The GNU Binary Utilities

(Sourcery G++ Lite 2010q1-188)
Version 2.19.51
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Introduction

This brief manual contains documentation for the GNU binary utilities (Sourcery G++ Lite 2010q1-188) version 2.19.51:

- `ar` Create, modify, and extract from archives
- `nm` List symbols from object files
- `objcopy` Copy and translate object files
- `objdump` Display information from object files
- `ranlib` Generate index to archive contents
- `readelf` Display the contents of ELF format files.
- `size` List file section sizes and total size
- `strings` List printable strings from files
- `strip` Discard symbols
- `c++filt` Demangle encoded C++ symbols (on MS-DOS, this program is named `cxxfilt`)
- `addr2line` Convert addresses into file names and line numbers
- `nlmconv` Convert object code into a Netware Loadable Module
- `windres` Manipulate Windows resources
- `windmc` Generator for Windows message resources
- `dlltool` Create the files needed to build and use Dynamic Link Libraries

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Chapter 1: ar

1 ar

ar ['--plugin' name] [-]p[mod [relpos] [count]] archive [member...]
ar -M [ <mri-script ]

The GNU ar program creates, modifies, and extracts from archives. An archive is a single file holding a collection of other files in a structure that makes it possible to retrieve the original individual files (called members of the archive).

The original files’ contents, mode (permissions), timestamp, owner, and group are preserved in the archive, and can be restored on extraction.

GNU ar can maintain archives whose members have names of any length; however, depending on how ar is configured on your system, a limit on member-name length may be imposed for compatibility with archive formats maintained with other tools. If it exists, the limit is often 15 characters (typical of formats related to a.out) or 16 characters (typical of formats related to coff).

ar is considered a binary utility because archives of this sort are most often used as libraries holding commonly needed subroutines.

ar creates an index to the symbols defined in relocatable object modules in the archive when you specify the modifier ‘s’. Once created, this index is updated in the archive whenever ar makes a change to its contents (save for the ‘q’ update operation). An archive with such an index speeds up linking to the library, and allows routines in the library to call each other without regard to their placement in the archive.

You may use ‘nm -s’ or ‘nm --print-armap’ to list this index table. If an archive lacks the table, another form of ar called ranlib can be used to add just the table.

GNU ar can optionally create a thin archive, which contains a symbol index and references to the original copies of the member files of the archives. Such an archive is useful for building libraries for use within a local build, where the relocatable objects are expected to remain available, and copying the contents of each object would only waste time and space. Thin archives are also flattened, so that adding one or more archives to a thin archive will add the elements of the nested archive individually. The paths to the elements of the archive are stored relative to the archive itself.

GNU ar is designed to be compatible with two different facilities. You can control its activity using command-line options, like the different varieties of ar on Unix systems; or, if you specify the single command-line option ‘-M’, you can control it with a script supplied via standard input, like the MRI “librarian” program.
1.1 Controlling ar on the Command Line

When you use ar in the Unix style, ar insists on at least two arguments to execute: one keyletterm specifying the operation (optionally accompanied by other keyletters specifying modifiers), and the archive name to act on.

Most operations can also accept further member arguments, specifying particular files to operate on.

GNU ar allows you to mix the operation code p and modifier flags mod in any order, within the first command-line argument.

If you wish, you may begin the first command-line argument with a dash.

The p keyletter specifies what operation to execute; it may be any of the following, but you must specify only one of them:

- **d**  
  *Delete* modules from the archive. Specify the names of modules to be deleted as member...; the archive is untouched if you specify no files to delete.
  If you specify the ‘v’ modifier, ar lists each module as it is deleted.

- **m**  
  Use this operation to move members in an archive.
  The ordering of members in an archive can make a difference in how programs are linked using the library, if a symbol is defined in more than one member.
  If no modifiers are used with m, any members you name in the member arguments are moved to the end of the archive; you can use the ‘a’, ‘b’, or ‘i’ modifiers to move them to a specified place instead.

- **p**  
  *Print* the specified members of the archive, to the standard output file. If the ‘v’ modifier is specified, show the member name before copying its contents to standard output.
  If you specify no member arguments, all the files in the archive are printed.

- **q**  
  *Quick append;* Historically, add the files member... to the end of archive, without checking for replacement.
  The modifiers ‘a’, ‘b’, and ‘i’ do not affect this operation; new members are always placed at the end of the archive.
  The modifier ‘v’ makes ar list each file as it is appended.
  Since the point of this operation is speed, the archive’s symbol table index is not updated, even if it already existed; you can use ‘ar s’ or ranlib explicitly to update the symbol table index.
  However, too many different systems assume quick append rebuilds the index, so GNU ar implements ‘q’ as a synonym for ‘r’.

- **r**  
  Insert the files member... into archive (with replacement). This operation differs from ‘q’ in that any previously existing members are deleted if their names match those being added.
  If one of the files named in member... does not exist, ar displays an error message, and leaves undisturbed any existing members of the archive matching that name.
By default, new members are added at the end of the file; but you may use one of the modifiers ‘a’, ‘b’, or ‘i’ to request placement relative to some existing member.

The modifier ‘v’ used with this operation elicits a line of output for each file inserted, along with one of the letters ‘a’ or ‘r’ to indicate whether the file was appended (no old member deleted) or replaced.

‘t’ Display a table listing the contents of archive, or those of the files listed in member... that are present in the archive. Normally only the member name is shown; if you also want to see the modes (permissions), timestamp, owner, group, and size, you can request that by also specifying the ‘v’ modifier.

If you do not specify a member, all files in the archive are listed.

If there is more than one file with the same name (say, ‘fie’) in an archive (say ‘b.a’), ‘ar t b.a fie’ lists only the first instance; to see them all, you must ask for a complete listing—in our example, ‘ar t b.a’.

‘x’ Extract members (named member) from the archive. You can use the ‘v’ modifier with this operation, to request that ar list each name as it extracts it.

If you do not specify a member, all files in the archive are extracted.

Files cannot be extracted from a thin archive.

A number of modifiers (mod) may immediately follow the p keyletter, to specify variations on an operation's behavior:

‘a’ Add new files after an existing member of the archive. If you use the modifier ‘a’, the name of an existing archive member must be present as the relopos argument, before the archive specification.

‘b’ Add new files before an existing member of the archive. If you use the modifier ‘b’, the name of an existing archive member must be present as the relopos argument, before the archive specification. (same as ‘i”).

‘c’ Create the archive. The specified archive is always created if it did not exist, when you request an update. But a warning is issued unless you specify in advance that you expect to create it, by using this modifier.

‘D’ Operate in deterministic mode. When adding files and the archive index use zero for UIDs, GIDs, timestamps, and use consistent file modes for all files. When this option is used, if ar is used with identical options and identical input files, multiple runs will create identical output files regardless of the input files’ owners, groups, file modes, or modification times.

‘f’ Truncate names in the archive. GNU ar will normally permit file names of any length. This will cause it to create archives which are not compatible with the native ar program on some systems. If this is a concern, the ‘f’ modifier may be used to truncate file names when putting them in the archive.

‘i’ Insert new files before an existing member of the archive. If you use the modifier ‘i’, the name of an existing archive member must be present as the relopos argument, before the archive specification. (same as ‘b”).

‘l’ This modifier is accepted but not used.
Chapter 1: ar

‘N’ Uses the count parameter. This is used if there are multiple entries in the archive with the same name. Extract or delete instance count of the given name from the archive.

‘o’ Preserve the original dates of members when extracting them. If you do not specify this modifier, files extracted from the archive are stamped with the time of extraction.

‘P’ Use the full path name when matching names in the archive. GNU ar can not create an archive with a full path name (such archives are not POSIX complaint), but other archive creators can. This option will cause GNU ar to match file names using a complete path name, which can be convenient when extracting a single file from an archive created by another tool.

‘s’ Write an object-file index into the archive, or update an existing one, even if no other change is made to the archive. You may use this modifier flag either with any operation, or alone. Running ‘ar s’ on an archive is equivalent to running ‘ranlib’ on it.

‘S’ Do not generate an archive symbol table. This can speed up building a large library in several steps. The resulting archive can not be used with the linker. In order to build a symbol table, you must omit the ‘S’ modifier on the last execution of ‘ar’, or you must run ‘ranlib’ on the archive.

‘T’ Make the specified archive a thin archive. If it already exists and is a regular archive, the existing members must be present in the same directory as archive.

‘u’ Normally, ‘ar r’... inserts all files listed into the archive. If you would like to insert only those of the files you list that are newer than existing members of the same names, use this modifier. The ‘u’ modifier is allowed only for the operation ‘r’ (replace). In particular, the combination ‘qu’ is not allowed, since checking the timestamps would lose any speed advantage from the operation ‘q’.

‘v’ This modifier requests the verbose version of an operation. Many operations display additional information, such as filenames processed, when the modifier ‘v’ is appended.

‘V’ This modifier shows the version number of ar.

ar ignores an initial option spelt ‘-X32_64’, for compatibility with AIX. The behaviour produced by this option is the default for GNU ar. ar does not support any of the other ‘-X’ options; in particular, it does not support ‘-X32’ which is the default for AIX ar.

The optional command line switch ‘--plugin’ name causes ar to load the plugin called name which adds support for more file formats. This option is only available if the toolchain has been built with plugin support enabled.

1.2 Controlling ar with a Script

ar -M [ <script ]

If you use the single command-line option ‘-M’ with ar, you can control its operation with a rudimentary command language. This form of ar operates interactively if standard
input is coming directly from a terminal. During interactive use, ar prompts for input (the prompt is ‘AR > ’), and continues executing even after errors. If you redirect standard input to a script file, no prompts are issued, and ar abandons execution (with a nonzero exit code) on any error.

The ar command language is not designed to be equivalent to the command-line options; in fact, it provides somewhat less control over archives. The only purpose of the command language is to ease the transition to GNU ar for developers who already have scripts written for the MRI “librarian” program.

The syntax for the ar command language is straightforward:

- commands are recognized in upper or lower case; for example, LIST is the same as list. In the following descriptions, commands are shown in upper case for clarity.
- a single command may appear on each line; it is the first word on the line.
- empty lines are allowed, and have no effect.
- comments are allowed; text after either of the characters ‘*’ or ‘;’ is ignored.
- Whenever you use a list of names as part of the argument to an ar command, you can separate the individual names with either commas or blanks. Commas are shown in the explanations below, for clarity.
- ‘+’ is used as a line continuation character; if ‘+’ appears at the end of a line, the text on the following line is considered part of the current command.

Here are the commands you can use in ar scripts, or when using ar interactively. Three of them have special significance:

OPEN or CREATE specify a current archive, which is a temporary file required for most of the other commands.

SAVE commits the changes so far specified by the script. Prior to SAVE, commands affect only the temporary copy of the current archive.

ADDLIB archive
ADDLIB archive (module, module, ... module)
Add all the contents of archive (or, if specified, each named module from archive) to the current archive.
Requires prior use of OPEN or CREATE.

ADDMOD member, member, ... member
Add each named member as a module in the current archive.
Requires prior use of OPEN or CREATE.

CLEAR
Discard the contents of the current archive, canceling the effect of any operations since the last SAVE. May be executed (with no effect) even if no current archive is specified.

CREATE archive
Creates an archive, and makes it the current archive (required for many other commands). The new archive is created with a temporary name; it is not actually saved as archive until you use SAVE. You can overwrite existing archives; similarly, the contents of any existing file named archive will not be destroyed until SAVE.
DELETE module, module, ... module
Delete each listed module from the current archive; equivalent to ‘ar -d
archive module ... module’.
Requires prior use of OPEN or CREATE.

DIRECTORY archive (module, ... module)
DIRECTORY archive (module, ... module) outputfile
List each named module present in archive. The separate command VERBOSE
specifies the form of the output: when verbose output is off, output is like that
of ‘ar -t archive module...’; When verbose output is on, the listing is like
‘ar -tv archive module...’.
Output normally goes to the standard output stream; however, if you specify
outputfile as a final argument, ar directs the output to that file.

END Exit from ar, with a 0 exit code to indicate successful completion. This com-
mand does not save the output file; if you have changed the current archive
since the last SAVE command, those changes are lost.

EXTRACT module, module, ... module
Extract each named module from the current archive, writing them into the
current directory as separate files. Equivalent to ‘ar -x archive module...’.
Requires prior use of OPEN or CREATE.

LIST Display full contents of the current archive, in “verbose” style regardless of the
state of VERBOSE. The effect is like ‘ar tv archive’. (This single command is
a GNU ar enhancement, rather than present for MRI compatibility.)
Requires prior use of OPEN or CREATE.

OPEN archive
Opens an existing archive for use as the current archive (required for many
other commands). Any changes as the result of subsequent commands will not
actually affect archive until you next use SAVE.

REPLACE module, module, ... module
In the current archive, replace each existing module (named in the REPLACE arg-
uments) from files in the current working directory. To execute this command
without errors, both the file, and the module in the current archive, must exist.
Requires prior use of OPEN or CREATE.

