 = trunc <2 x i64> undef to <2
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i64 = trunc <4 x i64> undef to <4
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i64 = trunc <8 x i64> undef to <8
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 11 for instruction: %V16i64 = trunc <16 x i64> undef to
<16 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i64 = trunc <32 x i64> undef to
<32 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction:
%V64i64 = trunc <64 x i64> undef to <64 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i32 = trunc <2 x i32> undef to <2
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i32 = trunc <4 x i32> undef to <4
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i32 = trunc <8 x i32> undef to <8
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i32 = trunc <16 x i32> undef to
<16 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V32i32 = trunc <32 x i32> undef to
<32 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: %V64i32 = trunc <64 x i32> undef to
<64 x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i16 = trunc <2 x i16> undef to <2
x i1>
; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i16 = trunc <4 x i16> undef to <4
x i1>
;

```

SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i16 = trunc <8 x i16> undef to <8 x i1>

; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i16 = trunc <16 x i16> undef to <16 x i1>

; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i16 = trunc <32 x i16> undef to <32 x i1>

; SKX512-NEXT: Cost Model: Found an estimated cost of 4 for instruction: %V64i16 = trunc <64 x i16> undef to <64 x i1>

; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V2i8 = trunc <2 x i8> undef to <2 x i1>

; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V4i8 = trunc <4 x i8> undef to <4 x i1>

; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V8i8 = trunc <8 x i8> undef to <8 x i1>

; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V16i8 = trunc <16 x i8> undef to <16 x i1>

; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V32i8 = trunc <32 x i8> undef to <32 x i1>

; SKX512-NEXT: Cost Model: Found an estimated cost of 2 for instruction: %V64i8 = trunc <64 x i8> undef to <64 x i1>

; SKX512-NEXT: Cost Model: Found an estimated cost of 0 for instruction: ret i32 undef

;

%V2i64 = trunc <2 x i64> undef to <2 x i1>

%V4i64 = trunc <4 x i64> undef to <4 x i1>

%V8i64 = trunc <8 x i64> undef to <8 x i1>

%V16i64 = trunc <16 x i64> undef to <16 x i1>

%V32i64 = trunc <32 x i64> undef to <32 x i1>

%V64i64 = trunc <64 x i64> undef to <64 x i1>

%V2i32 = trunc <2 x i32> undef to <2 x i1>

%V4i32 = trunc <4 x i32> undef to <4 x i1>

%V8i32 = trunc <8 x i32> undef to <8 x i1>

%V16i32 = trunc <16 x i32> undef to <16 x i1>

%V32i32 = trunc <32 x i32> undef to <32 x i1>

%V64i32 = trunc <64 x i32> undef to <64 x i1>

%V2i16 = trunc <2 x i16> undef to <2 x i1>

%V4i16 = trunc <4 x i16> undef to <4 x i1>

%V8i16 = trunc <8 x i16> undef to <8 x i1>

%V16i16 = trunc <16 x i16> undef to <16 x i1>

%V32i16 = trunc <32 x i16> undef to <32 x i1>

%V64i16 = trunc <64 x i16> undef to <64 x i1>

%V2i8 = trunc <2 x i8> undef to <2 x i1>

%V4i8 = trunc <4 x i8> undef to <4 x i1>

%V8i8 = trunc <8 x i8> undef to <8 x i1>

%V16i8 = trunc <16 x i8> undef to <16 x i1>

%V32i8 = trunc <32 x i8> undef to <32 x i1>

%V64i8 = trunc <64 x i8> undef to <64 x i1>

ret i32 undef

}

=====

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; NOTE: Assertions have been autogenerated by utils/update\_llc\_test\_checks.py

; RUN: llc -mtriple=riscv64 -mattr=+m -verify-machineinstrs < %s \

; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64

;

```

; Get the actual value of the overflow bit.
;
define zeroext i1 @saddo1.i32(i32 signext %v1, i32 signext %v2, ptr %res) {
; RV64-LABEL: saddo1.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a3, a0, a1
; RV64-NEXT:  slt a0, a3, a0
; RV64-NEXT:  slti a1, a1, 0
; RV64-NEXT:  xor a0, a1, a0
; RV64-NEXT:  sw a3, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

```

```

; Test the immediate version.
define zeroext i1 @saddo2.i32(i32 signext %v1, ptr %res) {
; RV64-LABEL: saddo2.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addiw a2, a0, 4
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 4)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

```

```

; Test negative immediates.
define zeroext i1 @saddo3.i32(i32 signext %v1, ptr %res) {
; RV64-LABEL: saddo3.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addiw a2, a0, -4
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 -4)
%val = extractvalue {i32, i1} %t, 0

```

```

%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

; Test immediates that are too large to be encoded.
define zeroext i1 @saddo4.i32(i32 signext %v1, ptr %res) {
; RV64-LABEL: saddo4.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT: lui a2, 4096
; RV64-NEXT: addi a2, a2, -1
; RV64-NEXT: addw a2, a0, a2
; RV64-NEXT: slt
a0, a2, a0
; RV64-NEXT: sw a2, 0(a1)
; RV64-NEXT: ret
entry:
%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 16777215)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @saddo1.i64(i64 %v1, i64 %v2, ptr %res) {
; RV64-LABEL: saddo1.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT: add a3, a0, a1
; RV64-NEXT: slt a0, a3, a0
; RV64-NEXT: slti a1, a1, 0
; RV64-NEXT: xor a0, a1, a0
; RV64-NEXT: sd a3, 0(a2)
; RV64-NEXT: ret
entry:
%t = call {i64, i1} @llvm.sadd.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @saddo2.i64(i64 %v1, ptr %res) {
; RV64-LABEL: saddo2.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT: addi a2, a0, 4
; RV64-NEXT: slt a0, a2, a0
; RV64-NEXT: sd a2, 0(a1)
; RV64-NEXT: ret

```



```

entry:
    %t = call {i64, i1}
    @llvm.sadd.with.overflow.i64(i64 %v1, i64 4)
    %val = extractvalue {i64, i1} %t, 0
    %obit = extractvalue {i64, i1} %t, 1
    store i64 %val, ptr %res
    ret i1 %obit
}

define zeroext i1 @saddo3.i64(i64 %v1, ptr %res) {
; RV64-LABEL: saddo3.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addi a2, a0, -4
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  sd a2, 0(a1)
; RV64-NEXT:  ret
entry:
    %t = call {i64, i1} @llvm.sadd.with.overflow.i64(i64 %v1, i64 -4)
    %val = extractvalue {i64, i1} %t, 0
    %obit = extractvalue {i64, i1} %t, 1
    store i64 %val, ptr %res
    ret i1 %obit
}

define zeroext i1 @uaddo.i32(i32 signext %v1, i32 signext %v2, ptr %res) {
; RV64-LABEL: uaddo.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a1, a0, a1
; RV64-NEXT:  sltu a0, a1, a0
; RV64-NEXT:  sw a1, 0(a2)
; RV64-NEXT:  ret
entry:
    %t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 %v2)
    %val = extractvalue {i32, i1} %t, 0
    %obit = extractvalue {i32,
i1} %t, 1
    store i32 %val, ptr %res
    ret i1 %obit
}

define zeroext i1 @uaddo.i32.constant(i32 signext %v1, ptr %res) {
; RV64-LABEL: uaddo.i32.constant:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addiw a2, a0, -2
; RV64-NEXT:  sltu a0, a2, a0
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret

```

```

entry:
%t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 -2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @uaddo.i32.constant_one(i32 signext %v1, ptr %res) {
; RV64-LABEL: uaddo.i32.constant_one:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addiw a2, a0, 1
; RV64-NEXT:  seqz a0, a2
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 1)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @uaddo.i64(i64 %v1, i64 %v2, ptr
%res) {
; RV64-LABEL: uaddo.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a1, a0, a1
; RV64-NEXT:  sltu a0, a1, a0
; RV64-NEXT:  sd a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @uaddo.i64.constant_one(i64 %v1, ptr %res) {
; RV64-LABEL: uaddo.i64.constant_one:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addi a2, a0, 1
; RV64-NEXT:  seqz a0, a2
; RV64-NEXT:  sd a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 1)

```

```

%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @ssubo1.i32(i32 signext %v1, i32 signext %v2, ptr %res) {
; RV64-LABEL: ssubo1.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sgtz a3, a1
; RV64-NEXT:  subw a1,
a0, a1
; RV64-NEXT:  slt a0, a1, a0
; RV64-NEXT:  xor a0, a3, a0
; RV64-NEXT:  sw a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.ssub.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @ssubo2.i32(i32 signext %v1, ptr %res) {
; RV64-LABEL: ssubo2.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addiw a2, a0, 4
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.ssub.with.overflow.i32(i32 %v1, i32 -4)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @ssubo.i64(i64 %v1, i64 %v2, ptr %res) {
; RV64-LABEL: ssubo.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sgtz a3, a1
; RV64-NEXT:  sub a1, a0, a1
; RV64-NEXT:  slt a0, a1, a0
; RV64-NEXT:  xor a0, a3, a0
; RV64-NEXT:  sd a1,

```

```

0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.ssub.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @usubo.i32(i32 signext %v1, i32 signext %v2, ptr %res) {
; RV64-LABEL: usubo.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  subw a1, a0, a1
; RV64-NEXT:  sltu a0, a0, a1
; RV64-NEXT:  sw a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.usub.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @usubo.i32.constant.rhs(i32 signext %v1, ptr %res) {
; RV64-LABEL: usubo.i32.constant.rhs:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addiw a2, a0, 2
; RV64-NEXT:  sltu a0, a0, a2
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.usub.with.overflow.i32(i32 %v1, i32 -2)

