

find

COLLABORATORS

	TITLE : find		
ACTION	NAME	DATE	SIGNATURE
WRITTEN BY		December 7, 2024	

REVISION HISTORY

NUMBER	DATE	DESCRIPTION	NAME

Contents

1	find	1
1.1	find.guide	1
1.2	find.guide/Introduction	1
1.3	find.guide/Scope	2
1.4	find.guide/Overview	3
1.5	find.guide/find Expressions	4
1.6	find.guide/Finding Files	5
1.7	find.guide/Name	5
1.8	find.guide/Base Name Patterns	5
1.9	find.guide/Full Name Patterns	6
1.10	find.guide/Fast Full Name Search	6
1.11	find.guide/Shell Pattern Matching	7
1.12	find.guide/Links	8
1.13	find.guide/Symbolic Links	8
1.14	find.guide/Hard Links	9
1.15	find.guide/Time	9
1.16	find.guide/Age Ranges	10
1.17	find.guide/Comparing Timestamps	10
1.18	find.guide/Size	11
1.19	find.guide/Type	12
1.20	find.guide/Owner	12
1.21	find.guide/Permissions	13
1.22	find.guide/Contents	13
1.23	find.guide/Directories	14
1.24	find.guide/Filesystems	15
1.25	find.guide/Combining Primaries With Operators	15
1.26	find.guide/Actions	16
1.27	find.guide/Print File Name	17
1.28	find.guide/Print File Information	17
1.29	find.guide/Escapes	18

1.30	find.guide/Format Directives	19
1.31	find.guide/Name Directives	19
1.32	find.guide/Ownership Directives	20
1.33	find.guide/Size Directives	20
1.34	find.guide/Location Directives	20
1.35	find.guide/Time Directives	21
1.36	find.guide/Time Formats	21
1.37	find.guide/Time Components	22
1.38	find.guide/Date Components	22
1.39	find.guide/Combined Time Formats	23
1.40	find.guide/Run Commands	24
1.41	find.guide/Single File	24
1.42	find.guide/Multiple Files	25
1.43	find.guide/Unsafe File Name Handling	25
1.44	find.guide/Safe File Name Handling	26
1.45	find.guide/Limiting Command Size	27
1.46	find.guide/Interspersing File Names	27
1.47	find.guide/Querying	28
1.48	find.guide/Adding Tests	28
1.49	find.guide/Common Tasks	29
1.50	find.guide/Viewing And Editing	30
1.51	find.guide/Archiving	30
1.52	find.guide/Cleaning Up	31
1.53	find.guide/Strange File Names	32
1.54	find.guide/Fixing Permissions	32
1.55	find.guide/Classifying Files	33
1.56	find.guide/Databases	33
1.57	find.guide/Database Locations	34
1.58	find.guide/Database Formats	34
1.59	find.guide/New Database Format	35
1.60	find.guide/Sample Database	35
1.61	find.guide/Old Database Format	36
1.62	find.guide/File Permissions	36
1.63	find.guide/Mode Structure	37
1.64	find.guide/Symbolic Modes	38
1.65	find.guide/Setting Permissions	38
1.66	find.guide/Copying Permissions	40
1.67	find.guide/Changing Special Permissions	40
1.68	find.guide/Conditional Executability	41

1.69	find.guide/Multiple Changes	42
1.70	find.guide/Umask and Protection	43
1.71	find.guide/Numeric Modes	43
1.72	find.guide/Reference	44
1.73	find.guide/Invoking find	44
1.74	find.guide/Invoking locate	45
1.75	find.guide/Invoking updatedb	45
1.76	find.guide/Invoking xargs	46
1.77	find.guide/Primary Index	48

Chapter 1

find

1.1 find.guide

This file documents the GNU utilities for finding files that match certain criteria and performing various actions on them. This is edition 1.1, for find version 4.1.

Introduction	Summary of the tasks this manual describes.
Finding Files	Finding files that match certain criteria.
Actions	Doing things to files you have found.
Common Tasks	Solutions to common real-world problems.
Databases	Maintaining file name databases.
File Permissions	How to control access to files.
Reference	Summary of how to invoke the programs.
Primary Index	The components of find expressions.

1.2 find.guide/Introduction

Introduction

This manual shows how to find files that meet criteria you specify, and how to perform various actions on the files that you find. The principal programs that you use to perform these tasks are find, locate, and xargs. Some of the examples in this manual use capabilities specific to the GNU versions of those programs.

GNU find was originally written by Eric Decker, with enhancements by David MacKenzie, Jay Plett, and Tim Wood. GNU xargs was originally written by Mike Rendell, with enhancements by David MacKenzie. GNU locate and its associated utilities were originally written by James Woods, with enhancements by David MacKenzie. The idea for find -print0 and xargs -0 came from Dan Bernstein. Many other people have contributed bug fixes, small improvements, and helpful suggestions. Thanks!

Mail suggestions and bug reports for these programs to bug-gnu-utils@prep.ai.mit.edu. Please include the version number, which you can get by running `find --version`.

Scope
Overview
find Expressions

1.3 find.guide/Scope

Scope
=====

For brevity, the word file in this manual means a regular file, a directory, a symbolic link, or any other kind of node that has a directory entry. A directory entry is also called a file name. A file name may contain some, all, or none of the directories in a path that leads to the file. These are all examples of what this manual calls "file names":

```
parser.c
README
./budget/may-94.sc
fred/.cshrc
/usr/local/include/termcap.h
```

A directory tree is a directory and the files it contains, all of its subdirectories and the files they contain, etc. It can also be a single non-directory file.

These programs enable you to find the files in one or more directory trees that:

- * have names that contain certain text or match a certain pattern;
 - * are links to certain files;
 - * were last used during a certain period of time;
 - * are within a certain size range;
 - * are of a certain type (regular file, directory, symbolic link, etc.);
 - * are owned by a certain user or group;
 - * have certain access permissions;
 - * contain text that matches a certain pattern;
 - * are within a certain depth in the directory tree;
 - * or some combination of the above.
-

Once you have found the files you're looking for (or files that are potentially the ones you're looking for), you can do more to them than simply list their names. You can get any combination of the files' attributes, or process the files in many ways, either individually or in groups of various sizes. Actions that you might want to perform on the files you have found include, but are not limited to:

- * view or edit
- * store in an archive
- * remove or rename
- * change access permissions
- * classify into groups

This manual describes how to perform each of those tasks, and more.

1.4 find.guide/Overview

Overview

=====

The principal programs used for making lists of files that match given criteria and running commands on them are `find`, `locate`, and `xargs`. An additional command, `updatedb`, is used by system administrators to create databases for `locate` to use.

`find` searches for files in a directory hierarchy and prints information about the files it found. It is run like this:

```
find [FILE...] [EXPRESSION]
```

Here is a typical use of `find`. This example prints the names of all files in the directory tree rooted in `/usr/src` whose name ends with `.c` and that are larger than 100 Kilobytes.

```
find /usr/src -name '*.c' -size +100k -print
```

`locate` searches special file name databases for file names that match patterns. The system administrator runs the `updatedb` program to create the databases. `locate` is run like this:

```
locate [OPTION...] PATTERN...
```

This example prints the names of all files in the default file name database whose name ends with `Makefile` or `makefile`. Which file names are stored in the database depends on how the system administrator ran `updatedb`.

```
locate '[Mm]akefile'
```

The name `xargs`, pronounced EX-args, means "combine arguments." `xargs` builds and executes command lines by gathering together arguments it

reads on the standard input. Most often, these arguments are lists of file names generated by find. xargs is run like this:

```
xargs [OPTION...] [COMMAND [INITIAL-ARGUMENTS]]
```

The following command searches the files listed in the file file-list and prints all of the lines in them that contain the word typedef.

```
xargs grep typedef < file-list
```

1.5 find.guide/find Expressions

find Expressions

=====

The expression that find uses to select files consists of one or more primaries, each of which is a separate command line argument to find. find evaluates the expression each time it processes a file. An expression can contain any of the following types of primaries:

options

affect overall operation rather than the processing of a specific file;

tests

return a true or false value, depending on the file's attributes;

actions

have side effects and return a true or false value; and

operators

connect the other arguments and affect when and whether they are evaluated.