VERBOSE Toggle an internal flag governing the output from DIRECTORY. When the flag
is on, DIRECTORY output matches output from ‘ar -tv ’....

SAVE Commit your changes to the current archive, and actually save it as a file with
the name specified in the last CREATE or OPEN command.
Requires prior use of OPEN or CREATE.
2 ld

The GNU linker ld is now described in a separate manual. See Section “Overview” in Using LD: the GNU linker.
3 nm

\texttt{nm} \[ ['-a'|'--debug-syms']
\[ ['-g'|'--extern-only']\[ '--plugin' name\]
\[ ['-B'] \[ ['-C'|'--demangle'=[style]] \[ ['-D'|'--dynamic']
\[ ['-S'|'--print-size'] \[ ['-m'|'--print-armap']
\[ ['-A'|'-o'|'--print-file-name']\[ '--special-syms']
\[ ['-n'|'-v'|'--numeric-sort'] \[ '-p'|'--no-sort']
\[ ['-r'|'--reverse-sort'] \[ '--size-sort'] \[ '-u'|'--undefined-only']
\[ ['-t' \[ 'radix'|'--radix=' radix\] \[ '-P'|'--portability']
\[ '--target=' bfdname\] \[ '-f' \[ 'format'|'--format=' format\]
\[ '--defined-only'] \[ '-l'|'--line-numbers'] \[ '--no-demangle']
\[ '-V'|'--version'] \[ '-X 32_64'] \[ '--help'] \[ objfile...\]

GNU \texttt{nm} lists the symbols from object files \texttt{objfile}... If no object files are listed as arguments, \texttt{nm} assumes the file \texttt{a.out}.

For each symbol, \texttt{nm} shows:

- The symbol value, in the radix selected by options (see below), or hexadecimal by default.
- The symbol type. At least the following types are used; others are, as well, depending on the object file format. If lowercase, the symbol is local; if uppercase, the symbol is global (external).

\begin{itemize}
\item \texttt{A} The symbol’s value is absolute, and will not be changed by further linking.
\item \texttt{B} The symbol is in the uninitialized data section (known as BSS).
\item \texttt{C} The symbol is common. Common symbols are uninitialized data. When linking, multiple common symbols may appear with the same name. If the symbol is defined anywhere, the common symbols are treated as undefined references. For more details on common symbols, see the discussion of \texttt{–warn-common} in Section “Linker options” in \textit{The GNU linker}.
\item \texttt{D} The symbol is in the initialized data section.
\item \texttt{G} The symbol is in an initialized data section for small objects. Some object file formats permit more efficient access to small data objects, such as a global int variable as opposed to a large global array.
\item \texttt{i} The symbol is in a section specific to the implementation of DLLs.
\item \texttt{N} The symbol is a debugging symbol.
\item \texttt{P} The symbols is in a stack unwind section.
\item \texttt{R} The symbol is in a read only data section.
\item \texttt{S} The symbol is in an uninitialized data section for small objects.
\item \texttt{T} The symbol is in the text (code) section.
\end{itemize}
The symbol is undefined.

The symbol is a weak object. When a weak defined symbol is linked with a normal defined symbol, the normal defined symbol is used with no error. When a weak undefined symbol is linked and the symbol is not defined, the value of the weak symbol becomes zero with no error. On some systems, uppercase indicates that a default value has been specified.

The symbol is a weak symbol that has not been specifically tagged as a weak object symbol. When a weak defined symbol is linked with a normal defined symbol, the normal defined symbol is used with no error. When a weak undefined symbol is linked and the symbol is not defined, the value of the symbol is determined in a system-specific manner without error. On some systems, uppercase indicates that a default value has been specified.

The symbol is a stabs symbol in an a.out object file. In this case, the next values printed are the stabs other field, the stabs desc field, and the stab type. Stabs symbols are used to hold debugging information. For more information, see Section “Stabs Overview” in The “stabs” debug format.

The symbol type is unknown, or object file format specific.

- The symbol name.

The long and short forms of options, shown here as alternatives, are equivalent.

-A
-o
--print-file-name

Precede each symbol by the name of the input file (or archive member) in which it was found, rather than identifying the input file once only, before all of its symbols.

-a
--debug-syms

Display all symbols, even debugger-only symbols; normally these are not listed.

-B

The same as ‘--format=bsd’ (for compatibility with the MIPS nm).

-C
--demangle[=style]

Decode (demangle) low-level symbol names into user-level names. Besides removing any initial underscore prepended by the system, this makes C++ function names readable. Different compilers have different mangling styles. The optional demangling style argument can be used to choose an appropriate demangling style for your compiler. See Chapter 10 [c++filt], page 41, for more information on demangling.

--no-demangle

Do not demangle low-level symbol names. This is the default.
-D
--dynamic
Display the dynamic symbols rather than the normal symbols. This is only
meaningful for dynamic objects, such as certain types of shared libraries.

-f format
--format=format
Use the output format format, which can be bsd, sysv, or posix. The default
is bsd. Only the first character of format is significant; it can be either upper
or lower case.

g
--extern-only
Display only external symbols.

--plugin name
Load the plugin called name to add support for extra target types. This option
is only available if the toolchain has been built with plugin support enabled.

-l
--line-numbers
For each symbol, use debugging information to try to find a filename and line
number. For a defined symbol, look for the line number of the address of the
symbol. For an undefined symbol, look for the line number of a relocation entry
which refers to the symbol. If line number information can be found, print it
after the other symbol information.

-n
-v
--numeric-sort
Sort symbols numerically by their addresses, rather than alphabetically by their
names.

-p
--no-sort
Do not bother to sort the symbols in any order; print them in the order en-
countered.

-P
--portability
Use the POSIX.2 standard output format instead of the default format. Equivalent to ‘-f posix’.

-S
--print-size
Print both value and size of defined symbols for the bsd output style. This
option has no effect for object formats that do not record symbol sizes, unless
‘--size-sort’ is also used in which case a calculated size is displayed.
-s
--print-armap
   When listing symbols from archive members, include the index: a mapping
   (stored in the archive by ar or ranlib) of which modules contain definitions
   for which names.

-r
--reverse-sort
   Reverse the order of the sort (whether numeric or alphabetic); let the last come
   first.

--size-sort
   Sort symbols by size. The size is computed as the difference between the value
   of the symbol and the value of the symbol with the next higher value. If the
   bsd output format is used the size of the symbol is printed, rather than the
   value, and ‘-S’ must be used in order both size and value to be printed.

--special-syms
   Display symbols which have a target-specific special meaning. These symbols
   are usually used by the target for some special processing and are not nor-
   mally helpful when included included in the normal symbol lists. For example
   for ARM targets this option would skip the mapping symbols used to mark
   transitions between ARM code, THUMB code and data.

-t radix
--radix=radix
   Use radix as the radix for printing the symbol values. It must be ‘d’ for decimal,
   ‘o’ for octal, or ‘x’ for hexadecimal.

--target=bfdname
   Specify an object code format other than your system’s default format. See
   Section 18.1 [Target Selection], page 64, for more information.

-u
--undefined-only
   Display only undefined symbols (those external to each object file).

--defined-only
   Display only defined symbols for each object file.

-V
--version
   Show the version number of nm and exit.

-X
   This option is ignored for compatibility with the AIX version of nm. It takes
   one parameter which must be the string ‘32_64’. The default mode of AIX nm
   corresponds to ‘-X 32’, which is not supported by GNU nm.

--help
   Show a summary of the options to nm and exit.
4 objcopy

objcopy ['-F' bfdname|--target='bfdname']
['-I' bfdname|--input-target='bfdname']
['-O' bfdname|--output-target='bfdname']
['-B' bfdarch|--binary-architecture='bfdarch']
['-S'|--strip-all]
['-g'|--strip-debug]
['-K' symbolname|--keep-symbol='symbolname']
['-N' symbolname|--strip-symbol='symbolname']
['-K' symbolname|--keep-global-symbol='symbolname']
['-O' symbolname|--keep-local-symbol='symbolname']
['-L' symbolname|--localize-symbol='symbolname']
['-W' symbolname|--weaken-symbol='symbolname']
['-w'|--wildcard']
['-x'|--discard-all']
['-X'|--discard-locals']
['-B' byte|--byte='byte']
['-i' interleave|--interleave='interleave']
['-j' sectionname|--only-section='sectionname']
['-R' sectionname|--remove-section='sectionname']
['-p'|--preserve-dates']
['-d'|--debugging']
['-g'|--gap-fill='val']
['-p'|--pad-to='address']
['-a'|--set-start='val']
['-r'|--adjust-start='incr']
['-r'|--change-addresses='incr']
['-r'|--change-section-address='section'={[=,+,-]}'val']
['-r'|--change-section-lma='section'={[=,+,-,'val']}
['-r'|--change-section-vma='section'={[=,+,-,'val']}
['-w'|--change-warnings']
['-w'|--no-change-warnings']
['-r'|--change-section-flags='section'=flags]
['-r'|--add-section='sectionname'=filename]
['-r'|--rename-section='oldname'=newname[,flags]]
['-r'|--long-section-names' {enable,disable,keep}]
['-r'|--change-leading-char']
['-r'|--reverse-bytes='num']
['-r'|--srec-len='ival']
['-r'|--srec-forceS3']
['-r'|--redefine-sym' old=new]
['-r'|--redefine-syms='filename']
['-r'|--weaken']
['-r'|--keep-symbols='filename']
['-r'|--strip-symbols='filename']
['-r'|--keep-global-symbols='filename']
['-r'|--localize-symbols='filename']
['-r'|--globalize-symbols='filename']
['-r'|--weak-symbols='filename']
['-r'|--alt-machine-code='index']
['-r'|--prefix-symbols='string']
['-r'|--prefix-sections='string']
['-r'|--prefix-alloc-sections='string']
['-r'|--add-gnu-debuglink='path-to-file']
['-r'|--keep-file-symbols']
['-r'|--only-keep-debug']
['-r'|--extract-symbol']
The GNU objcopy utility copies the contents of an object file to another. objcopy uses the GNU bfd Library to read and write the object files. It can write the destination object file in a format different from that of the source object file. The exact behavior of objcopy is controlled by command-line options. Note that objcopy should be able to copy a fully linked file between any two formats. However, copying a relocatable object file between any two formats may not work as expected.

objcopy creates temporary files to do its translations and deletes them afterward. objcopy uses BFD to do all its translation work; it has access to all the formats described in BFD and thus is able to recognize most formats without being told explicitly. See Section “BFD” in Using LD.

objcopy can be used to generate S-records by using an output target of ‘srec’ (e.g., use ‘-O srec’).

objcopy can be used to generate a raw binary file by using an output target of ‘binary’ (e.g., use ‘-O binary’). When objcopy generates a raw binary file, it will essentially produce a memory dump of the contents of the input object file. All symbols and relocation information will be discarded. The memory dump will start at the load address of the lowest section copied into the output file.

When generating an S-record or a raw binary file, it may be helpful to use ‘-S’ to remove sections containing debugging information. In some cases ‘-R’ will be useful to remove sections which contain information that is not needed by the binary file.

Note—objcopy is not able to change the endianness of its input files. If the input format has an endianness (some formats do not), objcopy can only copy the inputs into file formats that have the same endianness or which have no endianness (e.g., ‘srec’). (However, see the ‘--reverse-bytes’ option.)

infile
outfile

The input and output files, respectively. If you do not specify outfile, objcopy creates a temporary file and destructively renames the result with the name of infile.

-I bfdname
--input-target=bfdname

Consider the source file’s object format to be bfdname, rather than attempting to deduce it. See Section 18.1 [Target Selection], page 64, for more information.
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-0 bfdname
--output-target=bfdname
Write the output file using the object format bfdname. See Section 18.1 [Target Selection], page 64, for more information.

-F bfdname
--target=bfdname
Use bfdname as the object format for both the input and the output file; i.e., simply transfer data from source to destination with no translation. See Section 18.1 [Target Selection], page 64, for more information.

-B bfdarch
--binary-architecture=bfdarch
Useful when transforming a raw binary input file into an object file. In this case the output architecture can be set to bfdarch. This option will be ignored if the input file has a known bfdarch. You can access this binary data inside a program by referencing the special symbols that are created by the conversion process. These symbols are called _binary_objfile_start, _binary_objfile_end and _binary_objfile_size. e.g. you can transform a picture file into an object file and then access it in your code using these symbols.

-j sectionname
--only-section=sectionname
Copy only the named section from the input file to the output file. This option may be given more than once. Note that using this option inappropriately may make the output file unusable.

-R sectionname
--remove-section=sectionname
Remove any section named sectionname from the output file. This option may be given more than once. Note that using this option inappropriately may make the output file unusable.

-S
--strip-all
Do not copy relocation and symbol information from the source file.

-g
--strip-debug
Do not copy debugging symbols or sections from the source file.