%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @usubo.i32.constant.lhs(i32 signext %v1, ptr %res) {
; RV64-LABEL: usubo.i32.constant.lhs:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  li a2, -2
; RV64-NEXT:  subw a2, a2, a0
; RV64-NEXT:  addi a0, a2, 1
; RV64-NEXT:  seqz a0, a0

```

```

; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.usub.with.overflow.i32(i32 -2, i32 %v1)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @usubo.i64(i64 %v1, i64 %v2, ptr %res) {
; RV64-LABEL: usubo.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sub a1, a0, a1
; RV64-NEXT:  sltu a0, a0, a1
; RV64-NEXT:  sd a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.usub.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t,
1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @smulo.i32(i32 signext %v1, i32 signext %v2, ptr %res) {
; RV64-LABEL: smulo.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mul a1, a0, a1
; RV64-NEXT:  srai a0, a1, 32
; RV64-NEXT:  sraiw a3, a1, 31
; RV64-NEXT:  xor a0, a0, a3
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  sw a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.smul.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @smulo2.i32(i32 signext %v1, ptr %res) {
; RV64-LABEL: smulo2.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  li a2, 13

```

```

; RV64-NEXT:  mul a2, a0, a2
; RV64-NEXT:  srai a0, a2, 32
; RV64-NEXT:  sraiw a3, a2, 31
; RV64-NEXT:  xor a0, a0, a3
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.smul.with.overflow.i32(i32 %v1, i32
13)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @smulo.i64(i64 %v1, i64 %v2, ptr %res) {
; RV64-LABEL: smulo.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mulh a3, a0, a1
; RV64-NEXT:  mul a1, a0, a1
; RV64-NEXT:  srai a0, a1, 63
; RV64-NEXT:  xor a0, a3, a0
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  sd a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @smulo2.i64(i64 %v1, ptr %res) {
; RV64-LABEL: smulo2.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  li a2, 13
; RV64-NEXT:  mulh a3, a0, a2
; RV64-NEXT:  mul a2, a0, a2
; RV64-NEXT:  srai a0, a2, 63
; RV64-NEXT:  xor a0, a3, a0
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  sd a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call

```

```

{i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 13)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @umulo.i32(i32 signext %v1, i32 signext %v2, ptr %res) {
; RV64-LABEL: umulo.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  slli a1, a1, 32
; RV64-NEXT:  slli a0, a0, 32
; RV64-NEXT:  mulhu a1, a0, a1
; RV64-NEXT:  srli a0, a1, 32
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  sw a1, 0(a2)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.umul.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @umulo2.i32(i32 signext %v1, ptr %res) {
; RV64-LABEL: umulo2.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  li a2, 13
; RV64-NEXT:  slli a2, a2, 32
; RV64-NEXT:  slli a0, a0, 32
; RV64-NEXT:  mulhu a2, a0, a2
; RV64-NEXT:  srli a0, a2, 32
; RV64-NEXT:
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  sw a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.umul.with.overflow.i32(i32 %v1, i32 13)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
store i32 %val, ptr %res
ret i1 %obit
}

; Similar to umulo.i32, but storing the overflow and returning the result.
define signext i32 @umulo3.i32(i32 signext %0, i32 signext %1, ptr %2) {
; RV64-LABEL: umulo3.i32:

```

```

; RV64:    # %bb.0:
; RV64-NEXT:  slli a1, a1, 32
; RV64-NEXT:  slli a0, a0, 32
; RV64-NEXT:  mulhu a0, a0, a1
; RV64-NEXT:  srai a1, a0, 32
; RV64-NEXT:  snez a1, a1
; RV64-NEXT:  sext.w a0, a0
; RV64-NEXT:  sw a1, 0(a2)
; RV64-NEXT:  ret
%4 = tail call { i32, i1 } @llvm.umul.with.overflow.i32(i32 %0, i32 %1)
%5 = extractvalue { i32, i1 } %4, 1
%6 = extractvalue { i32, i1 } %4, 0
%7 = zext i1 %5 to i32
store i32 %7, ptr %2, align 4
ret i32 %6
}

```

```

define zeroext i1 @umulo.i64(i64 %v1, i64 %v2, ptr %res) {
; RV64-LABEL: umulo.i64:
;
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  mulhu a3, a0, a1
; RV64-NEXT:  snez a3, a3
; RV64-NEXT:  mul a0, a0, a1
; RV64-NEXT:  sd a0, 0(a2)
; RV64-NEXT:  mv a0, a3
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.umul.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

```

```

define zeroext i1 @umulo2.i64(i64 %v1, ptr %res) {
; RV64-LABEL: umulo2.i64:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  li a3, 13
; RV64-NEXT:  mulhu a2, a0, a3
; RV64-NEXT:  snez a2, a2
; RV64-NEXT:  mul a0, a0, a3
; RV64-NEXT:  sd a0, 0(a1)
; RV64-NEXT:  mv a0, a2
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.umul.with.overflow.i64(i64 %v1, i64 13)
%val = extractvalue {i64, i1} %t, 0

```



```

%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

;
; Check the use of the overflow bit in combination with a select instruction.
;
define i32 @saddo.select.i32(i32
  signext %v1, i32 signext %v2) {
; RV64-LABEL: saddo.select.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a2, a0, a1
; RV64-NEXT:  slt a2, a2, a0
; RV64-NEXT:  slti a3, a1, 0
; RV64-NEXT:  bne a3, a2, .LBB28_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB28_2: # %entry
; RV64-NEXT:  ret
entry:
  %t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 %v2)
  %obit = extractvalue {i32, i1} %t, 1
  %ret = select i1 %obit, i32 %v1, i32 %v2
  ret i32 %ret
}

define i1 @saddo.not.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: saddo.not.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a2, a0, a1
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  slti a1, a1, 0
; RV64-NEXT:  xor a0, a1, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
  %t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 %v2)
  %obit = extractvalue {i32, i1} %t, 1
  %ret = xor i1 %obit, true
  ret i1 %ret
}

define i64 @saddo.select.i64(i64
  %v1, i64 %v2) {
; RV64-LABEL: saddo.select.i64:
; RV64:      # %bb.0: # %entry

```

```

; RV64-NEXT:  add a2, a0, a1
; RV64-NEXT:  slt a2, a2, a0
; RV64-NEXT:  slti a3, a1, 0
; RV64-NEXT:  bne a3, a2, .LBB30_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB30_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.sadd.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = select i1 %obit, i64 %v1, i64 %v2
ret i64 %ret
}

define i1 @saddo.not.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: saddo.not.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a2, a0, a1
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  slti a1, a1, 0
; RV64-NEXT:  xor a0, a1, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.sadd.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

define i32 @uaddo.select.i32(i32 signext %v1,
i32 signext %v2) {
; RV64-LABEL: uaddo.select.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a2, a0, a1
; RV64-NEXT:  bltu a2, a0, .LBB32_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB32_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = select i1 %obit, i32 %v1, i32 %v2
ret i32 %ret
}

```

```

define i1 @uaddo.not.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: uaddo.not.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a1, a0, a1
; RV64-NEXT:  sltu a0, a1, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```

```

define i64 @uaddo.select.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: uaddo.select.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a2, a0, a1
; RV64-NEXT:
; RV64-NEXT:  bltu a2, a0, .LBB34_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB34_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = select i1 %obit, i64 %v1, i64 %v2
ret i64 %ret
}

```

```

define i1 @uaddo.not.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: uaddo.not.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a1, a0, a1
; RV64-NEXT:  sltu a0, a1, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```

```

define i32 @ssubo.select.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: ssubo.select.i32:
; RV64:      # %bb.0: # %entry

```

```

; RV64-NEXT:  sgtz a2, a1
; RV64-NEXT:  subw a3, a0, a1
; RV64-NEXT:  slt a3, a3, a0
; RV64-NEXT:  bne a2, a3, .LBB36_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0,
a1
; RV64-NEXT:  .LBB36_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.ssub.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = select i1 %obit, i32 %v1, i32 %v2
ret i32 %ret
}

```

```

define i1 @ssubo.not.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: ssubo.not.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sgtz a2, a1
; RV64-NEXT:  subw a1, a0, a1
; RV64-NEXT:  slt a0, a1, a0
; RV64-NEXT:  xor a0, a2, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.ssub.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```

```

define i64 @ssubo.select.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: ssubo.select.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sgtz a2, a1
; RV64-NEXT:  sub a3, a0, a1
; RV64-NEXT:  slt a3, a3, a0
; RV64-NEXT:  bne a2, a3, .LBB38_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:
.LBB38_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.ssub.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = select i1 %obit, i64 %v1, i64 %v2

```

```

ret i64 %ret
}

define i1 @ssub.not.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: ssub.not.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sgtz a2, a1
; RV64-NEXT:  sub a1, a0, a1
; RV64-NEXT:  slt a0, a1, a0
; RV64-NEXT:  xor a0, a2, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.ssub.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

define i32 @usubo.select.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: usubo.select.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  subw a2, a0, a1
; RV64-NEXT:  bltu a0, a2, .LBB40_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB40_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.usub.with.overflow.i32(i32
%v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = select i1 %obit, i32 %v1, i32 %v2
ret i32 %ret
}

define i1 @usubo.not.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: usubo.not.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  subw a1, a0, a1
; RV64-NEXT:  sltu a0, a0, a1
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.usub.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```

```

}

define i64 @usubo.select.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: usubo.select.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sub a2, a0, a1
; RV64-NEXT:  bltu a0, a2, .LBB42_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB42_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.usub.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = select i1 %obit, i64 %v1, i64 %v2
ret i64 %ret
}

```