You can omit the operator between two primaries; it defaults to -and. See Combining Primaries With Operators, for ways to connect primaries into more complex expressions. If the expression contains no actions other than -prune, -print is performed on all files for which the entire expression is true (see Print File Name).

Options take effect immediately, rather than being evaluated for each file when their place in the expression is reached. Therefore, for clarity, it is best to place them at the beginning of the expression.

Many of the primaries take arguments, which immediately follow them in the next command line argument to find. Some arguments are file names, patterns, or other strings; others are numbers. Numeric arguments can be specified as

+N

for greater than N,

-N

for less than N,

N
for exactly N.

1.6 find.guide/Finding Files

Finding Files

By default, find prints to the standard output the names of the files that match the given criteria. See Actions, for how to get more information about the matching files.

Name
Links
Time
Size
Type
Owner
Permissions
Contents
Directories
Filesystems
Combining Primaries With Operators

1.7 find.guide/Name

Name
====

Here are ways to search for files whose name matches a certain pattern. See Shell Pattern Matching, for a description of the PATTERN arguments to these tests.

Each of these tests has a case-sensitive version and a case-insensitive version, whose name begins with i. In a case-insensitive comparison, the patterns fo* and F?? match the file names Foo, FOO, foo, fOo, etc.

Base Name Patterns
Full Name Patterns
Fast Full Name Search
Shell Pattern Matching Wildcards used by these programs.

1.8 find.guide/Base Name Patterns

Base Name Patterns

- Test: -name PATTERN
- Test: -iname PATTERN
 - True if the base of the file name (the path with the leading directories removed) matches shell pattern PATTERN. For -iname, the match is case-insensitive. To ignore a whole directory tree, use -prune (see Directories). As an example, to find Texinfo source files in /usr/local/doc:

```
find /usr/local/doc -name '*.texi'
```

1.9 find.guide/Full Name Patterns

Full Name Patterns

- Test: -path PATTERN
- Test: -ipath PATTERN
 - True if the entire file name, starting with the command line argument under which the file was found, matches shell pattern PATTERN. For -ipath, the match is case-insensitive. To ignore a whole directory tree, use -prune rather than checking every file in the tree (see Directories).
- Test: -regex EXPR
- Test: -iregex EXPR
 - True if the entire file name matches regular expression EXPR. This is a match on the whole path, not a search. For example, to match a file named ./fubar3, you can use the regular expression .*bar. or .*b.*3, but not b.*r3. See Syntax of Regular Expressions, for a description of the syntax of regular expressions. For -iregex, the match is case-insensitive.

1.10 find.guide/Fast Full Name Search

Fast Full Name Search

To search for files by name without having to actually scan the directories on the disk (which can be slow), you can use the locate program. For each shell pattern you give it, locate searches one or more databases of file names and displays the file names that contain the pattern. See Shell Pattern Matching, for details about shell patterns.

If a pattern is a plain string--it contains no metacharacters--locate displays all file names in the database

that contain that string. If a pattern contains metacharacters, locate only displays file names that match the pattern exactly. As a result, patterns that contain metacharacters should usually begin with a *, and will most often end with one as well. The exceptions are patterns that are intended to explicitly match the beginning or end of a file name.

The command
locate PATTERN

is almost equivalent to
find DIRECTORIES -name PATTERN

where DIRECTORIES are the directories for which the file name databases contain information. The differences are that the locate information might be out of date, and that locate handles wildcards in the pattern slightly differently than find (see Shell Pattern Matching).

The file name databases contain lists of files that were on the system when the databases were last updated. The system administrator can choose the file name of the default database, the frequency with which the databases are updated, and the directories for which they contain entries.

Here is how to select which file name databases locate searches. The default is system-dependent.

--database=PATH
-d PATH

Instead of searching the default file name database, search the file name databases in PATH, which is a colon-separated list of database file names. You can also use the environment variable LOCATE_PATH to set the list of database files to search. The option overrides the environment variable if both are used.

1.11 find.guide/Shell Pattern Matching

Shell Pattern Matching

find and locate can compare file names, or parts of file names, to shell patterns. A shell pattern is a string that may contain the following special characters, which are known as wildcards or metacharacters.

You must quote patterns that contain metacharacters to prevent the shell from expanding them itself. Double and single quotes both work; so does escaping with a backslash.

*
Matches any zero or more characters.

?
Matches any one character.

[STRING]

Matches exactly one character that is a member of the string STRING. This is called a character class. As a shorthand, STRING may contain ranges, which consist of two characters with a dash between them. For example, the class [a-z0-9_] matches a lowercase letter, a number, or an underscore. You can negate a class by placing a ! or ^ immediately after the opening bracket. Thus, [^A-Z@] matches any character except an uppercase letter or an at sign.

\

Removes the special meaning of the character that follows it. This works even in character classes.

In the find tests that do shell pattern matching (-name, -path, etc.), wildcards in the pattern do not match a . at the beginning of a file name. This is not the case for locate. Thus, find -name '*macs' does not match a file named .emacs, but locate '*macs' does.

Slash characters have no special significance in the shell pattern matching that find and locate do, unlike in the shell, in which wildcards do not match them. Therefore, a pattern foo*bar can match a file name foo3/bar, and a pattern ./sr*sc can match a file name ./src/misc.

1.12 find.guide/Links

Links
=====

There are two ways that files can be linked together. Symbolic links are a special type of file whose contents are a portion of the name of another file. Hard links are multiple directory entries for one file; the file names all have the same index node (inode) number on the disk.

Symbolic Links
Hard Links

1.13 find.guide/Symbolic Links

Symbolic Links

- Test: -lname PATTERN
- Test: -ilname PATTERN

True if the file is a symbolic link whose contents match shell pattern PATTERN. For -ilname, the match is case-insensitive. See Shell Pattern Matching, for details about the PATTERN argument.

So, to list any symbolic links to `sysdep.c` in the current directory and its subdirectories, you can do:

```
find . -lname '*sysdep.c'
```

- Option: `-follow`

Dereference symbolic links. The following differences in behavior occur when this option is given:

- * `find` follows symbolic links to directories when searching directory trees.
- * `-lname` and `-ilname` always return false.
- * `-type` reports the types of the files that symbolic links point to.
- * Implies `-noleaf` (see Directories).

1.14 find.guide/Hard Links

Hard Links

To find hard links, first get the inode number of the file whose links you want to find. You can learn a file's inode number and the number of links to it by running `ls -li` or `find -ls`. If the file has more than one link, you can search for the other links by passing that inode number to `-inum`. Add the `-xdev` option if you are starting the search at a directory that has other filesystems mounted on it, such as `/usr` on many systems. Doing this saves needless searching, since hard links to a file must be on the same filesystem. See Filesystems.

- Test: `-inum N`
File has inode number N.

You can also search for files that have a certain number of links, with `-links`. Directories normally have at least two hard links; their `.` entry is the second one. If they have subdirectories, each of those also has a hard link called `..` to its parent directory.

- Test: `-links N`
File has N hard links.

1.15 find.guide/Time

Time

====

Each file has three time stamps, which record the last time that

certain operations were performed on the file:

1. access (read the file's contents)
2. change the status (modify the file or its attributes)
3. modify (change the file's contents)

You can search for files whose time stamps are within a certain age range, or compare them to other time stamps.

Age Ranges

Comparing Timestamps

1.16 find.guide/Age Ranges

Age Ranges

These tests are mainly useful with ranges (+N and -N).

- Test: -atime N
- Test: -ctime N
- Test: -mtime N

True if the file was last accessed (or its status changed, or it was modified) N*24 hours ago.

- Test: -amin N
- Test: -cmin N
- Test: -mmin N

True if the file was last accessed (or its status changed, or it was modified) N minutes ago. These tests provide finer granularity of measurement than -atime et al. For example, to list files in /u/bill that were last read from 2 to 6 hours ago:

```
find /u/bill -amin +2 -amin -6
```

- Option: -daystart

Measure times from the beginning of today rather than from 24 hours ago. So, to list the regular files in your home directory that were modified yesterday, do

```
find ~ -daystart -type f -mtime 1
```

1.17 find.guide/Comparing Timestamps

Comparing Timestamps

As an alternative to comparing timestamps to the current time, you can compare them to another file's timestamp. That file's timestamp could be updated by another program when some event occurs. Or you could set it to a particular fixed date using the touch command. For example, to list files in /usr modified after February 1 of the current year:

```
touch -t 02010000 /tmp/stamp$$
find /usr -newer /tmp/stamp$$
rm -f /tmp/stamp$$
```

- Test: -anewer FILE
- Test: -cnewer FILE
- Test: -newer FILE

True if the file was last accessed (or its status changed, or it was modified) more recently than FILE was modified. These tests are affected by -follow only if -follow comes before them on the command line. See Symbolic Links, for more information on -follow. As an example, to list any files modified since /bin/sh was last modified:

```
find . -newer /bin/sh
```

- Test: -used N
True if the file was last accessed N days after its status was last changed. Useful for finding files that are not being used, and could perhaps be archived or removed to save disk space.