--strip-unneeded
Strip all symbols that are not needed for relocation processing.

-K symbolname
--keep-symbol=symbolname
When stripping symbols, keep symbol symbolname even if it would normally be stripped. This option may be given more than once.

-N symbolname
--strip-symbol=symbolname
Do not copy symbol symbolname from the source file. This option may be given more than once.
--strip-unneeded-symbol=symbolname
Do not copy symbol symbolname from the source file unless it is needed by a relocation. This option may be given more than once.

-G symbolname
--keep-global-symbol=symbolname
Keep only symbol symbolname global. Make all other symbols local to the file, so that they are not visible externally. This option may be given more than once.

--localize-hidden
In an ELF object, mark all symbols that have hidden or internal visibility as local. This option applies on top of symbol-specific localization options such as ‘-L’.

-L symbolname
--localize-symbol=symbolname
Make symbol symbolname local to the file, so that it is not visible externally. This option may be given more than once.

-W symbolname
--weaken-symbol=symbolname
Make symbol symbolname weak. This option may be given more than once.

--globalize-symbol=symbolname
Give symbol symbolname global scoping so that it is visible outside of the file in which it is defined. This option may be given more than once.

-w
--wildcard
Permit regular expressions in symbolnames used in other command line options. The question mark (?), asterisk (*), backslash (\) and square brackets ([[]) operators can be used anywhere in the symbol name. If the first character of the symbol name is the exclamation point (!) then the sense of the switch is reversed for that symbol. For example:

-w -W !foo -W fo*

would cause objcopy to weaken all symbols that start with “fo” except for the symbol “foo”.

-x
--discard-all
Do not copy non-global symbols from the source file.

-X
--discard-locals
Do not copy compiler-generated local symbols. (These usually start with ‘L’ or ‘.’.)

-b byte
--byte=byte
Keep only every byte\texteth byte of the input file (header data is not affected). byte can be in the range from 0 to interleave-1, where interleave is given by the ‘-i’
or ‘--interleave’ option, or the default of 4. This option is useful for creating files to program ROM. It is typically used with an srec output target.

-i interleave
--interleave=interleave
Only copy one out of every interleave bytes. Select which byte to copy with the ‘-b’ or ‘--byte’ option. The default is 4. objcopy ignores this option if you do not specify either ‘-b’ or ‘--byte’.

-P
--preserve-dates
Set the access and modification dates of the output file to be the same as those of the input file.

--debugging
Convert debugging information, if possible. This is not the default because only certain debugging formats are supported, and the conversion process can be time consuming.

--gap-fill val
Fill gaps between sections with val. This operation applies to the load address (LMA) of the sections. It is done by increasing the size of the section with the lower address, and filling in the extra space created with val.

--pad-to address
Pad the output file up to the load address address. This is done by increasing the size of the last section. The extra space is filled in with the value specified by ‘--gap-fill’ (default zero).

--set-start val
Set the start address of the new file to val. Not all object file formats support setting the start address.

--change-start incr
--adjust-start incr
Change the start address by adding incr. Not all object file formats support setting the start address.

--change-addresses incr
--adjust-vma incr
Change the VMA and LMA addresses of all sections, as well as the start address, by adding incr. Some object file formats do not permit section addresses to be changed arbitrarily. Note that this does not relocate the sections; if the program expects sections to be loaded at a certain address, and this option is used to change the sections such that they are loaded at a different address, the program may fail.

--change-section-address section{=,+,-}val
--adjust-section-vma section{=,+,-}val
Set or change both the VMA address and the LMA address of the named section. If ‘=’ is used, the section address is set to val. Otherwise, val is added to or subtracted from the section address. See the comments under
Chapter 4: objcopy

```
--change-addresses', above. If section does not exist in the input file, a
warning will be issued, unless '--no-change-warnings' is used.

--change-section-lma section{=,+,-}val
Set or change the LMA address of the named section. The LMA address is
the address where the section will be loaded into memory at program load
time. Normally this is the same as the VMA address, which is the address
of the section at program run time, but on some systems, especially those
where a program is held in ROM, the two can be different. If '=' is used,
the section address is set to val. Otherwise, val is added to or subtracted from
the section address. See the comments under '--change-addresses', above.
If section does not exist in the input file, a warning will be issued, unless
'--no-change-warnings' is used.

--change-section-vma section{=,+,-}val
Set or change the VMA address of the named section. The VMA address is
the address where the section will be located once the program has started
executing. Normally this is the same as the LMA address, which is the address
where the section will be loaded into memory, but on some systems, especially
those where a program is held in ROM, the two can be different. If '=' is used,
the section address is set to val. Otherwise, val is added to or subtracted from
the section address. See the comments under '--change-addresses', above.
If section does not exist in the input file, a warning will be issued, unless
'--no-change-warnings' is used.

--change-warnings
--adjust-warnings
If '--change-section-address' or '--change-section-lma' or
'--change-section-vma' is used, and the named section does not exist, issue
a warning. This is the default.

--no-change-warnings
--no-adjust-warnings
Do not issue a warning if '--change-section-address' or
'--adjust-section-lma' or '--adjust-section-vma' is used, even if
the named section does not exist.

--set-section-flags section=flags
Set the flags for the named section. The flags argument is a comma separated
string of flag names. The recognized names are 'alloc', 'contents', 'load',
'noload', 'readonly', 'code', 'data', 'rom', 'share', and 'debug'. You can set
the 'contents' flag for a section which does not have contents, but it is not
meaningful to clear the 'contents' flag of a section which does have contents–
just remove the section instead. Not all flags are meaningful for all object file
formats.

--add-section sectionname=filename
Add a new section named sectionname while copying the file. The contents of
the new section are taken from the file filename. The size of the section will be
the size of the file. This option only works on file formats which can support
sections with arbitrary names.
```
--rename-section oldname=newname[,flags]

Rename a section from oldname to newname, optionally changing the section's flags to flags in the process. This has the advantage over using a linker script to perform the rename in that the output stays as an object file and does not become a linked executable.

This option is particularly helpful when the input format is binary, since this will always create a section called .data. If for example, you wanted instead to create a section called .rodata containing binary data you could use the following command line to achieve it:

```
objcopy -I binary -O <output_format> -B <architecture> \
--rename-section .data=.rodata,alloc,load,readonly,data,contents \ 
<input_binary_file> <output_object_file>
```

--long-section-names {enable,disable,keep}

Controls the handling of long section names when processing COFF and PE-COFF object formats. The default behaviour, ‘keep’, is to preserve long section names if any are present in the input file. The ‘enable’ and ‘disable’ options forcibly enable or disable the use of long section names in the output object; when ‘disable’ is in effect, any long section names in the input object will be truncated. The ‘enable’ option will only emit long section names if any are present in the inputs; this is mostly the same as ‘keep’, but it is left undefined whether the ‘enable’ option might force the creation of an empty string table in the output file.

--change-leading-char

Some object file formats use special characters at the start of symbols. The most common such character is underscore, which compilers often add before every symbol. This option tells objcopy to change the leading character of every symbol when it converts between object file formats. If the object file formats use the same leading character, this option has no effect. Otherwise, it will add a character, or remove a character, or change a character, as appropriate.

--remove-leading-char

If the first character of a global symbol is a special symbol leading character used by the object file format, remove the character. The most common symbol leading character is underscore. This option will remove a leading underscore from all global symbols. This can be useful if you want to link together objects of different file formats with different conventions for symbol names. This is different from ‘--change-leading-char’ because it always changes the symbol name when appropriate, regardless of the object file format of the output file.

--reverse-bytes=num

Reverse the bytes in a section with output contents. A section length must be evenly divisible by the value given in order for the swap to be able to take place. Reversing takes place before the interleaving is performed.

This option is used typically in generating ROM images for problematic target systems. For example, on some target boards, the 32-bit words fetched from 8-bit ROMs are re-assembled in little-endian byte order regardless of the CPU
byte order. Depending on the programming model, the endianness of the ROM may need to be modified.

Consider a simple file with a section containing the following eight bytes: 12345678.

Using `--reverse-bytes=2` for the above example, the bytes in the output file would be ordered 21436587.

Using `--reverse-bytes=4` for the above example, the bytes in the output file would be ordered 43218765.

By using `--reverse-bytes=2` for the above example, followed by `--reverse-bytes=4` on the output file, the bytes in the second output file would be ordered 34127856.

--srec-len=ival
Meaningful only for srec output. Set the maximum length of the Srecords being produced to ival. This length covers both address, data and crc fields.

--srec-forceS3
Meaningful only for srec output. Avoid generation of S1/S2 records, creating S3-only record format.

--redefine-sym old=new
Change the name of a symbol old, to new. This can be useful when one is trying link two things together for which you have no source, and there are name collisions.

--redefine-syms=filename
Apply `--redefine-sym` to each symbol pair "old new" listed in the file filename. filename is simply a flat file, with one symbol pair per line. Line comments may be introduced by the hash character. This option may be given more than once.

--weaken
Change all global symbols in the file to be weak. This can be useful when building an object which will be linked against other objects using the `-R` option to the linker. This option is only effective when using an object file format which supports weak symbols.

--keep-symbols=filename
Apply `--keep-symbol` option to each symbol listed in the file filename. filename is simply a flat file, with one symbol name per line. Line comments may be introduced by the hash character. This option may be given more than once.

--strip-symbols=filename
Apply `--strip-symbol` option to each symbol listed in the file filename. filename is simply a flat file, with one symbol name per line. Line comments may be introduced by the hash character. This option may be given more than once.

--strip-unneeded-symbols=filename
Apply `--strip-unneeded-symbol` option to each symbol listed in the file filename. filename is simply a flat file, with one symbol name per line. Line comments may be introduced by the hash character. This option may be given more than once.
--keep-global-symbols=filename
Apply ‘--keep-global-symbol’ option to each symbol listed in the file filename. filename is simply a flat file, with one symbol name per line. Line comments may be introduced by the hash character. This option may be given more than once.

--localize-symbols=filename
Apply ‘--localize-symbol’ option to each symbol listed in the file filename. filename is simply a flat file, with one symbol name per line. Line comments may be introduced by the hash character. This option may be given more than once.

--globalize-symbols=filename
Apply ‘--globalize-symbol’ option to each symbol listed in the file filename. filename is simply a flat file, with one symbol name per line. Line comments may be introduced by the hash character. This option may be given more than once.

--weaken-symbols=filename
Apply ‘--weaken-symbol’ option to each symbol listed in the file filename. filename is simply a flat file, with one symbol name per line. Line comments may be introduced by the hash character. This option may be given more than once.

--alt-machine-code=index
If the output architecture has alternate machine codes, use the indexth code instead of the default one. This is useful in case a machine is assigned an official code and the tool-chain adopts the new code, but other applications still depend on the original code being used. For ELF based architectures if the index alternative does not exist then the value is treated as an absolute number to be stored in the e_machine field of the ELF header.

--writable-text
Mark the output text as writable. This option isn’t meaningful for all object file formats.

--readonly-text
Make the output text write protected. This option isn’t meaningful for all object file formats.

--pure
Mark the output file as demand paged. This option isn’t meaningful for all object file formats.

--impure
Mark the output file as impure. This option isn’t meaningful for all object file formats.

--prefix-symbols=string
Prefix all symbols in the output file with string.

--prefix-sections=string
Prefix all section names in the output file with string.

--prefix-alloc-sections=string
Prefix all the names of all allocated sections in the output file with string.
--add-gnu-debuglink=path-to-file
   Creates a .gnu_debuglink section which contains a reference to path-to-file and adds it to the output file.

--keep-file-symbols
   When stripping a file, perhaps with '--strip-debug' or '--strip-unneeded', retain any symbols specifying source file names, which would otherwise get stripped.

--only-keep-debug
   Strip a file, removing contents of any sections that would not be stripped by '--strip-debug' and leaving the debugging sections intact. In ELF files, this preserves all note sections in the output.

   The intention is that this option will be used in conjunction with '--add-gnu-debuglink' to create a two part executable. One a stripped binary which will occupy less space in RAM and in a distribution and the second a debugging information file which is only needed if debugging abilities are required. The suggested procedure to create these files is as follows:

--file-alignment num
   Specify the file alignment. Sections in the file will always begin at file offsets which are multiples of this number. This defaults to 512. [This option is specific to PE targets.]

--heap reserve
--heap reserve,commit
   Specify the number of bytes of memory to reserve (and optionally commit) to be used as heap for this program. [This option is specific to PE targets.]

--image-base value
   Use value as the base address of your program or dll. This is the lowest memory location that will be used when your program or dll is loaded. To reduce the need to relocate and improve performance of your dlls, each should have a unique base address and not overlap any other dlls. The default is 0x400000 for executables, and 0x10000000 for dlls. [This option is specific to PE targets.]

--section-alignment num
   Sets the section alignment. Sections in memory will always begin at addresses which are a multiple of this number. Defaults to 0x1000. [This option is specific to PE targets.]