```

define
i1 @usubo.not.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: usubo.not.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sub a1, a0, a1
; RV64-NEXT:  sltu a0, a0, a1
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.usub.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```

```

define i32 @smulo.select.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: smulo.select.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mul a2, a0, a1
; RV64-NEXT:  srai a3, a2, 32
; RV64-NEXT:  sraiw a2, a2, 31
; RV64-NEXT:  bne a3, a2, .LBB44_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB44_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.smul.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = select i1 %obit, i32 %v1, i32 %v2

```

```

ret i32 %ret
}

define i1 @smulo.not.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL:
smulo.not.i32:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  mul a0, a0, a1
; RV64-NEXT:  srai a1, a0, 32
; RV64-NEXT:  sraiw a0, a0, 31
; RV64-NEXT:  xor a0, a1, a0
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.smul.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

define i64 @smulo.select.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: smulo.select.i64:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  mulh a2, a0, a1
; RV64-NEXT:  mul a3, a0, a1
; RV64-NEXT:  srai a3, a3, 63
; RV64-NEXT:  bne a2, a3, .LBB46_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB46_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = select i1 %obit, i64 %v1, i64 %v2
ret i64 %ret
}

define i1 @smulo.not.i64(i64 %v1, i64 %v2) {
; RV64-LABEL:
smulo.not.i64:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  mulh a2, a0, a1
; RV64-NEXT:  mul a0, a0, a1
; RV64-NEXT:  srai a0, a0, 63
; RV64-NEXT:  xor a0, a2, a0
; RV64-NEXT:  snez a0, a0

```

```

; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```

```

define i32 @umulo.select.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: umulo.select.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  slli a2, a1, 32
; RV64-NEXT:  slli a3, a0, 32
; RV64-NEXT:  mulhu a2, a3, a2
; RV64-NEXT:  srai a2, a2, 32
; RV64-NEXT:  bnez a2, .LBB48_2
; RV64-NEXT: # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT: .LBB48_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.umul.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = select i1 %obit, i32 %v1, i32 %v2
ret i32 %ret
}

```

```

define
i1 @umulo.not.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: umulo.not.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  slli a1, a1, 32
; RV64-NEXT:  slli a0, a0, 32
; RV64-NEXT:  mulhu a0, a0, a1
; RV64-NEXT:  srai a0, a0, 32
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.umul.with.overflow.i32(i32 %v1, i32 %v2)
%obit = extractvalue {i32, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```

```

define i64 @umulo.select.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: umulo.select.i64:

```



```

; RV64:    # %bb.0: # %entry
; RV64-NEXT:  mulhu a2, a0, a1
; RV64-NEXT:  bnez a2, .LBB50_2
; RV64-NEXT:  # %bb.1: # %entry
; RV64-NEXT:  mv a0, a1
; RV64-NEXT:  .LBB50_2: # %entry
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.umul.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = select i1 %obit, i64 %v1, i64 %v2
ret i64 %ret
}

```

```

define i1 @umulo.not.i64(i64 %v1, i64 %v2)
{
; RV64-LABEL: umulo.not.i64:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  mulhu a0, a0, a1
; RV64-NEXT:  snez a0, a0
; RV64-NEXT:  xori a0, a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.umul.with.overflow.i64(i64 %v1, i64 %v2)
%obit = extractvalue {i64, i1} %t, 1
%ret = xor i1 %obit, true
ret i1 %ret
}

```

```

;
; Check the use of the overflow bit in combination with a branch instruction.
;

```

```

define zeroext i1 @saddo.br.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: saddo.br.i32:
; RV64:    # %bb.0: # %entry
; RV64-NEXT:  addw a2, a0, a1
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  slti a1, a1, 0
; RV64-NEXT:  beq a1, a0, .LBB52_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT:  .LBB52_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.sadd.with.overflow.i32(i32 %v1, i32 %v2)

```

```

%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
br i1
%obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @saddo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: saddo.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a2, a0, a1
; RV64-NEXT:  slt a0, a2, a0
; RV64-NEXT:  slti a1, a1, 0
; RV64-NEXT:  beq a1, a0, .LBB53_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB53_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.sadd.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @uaddo.br.i32(i32 %v1, i32 %v2) {
; RV64-LABEL: uaddo.br.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addw a1, a0, a1
; RV64-NEXT:  sext.w a0, a0
; RV64-NEXT:  bgeu a1, a0, .LBB54_2
; RV64-NEXT:  # %bb.1: # %overflow
;
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret

```

```

; RV64-NEXT: .LBB54_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.uadd.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

```

```

define zeroext i1 @uaddo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: uaddo.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a1, a0, a1
; RV64-NEXT:  bgeu a1, a0, .LBB55_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB55_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

```

```

define zeroext i1 @ssubo.br.i32(i32
signext %v1, i32 signext %v2) {
; RV64-LABEL: ssubo.br.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  sgtz a2, a1
; RV64-NEXT:  subw a1, a0, a1
; RV64-NEXT:  slt a0, a1, a0
; RV64-NEXT:  beq a2, a0, .LBB56_2

```

```

; RV64-NEXT: # %bb.1: # %overflow
; RV64-NEXT: li a0, 0
; RV64-NEXT: ret
; RV64-NEXT: .LBB56_2: # %continue
; RV64-NEXT: li a0, 1
; RV64-NEXT: ret
entry:
%t = call {i32, i1} @llvm.ssub.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

```

```

define zeroext i1 @ssubo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: ssubo.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT: sgtz a2, a1
; RV64-NEXT: sub a1, a0, a1
; RV64-NEXT: slt a0, a1, a0
; RV64-NEXT: beq a2, a0, .LBB57_2
; RV64-NEXT: # %bb.1: # %overflow
; RV64-NEXT: li a0, 0
; RV64-NEXT: ret
; RV64-NEXT: .LBB57_2: # %continue
;
RV64-NEXT: li a0, 1
; RV64-NEXT: ret
entry:
%t = call {i64, i1} @llvm.ssub.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

```

```

define zeroext i1 @usubo.br.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: usubo.br.i32:

```

```

; RV64:    # %bb.0: # %entry
; RV64-NEXT:  subw a1, a0, a1
; RV64-NEXT:  bgeu a0, a1, .LBB58_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT:  .LBB58_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.usub.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @usubo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: usubo.br.i64:
;
RV64:    # %bb.0: # %entry
; RV64-NEXT:  sub a1, a0, a1
; RV64-NEXT:  bgeu a0, a1, .LBB59_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT:  .LBB59_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.usub.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @smulo.br.i32(i32 signext %v1, i32 signext %v2) {

```

```

; RV64-LABEL: smulo.br.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mul a0, a0, a1
; RV64-NEXT:  srai a1, a0, 32
; RV64-NEXT:  sraiw a0, a0, 31
; RV64-NEXT:  beq a1, a0, .LBB60_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB60_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i32, i1} @llvm.smul.with.overflow.i32(i32
%v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

```

```

define zeroext i1 @smulo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: smulo.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mulh a2, a0, a1
; RV64-NEXT:  mul a0, a0, a1
; RV64-NEXT:  srai a0, a0, 63
; RV64-NEXT:  beq a2, a0, .LBB61_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB61_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

```

```

continue:
    ret i1 true
}

define zeroext i1 @smulo2.br.i64(i64 %v1) {
; RV64-LABEL: smulo2.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  li a1, -13
; RV64-NEXT:
    mulh a2, a0, a1
; RV64-NEXT:  mul a0, a0, a1
; RV64-NEXT:  srai a0, a0, 63
; RV64-NEXT:  beq a2, a0, .LBB62_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB62_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
    %t = call {i64, i1} @llvm.smul.with.overflow.i64(i64 %v1, i64 -13)
    %val = extractvalue {i64, i1} %t, 0
    %obit = extractvalue {i64, i1} %t, 1
    br i1 %obit, label %overflow, label %continue

overflow:
    ret i1 false

continue:
    ret i1 true
}

define zeroext i1 @umulo.br.i32(i32 signext %v1, i32 signext %v2) {
; RV64-LABEL: umulo.br.i32:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  slli a1, a1, 32
; RV64-NEXT:  slli a0, a0, 32
; RV64-NEXT:  mulhu a0, a0, a1
; RV64-NEXT:  srai a0, a0, 32
; RV64-NEXT:  beqz a0, .LBB63_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB63_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
    %t = call

```

```

{i32, i1} @llvm.umul.with.overflow.i32(i32 %v1, i32 %v2)
%val = extractvalue {i32, i1} %t, 0
%obit = extractvalue {i32, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @umulo.br.i64(i64 %v1, i64 %v2) {
; RV64-LABEL: umulo.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  mulhu a0, a0, a1
; RV64-NEXT:  beqz a0, .LBB64_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB64_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.umul.with.overflow.i64(i64 %v1, i64 %v2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @umulo2.br.i64(i64 %v1) {
; RV64-LABEL: umulo2.br.i64:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  add a1, a0, a0
; RV64-NEXT:  bgeu a1, a0,
.LBB65_2
; RV64-NEXT:  # %bb.1: # %overflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  ret
; RV64-NEXT: .LBB65_2: # %continue
; RV64-NEXT:  li a0, 1
; RV64-NEXT:  ret