1.18 find.guide/Size

Size
====

- Test: -size N[BCKW]
True if the file uses N units of space, rounding up. The units are 512-byte blocks by default, but they can be changed by adding a one-character suffix to N:

b	512-byte blocks
c	bytes
k	kilobytes (1024 bytes)
w	2-byte words

The size does not count indirect blocks, but it does count blocks in sparse files that are not actually allocated.

- Test: -empty
-

True if the file is empty and is either a regular file or a directory. This might make it a good candidate for deletion. This test is useful with `-depth` (see Directories) and `-exec rm -rf '{}'` (see Single File).

1.19 find.guide/Type

Type

====

- Test: `-type C`
True if the file is of type C:
 - b
block (buffered) special
 - c
character (unbuffered) special
 - d
directory
 - p
named pipe (FIFO)
 - f
regular file
 - l
symbolic link
 - s
socket
- Test: `-xtype C`
The same as `-type` unless the file is a symbolic link. For symbolic links: if `-follow` has not been given, true if the file is a link to a file of type C; if `-follow` has been given, true if C is l. In other words, for symbolic links, `-xtype` checks the type of the file that `-type` does not check. See Symbolic Links, for more information on `-follow`.

1.20 find.guide/Owner

Owner

=====

- Test: `-user UNAME`
- Test: `-group GNAME`
True if the file is owned by user UNAME (belongs to group GNAME).

A numeric ID is allowed.

- Test: -uid N
- Test: -gid N
True if the file's numeric user ID (group ID) is N. These tests support ranges (+N and -N), unlike -user and -group.
- Test: -nouser
- Test: -nogroup
True if no user corresponds to the file's numeric user ID (no group corresponds to the numeric group ID). These cases usually mean that the files belonged to users who have since been removed from the system. You probably should change the ownership of such files to an existing user or group, using the chown or chgrp program.

1.21 find.guide/Permissions

Permissions
=====

See File Permissions, for information on how file permissions are structured and how to specify them.

- Test: -perm MODE
True if the file's permissions are exactly MODE (which can be numeric or symbolic). Symbolic modes use mode 0 as a point of departure. If MODE starts with -, true if all of the permissions set in MODE are set for the file; permissions not set in MODE are ignored. If MODE starts with +, true if any of the permissions set in MODE are set for the file; permissions not set in MODE are ignored.

1.22 find.guide/Contents

Contents
=====

To search for files based on their contents, you can use the grep program. For example, to find out which C source files in the current directory contain the string thing, you can do:

```
grep -l thing *.*[ch]
```

If you also want to search for the string in files in subdirectories, you can combine grep with find and xargs, like this:

```
find . -name '*.[ch]' | xargs grep -l thing
```

The -l option causes grep to print only the names of files that

contain the string, rather than the lines that contain it. The string argument (thing) is actually a regular expression, so it can contain metacharacters. This method can be refined a little by using the `-r` option to make xargs not run grep if find produces no output, and using the find action `-print0` and the xargs option `-0` to avoid misinterpreting files whose names contain spaces:

```
find . -name '*.ch' -print0 | xargs -r -0 grep -l thing
```

For a fuller treatment of finding files whose contents match a pattern, see the manual page for grep.

1.23 find.guide/Directories

Directories
=====

Here is how to control which directories find searches, and how it searches them. These two options allow you to process a horizontal slice of a directory tree.

- Option: `-maxdepth LEVELS`
Descend at most LEVELS (a non-negative integer) levels of directories below the command line arguments. `-maxdepth 0` means only apply the tests and actions to the command line arguments.
- Option: `-mindepth LEVELS`
Do not apply any tests or actions at levels less than LEVELS (a non-negative integer). `-mindepth 1` means process all files except the command line arguments.
- Option: `-depth`
Process each directory's contents before the directory itself. Doing this is a good idea when producing lists of files to archive with cpio or tar. If a directory does not have write permission for its owner, its contents can still be restored from the archive since the directory's permissions are restored after its contents.
- Action: `-prune`
If `-depth` is not given, true; do not descend the current directory. If `-depth` is given, false; no effect. `-prune` only affects tests and actions that come after it in the expression, not those that come before.

For example, to skip the directory `src/emacs` and all files and directories under it, and print the names of the other files found:

```
find . -path './src/emacs' -prune -o -print
```

- Option: `-noleaf`
Do not optimize by assuming that directories contain 2 fewer subdirectories than their hard link count. This option is needed when searching filesystems that do not follow the Unix directory-link convention, such as CD-ROM or MS-DOS filesystems or

AFS volume mount points. Each directory on a normal Unix filesystem has at least 2 hard links: its name and its `.` entry. Additionally, its subdirectories (if any) each have a `..` entry linked to that directory. When `find` is examining a directory, after it has stat'd 2 fewer subdirectories than the directory's link count, it knows that the rest of the entries in the directory are non-directories (leaf files in the directory tree). If only the files' names need to be examined, there is no need to stat them; this gives a significant increase in search speed.

1.24 find.guide/Filesystems

Filesystems
=====

A filesystem is a section of a disk, either on the local host or mounted from a remote host over a network. Searching network filesystems can be slow, so it is common to make `find` avoid them.

There are two ways to avoid searching certain filesystems. One way is to tell `find` to only search one filesystem:

- Option: `-xdev`
 - Option: `-mount`
- Don't descend directories on other filesystems. These options are synonyms.

The other way is to check the type of filesystem each file is on, and not descend directories that are on undesirable filesystem types:

- Test: `-fstype TYPE`
- True if the file is on a filesystem of type `TYPE`. The valid filesystem types vary among different versions of Unix; an incomplete list of filesystem types that are accepted on some version of Unix or another is:
- ufs 4.2 4.3 nfs tmp mfs S51K S52K
- You can use `-printf` with the `%F` directive to see the types of your filesystems. See Print File Information. `-fstype` is usually used with `-prune` to avoid searching remote filesystems (see Directories).

1.25 find.guide/Combining Primaries With Operators

Combining Primaries With Operators
=====

Operators build a complex expression from tests and actions. The operators are, in order of decreasing precedence:

(`EXPR`)

Force precedence. True if `EXPR` is true.

`! EXPR`

`-not EXPR`

True if `EXPR` is false.

`EXPR1 EXPR2`

`EXPR1 -a EXPR2`

`EXPR1 -and EXPR2`

And; `EXPR2` is not evaluated if `EXPR1` is false.

`EXPR1 -o EXPR2`

`EXPR1 -or EXPR2`

Or; `EXPR2` is not evaluated if `EXPR1` is true.

`EXPR1 , EXPR2`

List; both `EXPR1` and `EXPR2` are always evaluated. True if `EXPR2` is true. The value of `EXPR1` is discarded. This operator lets you do multiple independent operations on one traversal, without depending on whether other operations succeeded.

`find` searches the directory tree rooted at each file name by evaluating the expression from left to right, according to the rules of precedence, until the outcome is known (the left hand side is false for `-and`, true for `-or`), at which point `find` moves on to the next file name.

There are two other tests that can be useful in complex expressions:

- Test: `-true`

Always true.

- Test: `-false`

Always false.

1.26 find.guide/Actions

Actions

There are several ways you can print information about the files that match the criteria you gave in the `find` expression. You can print the information either to the standard output or to a file that you name. You can also execute commands that have the file names as arguments. You can use those commands as further filters to select files.