--stack reserve
--stack reserve,commit
   Specify the number of bytes of memory to reserve (and optionally commit) to be used as stack for this program. [This option is specific to PE targets.]

--subsystem which
--subsystem which:major
--subsystem which:major.minor
   Specifies the subsystem under which your program will execute. The legal values for which are native, windows, console, posix, efi-app, efi-bsd,
**efi-rtd, sal-rtd, and xbox.** You may optionally set the subsystem version also. Numeric values are also accepted for which. [This option is specific to PE targets.]

1. Link the executable as normal. Assuming that is is called `foo` then...
2. Run `objcopy --only-keep-debug foo foo.dbg` to create a file containing the debugging info.
3. Run `objcopy --strip-debug foo` to create a stripped executable.
4. Run `objcopy --add-gnu-debuglink=foo.dbg foo` to add a link to the debugging info into the stripped executable.

Note—the choice of `.dbg` as an extension for the debug info file is arbitrary. Also the `--only-keep-debug` step is optional. You could instead do this:

1. Link the executable as normal.
2. Copy `foo` to `foo.full`
3. Run `objcopy --strip-debug foo`
4. Run `objcopy --add-gnu-debuglink=foo.full foo`

i.e., the file pointed to by the `--add-gnu-debuglink` can be the full executable. It does not have to be a file created by the `--only-keep-debug` switch.

Note—this switch is only intended for use on fully linked files. It does not make sense to use it on object files where the debugging information may be incomplete. Besides the gnu_debuglink feature currently only supports the presence of one filename containing debugging information, not multiple filenames on a one-per-object-file basis.

**--extract-symbol**

Keep the file’s section flags and symbols but remove all section data. Specifically, the option:

- removes the contents of all sections;
- sets the size of every section to zero; and
- sets the file’s start address to zero.

This option is used to build a `.`sym file for a VxWorks kernel. It can also be a useful way of reducing the size of a `--just-symbols` linker input file.

**-V**

**--version**

Show the version number of `objcopy`.

**-v**

**--verbose**

Verbose output: list all object files modified. In the case of archives, `objcopy -V` lists all members of the archive.

**--help**

Show a summary of the options to `objcopy`.

**--info**

Display a list showing all architectures and object formats available.
5 objdump

objdump ['-a'|'--archive-headers']
['-b' bfdname|--target=bfdname']
['-C'|'--demangle'=[style] ]
['-d'|'--disassemble']
['-D'|'--disassemble-all']
['-z'|'--disassemble-zeroes']
['-EB'|'--endian={big | little}']
['-f'|'--file-headers']
['-F'|'--file-offsets']
['--file-start-context']
['-g'|'--debugging']
['-E'|'--debugging-tags']
['-h'|'--section-headers'|'--headers']
['-i'|'--info']
['-j' section|--section='section']
['-l'|'--line-numbers']
['-S'|'--source']
['-m' machine|--architecture='machine']
['-M' options|--disassembler-options='options']
['-p'|'--private-headers']
['-r'|'--reloc']
['-R'|'--dynamic-reloc']
['-s'|'--full-contents']
['-W[lLiaprmfFsoR]'|--dwarf=[rawline,=decodedline,=info,=abbrev,=pubnames,=aranges,=macro,=frames,=frames-interp,=str,=loc,=Ranges]}
['-G'|'--stabs']
['-t'|'--sym|x']
['-T'|'--dynamic-syms']
['-x'|'--all-headers']
['-w'|'--wide']
['--start-address='address]
['--stop-address='address]
['--prefix-addresses']
['--no-show-raw-insn']
['--adjust-vma='offset]
['--special-syms']
['--prefix']
['--prefix-strip='level']
['-V'|'--version']
['-H'|'--help']
ojfile...

objdump displays information about one or more object files. The options control what particular information to display. This information is mostly useful to programmers who are working on the compilation tools, as opposed to programmers who just want their program to compile and work.

objfile... are the object files to be examined. When you specify archives, objdump shows information on each of the member object files.

The long and short forms of options, shown here as alternatives, are equivalent. At least one option from the list ‘-a,-d,-D,-e,-f,-g,-h,-H,-p,-r,-R,-s,-S,-t,-T,-V,-x’ must be given.
Chapter 5: objdump

-a
--archive-header
If any of the objfile files are archives, display the archive header information (in a format similar to `ls -l`). Besides the information you could list with `ar tv`, `objdump -a` shows the object file format of each archive member.

--adjust-vma=offset
When dumping information, first add offset to all the section addresses. This is useful if the section addresses do not correspond to the symbol table, which can happen when putting sections at particular addresses when using a format which can not represent section addresses, such as a.out.

-b bfdname
--target=bfdname
Specify that the object-code format for the object files is bfdname. This option may not be necessary; objdump can automatically recognize many formats. For example,

```
objdump -b oasys -m vax -h fu.o
```
displays summary information from the section headers (`-h`) of `fu.o`, which is explicitly identified (`-m`) as a VAX object file in the format produced by Oasys compilers. You can list the formats available with the `-i` option. See Section 18.1 [Target Selection], page 64, for more information.

-C
--demangle[=style]
Decode (demangle) low-level symbol names into user-level names. Besides removing any initial underscore prepended by the system, this makes C++ function names readable. Different compilers have different mangling styles. The optional demangling style argument can be used to choose an appropriate demangling style for your compiler. See Chapter 10 [c++filt], page 41, for more information on demangling.

-g
--debugging
Display debugging information. This attempts to parse STABS and IEEE debugging format information stored in the file and print it out using a C like syntax. If neither of these formats are found this option falls back on the `-W` option to print any DWARF information in the file.

-e
--debugging-tags
Like `-g`, but the information is generated in a format compatible with ctags tool.

-d
--disassemble
Display the assembler mnemonics for the machine instructions from objfile. This option only disassembles those sections which are expected to contain instructions.
-D
--disassemble-all
   Like ‘-d’, but disassemble the contents of all sections, not just those expected
to contain instructions.

   If the target is an ARM architecture this switch also has the effect of forcing
the disassembler to decode pieces of data found in code sections as if they were
instructions.

--prefix-addresses
   When disassembling, print the complete address on each line. This is the older
disassembly format.

-EB
-EL
--endian={big|little}
   Specify the endianness of the object files. This only affects disassembly. This
can be useful when disassembling a file format which does not describe endian-
ness information, such as S-records.

-f
--file-headers
   Display summary information from the overall header of each of the objfile files.

-F
--file-offsets
   When disassembling sections, whenever a symbol is displayed, also display the
file offset of the region of data that is about to be dumped. If zeroes are being
skipped, then when disassembly resumes, tell the user how many zeroes were
skipped and the file offset of the location from where the disassembly resumes.
When dumping sections, display the file offset of the location from where the
dump starts.

--file-start-context
   Specify that when displaying interlisted source code/disassembly (assumes ‘-S’)  
from a file that has not yet been displayed, extend the context to the start of
the file.

-h
--section-headers
   Display summary information from the section headers of the object file.
File segments may be relocated to nonstandard addresses, for example by using
the ‘-Ttext’, ‘-Tdata’, or ‘-Tbss’ options to ld. However, some object file
formats, such as a.out, do not store the starting address of the file segments.
In those situations, although ld relocates the sections correctly, using ‘objdump
-h’ to list the file section headers cannot show the correct addresses. Instead,
it shows the usual addresses, which are implicit for the target.

-H
--help
   Print a summary of the options to objdump and exit.
-i
--info  Display a list showing all architectures and object formats available for specification with ‘-b’ or ‘-m’.

-j name
--section=name
  Display information only for section name.

-l
--line-numbers
  Label the display (using debugging information) with the filename and source line numbers corresponding to the object code or relocs shown. Only useful with ‘-d’, ‘-D’, or ‘-r’.

-m machine
--architecture=architecture
  Specify the architecture to use when disassembling object files. This can be useful when disassembling object files which do not describe architecture information, such as S-records. You can list the available architectures with the ‘-i’ option.
  If the target is an ARM architecture then this switch has an additional effect. It restricts the disassembly to only those instructions supported by the architecture specified by machine. If it is necessary to use this switch because the input file does not contain any architecture information, but it is also desired to disassemble all the instructions use ‘-marm’.

-M options
--disassembler-options=options
  Pass target specific information to the disassembler. Only supported on some targets. If it is necessary to specify more than one disassembler option then multiple ‘-M’ options can be used or can be placed together into a comma separated list.
  If the target is an ARM architecture then this switch can be used to select which register name set is used during disassembler. Specifying ‘-M reg-names-std’ (the default) will select the register names as used in ARM’s instruction set documentation, but with register 13 called ‘sp’, register 14 called ‘lr’ and register 15 called ‘pc’. Specifying ‘-M reg-names-apcs’ will select the name set used by the ARM Procedure Call Standard, whilst specifying ‘-M reg-names-raw’ will just use ‘r’ followed by the register number.
  There are also two variants on the APCS register naming scheme enabled by ‘-M reg-names-atpcs’ and ‘-M reg-names-special-atpcs’ which use the ARM/Thumb Procedure Call Standard naming conventions. (Either with the normal register names or the special register names).
  This option can also be used for ARM architectures to force the disassembler to interpret all instructions as Thumb instructions by using the switch ‘--disassembler-options=force-thumb’. This can be useful when attempting to disassemble thumb code produced by other compilers.
  For the x86, some of the options duplicate functions of the ‘-m’ switch, but allow finer grained control. Multiple selections from the following may be specified.
as a comma separated string. ‘x86-64’, ‘i386’ and ‘i8086’ select disassembly for the given architecture. ‘intel’ and ‘att’ select between Intel syntax mode and AT&T syntax mode. ‘intel-mnemonic’ and ‘att-mnemonic’ select between Intel mnemonic mode and AT&T mnemonic mode. ‘intel-mnemonic’ implies ‘intel’ and ‘att-mnemonic’ implies ‘att’. ‘addr64’, ‘addr32’, ‘addr16’, ‘data32’ and ‘data16’ specify the default address size and operand size. These four options will be overridden if ‘x86-64’, ‘i386’ or ‘i8086’ appear later in the option string. Lastly, ‘suffix’, when in AT&T mode, instructs the disassembler to print a mnemonic suffix even when the suffix could be inferred by the operands.

For PowerPC, ‘booke’ controls the disassembly of BookE instructions. ‘32’ and ‘64’ select PowerPC and PowerPC64 disassembly, respectively. ‘e300’ selects disassembly for the e300 family. ‘440’ selects disassembly for the PowerPC 440. ‘ppcps’ selects disassembly for the paired single instructions of the PPC750CL.

For MIPS, this option controls the printing of instruction mnemonic names and register names in disassembled instructions. Multiple selections from the following may be specified as a comma separated string, and invalid options are ignored:

no-aliases
Print the ‘raw’ instruction mnemonic instead of some pseudo instruction mnemonic. I.e., print ‘daddu’ or ‘or’ instead of ‘move’, ‘sll’ instead of ‘nop’, etc.

gpr-names=ABI
Print GPR (general-purpose register) names as appropriate for the specified ABI. By default, GPR names are selected according to the ABI of the binary being disassembled.

fpr-names=ABI
Print FPR (floating-point register) names as appropriate for the specified ABI. By default, FPR numbers are printed rather than names.

cp0-names=ARCH
Print CP0 (system control coprocessor; coprocessor 0) register names as appropriate for the CPU or architecture specified by ARCH. By default, CP0 register names are selected according to the architecture and CPU of the binary being disassembled.

hwr-names=ARCH
Print HWR (hardware register, used by the rdhwr instruction) names as appropriate for the CPU or architecture specified by ARCH. By default, HWR names are selected according to the architecture and CPU of the binary being disassembled.

reg-names=ABI
Print GPR and FPR names as appropriate for the selected ABI.
reg-names=ARCH
Print CPU-specific register names (CP0 register and HWR names)
as appropriate for the selected CPU or architecture.

For any of the options listed above, ABI or ARCH may be specified as ‘numeric’
to have numbers printed rather than names, for the selected types of registers.
You can list the available values of ABI and ARCH using the ‘--help’ option.
For VAX, you can specify function entry addresses with ‘-M entry:0xf00ba’.
You can use this multiple times to properly disassemble VAX binary files that
do’t contain symbol tables (like ROM dumps). In these cases, the function
entry mask would otherwise be decoded as VAX instructions, which would
probably lead the rest of the function being wrongly disassembled.

-p
--private-headers
Print information that is specific to the object file format. The exact informa-
tion printed depends upon the object file format. For some object file formats,
no additional information is printed.

-r
--reloc
Print the relocation entries of the file. If used with ‘-d’ or ‘-D’, the relocations
are printed interspersed with the disassembly.

-R
--dynamic-reloc
Print the dynamic relocation entries of the file. This is only meaningful for
dynamic objects, such as certain types of shared libraries. As for ‘-r’, if used
with ‘-d’ or ‘-D’, the relocations are printed interspersed with the disassembly.