```



```

entry:
%t = call {i64, i1} @llvm.umul.with.overflow.i64(i64 %v1, i64 2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %overflow, label %continue

overflow:
ret i1 false

continue:
ret i1 true
}

define zeroext i1 @uaddo.i64.constant(i64 %v1, ptr %res) {
; RV64-LABEL: uaddo.i64.constant:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  addi a2, a0, 2
; RV64-NEXT:  sltu a0, a2, a0
; RV64-NEXT:  sd a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @uaddo.i64.constant_2048(i64 %v1, ptr %res) {
; RV64-LABEL: uaddo.i64.constant_2048:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:
; RV64-NEXT:  addi a2, a0, 2047
; RV64-NEXT:  addi a2, a2, 1
; RV64-NEXT:  sltu a0, a2, a0
; RV64-NEXT:  sd a2, 0(a1)
; RV64-NEXT:  ret
entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 2048)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

define zeroext i1 @uaddo.i64.constant_2049(i64 %v1, ptr %res) {
; RV64-LABEL: uaddo.i64.constant_2049:
; RV64:      # %bb.0: # %entry

```

```

; RV64-NEXT:  addi a2, a0, 2047
; RV64-NEXT:  addi a2, a2, 2
; RV64-NEXT:  sltu a0, a2, a0
; RV64-NEXT:  sd a2, 0(a1)
; RV64-NEXT:  ret

entry:
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 2049)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
store i64 %val, ptr %res
ret i1 %obit
}

```

```

define i64 @uaddo.i64.constant_setcc_on_overflow_flag(ptr %p) {
; RV64-LABEL: uaddo.i64.constant_setcc_on_overflow_flag:
; RV64:      # %bb.0: # %entry
; RV64-NEXT:  ld a1, 0(a0)
;
; RV64-NEXT:  addi a0, a1, 2
; RV64-NEXT:  bltu a0, a1, .LBB69_2
; RV64-NEXT:  # %bb.1: # %IfOverflow
; RV64-NEXT:  li a0, 0
; RV64-NEXT:  .LBB69_2: # %IfNoOverflow
; RV64-NEXT:  ret

entry:
%v1 = load i64, ptr %p
%t = call {i64, i1} @llvm.uadd.with.overflow.i64(i64 %v1, i64 2)
%val = extractvalue {i64, i1} %t, 0
%obit = extractvalue {i64, i1} %t, 1
br i1 %obit, label %IfNoOverflow, label %IfOverflow
IfOverflow:
ret i64 0
IfNoOverflow:
ret i64 %val
}

```

```

declare {i32, i1} @llvm.sadd.with.overflow.i32(i32, i32) nounwind readnone
declare {i64, i1} @llvm.sadd.with.overflow.i64(i64, i64) nounwind readnone
declare {i32, i1} @llvm.uadd.with.overflow.i32(i32, i32) nounwind readnone
declare {i64, i1} @llvm.uadd.with.overflow.i64(i64, i64) nounwind readnone
declare {i32, i1} @llvm.ssub.with.overflow.i32(i32, i32) nounwind readnone
declare {i64, i1} @llvm.ssub.with.overflow.i64(i64, i64) nounwind readnone
declare {i32, i1} @llvm.usub.with.overflow.i32(i32, i32) nounwind readnone
declare
{i64, i1} @llvm.usub.with.overflow.i64(i64, i64) nounwind readnone
declare {i32, i1} @llvm.smul.with.overflow.i32(i32, i32) nounwind readnone
declare {i64, i1} @llvm.smul.with.overflow.i64(i64, i64) nounwind readnone
declare {i32, i1} @llvm.umul.with.overflow.i32(i32, i32) nounwind readnone

```

```
declare {i64, i1} @llvm.umul.with.overflow.i64(i64, i64) nounwind readnone
add_llvm_library(lldbPluginObjectContainerBSDArchive PLUGIN
ObjectContainerBSDArchive.cpp
```

LINK\_LIBS

lldbCore

lldbHost

lldbSymbol

LINK\_COMPONENTS

Support

)

=====

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```
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64I %s
; RUN: llc -mtriple=riscv64 -mattr=+m -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64IM %s
```

```
define i32 @udiv(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: udiv:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  slli a1, a1, 32
; RV64I-NEXT:  srli a1, a1, 32
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  divuw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = udiv i32 %a, %b
ret i32 %1
}
```

```
define i32 @udiv_constant(i32 %a) nounwind {
; RV64I-LABEL:
udiv_constant:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
```

```

; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a0, a0, 32
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv_constant:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 32
; RV64IM-NEXT:  lui a1, 838861
; RV64IM-NEXT:  addi a1, a1, -819
; RV64IM-NEXT:  slli a1, a1, 32
; RV64IM-NEXT:  mulhu a0, a0, a1
; RV64IM-NEXT:  srli a0, a0, 34
; RV64IM-NEXT:  ret
%1 = udiv i32 %a, 5
ret i32 %1
}

```

```

define i32 @udiv_pow2(i32 %a) nounwind {
; RV64I-LABEL: udiv_pow2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  srliw a0, a0, 3
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv_pow2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  srliw a0, a0, 3
; RV64IM-NEXT:  ret
%1 = udiv i32 %a, 8
ret i32 %1
}

```

```

define i32 @udiv_constant_lhs(i32
%a) nounwind {
; RV64I-LABEL: udiv_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 32
; RV64I-NEXT:  srli a1, a0, 32
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret

```

```

;
; RV64IM-LABEL: udiv_constant_lhs:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  divuw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = udiv i32 10, %a
ret i32 %1
}

```

```

define i64 @udiv64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: udiv64:
; RV64I:    # %bb.0:
; RV64I-NEXT:  tail __udivdi3
;
; RV64IM-LABEL: udiv64:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  divu a0, a0, a1
; RV64IM-NEXT:  ret
%1 = udiv i64 %a, %b
ret i64 %1
}

```

```

define i64 @udiv64_constant(i64 %a) nounwind {
; RV64I-LABEL: udiv64_constant:
; RV64I:    # %bb.0:
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:
;         tail __udivdi3
;
; RV64IM-LABEL: udiv64_constant:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  lui a1, 838861
; RV64IM-NEXT:  addiw a1, a1, -819
; RV64IM-NEXT:  slli a2, a1, 32
; RV64IM-NEXT:  add a1, a1, a2
; RV64IM-NEXT:  mulhu a0, a0, a1
; RV64IM-NEXT:  srli a0, a0, 2
; RV64IM-NEXT:  ret
%1 = udiv i64 %a, 5
ret i64 %1
}

```

```

define i64 @udiv64_constant_lhs(i64 %a) nounwind {
; RV64I-LABEL: udiv64_constant_lhs:
; RV64I:    # %bb.0:
; RV64I-NEXT:  mv a1, a0
; RV64I-NEXT:  li a0, 10

```

```

; RV64I-NEXT:  tail __udivdi3
;
; RV64IM-LABEL: udiv64_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  divu a0, a1, a0
; RV64IM-NEXT:  ret
%1 = udiv i64 10, %a
ret i64 %1
}

define i8 @udiv8(i8 %a, i8 %b) nounwind {
; RV64I-LABEL: udiv8:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  andi a0, a0, 255
; RV64I-NEXT:  andi a1, a1, 255
; RV64I-NEXT:  call
__udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv8:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  andi a1, a1, 255
; RV64IM-NEXT:  andi a0, a0, 255
; RV64IM-NEXT:  divuw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = udiv i8 %a, %b
ret i8 %1
}

define i8 @udiv8_constant(i8 %a) nounwind {
; RV64I-LABEL: udiv8_constant:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  andi a0, a0, 255
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv8_constant:
; RV64IM:      # %bb.0:

```

```

; RV64IM-NEXT:  andi a0, a0, 255
; RV64IM-NEXT:  li a1, 205
; RV64IM-NEXT:  mul a0, a0, a1
; RV64IM-NEXT:  srliw a0, a0, 10
; RV64IM-NEXT:  ret
%1 = udiv i8 %a, 5
ret i8 %1
}

define i8 @udiv8_pow2(i8 %a) nounwind
{
; RV64I-LABEL: udiv8_pow2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 56
; RV64I-NEXT:  srli a0, a0, 59
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv8_pow2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 56
; RV64IM-NEXT:  srli a0, a0, 59
; RV64IM-NEXT:  ret
%1 = udiv i8 %a, 8
ret i8 %1
}

define i8 @udiv8_constant_lhs(i8 %a) nounwind {
; RV64I-LABEL: udiv8_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  andi a1, a0, 255
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv8_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  andi a0, a0, 255
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  divuw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = udiv i8 10, %a
ret i8 %1
}

```

```

define i16 @udiv16(i16 %a, i16 %b) nounwind {
; RV64I-LABEL: udiv16:
;
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  lui a2, 16
; RV64I-NEXT:  addiw a2, a2, -1
; RV64I-NEXT:  and a0, a0, a2
; RV64I-NEXT:  and a1, a1, a2
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv16:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  lui a2, 16
; RV64IM-NEXT:  addi a2, a2, -1
; RV64IM-NEXT:  and a1, a1, a2
; RV64IM-NEXT:  and a0, a0, a2
; RV64IM-NEXT:  divuw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = udiv i16 %a, %b
ret i16 %1
}

```

```

define i16 @udiv16_constant(i16 %a) nounwind {
; RV64I-LABEL: udiv16_constant:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 48
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp)
; RV64I-NEXT:  # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv16_constant:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  lui a1, 52429
; RV64IM-NEXT:  slli a1, a1, 4
; RV64IM-NEXT:  slli a0, a0, 48
; RV64IM-NEXT:  mulhu a0, a0, a1
; RV64IM-NEXT:  srliw a0, a0, 18

```