Print File Name

Print File Information

Run Commands

Adding Tests

1.27 find.guide/Print File Name

Print File Name

=====

- Action: `-print`
True; print the full file name on the standard output, followed by a newline.
- Action: `-fprint FILE`
True; print the full file name into file FILE, followed by a newline. If FILE does not exist when find is run, it is created; if it does exist, it is truncated to 0 bytes. The file names `/dev/stdout` and `/dev/stderr` are handled specially; they refer to the standard output and standard error output, respectively.

1.28 find.guide/Print File Information

Print File Information

=====

- Action: `-ls`
True; list the current file in `ls -dils` format on the standard output. The output looks like this:

```
204744    17 -rw-r--r--    1 djm      staff      17337 Nov  2  1992 ./ ↵
      lwall-quotes
```

The fields are:

1. The inode number of the file. See Hard Links, for how to find files based on their inode number.
2. the number of blocks in the file. The block counts are of 1K blocks, unless the environment variable `POSIXLY_CORRECT` is set, in which case 512-byte blocks are used. See Size, for how to find files based on their size.
3. The file's type and permissions. The type is shown as a dash for a regular file; for other file types, a letter like `l` for `-type` is used (see Type). The permissions are read, write, and execute for the file's owner, its group, and other users, respectively; a dash means the permission is not granted. See File Permissions, for more details about file permissions. See Permissions, for how to find files based on their permissions.
4. The number of hard links to the file.
5. The user who owns the file.
6. The file's group.

- 7. The file's size in bytes.
 - 8. The date the file was last modified.
 - 9. The file's name. `-ls` quotes non-printable characters in the file names using C-like backslash escapes.
- Action: `-fls FILE`
True; like `-ls` but write to `FILE` like `-fprint` (see Print File Name).
 - Action: `-printf FORMAT`
True; print `FORMAT` on the standard output, interpreting `\` escapes and `%` directives. Field widths and precisions can be specified as with the `printf` C function. Unlike `-print`, `-printf` does not add a newline at the end of the string.
 - Action: `-fprintf FILE FORMAT`
True; like `-printf` but write to `FILE` like `-fprint` (see Print File Name).

Escapes
Format Directives
Time Formats

1.29 find.guide/Escapes

Escapes

The escapes that `-printf` and `-fprintf` recognize are:

<code>\a</code>	Alarm bell.
<code>\b</code>	Backspace.
<code>\c</code>	Stop printing from this format immediately and flush the output.
<code>\f</code>	Form feed.
<code>\n</code>	Newline.
<code>\r</code>	Carriage return.
<code>\t</code>	Horizontal tab.

`\v`
Vertical tab.

`\`
A literal backslash (`\`).

A `\` character followed by any other character is treated as an ordinary character, so they both are printed, and a warning message is printed to the standard error output (because it was probably a typo).

1.30 find.guide/Format Directives

Format Directives

`-printf` and `-fprintf` support the following format directives to print information about the file being processed. Unlike the C `printf` function, they do not support field width specifiers.

`%%` is a literal percent sign. A `%` character followed by any other character is discarded (but the other character is printed), and a warning message is printed to the standard error output (because it was probably a typo).

Name Directives
Ownership Directives
Size Directives
Location Directives
Time Directives

1.31 find.guide/Name Directives

Name Directives
.....

`%p`
File's name.

`%f`
File's name with any leading directories removed (only the last element).

`%h`
Leading directories of file's name (all but the last element and the slash before it).

`%P`
File's name with the name of the command line argument under which it was found removed from the beginning.

%H
Command line argument under which file was found.

1.32 find.guide/Ownership Directives

Ownership Directives
.....

%g
File's group name, or numeric group ID if the group has no name.

%G
File's numeric group ID.

%u
File's user name, or numeric user ID if the user has no name.

%U
File's numeric user ID.

%m
File's permissions (in octal).

1.33 find.guide/Size Directives

Size Directives
.....

%k
File's size in 1K blocks (rounded up).

%b
File's size in 512-byte blocks (rounded up).

%s
File's size in bytes.

1.34 find.guide/Location Directives

Location Directives
.....

%d
File's depth in the directory tree; files named on the command line have a depth of 0.

%F
Type of the filesystem the file is on; this value can be used for `-fstype` (see Directories).

%l
Object of symbolic link (empty string if file is not a symbolic link).

%i
File's inode number (in decimal).

%n
Number of hard links to file.

1.35 find.guide/Time Directives

Time Directives

.....

Some of these directives use the C `ctime` function. Its output depends on the current locale, but it typically looks like

Wed Nov 2 00:42:36 1994

%a
File's last access time in the format returned by the C `ctime` function.

%AK
File's last access time in the format specified by K (see Time Formats).

%c
File's last status change time in the format returned by the C `ctime` function.

%CK
File's last status change time in the format specified by K (see Time Formats).

%t
File's last modification time in the format returned by the C `ctime` function.

%TK
File's last modification time in the format specified by K (see Time Formats).

1.36 find.guide/Time Formats

Time Formats

Below are the formats for the directives %A, %C, and %T, which print the file's timestamps. Some of these formats might not be available on all systems, due to differences in the C strftime function between systems.

Time Components
Date Components
Combined Time Formats

1.37 find.guide/Time Components

Time Components

.....

The following format directives print single components of the time.

H	hour (00..23)
I	hour (01..12)
k	hour (0..23)
l	hour (1..12)
p	locale's AM or PM
Z	time zone (e.g., EDT), or nothing if no time zone is determinable
M	minute (00..59)
S	second (00..61)
@	seconds since Jan. 1, 1970, 00:00 GMT.

1.38 find.guide/Date Components

Date Components

.....

The following format directives print single components of the date.

a	locale's abbreviated weekday name (Sun..Sat)
A	locale's full weekday name, variable length (Sunday..Saturday)
b	
h	locale's abbreviated month name (Jan..Dec)
B	locale's full month name, variable length (January..December)
m	month (01..12)
d	day of month (01..31)
w	day of week (0..6)
j	day of year (001..366)
U	week number of year with Sunday as first day of week (00..53)
W	week number of year with Monday as first day of week (00..53)
Y	year (1970...)
y	last two digits of year (00..99)

1.39 find.guide/Combined Time Formats

Combined Time Formats

.....

The following format directives print combinations of time and date components.

r	time, 12-hour (hh:mm:ss [AP]M)
---	--------------------------------

T
time, 24-hour (hh:mm:ss)

X
locale's time representation (H:M:S)

C
locale's date and time (Sat Nov 04 12:02:33 EST 1989)

D
date (mm/dd/yy)

x
locale's date representation (mm/dd/yy)

1.40 find.guide/Run Commands

Run Commands

=====

You can use the list of file names created by find or locate as arguments to other commands. In this way you can perform arbitrary actions on the files.

Single File
Multiple Files
Querying

1.41 find.guide/Single File

Single File

Here is how to run a command on one file at a time.

- Action: `-exec COMMAND ;`
Execute COMMAND; true if 0 status is returned. find takes all arguments after `-exec` to be part of the command until an argument consisting of `;` is reached. It replaces the string `{}` by the current file name being processed everywhere it occurs in the command. Both of these constructions need to be escaped (with a `\`) or quoted to protect them from expansion by the shell. The command is executed in the directory in which find was run.

For example, to compare each C header file in the current directory with the file `/tmp/master`:

```
find . -name '*.h' -exec diff -u '{}' /tmp/master ';' 
```

1.42 find.guide/Multiple Files

Multiple Files

Sometimes you need to process files alone. But when you don't, it is faster to run a command on as many files as possible at a time, rather than once per file. Doing this saves on the time it takes to start up the command each time.

To run a command on more than one file at once, use the `xargs` command, which is invoked like this:

```
xargs [OPTION...] [COMMAND [INITIAL-ARGUMENTS]]
```

`xargs` reads arguments from the standard input, delimited by blanks (which can be protected with double or single quotes or a backslash) or newlines. It executes the `COMMAND` (default is `/bin/echo`) one or more times with any `INITIAL-ARGUMENTS` followed by arguments read from standard input. Blank lines on the standard input are ignored.

Instead of blank-delimited names, it is safer to use `find -print0` or `find -fprint0` and process the output by giving the `-0` or `--null` option to GNU `xargs`, GNU `tar`, GNU `cpio`, or `perl`.