-s
--full-contents
Display the full contents of any sections requested. By default all non-empty
sections are displayed.

-S
--source
Display source code intermixed with disassembly, if possible. Implies ‘-d’.

--prefix=prefix
Specify prefix to add to the absolute paths when used with ‘-S’.

--prefix-strip=level
Indicate how many initial directory names to strip off the hardwired absolute
paths. It has no effect without ‘--prefix=prefix’.

--show-raw-insn
When disassembling instructions, print the instruction in hex as well as in
symbolic form. This is the default except when ‘--prefix-addresses’ is used.

--no-show-raw-insn
When disassembling instructions, do not print the instruction bytes. This is
the default when ‘--prefix-addresses’ is used.
Chapter 5: objdump

-W[lLiaprmFsoR]
--dwarf[=rawline,=decodedline,=info,=abbrev,=pubnames,=aranges,=macro,=frames,=frames-interp,=str,=loc,=Ranges]
Displays the contents of the debug sections in the file, if any are present. If one of the optional letters or words follows the switch then only data found in those specific sections will be dumped.

-G
--stabs
Display the full contents of any sections requested. Display the contents of the .stab and .stab.index and .stab.excl sections from an ELF file. This is only useful on systems (such as Solaris 2.0) in which .stab debugging symbol-table entries are carried in an ELF section. In most other file formats, debugging symbol-table entries are interleaved with linkage symbols, and are visible in the ‘--syms’ output. For more information on stabs symbols, see Section “Stabs Overview” in The “stabs” debug format.

--start-address=address
Start displaying data at the specified address. This affects the output of the ‘-d’, ‘-r’ and ‘-s’ options.

--stop-address=address
Stop displaying data at the specified address. This affects the output of the ‘-d’, ‘-r’ and ‘-s’ options.

-t
--syms
Print the symbol table entries of the file. This is similar to the information provided by the ‘nm’ program, although the display format is different. The format of the output depends upon the format of the file being dumped, but there are two main types. One looks like this:

```
[ 4](sec 3)(fl 0x00)(ty 0)(scl 3) (nx 1) 0x00000000 .bss
[ 6](sec 1)(fl 0x00)(ty 0)(scl 2) (nx 0) 0x00000000 fred
```
where the number inside the square brackets is the number of the entry in the symbol table, the sec number is the section number, the fl value are the symbol’s flag bits, the ty number is the symbol’s type, the scl number is the symbol’s storage class and the nx value is the number of auxilary entries associated with the symbol. The last two fields are the symbol’s value and its name.

The other common output format, usually seen with ELF based files, looks like this:

```
 00000000 l  d .bss  00000000 .bss
 00000000 g .text  00000000 fred
```
Here the first number is the symbol’s value (sometimes refered to as its address). The next field is actually a set of characters and spaces indicating the flag bits that are set on the symbol. These characters are described below. Next is the section with which the symbol is associated or *ABS* if the section is absolute (ie not connected with any section), or *UND* if the section is referenced in the file being dumped, but not defined there.

After the section name comes another field, a number, which for common symbols is the alignment and for other symbol is the size. Finally the symbol’s name is displayed.

The flag characters are divided into 7 groups as follows:
The symbol is local (l), global (g), neither (a space) or both (!). A symbol can be neither local or global for a variety of reasons, e.g., because it is used for debugging, but it is probably an indication of a bug if it is ever both local and global.

The symbol is weak (w) or strong (a space).

The symbol denotes a constructor (C) or an ordinary symbol (a space).

The symbol is a warning (W) or a normal symbol (a space). A warning symbol’s name is a message to be displayed if the symbol following the warning symbol is ever referenced.

The symbol is an indirect reference to another symbol (I), a function to be evaluated during reloc processing (i) or a normal symbol (a space).

The symbol is a debugging symbol (d) or a dynamic symbol (D) or a normal symbol (a space).

The symbol is the name of a function (F) or a file (f) or an object (O) or just a normal symbol (a space).

- T
  --dynamic-syms
  Print the dynamic symbol table entries of the file. This is only meaningful for dynamic objects, such as certain types of shared libraries. This is similar to the information provided by the ‘nm’ program when given the ‘-D’ (‘--dynamic’) option.

  --special-syms
  When displaying symbols include those which the target considers to be special in some way and which would not normally be of interest to the user.

- V
  --version
  Print the version number of objdump and exit.

- x
  --all-headers
  Display all available header information, including the symbol table and relocation entries. Using ‘-x’ is equivalent to specifying all of ‘-a -f -h -p -r -t’.
-w
--wide Format some lines for output devices that have more than 80 columns. Also do not truncate symbol names when they are displayed.

-z
--disassemble-zeroes Normally the disassembly output will skip blocks of zeroes. This option directs the disassembler to disassemble those blocks, just like any other data.
6 ranlib

ranlib ['-vVt'] archive

ranlib generates an index to the contents of an archive and stores it in the archive. The index lists each symbol defined by a member of an archive that is a relocatable object file.

You may use ‘nm -s’ or ‘nm --print-armap’ to list this index.

An archive with such an index speeds up linking to the library and allows routines in the library to call each other without regard to their placement in the archive.

The GNU ranlib program is another form of GNU ar; running ranlib is completely equivalent to executing ‘ar -s’. See Chapter 1 [ar], page 2.

-v
-V
--version

Show the version number of ranlib.

-t

Update the timestamp of the symbol map of an archive.
7 size

size ['-A'|'-B'|'--format='compatibility']
[ '--help']
['-d'|'-o'|'-x'|'--radix='number']
['--common']
['-t'|'--totals']
['--target='bfdname] ['-V'|'--version']
[objfile...]

The GNU size utility lists the section sizes—and the total size—for each of the object or archive files objfile in its argument list. By default, one line of output is generated for each object file or each module in an archive.

objfile... are the object files to be examined. If none are specified, the file a.out will be used.

The command line options have the following meanings:

-A
-B
--format=compatibility

Using one of these options, you can choose whether the output from GNU size resembles output from System V size (using ‘-A’, or ‘--format=sysv’), or Berkeley size (using ‘-B’, or ‘--format=berkeley’). The default is the one-line format similar to Berkeley’s.

Here is an example of the Berkeley (default) format of output from size:

$ size --format=Berkeley ranlib size
  text  data   bss    dec  hex  filename
  294880  81920  11592  388392  5ed28  ranlib
  294880  81920  11888  388688  5ee50  size

This is the same data, but displayed closer to System V conventions:

$ size --format=SysV ranlib size
  ranlib :
   section  size   addr
    .text    294880    8192
    .data    81920    303104
    .bss    11592    385024
   Total    388392

$ size :
   section  size   addr
    .text    294880    8192
    .data    81920    303104
    .bss    11888    385024
   Total    388688

--help  Show a summary of acceptable arguments and options.

-d
-o
-x
--radix=number

Using one of these options, you can control whether the size of each section is given in decimal (‘-d’, or ‘--radix=10’); octal (‘-o’, or ‘--radix=8’); or hex-
decimal (`-x`, or `--radix=16`). In `--radix=number`, only the three values 
(8, 10, 16) are supported. The total size is always given in two radices; decimal 
and hexadecimal for `-d` or `-x` output, or octal and hexadecimal if you’re using 
`-o`.

```
--common
```
Print total size of common symbols in each file. When using Berkeley format 
these are included in the bss size.

```
-t
```
```
--totals
```
Show totals of all objects listed (Berkeley format listing mode only).

```
--target=bfdname
```
Specify that the object-code format for `objfile` is `bfdname`. This option may not 
be necessary; `size` can automatically recognize many formats. See Section 18.1 
[Test Selection], page 64, for more information.

```
-V
```
```
--version
```
Display the version number of `size`. 
Chapter 8: strings

8 strings

strings ['-afovV'] ['-min-len']
     ['n' min-len] ['--bytes=min-len']
     ['-t' radix] ['--radix=radix']
     ['-e' encoding] ['--encoding=encoding']
     ['-'] ['--all'] ['--print-file-name']
     ['-T bfdname'] ['--target=bfdname']
     ['--help'] ['--version'] file...

For each file given, GNU strings prints the printable character sequences that are at least 4 characters long (or the number given with the options below) and are followed by an unprintable character. By default, it only prints the strings from the initialized and loaded sections of object files; for other types of files, it prints the strings from the whole file.

strings is mainly useful for determining the contents of non-text files.

-a
--all
- Do not scan only the initialized and loaded sections of object files; scan the whole files.

-f
--print-file-name
Print the name of the file before each string.

--help
Print a summary of the program usage on the standard output and exit.

-min-len
-n min-len
--bytes=min-len
Print sequences of characters that are at least min-len characters long, instead of the default 4.

-o
Like ‘-t o’. Some other versions of strings have ‘-o’ act like ‘-t d’ instead. Since we can not be compatible with both ways, we simply chose one.

-t radix
--radix=radix
Print the offset within the file before each string. The single character argument specifies the radix of the offset—‘o’ for octal, ‘x’ for hexadecimal, or ‘d’ for decimal.

-e encoding
--encoding=encoding
Select the character encoding of the strings that are to be found. Possible values for encoding are: ‘s’ = single-7-bit-byte characters (ASCII, ISO 8859, etc., default), ‘S’ = single-8-bit-byte characters, ‘b’ = 16-bit bigendian, ‘l’ = 16-bit littleendian, ‘B’ = 32-bit bigendian, ‘L’ = 32-bit littleendian. Useful for finding wide character strings. (‘l’ and ‘b’ apply to, for example, Unicode UTF-16/UCS-2 encodings).

-T bfdname
--target=bfdname
Specify an object code format other than your system’s default format. See Section 18.1 [Target Selection], page 64, for more information.
-v
-V
--version

Print the program version number on the standard output and exit.
9 strip

strip ['-F' bfdname | '--target=' bfdname]
['-I' bfdname | '--input-target=' bfdname]
['-O' bfdname | '--output-target=' bfdname]
['-s'|'--strip-all']
['-S'|'-g'|'-d'|'--strip-debug']
['-K' symbolname | '--keep-symbol=' symbolname]
['-N' symbolname | '--strip-symbol=' symbolname]
['-w'|'--wildcard']
['-x'|'--discard-all'] ['-X' |'--discard-locals']
['-R' sectionname | '--remove-section=' sectionname]
['-o' file] ['-p'|'--preserve-dates']
['--keep-file-symbols']
['--only-keep-debug']
['-v' |'--verbose'] ['-V'|'--version']
['--help'] ['--info']
objfile...

GNU strip discards all symbols from object files objfile. The list of object files may include archives. At least one object file must be given.

strip modifies the files named in its argument, rather than writing modified copies under different names.

-F bfdname
--target=bfdname
Treat the original objfile as a file with the object code format bfdname, and rewrite it in the same format. See Section 18.1 [Target Selection], page 64, for more information.

--help     Show a summary of the options to strip and exit.

--info     Display a list showing all architectures and object formats available.

-I bfdname
--input-target=bfdname
Treat the original objfile as a file with the object code format bfdname. See Section 18.1 [Target Selection], page 64, for more information.

-O bfdname
--output-target=bfdname
Replace objfile with a file in the output format bfdname. See Section 18.1 [Target Selection], page 64, for more information.

-R sectionname
--remove-section=sectionname
Remove any section named sectionname from the output file. This option may be given more than once. Note that using this option inappropriately may make the output file unusable.

-s
--strip-all
Remove all symbols.
Chapter 9: strip

-g
-S
-d
--strip-debug
   Remove debugging symbols only.

--strip-unneeded
   Remove all symbols that are not needed for relocation processing.

-K symbolname
--keep-symbol=symbolname
   When stripping symbols, keep symbol symbolname even if it would normally be stripped. This option may be given more than once.

-N symbolname
--strip-symbol=symbolname
   Remove symbol symbolname from the source file. This option may be given more than once, and may be combined with strip options other than ‘-K’.

-o file
   Put the stripped output in file, rather than replacing the existing file. When this argument is used, only one objfile argument may be specified.

-P
--preserve-dates
   Preserve the access and modification dates of the file.

-w
--wildcard
   Permit regular expressions in symbolnames used in other command line options. The question mark (?), asterisk (*), backslash (\) and square brackets ([[]]) operators can be used anywhere in the symbol name. If the first character of the symbol name is the exclamation point (!) then the sense of the switch is reversed for that symbol. For example:
       -w -K !foo -K fo*
   would cause strip to only keep symbols that start with the letters “fo”, but to discard the symbol “foo”.

-x
--discard-all
   Remove non-global symbols.

-X
--discard-locals
   Remove compiler-generated local symbols. (These usually start with ‘L’ or ‘.’.)

--keep-file-symbols
   When stripping a file, perhaps with ‘--strip-debug’ or ‘--strip-unneeded’, retain any symbols specifying source file names, which would otherwise get stripped.
--only-keep-debug

Strip a file, removing contents of any sections that would not be stripped by `--strip-debug` and leaving the debugging sections intact. In ELF files, this preserves all note sections in the output.