```

; RV64IM-NEXT:  ret
%1 = udiv i16 %a, 5
ret i16 %1
}

define i16 @udiv16_pow2(i16 %a) nounwind {
; RV64I-LABEL: udiv16_pow2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a0, a0, 51
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv16_pow2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 48
; RV64IM-NEXT:  srli a0, a0, 51
; RV64IM-NEXT:  ret
%1 = udiv i16 %a, 8
ret i16 %1
}

define i16 @udiv16_constant_lhs(i16 %a) nounwind {
; RV64I-LABEL: udiv16_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 48
; RV64I-NEXT:  srli a1, a0, 48
; RV64I-NEXT:
    li a0, 10
; RV64I-NEXT:  call __udivdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: udiv16_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 48
; RV64IM-NEXT:  srli a0, a0, 48
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  divuw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = udiv i16 10, %a
ret i16 %1
}

define i32 @sdiv(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: sdiv:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  sext.w a1, a1
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  divw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i32 %a, %b
ret i32 %1
}

```

```

define i32 @sdiv_constant(i32 %a) nounwind {
; RV64I-LABEL: sdiv_constant:
;
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv_constant:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  sext.w a0, a0
; RV64IM-NEXT:  lui a1, 419430
; RV64IM-NEXT:  addiw a1, a1, 1639
; RV64IM-NEXT:  mul a0, a0, a1
; RV64IM-NEXT:  srli a1, a0, 63
; RV64IM-NEXT:  srai a0, a0, 33
; RV64IM-NEXT:  addw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i32 %a, 5
ret i32 %1
}

```

```

define i32 @sdiv_pow2(i32 %a) nounwind {
; RV64I-LABEL: sdiv_pow2:
; RV64I:    # %bb.0:

```



```

; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  srlw a1, a1, 29
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  sraiw a0, a0, 3
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv_pow2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  sraiw a1, a0,
31
; RV64IM-NEXT:  srlw a1, a1, 29
; RV64IM-NEXT:  add a0, a0, a1
; RV64IM-NEXT:  sraiw a0, a0, 3
; RV64IM-NEXT:  ret
%1 = sdiv i32 %a, 8
ret i32 %1
}

```

```

define i32 @sdiv_pow2_2(i32 %a) nounwind {
; RV64I-LABEL: sdiv_pow2_2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sraiw a1, a0, 31
; RV64I-NEXT:  srlw a1, a1, 16
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  sraiw a0, a0, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv_pow2_2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  sraiw a1, a0, 31
; RV64IM-NEXT:  srlw a1, a1, 16
; RV64IM-NEXT:  add a0, a0, a1
; RV64IM-NEXT:  sraiw a0, a0, 16
; RV64IM-NEXT:  ret
%1 = sdiv i32 %a, 65536
ret i32 %1
}

```

```

define i32 @sdiv_constant_lhs(i32 %a) nounwind {
; RV64I-LABEL: sdiv_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  sext.w a1, a0
; RV64I-NEXT:  li a0, -10
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded

```

```

Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  li a1, -10
; RV64IM-NEXT:  divw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = sdiv i32 -10, %a
ret i32 %1
}

```

```

define i64 @sdiv64(i64 %a, i64 %b) nounwind {
; RV64I-LABEL: sdiv64:
; RV64I:      # %bb.0:
; RV64I-NEXT:  tail __divdi3
;
; RV64IM-LABEL: sdiv64:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  div a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i64 %a, %b
ret i64 %1
}

```

```

define i64 @sdiv64_constant(i64 %a) nounwind {
; RV64I-LABEL: sdiv64_constant:
; RV64I:      # %bb.0:
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  tail __divdi3
;
; RV64IM-LABEL: sdiv64_constant:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  lui a1, %hi(.LCPI21_0)
; RV64IM-NEXT:  ld a1, %lo(.LCPI21_0)(a1)
; RV64IM-NEXT:  mulh a0, a0, a1
; RV64IM-NEXT:  srli a1, a0, 63
; RV64IM-NEXT:  srai a0, a0, 1
; RV64IM-NEXT:  add a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i64 %a,
5
ret i64 %1
}

```

```

define i64 @sdiv64_constant_lhs(i64 %a) nounwind {
; RV64I-LABEL: sdiv64_constant_lhs:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  mv a1, a0
; RV64I-NEXT:  li a0, 10
; RV64I-NEXT:  tail __divdi3
;
; RV64IM-LABEL: sdiv64_constant_lhs:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  li a1, 10
; RV64IM-NEXT:  div a0, a1, a0
; RV64IM-NEXT:  ret
%1 = sdiv i64 10, %a
ret i64 %1
}

```

; Although this sdiv has two sexti32 operands, it shouldn't compile to divw on  
; RV64M as that wouldn't produce the correct result for e.g. INT\_MIN/-1.

```

define i64 @sdiv64_sext_operands(i32 %a, i32 %b) nounwind {
; RV64I-LABEL: sdiv64_sext_operands:
; RV64I:    # %bb.0:
; RV64I-NEXT:  sext.w a0, a0
; RV64I-NEXT:  sext.w a1, a1
; RV64I-NEXT:  tail __divdi3
;
; RV64IM-LABEL: sdiv64_sext_operands:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  sext.w a0, a0
; RV64IM-NEXT:  sext.w a1, a1
; RV64IM-NEXT:  div a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sext i32 %a to i64
%2 = sext i32 %b to
i64
%3 = sdiv i64 %1, %2
ret i64 %3
}

```

```

define i8 @sdiv8(i8 %a, i8 %b) nounwind {
; RV64I-LABEL: sdiv8:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a1, a1, 24
; RV64I-NEXT:  sraiw a1, a1, 24
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:  sraiw a0, a0, 24
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload

```

```

; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv8:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a1, a1, 24
; RV64IM-NEXT:  sraiw a1, a1, 24
; RV64IM-NEXT:  slli a0, a0, 24
; RV64IM-NEXT:  sraiw a0, a0, 24
; RV64IM-NEXT:  divw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i8 %a, %b
ret i8 %1
}

define i8 @sdiv8_constant(i8 %a) nounwind {
; RV64I-LABEL: sdiv8_constant:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:
    sraiw a0, a0, 24
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv8_constant:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 24
; RV64IM-NEXT:  sraiw a0, a0, 24
; RV64IM-NEXT:  li a1, 103
; RV64IM-NEXT:  mul a0, a0, a1
; RV64IM-NEXT:  sraiw a1, a0, 9
; RV64IM-NEXT:  slli a0, a0, 48
; RV64IM-NEXT:  srli a0, a0, 63
; RV64IM-NEXT:  addw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = sdiv i8 %a, 5
ret i8 %1
}

define i8 @sdiv8_pow2(i8 %a) nounwind {
; RV64I-LABEL: sdiv8_pow2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a1, a0, 24

```

```

; RV64I-NEXT:  sraiw a1, a1, 24
; RV64I-NEXT:  slli a1, a1, 49
; RV64I-NEXT:  srli a1, a1, 61
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:  sraiw a0, a0, 27
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv8_pow2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a1, a0,
24
; RV64IM-NEXT:  sraiw a1, a1, 24
; RV64IM-NEXT:  slli a1, a1, 49
; RV64IM-NEXT:  srli a1, a1, 61
; RV64IM-NEXT:  add a0, a0, a1
; RV64IM-NEXT:  slli a0, a0, 24
; RV64IM-NEXT:  sraiw a0, a0, 27
; RV64IM-NEXT:  ret
%1 = sdiv i8 %a, 8
ret i8 %1
}

define i8 @sdiv8_constant_lhs(i8 %a) nounwind {
; RV64I-LABEL: sdiv8_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 24
; RV64I-NEXT:  sraiw a1, a0, 24
; RV64I-NEXT:  li a0, -10
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv8_constant_lhs:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 24
; RV64IM-NEXT:  sraiw a0, a0, 24
; RV64IM-NEXT:  li a1, -10
; RV64IM-NEXT:  divw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = sdiv i8 -10, %a
ret i8 %1
}

define i16 @sdiv16(i16 %a, i16 %b) nounwind {

```

```

; RV64I-LABEL:
sdiv16:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a1, a1, 16
; RV64I-NEXT:  sraiw a1, a1, 16
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a0, a0, 16
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv16:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  slli a1, a1, 16
; RV64IM-NEXT:  sraiw a1, a1, 16
; RV64IM-NEXT:  slli a0, a0, 16
; RV64IM-NEXT:  sraiw a0, a0, 16
; RV64IM-NEXT:  divw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i16 %a, %b
ret i16 %1
}

```

```

define i16 @sdiv16_constant(i16 %a) nounwind {
; RV64I-LABEL: sdiv16_constant:
; RV64I:    # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a0, a0, 16
; RV64I-NEXT:  li a1, 5
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:
    ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv16_constant:
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 16
; RV64IM-NEXT:  sraiw a0, a0, 16
; RV64IM-NEXT:  lui a1, 6
; RV64IM-NEXT:  addi a1, a1, 1639
; RV64IM-NEXT:  mul a0, a0, a1
; RV64IM-NEXT:  srliw a1, a0, 31

```

```

; RV64IM-NEXT:  sraiw a0, a0, 17
; RV64IM-NEXT:  addw a0, a0, a1
; RV64IM-NEXT:  ret
%1 = sdiv i16 %a, 5
ret i16 %1
}

```