You can use shell command substitution (backquotes) to process a list of arguments, like this:

```
grep -l sprintf `find $HOME -name '*.c' -print`
```

However, that method produces an error if the length of the `.c` file names exceeds the operating system's command-line length limit. `xargs` avoids that problem by running the command as many times as necessary without exceeding the limit:

```
find $HOME -name '*.c' -print | grep -l sprintf
```

However, if the command needs to have its standard input be a terminal (less, for example), you have to use the shell command substitution method.

Unsafe File Name Handling
 Safe File Name Handling
 Limiting Command Size
 Interspersing File Names

1.43 find.guide/Unsafe File Name Handling

Unsafe File Name Handling

.....

Because file names can contain quotes, backslashes, blank characters,

and even newlines, it is not safe to process them using xargs in its default mode of operation. But since most files' names do not contain blanks, this problem occurs only infrequently. If you are only searching through files that you know have safe names, then you need not be concerned about it.

In many applications, if xargs botches processing a file because its name contains special characters, some data might be lost. The importance of this problem depends on the importance of the data and whether anyone notices the loss soon enough to correct it. However, here is an extreme example of the problems that using blank-delimited names can cause. If the following command is run daily from cron, then any user can remove any file on the system:

```
find / -name '#*' -atime +7 -print | xargs rm
```

For example, you could do something like this:

```
eg$ echo > '#
vmunix'
```

and then cron would delete /vmunix, if it ran xargs with / as its current directory.

To delete other files, for example /u/joeuser/.plan, you could do this:

```
eg$ mkdir '#
,
eg$ cd '#
,
eg$ mkdir u u/joeuser u/joeuser/.plan'
,
eg$ echo > u/joeuser/.plan'
/#foo'
eg$ cd ..
eg$ find . -name '#*' -print | xargs echo
./# ./# /u/joeuser/.plan /#foo
```

1.44 find.guide/Safe File Name Handling

Safe File Name Handling

.....

Here is how to make find output file names so that they can be used by other programs without being mangled or misinterpreted. You can process file names generated this way by giving the -0 or --null option to GNU xargs, GNU tar, GNU cpio, or perl.

- Action: -print0
True; print the full file name on the standard output, followed by a null character.
- Action: -fprint0 FILE

True; like `-print0` but write to FILE like `-fprint` (see Print File Name).

1.45 find.guide/Limiting Command Size

Limiting Command Size
.....

`xargs` gives you control over how many arguments it passes to the command each time it executes it. By default, it uses up to ARG_MAX - 2k, or 20k, whichever is smaller, characters per command. It uses as many lines and arguments as fit within that limit. The following options modify those values.

`--no-run-if-empty`
`-r`

If the standard input does not contain any nonblanks, do not run the command. By default, the command is run once even if there is no input.

`--max-lines[=MAX-LINES]`
`-l[MAX-LINES]`

Use at most MAX-LINES nonblank input lines per command line; MAX-LINES defaults to 1 if omitted. Trailing blanks cause an input line to be logically continued on the next input line, for the purpose of counting the lines. Implies `-x`.

`--max-args=MAX-ARGS`
`-n MAX-ARGS`

Use at most MAX-ARGS arguments per command line. Fewer than MAX-ARGS arguments will be used if the size (see the `-s` option) is exceeded, unless the `-x` option is given, in which case `xargs` will exit.

`--max-chars=MAX-CHARS`
`-s MAX-CHARS`

Use at most MAX-CHARS characters per command line, including the command and initial arguments and the terminating nulls at the ends of the argument strings.

`--max-procs=MAX-PROCS`
`-P MAX-PROCS`

Run up to MAX-PROCS processes at a time; the default is 1. If MAX-PROCS is 0, `xargs` will run as many processes as possible at a time. Use the `-n`, `-s`, or `-l` option with `-P`; otherwise chances are that the command will be run only once.

1.46 find.guide/Interspersing File Names

Interspersing File Names

xargs can insert the name of the file it is processing between arguments you give for the command. Unless you also give options to limit the command size (see Limiting Command Size), this mode of operation is equivalent to `find -exec` (see Single File).

`--replace[=REPLACE-STR]`

`-i[REPLACE-STR]`

Replace occurrences of REPLACE-STR in the initial arguments with names read from standard input. Also, unquoted blanks do not terminate arguments. If REPLACE-STR is omitted, it defaults to {} (like for `find -exec`). Implies `-x` and `-l 1`. As an example, to sort each file the bills directory, leaving the output in that file name with .sorted appended, you could do:

```
find bills -type f | xargs -iXX sort -o XX.sorted XX
```

The equivalent command using `find -exec` is:

```
find bills -type f -exec sort -o '{}.sorted' '{} ' ';' ;
```

1.47 find.guide/Querying

Querying

To ask the user whether to execute a command on a single file, you can use the `find` primary `-ok` instead of `-exec`:

- Action: `-ok COMMAND` ;

Like `-exec` (see Single File), but ask the user first (on the standard input); if the response does not start with y or Y, do not run the command, and return false.

When processing multiple files with a single command, to query the user you give xargs the following option. When using this option, you might find it useful to control the number of files processed per invocation of the command (see Limiting Command Size).

`--interactive`

`-p`

Prompt the user about whether to run each command line and read a line from the terminal. Only run the command line if the response starts with y or Y. Implies `-t`.

1.48 find.guide/Adding Tests

Adding Tests

=====

You can test for file attributes that none of the find builtin tests check. To do this, use xargs to run a program that filters a list of files printed by find. If possible, use find builtin tests to pare down the list, so the program run by xargs has less work to do. The tests builtin to find will likely run faster than tests that other programs perform.

For example, here is a way to print the names of all of the unstripped binaries in the /usr/local directory tree. Builtin tests avoid running file on files that are not regular files or are not executable.

```
find /usr/local -type f -perm +a=x | xargs file |
    grep 'not stripped' | cut -d: -f1
```

The cut program removes everything after the file name from the output of file.

If you want to place a special test somewhere in the middle of a find expression, you can use -exec to run a program that performs the test. Because -exec evaluates to the exit status of the executed program, you can write a program (which can be a shell script) that tests for a special attribute and make it exit with a true (zero) or false (non-zero) status. It is a good idea to place such a special test after the builtin tests, because it starts a new process which could be avoided if a builtin test evaluates to false. Use this method only when xargs is not flexible enough, because starting one or more new processes to test each file is slower than using xargs to start one process that tests many files.

Here is a shell script called unstripped that checks whether its argument is an unstripped binary file:

```
#!/bin/sh
file $1 | grep 'not stripped' > /dev/null
```

This script relies on the fact that the shell exits with the status of the last program it executed, in this case grep. grep exits with a true status if it found any matches, false if not. Here is an example of using the script (assuming it is in your search path). It lists the stripped executables in the file sbins and the unstripped ones in ubins.

```
find /usr/local -type f -perm +a=x \
    \( -exec unstripped '{}' \; -fprint ubins -o -fprint sbins \)
```

1.49 find.guide/Common Tasks

Common Tasks

The sections that follow contain some extended examples that both give a good idea of the power of these programs, and show you how to solve common real-world problems.

Viewing And Editing
Archiving
Cleaning Up
Strange File Names
Fixing Permissions
Classifying Files

1.50 find.guide/Viewing And Editing

Viewing And Editing
=====

To view a list of files that meet certain criteria, simply run your file viewing program with the file names as arguments. Shells substitute a command enclosed in backquotes with its output, so the whole command looks like this:

```
less `find /usr/include -name '*.h' | xargs grep -l mode_t`
```

You can edit those files by giving an editor name instead of a file viewing program.

1.51 find.guide/Archiving

Archiving
=====

You can pass a list of files produced by find to a file archiving program. GNU tar and cpio can both read lists of file names from the standard input--either delimited by nulls (the safe way) or by blanks (the lazy, risky default way). To use null-delimited names, give them the --null option. You can store a file archive in a file, write it on a tape, or send it over a network to extract on another machine.

