The UDUNITS-2 Package

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1 Introduction

The UDUNITS-2 package provides support for units of physical quantities. Its three main components are: 1) ⟨undefined⟩ [a C library], page ⟨undefined⟩ for units of physical quantities; 2) ⟨undefined⟩ [a utility], page ⟨undefined⟩; for obtaining the definition of a unit and for converting numeric values between compatible units; and 3) an extensive database of units.

2 How This Package Differs from the Original UDUNITS Package

The UDUNIT-2 package differs from the original UDUNITS package in the following ways:

- **Support for non-ASCII characters:** The original UDUNITS package only supports the ASCII character set. The UDUNITS-2 package supports the following character sets: ASCII, ISO 8859-1 (Latin-1), and the UTF-8 encoding of ISO 10646 (Unicode). This means that unit string specifications like "F" are now supported (your viewer must support UTF-8 to display this string correctly).

- **Support for logarithmic units:** The unit string specification "0.1 lg(re 1 mW)" specifies a deciBel unit with a one milliwatt reference level. Such units are fully integrated into the package and all meaningful operations and conversions are supported.

- **Persistent value converters:** It is now possible to obtain a *converter* data-object, which can be used to convert numeric values in one unit to numeric values in another, compatible unit. The values can be `float`, `double`, or one-dimensional arrays of `float`s or `double`s.

- **Improved API:** Due to the above changes, it was not possible to keep the application programming interface (API) of the original UDUNITS package. The new interface, however, is easily understood and easy to use. To support backward comptibility, the package does contain a version 1 C API, which uses the version 2 library.

- **XML unit database:** The unit database is encoded using human-readable XML rather than a custom format. The XML parser included in the package supports an <*import*> element to allow easy and convenient customization.

- **No Fortran or Perl API:** Interfaces for these languages have not yet been created. Contact support-udunits@unidata.ucar.edu if you are interested in helping to create these interfaces.

One thing that has not changed is that almost all unit string specifications understood by the original UDUNITS package are also understood by the new UDUNITS-2 package. The one exception is the symbol g, which in the original package was associated with standard free fall (a unit of accelleration) but which is associated with gram in the new package.

3 Obtaining this Package

Get this package from its download-page at http://www.unidata.ucar.edu/downloads/udunits/
and unpack it in an appropriate place, e.g.,

```
cd /usr/local/src
gunzip -c udunits-2.1.9.tar.gz | pax -r
```

4 Installing this Package

4.1 Short Installation Instructions

Not all development enviroments can build and install this package. See the long instructions in the next section for details.

The following assumes that you are familiar with autoconf-based package-installation. If you're not, then follow the long instructions in the next section.

```
./configure [--prefix=root] [--disable-shared] [CC=path]
make
make check     # optional; requires CUNIT installation
make install
make install-info install-html install-pdf
make clean
```

By default, the installation root is `/usr/local`.

If you encounter problems, then follow the instructions in the next section.

4.2 Long Installation Instructions

1. Go to the top-level source-directory of this package, e.g.,

   ```
   cd udunits-2.1.9
   ```

2. Because some `make` utilities cannot build this package correctly, locate the operating system that is closest to yours in the following table and determine the *make* utility that you will use.

O/S	make Utility
AIX 1 5	/bin/make
AIX 1 5	/opt/gnu/bin/make
AIX 1 5	/usr/ccs/bin/make
Darwin 10.0.0	/usr/bin/gnumake
Darwin 10.0.0	/usr/bin/make
Darwin 8.11.0	/usr/bin/gnumake
Darwin 8.11.0	/usr/bin/make
HP-UX B.11.00	/bin/make
HP-UX B.11.00	/opt/gnu/bin/make
IRIX64 6.5	/bin/make
IRIX64 6.5	/opt/gnu/bin/make
Linux 2.6.27.24-78.2.53.fc9.x86_64	/usr/bin/gmake
Linux 2.6.27.24-78.2.53.fc9.x86_64	/usr/bin/make
Linux 2.6.27.25-170.2.72.fc10.x86_64	/usr/bin/gmake
Linux 2.6.27.25-170.2.72.fc10.x86_64	/usr/bin/make

```
OSF1 V5.1                        /bin/make
OSF1 V5.1                        /opt/gnu/bin/gmake
OSF1 V5.1                        /usr/bin/posix/make
OSF1 V5.1                        /usr/ccs/bin/make
SunOS 5.10                       /opt/csw/bin/gmake
SunOS 5.10                       /usr/ccs/bin/make
SunOS 5.10                       /usr/xpg4/bin/make
SunOS 5.9                        /opt/gnu/bin/gmake
SunOS 5.9                        /usr/ccs/bin/make
SunOS 5.9                        /usr/xpg4/bin/make
```

3. If necessary, clean-up from a previous installation attempt by making the `distclean` target using the *make* utility from step 2:

    make `distclean`

4. Because some compilers cannot build this package correctly, locate the operating system closest to yours in the following table and determine the compiler that you will use and any required option for the `configure` script.