```

define i16 @sdiv16_pow2(i16 %a) nounwind {
; RV64I-LABEL: sdiv16_pow2:
; RV64I:      # %bb.0:
; RV64I-NEXT:  slli a1, a0, 16
; RV64I-NEXT:  sraiw a1, a1, 16
; RV64I-NEXT:  slli a1, a1, 33
; RV64I-NEXT:  srli a1, a1, 61
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a0, a0, 19
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv16_pow2:
; RV64IM:      # %bb.0:
; RV64IM-NEXT:  slli a1, a0, 16
; RV64IM-NEXT:  sraiw a1, a1, 16
; RV64IM-NEXT:  slli a1, a1, 33
;
; RV64IM-NEXT:  srli a1, a1, 61
; RV64IM-NEXT:  add a0, a0, a1
; RV64IM-NEXT:  slli a0, a0, 16
; RV64IM-NEXT:  sraiw a0, a0, 19
; RV64IM-NEXT:  ret
%1 = sdiv i16 %a, 8
ret i16 %1
}

```

```

define i16 @sdiv16_constant_lhs(i16 %a) nounwind {
; RV64I-LABEL: sdiv16_constant_lhs:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  slli a0, a0, 16
; RV64I-NEXT:  sraiw a1, a0, 16
; RV64I-NEXT:  li a0, -10
; RV64I-NEXT:  call __divdi3
; RV64I-NEXT:  ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
;
; RV64IM-LABEL: sdiv16_constant_lhs:

```

```
; RV64IM:    # %bb.0:
; RV64IM-NEXT:  slli a0, a0, 16
; RV64IM-NEXT:  sraiw a0, a0, 16
; RV64IM-NEXT:  li a1, -10
; RV64IM-NEXT:  divw a0, a1, a0
; RV64IM-NEXT:  ret
%1 = sdiv i16 -10, %a
ret i16 %1
}
```

LLVM System Interface Library

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```
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck -check-prefix=RV64I %s
```

```
; Check indexed and unindexed, sext, zext and anyext loads
```

```
define dso_local i64 @lb(ptr %a) nounwind {
; RV64I-LABEL: lb:
; RV64I:      # %bb.0:
; RV64I-NEXT: lb a1, 1(a0)
; RV64I-NEXT: lbu zero, 0(a0)
; RV64I-NEXT: mv a0, a1
; RV64I-NEXT: ret
%1 = getelementptr i8, ptr %a, i32 1
%2 = load i8, ptr %1
%3 = sext i8 %2 to i64
; the unused load will produce an anyext for selection
%4 = load volatile i8, ptr %a
ret i64 %3
}
```

```
define dso_local i64 @lh(ptr %a) nounwind {
; RV64I-LABEL: lh:
; RV64I:      # %bb.0:
; RV64I-NEXT: lh a1, 4(a0)
; RV64I-NEXT: lh zero, 0(a0)
; RV64I-NEXT: mv a0, a1
; RV64I-NEXT: ret
%1 = getelementptr i16, ptr %a, i32 2
```

```

%2 = load i16, ptr %1
%3 = sext i16 %2 to i64
; the unused load will produce an anyext for selection
%4 = load volatile i16, ptr %a
ret i64 %3
}

```

```

define dso_local i64 @lw(ptr %a) nounwind {
; RV64I-LABEL: lw:
; RV64I:      # %bb.0:
; RV64I-NEXT: lw a1, 12(a0)
; RV64I-NEXT: lw zero, 0(a0)
; RV64I-NEXT: mv a0, a1
; RV64I-NEXT: ret
%1 = getelementptr i32, ptr %a, i32 3
%2 = load i32, ptr %1
%3 = sext i32 %2 to i64
; the unused load will produce an anyext for selection
%4 = load volatile i32, ptr %a
ret i64 %3
}

```

```

define dso_local i64 @lbu(ptr %a) nounwind {
; RV64I-LABEL: lbu:
; RV64I:      # %bb.0:
; RV64I-NEXT: lbu a1, 4(a0)
; RV64I-NEXT: lbu a0, 0(a0)
; RV64I-NEXT: add a0, a1, a0
; RV64I-NEXT: ret
%1 = getelementptr i8, ptr %a, i32 4
%2 = load i8, ptr %1
%3 = zext i8 %2 to i64
%4 = load volatile i8, ptr %a
%5 = zext i8 %4 to i64
%6 = add i64 %3, %5
ret i64 %6
}

```

```

define dso_local i64 @lhu(ptr %a) nounwind {
; RV64I-LABEL: lhu:
; RV64I:      # %bb.0:
; RV64I-NEXT: lhu a1, 10(a0)
; RV64I-NEXT: lhu a0, 0(a0)
; RV64I-NEXT:
    add a0, a1, a0
; RV64I-NEXT: ret
%1 = getelementptr i16, ptr %a, i32 5
%2 = load i16, ptr %1

```



```

%3 = zext i16 %2 to i64
%4 = load volatile i16, ptr %a
%5 = zext i16 %4 to i64
%6 = add i64 %3, %5
ret i64 %6
}

define dso_local i64 @lwu(ptr %a) nounwind {
; RV64I-LABEL: lwu:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lwu a1, 24(a0)
; RV64I-NEXT:  lwu a0, 0(a0)
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  ret
%1 = getelementptr i32, ptr %a, i32 6
%2 = load i32, ptr %1
%3 = zext i32 %2 to i64
%4 = load volatile i32, ptr %a
%5 = zext i32 %4 to i64
%6 = add i64 %3, %5
ret i64 %6
}

```

; 64-bit loads and stores

```

define dso_local i64 @ld(ptr %a) nounwind {
; RV64I-LABEL: ld:
; RV64I:      # %bb.0:
; RV64I-NEXT:  ld a1, 80(a0)
; RV64I-NEXT:  ld zero, 0(a0)
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  ret
%1 = getelementptr i64, ptr %a, i32 10
%2 = load i64, ptr %1
%3 = load volatile i64, ptr %a
ret i64 %2
}

```

```

define dso_local void @sd(ptr %a, i64 %b)
nounwind {
; RV64I-LABEL: sd:
; RV64I:      # %bb.0:
; RV64I-NEXT:  sd a1, 0(a0)
; RV64I-NEXT:  sd a1, 88(a0)
; RV64I-NEXT:  ret
store i64 %b, ptr %a
%1 = getelementptr i64, ptr %a, i32 11
store i64 %b, ptr %1
}

```

```

ret void
}

; Check load and store to an i1 location
define dso_local i64 @load_sext_zext_anyext_i1(ptr %a) nounwind {
; RV64I-LABEL: load_sext_zext_anyext_i1:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lbu a1, 1(a0)
; RV64I-NEXT:  lbu a2, 2(a0)
; RV64I-NEXT:  lbu zero, 0(a0)
; RV64I-NEXT:  sub a0, a2, a1
; RV64I-NEXT:  ret
; sextload i1
%1 = getelementptr i1, ptr %a, i32 1
%2 = load i1, ptr %1
%3 = sext i1 %2 to i64
; zextload i1
%4 = getelementptr i1, ptr %a, i32 2
%5 = load i1, ptr %4
%6 = zext i1 %5 to i64
%7 = add i64 %3, %6
; extload i1 (anyext). Produced as the load is unused.
%8 = load volatile i1, ptr %a
ret i64 %7
}

define dso_local i16 @load_sext_zext_anyext_i1_i16(ptr %a) nounwind {
; RV64I-LABEL: load_sext_zext_anyext_i1_i16:
;
; RV64I:      # %bb.0:
; RV64I-NEXT:  lbu a1, 1(a0)
; RV64I-NEXT:  lbu a2, 2(a0)
; RV64I-NEXT:  lbu zero, 0(a0)
; RV64I-NEXT:  subw a0, a2, a1
; RV64I-NEXT:  ret
; sextload i1
%1 = getelementptr i1, ptr %a, i32 1
%2 = load i1, ptr %1
%3 = sext i1 %2 to i16
; zextload i1
%4 = getelementptr i1, ptr %a, i32 2
%5 = load i1, ptr %4
%6 = zext i1 %5 to i16
%7 = add i16 %3, %6
; extload i1 (anyext). Produced as the load is unused.
%8 = load volatile i1, ptr %a
ret i16 %7
}

```

```

; Check load and store to a global
@G = dso_local global i64 0

define dso_local i64 @ld_sd_global(i64 %a) nounwind {
; RV64I-LABEL: ld_sd_global:
; RV64I:      # %bb.0:
; RV64I-NEXT:  lui a2, %hi(G)
; RV64I-NEXT:  ld a1, %lo(G)(a2)
; RV64I-NEXT:  addi a3, a2, %lo(G)
; RV64I-NEXT:  sd a0, %lo(G)(a2)
; RV64I-NEXT:  ld zero, 72(a3)
; RV64I-NEXT:  sd a0, 72(a3)
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  ret
%1 = load volatile i64, ptr @G
store i64 %a, ptr @G
%2 = getelementptr
i64, ptr @G, i64 9
%3 = load volatile i64, ptr %2
store i64 %a, ptr %2
ret i64 %1
}

define i64 @lw_near_local(ptr %a) {
; RV64I-LABEL: lw_near_local:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a0, a0, 2047
; RV64I-NEXT:  ld a0, 9(a0)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 257
%2 = load volatile i64, ptr %1
ret i64 %2
}

define void @st_near_local(ptr %a, i64 %b) {
; RV64I-LABEL: st_near_local:
; RV64I:      # %bb.0:
; RV64I-NEXT:  addi a0, a0, 2047
; RV64I-NEXT:  sd a1, 9(a0)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 257
store i64 %b, ptr %1
ret void
}

define i64 @lw_sw_near_local(ptr %a, i64 %b) {
; RV64I-LABEL: lw_sw_near_local:

```

```

; RV64I:    # %bb.0:
; RV64I-NEXT:  addi a2, a0, 2047
; RV64I-NEXT:  ld a0, 9(a2)
; RV64I-NEXT:  sd a1, 9(a2)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 257
%2 = load volatile i64, ptr %1
store i64 %b, ptr %1
ret i64 %2
}