One common use of find to archive files is to send a list of the files in a directory tree to cpio. Use -depth so if a directory does not have write permission for its owner, its contents can still be restored from the archive since the directory's permissions are restored after its contents. Here is an example of doing this using cpio; you could use a more complex find expression to archive only certain files.

```
find . -depth -print0 |  
  cpio --create --null --format=crc --file=/dev/nrst0
```

You could restore that archive using this command:

```
cpio --extract --null --make-dir --unconditional \  
  --preserve --file=/dev/nrst0
```

Here are the commands to do the same things using tar:

```
find . -depth -print0 |  
  tar --create --null --files-from=- --file=/dev/nrst0  
  
tar --extract --null --preserve-perm --same-owner \  
  --file=/dev/nrst0
```

Here is an example of copying a directory from one machine to another:

```
find . -depth -print0 | cpio -0o -Hnewc |  
  rsh OTHER-MACHINE "cd `pwd` && cpio -i0dum"
```

1.52 find.guide/Cleaning Up

Cleaning Up

=====

This section gives examples of removing unwanted files in various situations. Here is a command to remove the CVS backup files created when an update requires a merge:

```
find . -name '.#*' -print0 | xargs -0r rm -f
```

You can run this command to clean out your clutter in /tmp. You might place it in the file your shell runs when you log out (.bash_logout, .logout, or .zlogout, depending on which shell you use).

```
find /tmp -user $LOGNAME -type f -print0 | xargs -0 -r rm -f
```

To remove old Emacs backup and auto-save files, you can use a command like the following. It is especially important in this case to use null-terminated file names because Emacs packages like the VM mailer often create temporary file names with spaces in them, like #reply to David J. MacKenzie<1>#.

```
find ~ \( -name '*~' -o -name '#*#' \) -print0 |  
  xargs --no-run-if-empty --null rm -vf
```

Removing old files from /tmp is commonly done from cron:

```
find /tmp /var/tmp -not -type d -mtime +3 -print0 |  
  xargs --null --no-run-if-empty rm -f  
  
find /tmp /var/tmp -depth -mindepth 1 -type d -empty -print0 |  
  xargs --null --no-run-if-empty rmdir
```

The second find command above uses `-depth` so it cleans out empty directories depth-first, hoping that the parents become empty and can be removed too. It uses `-mindepth` to avoid removing `/tmp` itself if it becomes totally empty.

1.53 find.guide/Strange File Names

Strange File Names
=====

find can help you remove or rename a file with strange characters in its name. People are sometimes stymied by files whose names contain characters such as spaces, tabs, control characters, or characters with the high bit set. The simplest way to remove such files is:

```
rm -i SOME*PATTERN*THAT*MATCHES*THE*PROBLEM*FILE
```

rm asks you whether to remove each file matching the given pattern. If you are using an old shell, this approach might not work if the file name contains a character with the high bit set; the shell may strip it off. A more reliable way is:

```
find . -maxdepth 1 TESTS -ok rm '{}' \;
```

where TESTS uniquely identify the file. The `-maxdepth 1` option prevents find from wasting time searching for the file in any subdirectories; if there are no subdirectories, you may omit it. A good way to uniquely identify the problem file is to figure out its inode number; use

```
ls -i
```

Suppose you have a file whose name contains control characters, and you have found that its inode number is 12345. This command prompts you for whether to remove it:

```
find . -maxdepth 1 -inum 12345 -ok rm -f '{}' \;
```

If you don't want to be asked, perhaps because the file name may contain a strange character sequence that will mess up your screen when printed, then use `-exec` instead of `-ok`.

If you want to rename the file instead, you can use `mv` instead of `rm`:

```
find . -maxdepth 1 -inum 12345 -ok mv '{}' NEW-FILE-NAME \;
```

1.54 find.guide/Fixing Permissions

Fixing Permissions
=====

Suppose you want to make sure that everyone can write to the directories in a certain directory tree. Here is a way to find directories lacking either user or group write permission (or both), and fix their permissions:

```
find . -type d -not -perm -ug=w | xargs chmod ug+w
```

You could also reverse the operations, if you want to make sure that directories do not have world write permission.

1.55 find.guide/Classifying Files

Classifying Files

=====

If you want to classify a set of files into several groups based on different criteria, you can use the comma operator to perform multiple independent tests on the files. Here is an example:

```
find / -type d \( -perm -o=w -fprint allwrite , \
    -perm -o=x -fprint allexec \)

echo "Directories that can be written to by everyone:"
cat allwrite
echo ""
echo "Directories with search permissions for everyone:"
cat allexec
```

find has only to make one scan through the directory tree (which is one of the most time consuming parts of its work).

1.56 find.guide/Databases

File Name Databases

The file name databases used by locate contain lists of files that were in particular directory trees when the databases were last updated. The file name of the default database is determined when locate and updatedb are configured and installed. The frequency with which the databases are updated and the directories for which they contain entries depend on how often updatedb is run, and with which arguments.

Database Locations
Database Formats

1.57 find.guide/Database Locations

Database Locations

=====

There can be multiple file name databases. Users can select which databases locate searches using an environment variable or a command line option. The system administrator can choose the file name of the default database, the frequency with which the databases are updated, and the directories for which they contain entries. File name databases are updated by running the updatedb program, typically nightly.

In networked environments, it often makes sense to build a database at the root of each filesystem, containing the entries for that filesystem. updatedb is then run for each filesystem on the fileserver where that filesystem is on a local disk, to prevent thrashing the network. Here are the options to updatedb to select which directories each database contains entries for:

```
--localpaths='PATH...'  
    Non-network directories to put in the database. Default is /.  
  
--netpaths='PATH...'  
    Network (NFS, AFS, RFS, etc.) directories to put in the database.  
    Default is none.  
  
--prunepaths='PATH...'  
    Directories to not put in the database, which would otherwise be.  
    Default is /tmp /usr/tmp /var/tmp /afs.  
  
--output=DBFILE  
    The database file to build. Default is system-dependent, but  
    typically /usr/local/var/locatedb.  
  
--netuser=USER  
    The user to search network directories as, using su. Default is  
    daemon.
```

1.58 find.guide/Database Formats

Database Formats

=====

The file name databases contain lists of files that were in particular directory trees when the databases were last updated. The file name database format changed starting with GNU locate version 4.0 to allow machines with different byte orderings to share the databases. The new GNU locate can read both the old and new database formats. However, old versions of locate and find produce incorrect results if given a new-format database.

New Database Format
Sample Database
Old Database Format

1.59 find.guide/New Database Format

New Database Format

updatedb runs a program called frcode to front-compress the list of file names, which reduces the database size by a factor of 4 to 5. Front-compression (also known as incremental encoding) works as follows.

The database entries are a sorted list (case-insensitively, for users' convenience). Since the list is sorted, each entry is likely to share a prefix (initial string) with the previous entry. Each database entry begins with an offset-differential count byte, which is the additional number of characters of prefix of the preceding entry to use beyond the number that the preceding entry is using of its predecessor. (The counts can be negative.) Following the count is a null-terminated ASCII remainder--the part of the name that follows the shared prefix.

If the offset-differential count is larger than can be stored in a byte (+/-127), the byte has the value 0x80 and the count follows in a 2-byte word, with the high byte first (network byte order).

Every database begins with a dummy entry for a file called LOCATE02, which locate checks for to ensure that the database file has the correct format; it ignores the entry in doing the search.

Databases can not be concatenated together, even if the first (dummy) entry is trimmed from all but the first database. This is because the offset-differential count in the first entry of the second and following databases will be wrong.

1.60 find.guide/Sample Database

Sample Database

Sample input to frcode:

```
/usr/src  
/usr/src/cmd/aardvark.c  
/usr/src/cmd/armadillo.c  
/usr/tmp/zoo
```

Length of the longest prefix of the preceding entry to share:

```
0 /usr/src
8 /cmd/aardvark.c
14 rmadillo.c
5 tmp/zoo
```

Output from `frcode`, with trailing nulls changed to newlines and count bytes made printable:

```
0 LOCATE02
0 /usr/src
8 /cmd/aardvark.c
6 rmadillo.c
-9 tmp/zoo
```

(6 = 14 - 8, and -9 = 5 - 14)

1.61 find.guide/Old Database Format

Old Database Format

The old database format is used by Unix `locate` and `find` programs and earlier releases of the GNU ones. `updatedb` produces this format if given the `--old-format` option.

`updatedb` runs programs called `bigram` and `code` to produce old-format databases. The old format differs from the new one in the following ways. Instead of each entry starting with an offset-differential count byte and ending with a null, byte values from 0 through 28 indicate offset-differential counts from -14 through 14. The byte value indicating that a long offset-differential count follows is 0x1e (30), not 0x80. The long counts are stored in host byte order, which is not necessarily network byte order, and host integer word size, which is usually 4 bytes. They also represent a count 14 less than their value. The database lines have no termination byte; the start of the next line is indicated by its first byte having a value ≤ 30 .