O/S	Compiler	configure **Option**
AIX 1 5	/opt/gnu/bin/gcc	--disable-shared
AIX 1 5	/usr/vac/bin/c89	--disable-shared
AIX 1 5	/usr/vac/bin/cc	--disable-shared
AIX 1 5	/usr/vac/bin/xlc	--disable-shared
Darwin 10.0.0	/usr/bin/c89	--disable-shared
Darwin 10.0.0	/usr/bin/cc	
Darwin 10.0.0	/usr/bin/cc	--disable-shared
Darwin 10.0.0	/usr/bin/gcc	
Darwin 10.0.0	/usr/bin/gcc	--disable-shared
Darwin 8.11.0	/usr/bin/c89	--disable-shared
Darwin 8.11.0	/usr/bin/cc	
Darwin 8.11.0	/usr/bin/cc	--disable-shared
Darwin 8.11.0	/usr/bin/gcc	
Darwin 8.11.0	/usr/bin/gcc	--disable-shared
HP-UX B.11.00	/bin/c89	--disable-shared
HP-UX B.11.00	/bin/cc	--disable-shared
HP-UX B.11.00	/opt/gnu/bin/gcc	
HP-UX B.11.00	/opt/gnu/bin/gcc	--disable-shared
IRIX64 6.5	/bin/c89	
IRIX64 6.5	/bin/c89	--disable-shared
IRIX64 6.5	/bin/cc	
IRIX64 6.5	/bin/cc	--disable-shared
IRIX64 6.5	/opt/gnu/bin/gcc	
IRIX64 6.5	/opt/gnu/bin/gcc	--disable-shared
Linux 2.6.27.24-78.2.53.fc9.x86_64	/usr/bin/c89	
Linux 2.6.27.24-78.2.53.fc9.x86_64	/usr/bin/c89	--disable-shared

```
Linux 2.6.27.24-          /usr/bin/cc
78.2.53.fc9.x86_64
Linux 2.6.27.24-          /usr/bin/cc            --disable-shared
78.2.53.fc9.x86_64
Linux 2.6.27.24-          /usr/bin/gcc
78.2.53.fc9.x86_64
Linux 2.6.27.24-          /usr/bin/gcc           --disable-shared
78.2.53.fc9.x86_64
Linux 2.6.27.25-          /usr/bin/c89
170.2.72.fc10.x86_64
Linux 2.6.27.25-          /usr/bin/c89           --disable-shared
170.2.72.fc10.x86_64
Linux 2.6.27.25-          /usr/bin/cc
170.2.72.fc10.x86_64
Linux 2.6.27.25-          /usr/bin/cc            --disable-shared
170.2.72.fc10.x86_64
Linux 2.6.27.25-          /usr/bin/gcc
170.2.72.fc10.x86_64
Linux 2.6.27.25-          /usr/bin/gcc           --disable-shared
170.2.72.fc10.x86_64
OSF1 V5.1                 /bin/c89
OSF1 V5.1                 /bin/c89              --disable-shared
OSF1 V5.1                 /bin/cc
OSF1 V5.1                 /bin/cc               --disable-shared
OSF1 V5.1                 /opt/gnu/bin/gcc
OSF1 V5.1                 /opt/gnu/bin/gcc      --disable-shared
OSF1 V5.1                 /usr/ccs/bin/c89
OSF1 V5.1                 /usr/ccs/bin/c89      --disable-shared
OSF1 V5.1                 /usr/ccs/bin/cc
OSF1 V5.1                 /usr/ccs/bin/cc       --disable-shared
SunOS 5.10                /opt/csw/gcc3/bin/gcc
SunOS 5.10                /opt/csw/gcc3/bin/gcc  --disable-shared
SunOS 5.10                /opt/csw/gcc4/bin/gcc
SunOS 5.10                /opt/csw/gcc4/bin/gcc  --disable-shared
SunOS 5.10                /opt/SUNWspro/bin/c89
SunOS 5.10                /opt/SUNWspro/bin/c89  --disable-shared
SunOS 5.10                /opt/SUNWspro/bin/cc
SunOS 5.10                /opt/SUNWspro/bin/cc   --disable-shared
SunOS 5.9                 /opt/csw/gcc3/bin/gcc
SunOS 5.9                 /opt/csw/gcc3/bin/gcc  --disable-shared
SunOS 5.9                 /opt/csw/gcc4/bin/gcc
SunOS 5.9                 /opt/csw/gcc4/bin/gcc  --disable-shared
SunOS 5.9                 /opt/SUNWspro/bin/c89
SunOS 5.9                 /opt/SUNWspro/bin/c89  --disable-shared
SunOS 5.9                 /opt/SUNWspro/bin/cc
SunOS 5.9                 /opt/SUNWspro/bin/cc   --disable-shared
```

The option `--disable-shared` causes the build process to create a static library only: a sharable library is not created. This option is necessary if the `libtool` utility that's included in this package can't build a sharable library using the given compiler.