```

```

define
i64 @lw_far_local(ptr %a) {
; RV64I-LABEL: lw_far_local:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a1, 8
; RV64I-NEXT:  add a0, a0, a1
; RV64I-NEXT:  ld a0, -8(a0)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 4095
%2 = load volatile i64, ptr %1
ret i64 %2
}

```

```

define void @st_far_local(ptr %a, i64 %b) {
; RV64I-LABEL: st_far_local:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a2, 8
; RV64I-NEXT:  add a0, a0, a2
; RV64I-NEXT:  sd a1, -8(a0)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 4095
store i64 %b, ptr %1
ret void
}

```

```

define i64 @lw_sw_far_local(ptr %a, i64 %b) {
; RV64I-LABEL: lw_sw_far_local:
; RV64I:    # %bb.0:
; RV64I-NEXT:  lui a2, 8
; RV64I-NEXT:  add a2, a0, a2
; RV64I-NEXT:  ld a0, -8(a2)
; RV64I-NEXT:  sd a1, -8(a2)
; RV64I-NEXT:  ret
%1 = getelementptr inbounds i64, ptr %a, i64 4095
%2 = load volatile i64, ptr %1
store i64 %b, ptr %1
ret i64 %2
}

```

```
}
```

```
; Make sure we don't fold the addiw  
into the load offset. The sign extend of the  
; addiw is required.
```

```
define i64 @lw_really_far_local(ptr %a) {  
; RV64I-LABEL: lw_really_far_local:  
; RV64I:    # %bb.0:  
; RV64I-NEXT:  lui a1, 524288  
; RV64I-NEXT:  addiw a1, a1, -2048  
; RV64I-NEXT:  add a0, a0, a1  
; RV64I-NEXT:  ld a0, 0(a0)  
; RV64I-NEXT:  ret  
%1 = getelementptr inbounds i64, ptr %a, i64 268435200  
%2 = load volatile i64, ptr %1  
ret i64 %2  
}
```

```
; Make sure we don't fold the addiw into the store offset. The sign extend of  
; the addiw is required.
```

```
define void @st_really_far_local(ptr %a, i64 %b) {  
; RV64I-LABEL: st_really_far_local:  
; RV64I:    # %bb.0:  
; RV64I-NEXT:  lui a2, 524288  
; RV64I-NEXT:  addiw a2, a2, -2048  
; RV64I-NEXT:  add a0, a0, a2  
; RV64I-NEXT:  sd a1, 0(a0)  
; RV64I-NEXT:  ret  
%1 = getelementptr inbounds i64, ptr %a, i64 268435200  
store i64 %b, ptr %1  
ret void  
}
```

```
; Make sure we don't fold the addiw into the load/store offset. The sign extend  
; of the addiw is required.
```

```
define  
i64 @lw_sw_really_far_local(ptr %a, i64 %b) {  
; RV64I-LABEL: lw_sw_really_far_local:  
; RV64I:    # %bb.0:  
; RV64I-NEXT:  lui a2, 524288  
; RV64I-NEXT:  addiw a2, a2, -2048  
; RV64I-NEXT:  add a2, a0, a2  
; RV64I-NEXT:  ld a0, 0(a2)  
; RV64I-NEXT:  sd a1, 0(a2)  
; RV64I-NEXT:  ret  
%1 = getelementptr inbounds i64, ptr %a, i64 268435200  
%2 = load volatile i64, ptr %1  
store i64 %b, ptr %1
```

```
ret i64 %2
}
```

```
%struct.quux = type { i32, [0 x i8] }
```

```
; Make sure we don't remove the addi and fold the C from
; (add (addi FrameIndex, C), X) into the store address.
; FrameIndex cannot be the operand of an ADD. We must keep the ADDI.
define void @addi_fold_crash(i64 %arg) nounwind {
; RV64I-LABEL: addi_fold_crash:
; RV64I:      # %bb.0: # %bb
; RV64I-NEXT:  addi sp, sp, -16
; RV64I-NEXT:  sd ra, 8(sp) # 8-byte Folded Spill
; RV64I-NEXT:  addi a1, sp, 4
; RV64I-NEXT:  add a0, a1, a0
; RV64I-NEXT:  sb zero, 0(a0)
; RV64I-NEXT:  mv a0, a1
; RV64I-NEXT:  call snork
; RV64I-NEXT:
    ld ra, 8(sp) # 8-byte Folded Reload
; RV64I-NEXT:  addi sp, sp, 16
; RV64I-NEXT:  ret
bb:
    %tmp = alloca %struct.quux, align 8
    %tmp1 = getelementptr inbounds %struct.quux, ptr %tmp, i64 0, i32 1
    %tmp2 = getelementptr inbounds %struct.quux, ptr %tmp, i64 0, i32 1, i64 %arg
    store i8 0, ptr %tmp2, align 1
    call void @snork(ptr %tmp1)
    ret void
}
```

```
declare void @snork(ptr)
; NOTE: Assertions have been autogenerated by utils/update_test_checks.py UTC_ARGS: --function-signature --
scrub-attributes
; RUN: opt -S -passes=argpromotion < %s | FileCheck %s
; Test that we only promote arguments when the caller/callee have compatible
; function attributes.
```

```
target triple = "x86_64-unknown-linux-gnu"
```

```
; This should promote
define internal fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %arg, ptr
readonly %arg1) #0 {
; CHECK-LABEL: define {{{^@}+}}@callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512
; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT:  store <8 x i64> [[ARG1_VAL]], ptr [[ARG]]
; CHECK-NEXT:  ret void
```

```

;
bb:
    %tmp = load <8 x i64>, ptr %arg1
    store <8 x i64> %tmp, ptr %arg
    ret void
}

define void @avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %arg) #0 {
; CHECK-LABEL: define {{{^@}+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer512
; CHECK-SAME:
    (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT: call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr
[[TMP2]], <8 x i64> [[TMP_VAL]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
    %tmp = alloca <8 x i64>, align 32
    %tmp2 = alloca <8 x i64>, align 32
    call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
    call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer512(ptr %tmp2, ptr %tmp)
    %tmp4 = load <8 x i64>, ptr %tmp2, align 32
    store <8 x i64> %tmp4, ptr %arg, align 2
    ret void
}

; This should promote
define
    internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %arg, ptr readonly
%arg1) #1 {
; CHECK-LABEL: define {{{^@}+}}@callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: store <8 x i64> [[ARG1_VAL]], ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
    %tmp = load <8 x i64>, ptr %arg1
    store <8 x i64> %tmp, ptr %arg
    ret void
}

```

```

define void @avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %arg) #1 {
; CHECK-LABEL: define {{{^@}+}}@avx512_legal512_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT: call fastcc
void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr [[TMP2]], <8 x i64>
[[TMP_VAL]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr %arg, ptr
readonly %arg1) #1 {
; CHECK-LABEL: define {{{^@}+}}@callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: store <8 x i64> [[ARG1_VAL]],
ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr %arg) #0 {
; CHECK-LABEL: define {{{^@}+}}@avx512_legal512_prefer512_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)

```



```

; CHECK-NEXT: [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT: call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr
[[TMP2]], <8 x i64> [[TMP_VAL]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align
32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer512_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

```

; This should promote

```

define internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr %arg, ptr
readonly %arg1) #0 {
; CHECK-LABEL: define {{^@}+}@callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512
; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: store <8 x i64> [[ARG1_VAL]], ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

```

```

define void @avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr %arg) #1 {
; CHECK-LABEL: define {{^@}+}@avx512_legal512_prefer256_call_avx512_legal512_prefer512
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT:
bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT: call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr
[[TMP2]], <8 x i64> [[TMP_VAL]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;

```

```

bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal512_prefer512(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should not promote
define internal fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr
%arg, ptr readonly %arg1) #1 {
; CHECK-LABEL: define {{[^\@]+}}@callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], ptr readonly [[ARG1:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1]]
; CHECK-NEXT: store <8 x i64> [[TMP]], ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %arg) #2 {
; CHECK-LABEL: define {{[^\@]+}}@avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: call fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr
[[TMP2]], ptr [[TMP]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

```

```

; This should not promote
define internal fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %arg, ptr
readonly %arg1) #2 {
; CHECK-LABEL: define {{^[^@]+}}@callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], ptr readonly [[ARG1:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = load <8 x i64>, ptr [[ARG1]]
; CHECK-NEXT: store <8 x i64>
[[TMP]], ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %arg) #1 {
; CHECK-LABEL: define {{^[^@]+}}@avx512_legal512_prefer256_call_avx512_legal256_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr
[[TMP2]], ptr [[TMP]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64
32, i1 false)
call fastcc void @callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %arg, ptr readonly
%arg1) #3 {
; CHECK-LABEL: define {{^[^@]+}}@callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:

```

```

; CHECK-NEXT: store <8 x i64> [[ARG1_VAL]], ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void
}

define void @avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %arg) #4 {
; CHECK-LABEL: define {{^[^@]+}}@avx2_legal256_prefer256_call_avx2_legal512_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT:
[[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT: call fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr
[[TMP2]], <8 x i64> [[TMP_VAL]])
; CHECK-NEXT: [[TMP4:%.*]] = load <8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx2_legal256_prefer256_call_avx2_legal512_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; This should promote
define internal fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr %arg, ptr readonly
%arg1) #4 {
;
CHECK-LABEL: define {{^[^@]+}}@callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]], <8 x i64> [[ARG1_VAL:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: store <8 x i64> [[ARG1_VAL]], ptr [[ARG]]
; CHECK-NEXT: ret void
;
bb:
%tmp = load <8 x i64>, ptr %arg1
store <8 x i64> %tmp, ptr %arg
ret void