In addition, instead of starting with a dummy entry, the old database format starts with a 256 byte table containing the 128 most common bigrams in the file list. A bigram is a pair of adjacent bytes. Bytes in the database that have the high bit set are indexes (with the high bit cleared) into the bigram table. The bigram and offset-differential count coding makes these databases 20-25% smaller than the new format, but makes them not 8-bit clean. Any byte in a file name that is in the ranges used for the special codes is replaced in the database by a question mark, which not coincidentally is the shell wildcard to match a single character.

1.62 find.guide/File Permissions

File Permissions

Each file has a set of permissions that control the kinds of access that users have to that file. The permissions for a file are also called its access mode. They can be represented either in symbolic form or as an octal number.

Mode Structure	Structure of file permissions.
Symbolic Modes	Mnemonic permissions representation.
Numeric Modes	Permissions as octal numbers.

1.63 find.guide/Mode Structure

Structure of File Permissions

=====

There are three kinds of permissions that a user can have for a file:

1. permission to read the file. For directories, this means permission to list the contents of the directory.
2. permission to write to (change) the file. For directories, this means permission to create and remove files in the directory.
3. permission to execute the file (run it as a program). For directories, this means permission to access files in the directory.

There are three categories of users who may have different permissions to perform any of the above operations on a file:

1. the file's owner;
2. other users who are in the file's group;
3. everyone else.

Files are given an owner and group when they are created. Usually the owner is the current user and the group is the group of the directory the file is in, but this varies with the operating system, the filesystem the file is created on, and the way the file is created. You can change the owner and group of a file by using the `chown` and `chgrp` commands.

In addition to the three sets of three permissions listed above, a file's permissions have three special components, which affect only executable files (programs) and, on some systems, directories:

1. set the process's effective user ID to that of the file upon execution (called the `setuid` bit). No effect on directories.

2. set the process's effective group ID to that of the file upon execution (called the setgid bit). For directories on some systems, put files created in the directory into the same group as the directory, no matter what group the user who creates them is in.
3. save the program's text image on the swap device so it will load more quickly when run (called the sticky bit). For directories on some systems, prevent users from removing files that they do not own in the directory; this is called making the directory append-only.

1.64 find.guide/Symbolic Modes

Symbolic Modes
=====

Symbolic modes represent changes to files' permissions as operations on single-character symbols. They allow you to modify either all or selected parts of files' permissions, optionally based on their previous values, and perhaps on the current umask as well (see Umask and Protection).

The format of symbolic modes is:

```
[ugoa...][[+|=][rwxXstugo...]...][,...]
```

The following sections describe the operators and other details of symbolic modes.

Setting Permissions	Basic operations on permissions.
Copying Permissions	Copying existing permissions.
Changing Special Permissions	Special permissions.
Conditional Executability	Conditionally affecting executability.
Multiple Changes	Making multiple changes.
Umask and Protection	The effect of the umask.

1.65 find.guide/Setting Permissions

Setting Permissions

The basic symbolic operations on a file's permissions are adding, removing, and setting the permission that certain users have to read, write, and execute the file. These operations have the following format:

```
USERS OPERATION PERMISSIONS
```

The spaces between the three parts above are shown for readability only; symbolic modes can not contain spaces.

The USERS part tells which users' access to the file is changed. It consists of one or more of the following letters (or it can be empty; see Umask and Protection, for a description of what happens then). When more than one of these letters is given, the order that they are in does not matter.

- u
the user who owns the file;
- g
other users who are in the file's group;
- o
all other users;
- a
all users; the same as ugo.

The OPERATION part tells how to change the affected users' access to the file, and is one of the following symbols:

- +
to add the PERMISSIONS to whatever permissions the USERS already have for the file;
- to remove the PERMISSIONS from whatever permissions the USERS already have for the file;
- =
to make the PERMISSIONS the only permissions that the USERS have for the file.

The PERMISSIONS part tells what kind of access to the file should be changed; it is zero or more of the following letters. As with the USERS part, the order does not matter when more than one letter is given. Omitting the PERMISSIONS part is useful only with the = operation, where it gives the specified USERS no access at all to the file.

- r
the permission the USERS have to read the file;
- w
the permission the USERS have to write to the file;
- x
the permission the USERS have to execute the file.

For example, to give everyone permission to read and write a file, but not to execute it, use:

```
a=rw
```

To remove write permission for from all users other than the file's owner, use:

```
go-w
```

The above command does not affect the access that the owner of the file has to it, nor does it affect whether other users can read or execute the file.

To give everyone except a file's owner no permission to do anything with that file, use the mode below. Other users could still remove the file, if they have write permission on the directory it is in.

```
go=
```

Another way to specify the same thing is:

```
og-rxw
```

1.66 find.guide/Copying Permissions

Copying Existing Permissions

You can base part of a file's permissions on part of its existing permissions. To do this, instead of using r, w, or x after the operator, you use the letter u, g, or o. For example, the mode

```
o+g
```

adds the permissions for users who are in a file's group to the permissions that other users have for the file. Thus, if the file started out as mode 664 (rw-rw-r--), the above mode would change it to mode 666 (rw-rw-rw-). If the file had started out as mode 741 (rwxr---x), the above mode would change it to mode 745 (rwxr--r-x). The - and = operations work analogously.

1.67 find.guide/Changing Special Permissions

Changing Special Permissions

In addition to changing a file's read, write, and execute permissions, you can change its special permissions. See Mode Structure, for a summary of these permissions.

To change a file's permission to set the user ID on execution, use u in the USERS part of the symbolic mode and s in the PERMISSIONS part.

To change a file's permission to set the group ID on execution, use

g in the USERS part of the symbolic mode and s in the PERMISSIONS part.

To change a file's permission to stay permanently on the swap device, use o in the USERS part of the symbolic mode and t in the PERMISSIONS part.

For example, to add set user ID permission to a program, you can use the mode:

```
u+s
```

To remove both set user ID and set group ID permission from it, you can use the mode:

```
ug-s
```

To cause a program to be saved on the swap device, you can use the mode:

```
o+t
```

Remember that the special permissions only affect files that are executable, plus, on some systems, directories (on which they have different meanings; see Mode Structure). Using a in the USERS part of a symbolic mode does not cause the special permissions to be affected; thus,

```
a+s
```

has no effect. You must use u, g, and o explicitly to affect the special permissions. Also, the combinations u+t, g+t, and o+s have no effect.

The = operator is not very useful with special permissions; for example, the mode:

```
o=t
```

does cause the file to be saved on the swap device, but it also removes all read, write, and execute permissions that users not in the file's group might have had for it.

1.68 find.guide/Conditional Executability

Conditional Executability

There is one more special type of symbolic permission: if you use X instead of x, execute permission is affected only if the file already had execute permission or is a directory. It affects directories' execute permission even if they did not initially have any execute permissions set.

For example, this mode:

```
a+X
```

gives all users permission to execute files (or search directories) if anyone could before.

1.69 find.guide/Multiple Changes

Making Multiple Changes

The format of symbolic modes is actually more complex than described above (see Setting Permissions). It provides two ways to make multiple changes to files' permissions.

The first way is to specify multiple OPERATION and PERMISSIONS parts after a USERS part in the symbolic mode.

For example, the mode:

```
og+rX-w
```

gives users other than the owner of the file read permission and, if it is a directory or if someone already had execute permission to it, gives them execute permission; and it also denies them write permission to it file. It does not affect the permission that the owner of the file has for it. The above mode is equivalent to the two modes:

```
og+rX
og-w
```

The second way to make multiple changes is to specify more than one simple symbolic mode, separated by commas. For example, the mode:

```
a+r,go-w
```

gives everyone permission to read the file and removes write permission on it for all users except its owner. Another example:

```
u=rwx,g=rx,o=
```

sets all of the non-special permissions for the file explicitly. (It gives users who are not in the file's group no permission at all for it.)

The two methods can be combined. The mode:

```
a+r,g+x-w
```

gives all users permission to read the file, and gives users who are in the file's group permission to execute it, as well, but not permission to write to it. The above mode could be written in several different ways; another is:

```
u+r,g+rx,o+r,g-w
```

1.70 find.guide/Umask and Protection

The Umask and Protection

If the USERS part of a symbolic mode is omitted, it defaults to a (affect all users), except that any permissions that are set in the system variable umask are not affected. The value of umask can be set using the umask command. Its default value varies from system to system.