The intention is that this option will be used in conjunction with `--add-gnu-debuglink` to create a two part executable. One a stripped binary which will occupy less space in RAM and in a distribution and the second a debugging information file which is only needed if debugging abilities are required. The suggested procedure to create these files is as follows:

1. Link the executable as normal. Assuming that is is called `foo` then...
2. Run `objcopy --only-keep-debug foo foo.dbg` to create a file containing the debugging info.
3. Run `objcopy --strip-debug foo` to create a stripped executable.
4. Run `objcopy --add-gnu-debuglink=foo.dbg foo` to add a link to the debugging info into the stripped executable.

Note—the choice of `.dbg` as an extension for the debug info file is arbitrary. Also the `--only-keep-debug` step is optional. You could instead do this:

1. Link the executable as normal.
2. Copy `foo` to `foo.full`
3. Run `strip --strip-debug foo`
4. Run `objcopy --add-gnu-debuglink=foo.full foo`

i.e., the file pointed to by the `--add-gnu-debuglink` can be the full executable. It does not have to be a file created by the `--only-keep-debug` switch.

Note—this switch is only intended for use on fully linked files. It does not make sense to use it on object files where the debugging information may be incomplete. Besides the gnu_debuglink feature currently only supports the presence of one filename containing debugging information, not multiple filenames on a one-per-object-file basis.

-V
--version

Show the version number for `strip`.

-v
--verbose

Verbose output: list all object files modified. In the case of archives, `strip -v` lists all members of the archive.
Chapter 10: c++filt

10 c++filt

c++filt ['-_'|'--strip-underscores']
[-n'|'--no-strip-underscores']
[-p'|'--no-params']
[-t'|'--types']
[-i'|'--no-verbose']
[-s'|'--format='format']
[--help'] [--version'] [symbol...]

The C++ and Java languages provide function overloading, which means that you can write many functions with the same name, providing that each function takes parameters of different types. In order to be able to distinguish these similarly named functions C++ and Java encode them into a low-level assembler name which uniquely identifies each different version. This process is known as mangling. The c++filt1 program does the inverse mapping: it decodes (demangles) low-level names into user-level names so that they can be read.

Every alphanumeric word (consisting of letters, digits, underscores, dollars, or periods) seen in the input is a potential mangled name. If the name decodes into a C++ name, the C++ name replaces the low-level name in the output, otherwise the original word is output. In this way you can pass an entire assembler source file, containing mangled names, through c++filt and see the same source file containing demangled names.

You can also use c++filt to decipher individual symbols by passing them on the command line:

c++filt symbol

If no symbol arguments are given, c++filt reads symbol names from the standard input instead. All the results are printed on the standard output. The difference between reading names from the command line versus reading names from the standard input is that command line arguments are expected to be just mangled names and no checking is performed to separate them from surrounding text. Thus for example:

c++filt -n _Z1fv

will work and demangle the name to “f()” whereas:

c++filt -n _Z1fv,

will not work. (Note the extra comma at the end of the mangled name which makes it invalid). This command however will work:

echo _Z1fv, | c++filt -n

and will display “f(),” i.e., the demangled name followed by a trailing comma. This behaviour is because when the names are read from the standard input it is expected that they might be part of an assembler source file where there might be extra, extraneous characters trailing after a mangled name. For example:

.type _Z1fv, @function

--strip-underscores

On some systems, both the C and C++ compilers put an underscore in front of every name. For example, the C name foo gets the low-level name _foo.

1 MS-DOS does not allow + characters in file names, so on MS-DOS this program is named CXXFILT.
This option removes the initial underscore. Whether `c++filt` removes the underscore by default is target dependent.

- `j`  
  `--java`  Prints demangled names using Java syntax. The default is to use C++ syntax.

- `n`  
  `--no-strip-underscores`  Do not remove the initial underscore.

- `p`  
  `--no-params`  When demangling the name of a function, do not display the types of the function’s parameters.

- `t`  
  `--types`  Attempt to demangle types as well as function names. This is disabled by default since mangled types are normally only used internally in the compiler, and they can be confused with non-mangled names. For example, a function called “a” treated as a mangled type name would be demangled to “signed char”.

- `i`  
  `--no-verbose`  Do not include implementation details (if any) in the demangled output.

- `s format`  
  `--format=format`  
  `c++filt` can decode various methods of mangling, used by different compilers. The argument to this option selects which method it uses:
  
  - `auto`  Automatic selection based on executable (the default method)
  - `gnu`  the one used by the GNU C++ compiler (g++)
  - `lucid`  the one used by the Lucid compiler (lcc)
  - `arm`  the one specified by the C++ Annotated Reference Manual
  - `hp`  the one used by the HP compiler (aCC)
  - `edg`  the one used by the EDG compiler
  - `gnu-v3`  the one used by the GNU C++ compiler (g++) with the V3 ABI.
  - `java`  the one used by the GNU Java compiler (gcj)
  - `gnat`  the one used by the GNU Ada compiler (GNAT).

- `--help`  Print a summary of the options to `c++filt` and exit.

- `--version`  Print the version number of `c++filt` and exit.

Warning: `c++filt` is a new utility, and the details of its user interface are subject to change in future releases. In particular, a command-line option may be required in the future to decode a name passed as an argument on the command line; in other words,
c++filt symbol
may in a future release become
c++filt option symbol
11 addr2line

addr2line ['-b' bfdname|'--target=bfdname]
['-C'|'--demangle[=style]]
['-e' filename|'--exe=filename]
['-f'|'--functions'] ['-s'|'--basename']
['-i'|'--inlines']
['-j'|'--section=']
['-H'|'--help'] ['-V'|'--version']
[addr addr ...]

addr2line translates addresses into file names and line numbers. Given an address in an executable or an offset in a section of a relocatable object, it uses the debugging information to figure out which file name and line number are associated with it.

The executable or relocatable object to use is specified with the ‘-e’ option. The default is the file ‘a.out’. The section in the relocatable object to use is specified with the ‘-j’ option.

addr2line has two modes of operation.

In the first, hexadecimal addresses are specified on the command line, and addr2line displays the file name and line number for each address.

In the second, addr2line reads hexadecimal addresses from standard input, and prints the file name and line number for each address on standard output. In this mode, addr2line may be used in a pipe to convert dynamically chosen addresses.

The format of the output is ‘FILENAME:LINENO’. The file name and line number for each address is printed on a separate line. If the -f option is used, then each ‘FILENAME:LINENO’ line is preceded by a ‘FUNCTIONNAME’ line which is the name of the function containing the address.

If the file name or function name can not be determined, addr2line will print two question marks in their place. If the line number can not be determined, addr2line will print 0.

The long and short forms of options, shown here as alternatives, are equivalent.

-b bfdname
--target=bfdname
Specify that the object-code format for the object files is bfdname.

-C
--demangle[=style]
Decode (demangle) low-level symbol names into user-level names. Besides removing any initial underscore prepended by the system, this makes C++ function names readable. Different compilers have different mangling styles. The optional demangling style argument can be used to choose an appropriate demangling style for your compiler. See Chapter 10 [c++filt], page 41, for more information on demangling.

-e filename
--exe=filename
Specify the name of the executable for which addresses should be translated. The default file is ‘a.out’.
-f    --functions
       Display function names as well as file and line number information.

-s    --basenames
       Display only the base of each file name.

-i    --inlines
       If the address belongs to a function that was inlined, the source information for
       all enclosing scopes back to the first non-inlined function will also be printed.
       For example, if main inlines callee1 which inlines callee2, and address is from
calleee2, the source information for callee1 and main will also be printed.

-j    --section
       Read offsets relative to the specified section instead of absolute addresses.
Chapter 12: nlmconv

12 nlmconv

nlmconv converts a relocatable object file into a NetWare Loadable Module.

Warning: nlmconv is not always built as part of the binary utilities, since it is only useful for NLM targets.

```
nlmconv ['-I' bfdname] ['-input-target=' bfdname]
[-O' bfdname] ['-output-target=' bfdname]
[-T' headerfile] ['-header-file=' headerfile]
[-d] ['-debug'] [-l linker] ['-linker=' linker]
[-h] ['-help'] ['-V'] ['-version']
infile outfile
```

nlmconv converts the relocatable ‘i386’ object file infile into the NetWare Loadable Module outfile, optionally reading headerfile for NLM header information. For instructions on writing the NLM command file language used in header files, see the ‘linkers’ section, ‘NMLINK’ in particular, of the NLM Development and Tools Overview, which is part of the NLM Software Developer’s Kit (“NLM SDK”), available from Novell, Inc. nlmconv uses the GNU Binary File Descriptor library to read infile; see Section “BFD” in Using LD, for more information.

nlmconv can perform a link step. In other words, you can list more than one object file for input if you list them in the definitions file (rather than simply specifying one input file on the command line). In this case, nlmconv calls the linker for you.

```
-I bfdname
--input-target=bfdname
```

Object format of the input file. nlmconv can usually determine the format of a given file (so no default is necessary). See Section 18.1 [Target Selection], page 64, for more information.

```
-O bfdname
--output-target=bfdname
```

Object format of the output file. nlmconv infers the output format based on the input format, e.g. for a ‘i386’ input file the output format is ‘nlm32-i386’. See Section 18.1 [Target Selection], page 64, for more information.

```
-T headerfile
--header-file=headerfile
```

Reads headerfile for NLM header information. For instructions on writing the NLM command file language used in header files, see see the ‘linkers’ section, of the NLM Development and Tools Overview, which is part of the NLM Software Developer’s Kit, available from Novell, Inc.

```
-d
--debug
```

Displays (on standard error) the linker command line used by nlmconv.

```
-l linker
--linker=linker
```

Use linker for any linking. linker can be an absolute or a relative pathname.

```
-h
--help
```

Prints a usage summary.
> -V
> --version
>
> Prints the version number for nlmconv.
13 windmc

windmc may be used to generator Windows message resources.

*Warning:* windmc is not always built as part of the binary utilities, since it is only useful for Windows targets.

```
windmc [options] input-file
```

windmc reads message definitions from an input file (.mc) and translate them into a set of output files. The output files may be of four kinds:

- **h** A C header file containing the message definitions.
- **rc** A resource file compilable by the windres tool.
- **bin** One or more binary files containing the resource data for a specific message language.
- **dbg** A C include file that maps message id’s to their symbolic name.

The exact description of these different formats is available in documentation from Microsoft.

When windmc converts from the mc format to the bin format, rc, h, and optional dbg it is acting like the Windows Message Compiler.

- **-a**
  --ascii_in
  Specifies that the input file specified is ANSI. This is the default behaviour.

- **-A**
  --ascii_out
  Specifies that messages in the output bin files should be in ANSI format.

- **-b**
  --binprefix
  Specifies that bin filenames should have to be prefixed by the basename of the source file.

- **-c**
  --customflag
  Sets the customer bit in all message id’s.

- **-C codepage**
  --codepage_in codepage
  Sets the default codepage to be used to convert input file to UTF16. The default is codepage 1252.

- **-d**
  --decimal_values
  Outputs the constants in the header file in decimal. Default is using hexadecimal output.

- **-e ext**
  --extension ext
  The extension for the header file. The default is .h extension.
-F target
   --target target
   Specify the BFD format to use for a bin file as output. This is a BFD target
   name; you can use the ‘--help’ option to see a list of supported targets. Nor-
   mally windmc will use the default format, which is the first one listed by the
   ‘--help’ option. Section 18.1 [Target Selection], page 64.

-h path
   --headerdir path
   The target directory of the generated header file. The default is the current
directory.

-H
   --help
   Displays a list of command line options and then exits.

-m characters
   --maxlength characters
   Instructs windmc to generate a warning if the length of any message exceeds
   the number specified.

-n
   --nullterminate
   Terminate message text in bin files by zero. By default they are terminated by
   CR/LF.

-o
   --hresult_use
   Not yet implemented. Instructs windmc to generate an OLE2 header file, using
   HRESULT definitions. Status codes are used if the flag is not specified.

-O codepage
   --codepage_out codepage
   Sets the default codepage to be used to output text files. The default is ocdepage
   1252.

-r path
   --rcdir path
   The target directory for the generated rc script and the generated bin files that
   the resource compiler script includes. The default is the current directory.

-u
   --unicode_in
   Specifies that the input file is UTF16.

-U
   --unicode_out
   Specifies that messages in the output bin file should be in UTF16 format. This
   is the default behaviour.

-v
   --verbose
   Enable verbose mode.
-V

--version

Prints the version number for windmc.

-x path
--xdgb path

The path of the dbg C include file that maps message id’s to the symbolic name. No such file is generated without specifying the switch.
14 windres

windres may be used to manipulate Windows resources.