```

```

}

define void @avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr %arg) #3 {
; CHECK-LABEL: define {{^@}+}}@avx2_legal512_prefer256_call_avx2_legal256_prefer256
; CHECK-SAME: (ptr [[ARG:%.*]])
; CHECK-NEXT: bb:
; CHECK-NEXT: [[TMP:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: [[TMP2:%.*]] = alloca <8 x i64>, align 32
; CHECK-NEXT: call void @llvm.memset.p0.i64(ptr align 32 [[TMP]], i8 0, i64 32, i1 false)
; CHECK-NEXT: [[TMP_VAL:%.*]] = load <8 x i64>, ptr [[TMP]]
; CHECK-NEXT: call fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr
[[TMP2]], <8 x i64> [[TMP_VAL]])
; CHECK-NEXT: [[TMP4:%.*]] = load
<8 x i64>, ptr [[TMP2]], align 32
; CHECK-NEXT: store <8 x i64> [[TMP4]], ptr [[ARG]], align 2
; CHECK-NEXT: ret void
;
bb:
%tmp = alloca <8 x i64>, align 32
%tmp2 = alloca <8 x i64>, align 32
call void @llvm.memset.p0.i64(ptr align 32 %tmp, i8 0, i64 32, i1 false)
call fastcc void @callee_avx2_legal512_prefer256_call_avx2_legal256_prefer256(ptr %tmp2, ptr %tmp)
%tmp4 = load <8 x i64>, ptr %tmp2, align 32
store <8 x i64> %tmp4, ptr %arg, align 2
ret void
}

; If the arguments are scalar, its ok to promote.
define internal i32 @scalar_callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %X, ptr %Y)
#2 {
; CHECK-LABEL: define
{{^@}+}}@scalar_callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (i32 [[X_VAL:%.*]], i32 [[Y_VAL:%.*]])
; CHECK-NEXT: [[C:%.*]] = add i32 [[X_VAL]], [[Y_VAL]]
; CHECK-NEXT: ret i32 [[C]]
;
%A = load i32, ptr %X
%B = load i32, ptr %Y
%C = add i32 %A, %B
ret i32 %C
}

define i32 @scalar_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr
%B) #2 {
; CHECK-LABEL: define {{^@}+}}@scalar_avx512_legal256_prefer256_call_avx512_legal512_prefer256
; CHECK-SAME: (ptr [[B:%.*]])
; CHECK-NEXT: [[A:%.*]] = alloca i32
; CHECK-NEXT: store i32 1, ptr [[A]]

```

```

; CHECK-NEXT: [[A_VAL:%.*]] = load i32, ptr [[A]]
; CHECK-NEXT: [[B_VAL:%.*]] = load i32, ptr [[B]]
; CHECK-NEXT: [[C:%.*]] = call i32
@scalar_callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(i32 [[A_VAL]], i32 [[B_VAL]])
; CHECK-NEXT: ret i32 [[C]]
;
%A = alloca i32
store i32 1, ptr %A
%C = call i32 @scalar_callee_avx512_legal256_prefer256_call_avx512_legal512_prefer256(ptr %A, ptr %B)
ret i32 %C
}

; If the arguments are scalar, its ok to promote.
define internal i32 @scalar_callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %X, ptr %Y)
#2 {
; CHECK-LABEL: define
{{{^@}+}}@scalar_callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256
; CHECK-SAME: (i32 [[X_VAL:%.*]],
i32 [[Y_VAL:%.*]])
; CHECK-NEXT: [[C:%.*]] = add i32 [[X_VAL]], [[Y_VAL]]
; CHECK-NEXT: ret i32 [[C]]
;
%A = load i32, ptr %X
%B = load i32, ptr %Y
%C = add i32 %A, %B
ret i32 %C
}

define i32 @scalar_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %B) #2 {
; CHECK-LABEL: define {{{^@}+}}@scalar_avx512_legal512_prefer256_call_avx512_legal256_prefer256
; CHECK-SAME: (ptr [[B:%.*]])
; CHECK-NEXT: [[A:%.*]] = alloca i32
; CHECK-NEXT: store i32 1, ptr [[A]]
; CHECK-NEXT: [[A_VAL:%.*]] = load i32, ptr [[A]]
; CHECK-NEXT: [[B_VAL:%.*]] = load i32, ptr [[B]]
; CHECK-NEXT: [[C:%.*]] = call i32
@scalar_callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(i32 [[A_VAL]], i32 [[B_VAL]])
; CHECK-NEXT: ret i32 [[C]]
;
%A = alloca i32
store i32 1, ptr %A
%C = call i32 @scalar_callee_avx512_legal512_prefer256_call_avx512_legal256_prefer256(ptr %A, ptr %B)
ret i32 %C
}

; Function Attrs: argmemonly nounwind
declare void @llvm.memset.p0.i64(ptr

```

nocapture writeonly, i8, i64, i1) #5

```
attributes #0 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-width"="512" "prefer-vector-width"="512" }
attributes #1 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-width"="512" "prefer-vector-width"="256" }
attributes #2 = { inlinehint norecurse nounwind uwtable "target-features"="+avx512vl" "min-legal-vector-width"="256" "prefer-vector-width"="256" }
attributes #3 = { inlinehint norecurse nounwind uwtable "target-features"="+avx2" "min-legal-vector-width"="512" "prefer-vector-width"="256" }
attributes #4 = { inlinehint norecurse nounwind uwtable "target-features"="+avx2" "min-legal-vector-width"="256" "prefer-vector-width"="256" }
attributes #5 = { argmemonly nounwind }
; NOTE: Assertions have been autogenerated by utils/update_llc_test_checks.py
; RUN: llc -mtriple=riscv64 -mattr=+zbc -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBC-ZBKC
; RUN: llc -mtriple=riscv64 -mattr=+zbbc -verify-machineinstrs < %s \
; RUN: -riscv-experimental-rv64-legal-i32 | FileCheck %s -check-prefix=RV64ZBC-ZBKC
```

declare i64 @llvm.riscv.clmul.i64(i64 %a, i64 %b)

```
define i64 @clmul64(i64 %a, i64 %b) nounwind {
; RV64ZBC-ZBKC-LABEL: clmul64:
; RV64ZBC-ZBKC:      # %bb.0:
; RV64ZBC-ZBKC-NEXT:  clmul a0, a0, a1
; RV64ZBC-ZBKC-NEXT:  ret
  %tmp = call i64 @llvm.riscv.clmul.i64(i64 %a, i64 %b)
  ret i64 %tmp
}
```

declare i64 @llvm.riscv.clmulh.i64(i64 %a, i64 %b)

```
define i64 @clmul64h(i64 %a, i64 %b) nounwind {
; RV64ZBC-ZBKC-LABEL: clmul64h:
; RV64ZBC-ZBKC:      # %bb.0:
; RV64ZBC-ZBKC-NEXT:  clmulh a0, a0, a1
; RV64ZBC-ZBKC-NEXT:  ret
  %tmp = call i64 @llvm.riscv.clmulh.i64(i64 %a, i64 %b)
  ret i64 %tmp
}
```

declare

i32 @llvm.riscv.clmul.i32(i32 %a, i32 %b)

```
define signext i32 @clmul32(i32 signext %a, i32 signext %b) nounwind {
; RV64ZBC-ZBKC-LABEL: clmul32:
; RV64ZBC-ZBKC:      # %bb.0:
; RV64ZBC-ZBKC-NEXT:  clmul a0, a0, a1
```

```

; RV64ZBC-ZBKC-NEXT:  sext.w a0, a0
; RV64ZBC-ZBKC-NEXT:  ret
    %tmp = call i32 @llvm.riscv.clmul.i32(i32 %a, i32 %b)
    ret i32 %tmp
}

declare i32 @llvm.riscv.clmulh.i32(i32 %a, i32 %b)

define signext i32 @clmul32h(i32 signext %a, i32 signext %b) nounwind {
; RV64ZBC-ZBKC-LABEL: clmul32h:
; RV64ZBC-ZBKC:      # %bb.0:
; RV64ZBC-ZBKC-NEXT:  slli a1, a1, 32
; RV64ZBC-ZBKC-NEXT:  slli a0, a0, 32
; RV64ZBC-ZBKC-NEXT:  clmulh a0, a0, a1
; RV64ZBC-ZBKC-NEXT:  srai a0, a0, 32
; RV64ZBC-ZBKC-NEXT:  ret
    %tmp = call i32 @llvm.riscv.clmulh.i32(i32 %a, i32 %b)
    ret i32 %tmp
}

; FIXME: We could avoid the slli instructions by using clmul+srai since the
; inputs are zero extended.
define signext i32 @clmul32h_zext(i32 zeroext %a, i32 zeroext %b) nounwind {
;
; RV64ZBC-ZBKC-LABEL: clmul32h_zext:
; RV64ZBC-ZBKC:      # %bb.0:
; RV64ZBC-ZBKC-NEXT:  slli a1, a1, 32
; RV64ZBC-ZBKC-NEXT:  slli a0, a0, 32
; RV64ZBC-ZBKC-NEXT:  clmulh a0, a0, a1
; RV64ZBC-ZBKC-NEXT:  srai a0, a0, 32
; RV64ZBC-ZBKC-NEXT:  ret
    %tmp = call i32 @llvm.riscv.clmulh.i32(i32 %a, i32 %b)
    ret i32 %tmp
}

```

# 1.186 jq 1.8.1-r0

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