The following table lists the build environments that do not work — so don't use them:

O/S	**Compiler**	`configure` **Option**
AIX 1 5	/opt/gnu/bin/gcc	
AIX 1 5	/usr/vac/bin/c89	
AIX 1 5	/usr/vac/bin/cc	
AIX 1 5	/usr/vac/bin/xlc	
Darwin 10.0.0	/usr/bin/c89	
Darwin 8.11.0	/usr/bin/c89	
HP-UX B.11.00	/bin/c89	
HP-UX B.11.00	/bin/cc	
HP-UX B.11.00	/usr/ccs/bin/cc	
HP-UX B.11.00	/usr/ccs/bin/cc	--disable-shared
SunOS 5.10	/opt/SUNWspro/bin/c99	
SunOS 5.10	/opt/SUNWspro/bin/c99	--disable-shared
SunOS 5.9	/opt/SUNWspro/bin/c99	
SunOS 5.9	/opt/SUNWspro/bin/c99	--disable-shared

5. Execute the `configure` script. Specify the installation prefix, the compiler from the previous step, and any required option. For example, if you are on an HP-UX system and want to use the `/bin/c89` compiler and install under `/opt`, then the following command is appropriate:

    ```
    ./configure --prefix=/opt --disable-shared CC=/bin/c89
    ```

    If the installation prefix is not specified, then the default is to install under `/usr/local`.

    If the compiler isn't specified, then the default is to use `gcc`.

6. Build this package by making the default target using the *make* utility from step 2:

    ```
    make
    ```

7. If you wish to verify that this package works correctly, then make the `check` target using the *make* utility from step 2:

    ```
    make check
    ```

    This step is only effective if the `configure` script found an installed `CUNIT` unit-testing package. If that package wasn't found, then the above command will quickly exit without testing this package.

8. Install the ⟨undefined⟩ [library], page ⟨undefined⟩, ⟨undefined⟩ [utility], page ⟨undefined⟩, header-files, and units-database by making the `install` target using the *make* utility from step 2:

    ```
    make install
    ```

9. If desired, install the documentation by making one or more of the following targets using the *make* utility from step 2:

    ```
    make install-info install-html install-pdf
    ```

10. Clean up by making the `clean` target using the *make* utility from step 2:

    ```
    make clean
    ```

4.3 What Gets Installed

By default, the following files are created or installed under the installation directory:

```
    bin/:
    udunits2                # Unit ⟨undefined⟩ [utility], page ⟨undefined⟩

    include/:
    converter.h             # API for value converters
    udunits2.h              # API for units

    lib/:
    libudunits2.a           # Static unit ⟨undefined⟩ [library], page ⟨undefined⟩
    libudunits2.la          # libtool(1) reference for unit ⟨undefined⟩ [library],
    page ⟨undefined⟩
    libudunits2.so          # Link to shared ⟨undefined⟩ [library], page ⟨un
    defined⟩
    libudunits2.so.0        # Link to shared ⟨undefined⟩ [library], page ⟨un
    defined⟩
    libudunits2.so.0.0.0    # Shared ⟨undefined⟩ [library], page ⟨undefined⟩

    share/:
    doc                     # Directory. Created if it doesn't exist
    info                    # Directory. Created if it doesn't exist
    udunits                 # Directory. Created if it doesn't exist

    share/doc:
    udunits                 # Directory. Created if it doesn't exist

    share/doc/udunits:
    udunits2.html           # HTML documentation on this package
    udunits2lib.html        # HTML documentation on the unit ⟨undefined⟩ [library],
    page ⟨undefined⟩
    udunits2lib.pdf         # PDF documentation on the unit ⟨undefined⟩ [library],
    page ⟨undefined⟩
    udunits2.pdf            # PDF documentation on this package
    udunits2prog.html       # HTML documentation on the unit ⟨undefined⟩ [utility],
    page ⟨undefined⟩
    udunits2prog.pdf        # PDF documentation on the unit ⟨undefined⟩ [utility],
    page ⟨undefined⟩

    share/info:
    dir                     # Top-level "info" file.  Created if it doesn't exist
    udunits2.info           # INFO documentation on this package
    udunits2lib.info        # INFO documentation on the unit ⟨undefined⟩ [library],
    page ⟨undefined⟩
    udunits2prog.info       # INFO documentation on the unit ⟨undefined⟩ [utility],
    page ⟨undefined⟩
```

```
share/udunits:
udunits2.xml            # Default unit database
udunits2-accepted.xml   # Units accepted for use with the SI
udunits2-base.xml       # SI base units
udunits2-common.xml     # Common, non-SI units
udunits2-derived.xml    # Derived units of the SI
udunits2-prefixes.xml   # SI unit prefixes
```

5 Support for this Package

The home-page for this package can be found at `http://www.unidata.ucar.edu/software/udunits/`.
Bug reports should be sent to `support-udunits@unidata.ucar.edu`.

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