Warning: windres is not always built as part of the binary utilities, since it is only useful for Windows targets.

windres [options] [input-file] [output-file]

windres reads resources from an input file and copies them into an output file. Either file may be in one of three formats:

rc A text format read by the Resource Compiler.
res A binary format generated by the Resource Compiler.
coff A COFF object or executable.

The exact description of these different formats is available in documentation from Microsoft.

When windres converts from the rc format to the res format, it is acting like the Windows Resource Compiler. When windres converts from the res format to the coff format, it is acting like the Windows CVTRES program.

When windres generates an rc file, the output is similar but not identical to the format expected for the input. When an input rc file refers to an external filename, an output rc file will instead include the file contents.

If the input or output format is not specified, windres will guess based on the file name, or, for the input file, the file contents. A file with an extension of ‘.rc’ will be treated as an rc file, a file with an extension of ‘.res’ will be treated as a res file, and a file with an extension of ‘.o’ or ‘.exe’ will be treated as a coff file.

If no output file is specified, windres will print the resources in rc format to standard output.

The normal use is for you to write an rc file, use windres to convert it to a COFF object file, and then link the COFF file into your application. This will make the resources described in the rc file available to Windows.

-i filename
--input filename

The name of the input file. If this option is not used, then windres will use the first non-option argument as the input file name. If there are no non-option arguments, then windres will read from standard input. windres can not read a COFF file from standard input.

-o filename
--output filename

The name of the output file. If this option is not used, then windres will use the first non-option argument, after any used for the input file name, as the output file name. If there is no non-option argument, then windres will write to standard output. windres can not write a COFF file to standard output. Note, for compatibility with rc the option ‘-fo’ is also accepted, but its use is not recommended.
-J format
--input-format format
    The input format to read. format may be 'res', 'rc', or 'coff'. If no input
    format is specified, windres will guess, as described above.

-O format
--output-format format
    The output format to generate. format may be 'res', 'rc', or 'coff'. If no
    output format is specified, windres will guess, as described above.

-F target
--target target
    Specify the BFD format to use for a COFF file as input or output. This is a
    BFD target name; you can use the '--help' option to see a list of supported
    targets. Normally windres will use the default format, which is the first one
    listed by the '--help' option. Section 18.1 [Target Selection], page 64.

--preprocessor program
    When windres reads an rc file, it runs it through the C preprocessor first. This
    option may be used to specify the preprocessor to use, including any leading
    arguments. The default preprocessor argument is gcc -E -xc-header -DRC_-
    INVOKED.

-I directory
--include-dir directory
    Specify an include directory to use when reading an rc file. windres will
    pass this to the preprocessor as an '-I' option. windres will also search this
    directory when looking for files named in the rc file. If the argument passed to
    this command matches any of the supported formats (as described in the '-J'
    option), it will issue a deprecation warning, and behave just like the '-J' option.
    New programs should not use this behaviour. If a directory happens to match
    a format, simple prefix it with './' to disable the backward compatibility.

-D target
--define sym [=val]
    Specify a '-D' option to pass to the preprocessor when reading an rc file.

-U target
--undefine sym
    Specify a '-U' option to pass to the preprocessor when reading an rc file.

-r
    Ignored for compatibility with rc.

-v
    Enable verbose mode. This tells you what the preprocessor is if you didn’t
    specify one.

-c val
--codepage val
    Specify the default codepage to use when reading an rc file. val should be
    a hexadecimal prefixed by '0x' or decimal codepage code. The valid range is
    from zero up to 0xffff, but the validity of the codepage is host and configuration
    dependent.
-l val
--language val
Specify the default language to use when reading an rc file. val should be a hexadecimal language code. The low eight bits are the language, and the high eight bits are the sublanguage.

--use-temp-file
Use a temporary file to instead of using popen to read the output of the preprocessor. Use this option if the popen implementation is buggy on the host (eg., certain non-English language versions of Windows 95 and Windows 98 are known to have buggy popen where the output will instead go the console).

--no-use-temp-file
Use popen, not a temporary file, to read the output of the preprocessor. This is the default behaviour.

-h
--help
Prints a usage summary.

-V
--version
Prints the version number for windres.

--yydebug
If windres is compiled with YYDEBUG defined as 1, this will turn on parser debugging.
15 dlltool

dlltool is used to create the files needed to create dynamic link libraries (DLLs) on systems which understand PE format image files such as Windows. A DLL contains an export table which contains information that the runtime loader needs to resolve references from a referencing program.

The export table is generated by this program by reading in a `.def` file or scanning the `.a` and `.o` files which will be in the DLL. A `.o` file can contain information in special `.drectve` sections with export information.

*Note:* dlltool is not always built as part of the binary utilities, since it is only useful for those targets which support DLLs.


dlltool reads its inputs, which can come from the `-d` and `-b` options as well as object files specified on the command line. It then processes these inputs and if the `-e` option has been specified it creates a exports file. If the `-l` option has been specified it creates a library file and if the `-z` option has been specified it creates a def file. Any or all of the `-e`, `-l` and `-z` options can be present in one invocation of dlltool.

When creating a DLL, along with the source for the DLL, it is necessary to have three other files. dlltool can help with the creation of these files.

The first file is a `.def` file which specifies which functions are exported from the DLL, which functions the DLL imports, and so on. This is a text file and can be created by hand, or dlltool can be used to create it using the `-z` option. In this case dlltool will scan the object files specified on its command line looking for those functions which have been specially marked as being exported and put entries for them in the `.def` file it creates.

In order to mark a function as being exported from a DLL, it needs to have an `'-export:<name_of_function>'` entry in the `.drectve` section of the object file. This can be done in C by using the asm() operator:

```c
asm (".section .drectve");
asm (".ascii "'-export:my_func'"");
```
int my_func (void) {... }

The second file needed for DLL creation is an exports file. This file is linked with the object files that make up the body of the DLL and it handles the interface between the DLL and the outside world. This is a binary file and it can be created by giving the ‘-e’ option to dlltool when it is creating or reading in a ‘.def’ file.

The third file needed for DLL creation is the library file that programs will link with in order to access the functions in the DLL (an ‘import library’). This file can be created by giving the ‘-l’ option to dlltool when it is creating or reading in a ‘.def’ file.

dlltool builds the library file by hand, but it builds the exports file by creating temporary files containing assembler statements and then assembling these. The ‘-S’ command line option can be used to specify the path to the assembler that dlltool will use, and the ‘-f’ option can be used to pass specific flags to that assembler. The ‘-n’ can be used to prevent dlltool from deleting these temporary assembler files when it is done, and if ‘-n’ is specified twice then this will prevent dlltool from deleting the temporary object files it used to build the library.

Here is an example of creating a DLL from a source file ‘dll.c’ and also creating a program (from an object file called ‘program.o’) that uses that DLL:

    gcc -c dll.c
    dlltool -e exports.o -l dll.lib dll.o
    gcc dll.o exports.o -o dll.dll
    gcc program.o dll.lib -o program

dlltool may also be used to query an existing import library to determine the name of the DLL to which it is associated. See the description of the ‘-I’ or ‘--identify’ option.

The command line options have the following meanings:

-d filename
--input-def filename
    Specifies the name of a ‘.def’ file to be read in and processed.

-b filename
--base-file filename
    Specifies the name of a base file to be read in and processed. The contents of this file will be added to the relocation section in the exports file generated by dlltool.

-e filename
--output-exp filename
    Specifies the name of the export file to be created by dlltool.

-z filename
--output-def filename
    Specifies the name of the ‘.def’ file to be created by dlltool.

-l filename
--output-lib filename
    Specifies the name of the library file to be created by dlltool.

--export-all-symbols
    Treat all global and weak defined symbols found in the input object files as symbols to be exported. There is a small list of symbols which are not exported
by default; see the ‘--no-default-excludes’ option. You may add to the list of symbols to not export by using the ‘--exclude-symbols’ option.

--no-export-all-symbols
Only export symbols explicitly listed in an input ‘.def’ file or in ‘.drectve’ sections in the input object files. This is the default behaviour. The ‘.drectve’ sections are created by ‘dllexport’ attributes in the source code.

--exclude-symbols list
Do not export the symbols in list. This is a list of symbol names separated by comma or colon characters. The symbol names should not contain a leading underscore. This is only meaningful when ‘--export-all-symbols’ is used.

--no-default-excludes
When ‘--export-all-symbols’ is used, it will by default avoid exporting certain special symbols. The current list of symbols to avoid exporting is ‘DllMain@12’, ‘DllEntryPoint@0’, ‘impure_ptr’. You may use the ‘--no-default-excludes’ option to go ahead and export these special symbols. This is only meaningful when ‘--export-all-symbols’ is used.

-S path
--as path
Specifies the path, including the filename, of the assembler to be used to create the exports file.

-f options
--as-flags options
Specifies any specific command line options to be passed to the assembler when building the exports file. This option will work even if the ‘-S’ option is not used. This option only takes one argument, and if it occurs more than once on the command line, then later occurrences will override earlier occurrences. So if it is necessary to pass multiple options to the assembler they should be enclosed in double quotes.

-D name
--dll-name name
Specifies the name to be stored in the ‘.def’ file as the name of the DLL when the ‘-e’ option is used. If this option is not present, then the filename given to the ‘-e’ option will be used as the name of the DLL.

-m machine
--machine machine
Specifies the type of machine for which the library file should be built. dlltool has a built in default type, depending upon how it was created, but this option can be used to override that. This is normally only useful when creating DLLs for an ARM processor, when the contents of the DLL are actually encode using Thumb instructions.
-a
--add-indirect
   Specifies that when dlltool is creating the exports file it should add a section which allows the exported functions to be referenced without using the import library. Whatever the hell that means!

-U
--add-underscore
   Specifies that when dlltool is creating the exports file it should prepend an underscore to the names of all exported symbols.

--add-stdcall-underscore
   Specifies that when dlltool is creating the exports file it should prepend an underscore to the names of exported stdcall functions. Variable names and non-stdcall function names are not modified. This option is useful when creating GNU-compatible import libs for third party DLLs that were built with MS-Windows tools.

-k
--kill-at
   Specifies that when dlltool is creating the exports file it should not append the string '@ <number>'. These numbers are called ordinal numbers and they represent another way of accessing the function in a DLL, other than by name.

-A
--add-stdcall-alias
   Specifies that when dlltool is creating the exports file it should add aliases for stdcall symbols without '@ <number>' in addition to the symbols with '@ <number>'.

-p
--ext-prefix-alias prefix
   Causes dlltool to create external aliases for all DLL imports with the specified prefix. The aliases are created for both external and import symbols with no leading underscore.

-x
--no-idata4
   Specifies that when dlltool is creating the exports and library files it should omit the .idata4 section. This is for compatibility with certain operating systems.

--use-nul-prefixed-import-tables
   Specifies that when dlltool is creating the exports and library files it should prefix the .idata4 and .idata5 by zero an element. This emulates old gnu import library generation of dlltool. By default this option is turned off.

-c
--no-idata5
   Specifies that when dlltool is creating the exports and library files it should omit the .idata5 section. This is for compatibility with certain operating systems.
-I filename
--identify filename
  Specifies that dlltool should inspect the import library indicated by filename and report, on stdout, the name(s) of the associated DLL(s). This can be performed in addition to any other operations indicated by the other options and arguments. dlltool fails if the import library does not exist or is not actually an import library. See also ‘--identify-strict’.

--identify-strict
  Modifies the behavior of the ‘--identify’ option, such that an error is reported if filename is associated with more than one DLL.

-i
--interwork
  Specifies that dlltool should mark the objects in the library file and exports file that it produces as supporting interworking between ARM and Thumb code.

-n
--nodelete
  Makes dlltool preserve the temporary assembler files it used to create the exports file. If this option is repeated then dlltool will also preserve the temporary object files it uses to create the library file.

-t prefix
--temp-prefix prefix
  Makes dlltool use prefix when constructing the names of temporary assembler and object files. By default, the temp file prefix is generated from the pid.

-v
--verbose
  Make dlltool describe what it is doing.

-h
--help
  Displays a list of command line options and then exits.

-V
--version
  Displays dlltool’s version number and then exits.

15.1 The format of the dlltool ‘.def’ file

A ‘.def’ file contains any number of the following commands:

NAME name [ , base ]
  The result is going to be named name.exe.

LIBRARY name [ , base ]
  The result is going to be named name.dll.

EXPORTS ( ( ( name1 [ = name2 ] ) | ( name1 = module-name . external-name ) )
[ integer ] [ NONAME ] [ CONSTANT ] [ DATA ] [ PRIVATE ] ) *
  Declares name1 as an exported symbol from the DLL, with optional ordinal number integer, or declares name1 as an alias (forward) of the function external-name in the DLL module-name.
IMPORTS ( ( internal-name = module-name . integer ) | [ internal-name = ]
module-name . external-name ) ) *

Declares that external-name or the exported function whose ordinal number
is integer is to be imported from the file module-name. If internal-name is
specified then this is the name that the imported function will be referred to in
the body of the DLL.