Omitting the USERS part of a symbolic mode is generally not useful with operations other than +. It is useful with + because it allows you to use umask as an easily customizable protection against giving away more permission to files than you intended to.

As an example, if umask has the value 2, which removes write permission for users who are not in the file's group, then the mode:

```
+w
```

adds permission to write to the file to its owner and to other users who are in the file's group, but not to other users. In contrast, the mode:

```
a+w
```

ignores umask, and does give write permission for the file to all users.

1.71 find.guide/Numeric Modes

Numeric Modes

=====

File permissions are stored internally as 16 bit integers. As an alternative to giving a symbolic mode, you can give an octal (base 8) number that corresponds to the internal representation of the new mode. This number is always interpreted in octal; you do not have to add a leading 0, as you do in C. Mode 0055 is the same as mode 55.

A numeric mode is usually shorter than the corresponding symbolic mode, but it is limited in that it can not take into account a file's previous permissions; it can only set them absolutely.

The permissions granted to the user, to other users in the file's group, and to other users not in the file's group are each stored as three bits, which are represented as one octal digit. The three special permissions are also each stored as one bit, and they are as a group

represented as another octal digit. Here is how the bits are arranged in the 16 bit integer, starting with the lowest valued bit:

Value in Mode	Corresponding Permission
Other users not in the file's group:	
1	Execute
2	Write
4	Read
Other users in the file's group:	
10	Execute
20	Write
40	Read
The file's owner:	
100	Execute
200	Write
400	Read
Special permissions:	
1000	Save text image on swap device
2000	Set group ID on execution
4000	Set user ID on execution

For example, numeric mode 4755 corresponds to symbolic mode `u=rwx,go=rx`, and numeric mode 664 corresponds to symbolic mode `ug=rw,o=r`. Numeric mode 0 corresponds to symbolic mode `ugo=`.

1.72 find.guide/Reference

Reference

Below are summaries of the command line syntax for the programs discussed in this manual.

```
Invoking find
Invoking locate
Invoking updatedb
Invoking xargs
```

1.73 find.guide/Invoking find

Invoking find

=====

```
find [FILE...] [EXPRESSION]
```

find searches the directory tree rooted at each file name FILE by evaluating the EXPRESSION on each file it finds in the tree.

find considers the first argument that begins with -, (,), ,, or ! to be the beginning of the expression; any arguments before it are paths to search, and any arguments after it are the rest of the expression. If no paths are given, the current directory is used. If no expression is given, the expression -print is used.

find exits with status 0 if all files are processed successfully, greater than 0 if errors occur.

See Primary Index, for a summary of all of the tests, actions, and options that the expression can contain.

find also recognizes two options for administrative use:

--help

Print a summary of the command-line argument format and exit.

--version

Print the version number of find and exit.

1.74 find.guide/Invoking locate

Invoking locate

=====

locate [OPTION...] PATTERN...

--database=PATH

-d PATH

Instead of searching the default file name database, search the file name databases in PATH, which is a colon-separated list of database file names. You can also use the environment variable LOCATE_PATH to set the list of database files to search. The option overrides the environment variable if both are used.

--help

Print a summary of the options to locate and exit.

--version

Print the version number of locate and exit.

1.75 find.guide/Invoking updatedb

Invoking updatedb

=====

```

    updatedb [OPTION...]

--localpaths='PATH...'
    Non-network directories to put in the database.  Default is /.

--netpaths='PATH...'
    Network (NFS, AFS, RFS, etc.) directories to put in the database.
    Default is none.

--prunepaths='PATH...'
    Directories to not put in the database, which would otherwise be.
    Default is /tmp /usr/tmp /var/tmp /afs.

--output=DBFILE
    The database file to build.  Default is system-dependent, but
    typically /usr/local/var/locatedb.

--netuser=USER
    The user to search network directories as, using su(1).  Default
    is daemon.

```

1.76 find.guide/Invoking xargs

Invoking xargs

=====

```
xargs [OPTION...] [COMMAND [INITIAL-ARGUMENTS]]
```

xargs exits with the following status:

```

0
    if it succeeds

123
    if any invocation of the command exited with status 1-125

124
    if the command exited with status 255

125
    if the command is killed by a signal

126
    if the command cannot be run

127
    if the command is not found

1
    if some other error occurred.

```

```
--null
```

```
-0
```

Input filenames are terminated by a null character instead of by

whitespace, and the quotes and backslash are not special (every character is taken literally). Disables the end of file string, which is treated like any other argument.

--eof[=EOF-STR]

-e[EOF-STR]

Set the end of file string to EOF-STR. If the end of file string occurs as a line of input, the rest of the input is ignored. If EOF-STR is omitted, there is no end of file string. If this option is not given, the end of file string defaults to _.

--help

Print a summary of the options to xargs and exit.

--replace[=REPLACE-STR]

-i[REPLACE-STR]

Replace occurrences of REPLACE-STR in the initial arguments with names read from standard input. Also, unquoted blanks do not terminate arguments. If REPLACE-STR is omitted, it defaults to {} (like for find -exec). Implies -x and -l 1.

--max-lines[=MAX-LINES]

-l[MAX-LINES]

Use at most MAX-LINES nonblank input lines per command line; MAX-LINES defaults to 1 if omitted. Trailing blanks cause an input line to be logically continued on the next input line, for the purpose of counting the lines. Implies -x.

--max-args=MAX-ARGS

-n MAX-ARGS

Use at most MAX-ARGS arguments per command line. Fewer than MAX-ARGS arguments will be used if the size (see the -s option) is exceeded, unless the -x option is given, in which case xargs will exit.

--interactive

-p

Prompt the user about whether to run each command line and read a line from the terminal. Only run the command line if the response starts with y or Y. Implies -t.

--no-run-if-empty

-r

If the standard input does not contain any nonblanks, do not run the command. By default, the command is run once even if there is no input.

--max-chars=MAX-CHARS

-s MAX-CHARS

Use at most MAX-CHARS characters per command line, including the command and initial arguments and the terminating nulls at the ends of the argument strings.

--verbose

-t

Print the command line on the standard error output before executing it.

```
--version
    Print the version number of xargs and exit.

--exit

-x
    Exit if the size (see the -S option) is exceeded.

--max-procs=MAX-PROCS
-P MAX-PROCS
    Run up to MAX-PROCS processes at a time; the default is 1. If
    MAX-PROCS is 0, xargs will run as many processes as possible at a
    time.
```

1.77 find.guide/Primary Index

```
find Primary Index
*****
```

This is a list of all of the primaries (tests, actions, and options) that make up find expressions for selecting files. See find Expressions, for more information on expressions.

-amin	Age Ranges
-anewer	Comparing Timestamps
-atime	Age Ranges
-cmin	Age Ranges
-cnewer	Comparing Timestamps
-ctime	Age Ranges
-daystart	Age Ranges
-depth	Directories
-empty	Size
-exec	Single File
-false	Combining Primaries With Operators
-fls	Print File Information
-follow	Symbolic Links
-fprint	Print File Name
-fprint0	Safe File Name Handling
-fprintf	Print File Information
-fstype	Filesystems
-gid	Owner
-group	Owner
-ilname	Symbolic Links
-iname	Base Name Patterns
-inum	Hard Links
-ipath	Full Name Patterns
-iregex	Full Name Patterns
-links	Hard Links
-lname	Symbolic Links
-ls	Print File Information
-maxdepth	Directories
-mindepth	Directories

-mmin	Age Ranges
-mount	Filesystems
-mtime	Age Ranges
-name	Base Name Patterns
-newer	Comparing Timestamps
-nogroup	Owner
-noleaf	Directories
-nouser	Owner
-ok	Querying
-path	Full Name Patterns
-perm	Permissions
-print	Print File Name
-print0	Safe File Name Handling
-printf	Print File Information
-prune	Directories
-regex	Full Name Patterns
-size	Size
-true	Combining Primaries With Operators
-type	Type
-uid	Owner
-used	Comparing Timestamps
-user	Owner
-xdev	Filesystems
-xtype	Type