DESCRIPTION string

Puts string into the output ‘.exp’ file in the .rdata section.

STACKSIZE number-reserve [, number-commit ]

HEAPSIZE number-reserve [, number-commit ]

Generates --stack or --heap number-reserve,number-commit in the output
.drectve section. The linker will see this and act upon it.

CODE attr +

DATA attr +

SECTIONS ( section-name attr + ) *

Generates --attr section-name attr in the output .drectve section, where
attr is one of READ, WRITE, EXECUTE or SHARED. The linker will see this and act
upon it.
16 readelf

readelf ['-a'|'--all']
['-h'|'--file-header']
['-l'|'--program-headers']
['-S'|'--section-headers']
['-g'|'--section-groups']
['-t'|'--section-details']
['-e'|'--headers']
['-s'|'--syms'|'--symbols']
['-n'|'--notes']
['-r'|'--relocs']
['-u'|'--unwind']
['-V'|'--version-info']
['-A'|'--arch-specific']
['-D'|'--use-dynamic']
['-x '<number or name>']
['-p '<number or name>']
['-R '<number or name>']
['-c']
['-w[llIaprmfFsoR]']
['-I'|'-histogram']
['-v'|'--version']
['-W'|'--wide']
['-H'|'--help']
elffile...

readelf displays information about one or more ELF format object files. The options control what particular information to display.

efile... are the object files to be examined. 32-bit and 64-bit ELF files are supported, as are archives containing ELF files.

This program performs a similar function to objdump but it goes into more detail and it exists independently of the bfd library, so if there is a bug in bfd then readelf will not be affected.

The long and short forms of options, shown here as alternatives, are equivalent. At least one option besides ‘-v’ or ‘-H’ must be given.

-a

-h
--file-header

Displays the information contained in the ELF header at the start of the file.

-l
--program-headers
--segments

Displays the information contained in the file’s segment headers, if it has any.
-S  
--sections  
--section-headers  
Displays the information contained in the file’s section headers, if it has any.

-g  
--section-groups  
Displays the information contained in the file’s section groups, if it has any.

-t  
--section-details  
Displays the detailed section information. Implies ‘-S’.

-s  
--symbols  
--syms  
Displays the entries in symbol table section of the file, if it has one.

-e  
--headers  
Display all the headers in the file. Equivalent to ‘-h -l -S’.

-n  
--notes  
Displays the contents of the NOTE segments and/or sections, if any.

-r  
--relocs  
Displays the contents of the file’s relocation section, if it has one.

-u  
--unwind  
Displays the contents of the file’s unwind section, if it has one. Only the unwind sections for IA64 ELF files are currently supported.

-d  
--dynamic  
Displays the contents of the file’s dynamic section, if it has one.

-V  
--version-info  
Displays the contents of the version sections in the file, if they exist.

-A  
--arch-specific  
Displays architecture-specific information in the file, if there is any.

-D  
--use-dynamic  
When displaying symbols, this option makes readelf use the symbol table in the file’s dynamic section, rather than the one in the symbols section.

-x <number or name>  
--hex-dump=<number or name>  
Displays the contents of the indicated section as a hexadecimal bytes. A number identifies a particular section by index in the section table; any other string identifies all sections with that name in the object file.
-R <number or name>
--relocated-dump=<number or name>
Displays the contents of the indicated section as a hexadecimal bytes. A number identifies a particular section by index in the section table; any other string identifies all sections with that name in the object file. The contents of the section will be relocated before they are displayed.

-p <number or name>
--string-dump=<number or name>
Displays the contents of the indicated section as printable strings. A number identifies a particular section by index in the section table; any other string identifies all sections with that name in the object file.

-c
--archive-index
Displays the file symbol index information contained in the header part of binary archives. Performs the same function as the ‘t’ command to ar, but without using the BFD library. See Chapter 1 [ar], page 2.

-w[lLiaprmfFsoR]
--debug-dump[=rawline,=decodedline,=info,=abbrev,=pubnames,=aranges,=macro,=frames,=frames-interp,=str,=loc,=Ranges]
Displays the contents of the debug sections in the file, if any are present. If one of the optional letters or words follows the switch then only data found in those specific sections will be dumped.
Note: the ‘=decodedline’ option will display the interpreted contents of a .debug_line section whereas the ‘=rawline’ option dumps the contents in a raw format.

-I
--histogram
Display a histogram of bucket list lengths when displaying the contents of the symbol tables.

-v
--version
Display the version number of readelf.

-W
--wide
Don’t break output lines to fit into 80 columns. By default readelf breaks section header and segment listing lines for 64-bit ELF files, so that they fit into 80 columns. This option causes readelf to print each section header resp. each segment one a single line, which is far more readable on terminals wider than 80 columns.

-H
--help
Display the command line options understood by readelf.
17 Common Options

The following command-line options are supported by all of the programs described in this manual.

@file Read command-line options from file. The options read are inserted in place of the original @file option. If file does not exist, or cannot be read, then the option will be treated literally, and not removed.

Options in file are separated by whitespace. A whitespace character may be included in an option by surrounding the entire option in either single or double quotes. Any character (including a backslash) may be included by prefixing the character to be included with a backslash. The file may itself contain additional @file options; any such options will be processed recursively.

--help Display the command-line options supported by the program.

--version Display the version number of the program.
Chapter 18: Selecting the Target System

18 Selecting the Target System

You can specify two aspects of the target system to the GNU binary file utilities, each in several ways:

- the target
- the architecture

In the following summaries, the lists of ways to specify values are in order of decreasing precedence. The ways listed first override those listed later.

The commands to list valid values only list the values for which the programs you are running were configured. If they were configured with `--enable-targets=all`, the commands list most of the available values, but a few are left out; not all targets can be configured in at once because some of them can only be configured native (on hosts with the same type as the target system).

18.1 Target Selection

A target is an object file format. A given target may be supported for multiple architectures (see Section 18.2 [Architecture Selection], page 65). A target selection may also have variations for different operating systems or architectures.

The command to list valid target values is `objdump -i` (the first column of output contains the relevant information).

Some sample values are: `a.out-hp300bsd`, `ecoff-littlemips`, `a.out-sunos-big`.

You can also specify a target using a configuration triplet. This is the same sort of name that is passed to `configure` to specify a target. When you use a configuration triplet as an argument, it must be fully canonicalized. You can see the canonical version of a triplet by running the shell script `config.sub` which is included with the sources.

Some sample configuration triplets are: `m68k-hp-bsd`, `mips-dec-ultrix`, `sparc-sun-sunos`.

objdump Target

Ways to specify:

1. command line option: `-b` or `--target`
2. environment variable GNUTARGET
3. deduced from the input file

objcopy and strip Input Target

Ways to specify:

1. command line options: `-I` or `--input-target`, or `-F` or `--target`
2. environment variable GNUTARGET
3. deduced from the input file
objcopy and strip Output Target

Ways to specify:
1. command line options: ‘-O’ or ‘--output-target’, or ‘-F’ or ‘--target’
2. the input target (see “objcopy and strip Input Target” above)
3. environment variable GNUTARGET
4. deduced from the input file

nm, size, and strings Target

Ways to specify:
1. command line option: ‘--target’
2. environment variable GNUTARGET
3. deduced from the input file

18.2 Architecture Selection

An architecture is a type of CPU on which an object file is to run. Its name may contain a colon, separating the name of the processor family from the name of the particular CPU.

The command to list valid architecture values is ‘objdump -i’ (the second column contains the relevant information).


objdump Architecture

Ways to specify:
1. command line option: ‘-m’ or ‘--architecture’
2. deduced from the input file

objcopy, nm, size, strings Architecture

Ways to specify:
1. deduced from the input file
19 Reporting Bugs

Your bug reports play an essential role in making the binary utilities reliable.

Reporting a bug may help you by bringing a solution to your problem, or it may not. But in any case the principal function of a bug report is to help the entire community by making the next version of the binary utilities work better. Bug reports are your contribution to their maintenance.

In order for a bug report to serve its purpose, you must include the information that enables us to fix the bug.

19.1 Have You Found a Bug?

If you are not sure whether you have found a bug, here are some guidelines:

• If a binary utility gets a fatal signal, for any input whatever, that is a bug. Reliable utilities never crash.
• If a binary utility produces an error message for valid input, that is a bug.
• If you are an experienced user of binary utilities, your suggestions for improvement are welcome in any case.

19.2 How to Report Bugs

A number of companies and individuals offer support for GNU products. If you obtained the binary utilities from a support organization, we recommend you contact that organization first.

You can find contact information for many support companies and individuals in the file ‘etc/SERVICE’ in the GNU Emacs distribution.

In any event, we also recommend that you send bug reports for the binary utilities to https://support.codesourcery.com/GNUToolchain/.

The fundamental principle of reporting bugs usefully is this: report all the facts. If you are not sure whether to state a fact or leave it out, state it!

Often people omit facts because they think they know what causes the problem and assume that some details do not matter. Thus, you might assume that the name of a file you use in an example does not matter. Well, probably it does not, but one cannot be sure. Perhaps the bug is a stray memory reference which happens to fetch from the location where that pathname is stored in memory; perhaps, if the pathname were different, the contents of that location would fool the utility into doing the right thing despite the bug. Play it safe and give a specific, complete example. That is the easiest thing for you to do, and the most helpful.

Keep in mind that the purpose of a bug report is to enable us to fix the bug if it is new to us. Therefore, always write your bug reports on the assumption that the bug has not been reported previously.

Sometimes people give a few sketchy facts and ask, “Does this ring a bell?” This cannot help us fix a bug, so it is basically useless. We respond by asking for enough details to enable us to investigate. You might as well expedite matters by sending them to begin with.

To enable us to fix the bug, you should include all these things:
• The version of the utility. Each utility announces it if you start it with the `--version` argument.

Without this, we will not know whether there is any point in looking for the bug in the current version of the binary utilities.

• Any patches you may have applied to the source, including any patches made to the BFD library.

• The type of machine you are using, and the operating system name and version number.

• What compiler (and its version) was used to compile the utilities—e.g. “gcc-2.7”.

• The command arguments you gave the utility to observe the bug. To guarantee you will not omit something important, list them all. A copy of the Makefile (or the output from make) is sufficient. If we were to try to guess the arguments, we would probably guess wrong and then we might not encounter the bug.

• A complete input file, or set of input files, that will reproduce the bug. If the utility is reading an object file or files, then it is generally most helpful to send the actual object files.

If the source files were produced exclusively using GNU programs (e.g., gcc, gas, and/or the GNU ld), then it may be OK to send the source files rather than the object files. In this case, be sure to say exactly what version of gcc, or whatever, was used to produce the object files. Also say how gcc, or whatever, was configured.

• A description of what behavior you observe that you believe is incorrect. For example, “It gets a fatal signal.”

Of course, if the bug is that the utility gets a fatal signal, then we will certainly notice it. But if the bug is incorrect output, we might not notice unless it is glaringly wrong. You might as well not give us a chance to make a mistake.

Even if the problem you experience is a fatal signal, you should still say so explicitly. Suppose something strange is going on, such as your copy of the utility is out of sync, or you have encountered a bug in the C library on your system. (This has happened!) Your copy might crash and ours would not. If you told us to expect a crash, then when ours fails to crash, we would know that the bug was not happening for us. If you had not told us to expect a crash, then we would not be able to draw any conclusion from our observations.

• If you wish to suggest changes to the source, send us context diffs, as generated by `diff` with the `'-u'`, `'-c'`, or `'-p'` option. Always send diffs from the old file to the new file. If you wish to discuss something in the ld source, refer to it by context, not by line number.

The line numbers in our development sources will not match those in your sources. Your line numbers would convey no useful information to us.

Here are some things that are not necessary:

• A description of the envelope of the bug.

Often people who encounter a bug spend a lot of time investigating which changes to the input file will make the bug go away and which changes will not affect it.
This is often time consuming and not very useful, because the way we will find the bug is by running a single example under the debugger with breakpoints, not by pure deduction from a series of examples. We recommend that you save your time for something else.

Of course, if you can find a simpler example to report instead of the original one, that is a convenience for us. Errors in the output will be easier to spot, running under the debugger will take less time, and so on.

However, simplification is not vital; if you do not want to do this, report the bug anyway and send us the entire test case you used.

- A patch for the bug.

A patch for the bug does help us if it is a good one. But do not omit the necessary information, such as the test case, on the assumption that a patch is all we need. We might see problems with your patch and decide to fix the problem another way, or we might not understand it at all.

Sometimes with programs as complicated as the binary utilities it is very hard to construct an example that will make the program follow a certain path through the code. If you do not send us the example, we will not be able to construct one, so we will not be able to verify that the bug is fixed.

And if we cannot understand what bug you are trying to fix, or why your patch should be an improvement, we will not install it. A test case will help us to understand.

- A guess about what the bug is or what it depends on.

Such guesses are usually wrong. Even we cannot guess right about such things without first using the debugger to find the facts.
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