1. Command to show directory contents

I

ls

O:

Bui Desktop Documents Downloads examples.desktop Music Pictures Public Templates Videos

2. Get directory listing showing all files in long format

I:

ls -a -l

O:

```
total 156
drwxr-xr-x 21 cong cong 4096 Feb 23 20:06 .
drwxr-xr-x  3 root root 4096 Feb 22 09:13 ..
-rw-------  1 cong cong 8767 Feb 22 21:54 .bash_history
-rw-r--r--  1 cong cong  220 Feb 15 16:53 .bash_logout
-rw-r--r--  1 cong cong 3771 Feb 15 16:53 .bashrc
drwxrwxr-x  4 cong cong 4096 Feb 22 21:24 Bui
drwx------ 12 cong cong 4096 Feb 15 17:19 .cache
drwx------ 14 cong cong 4096 Feb 22 20:45 .config
drwxr-xr-x  2 cong cong 4096 Feb 15 18:46 Desktop
drwxr-xr-x  4 cong cong 4096 Feb 22 19:36 Documents
drwxr-xr-x  5 cong cong 4096 Feb 22 21:34 Downloads
-rw-r--r--  1 cong cong 8980 Feb 15 16:53 examples.desktop
drwx------  3 cong cong 4096 Feb 23 20:25 .gconf
-rw-rw-r--  1 cong cong   85 Feb 22 21:50 .gitconfig
drwx------  3 cong cong 4096 Feb 23 20:06 .gnupg
-rw-------  1 cong cong 2832 Feb 23 20:06 .ICEauthority
drwxrwxr-x  3 cong cong 4096 Feb 15 18:43 .java
drwx------  3 cong cong 4096 Feb 15 17:07 .local
drwxrwxr-x  3 cong cong 4096 Feb 15 18:42 .matlab
drwx------  4 cong cong 4096 Feb 15 17:13 .mozilla
drwxr-xr-x  2 cong cong 4096 Feb 15 17:07 Music
drwxrwxr-x  2 cong cong 4096 Feb 20 10:40 .nano
drwxr-xr-x  2 cong cong 4096 Feb 15 17:07 Pictures
-rw-r--r--  1 cong cong  655 Feb 15 16:53 .profile
drwxr-xr-x  2 cong cong 4096 Feb 15 17:07 Public
drwxrwxr-x  3 cong cong 4096 Feb 15 18:45 .subversion
-rw-r--r--  1 cong cong 0 Feb 15 17:36 .sudo_as_admin_successful
drwxr-xr-x  2 cong cong 4096 Feb 15 17:07 Templates
-rw-r-----  1 cong cong 5 Feb 23 20:06 .vboxclient-clipboard.pid
-rw-r-----  1 cong cong 5 Feb 23 20:06 .vboxclient-display.pid
-rw-r-----  1 cong cong 5 Feb 23 20:06 .vboxclient-draganddrop.pid
-rw-r-----  1 cong cong 5 Feb 23 20:06 .vboxclient-seamless.pid
```

drwxr-xr-x 2 cong cong 4096 Feb 15 17:07 Videos
-rw------- 1 cong cong   60 Feb 23 20:06 .Xauthority
-rw------- 1 cong cong   82 Feb 23 20:06 .xsession-errors
-rw------- 1 cong cong 1156 Feb 22 21:54 .xsession-errors.old

3. What do first ten characters represent?
Types and access right to files.
4. Assess file system disk usage in human readable format
I:
du
O:
4 ./Public
48 ./.java/fonts/1.7.0_60
52 ./.java/fonts
56 ./.java
4 ./Desktop
4 ./Music
4 ./.nano
4 ./.config/upstart
4 ./.config/unity
8 ./.config/gtk-3.0
8 ./.config/ibus/bus
12 ./.config/ibus
20 ./.config/dconf
16 ./.config/libaccounts-glib
4 ./.config/gnome-session/saved-session
8 ./.config/gnome-session
20 ./.config/nautilus
84 ./.config/pulse
4 ./.config/update-notifier
8 ./.config/evolution/sources
12 ./.config/evolution
12 ./.config/compiz-1/compizconfig
16 ./.config/compiz-1
224 ./.config
4 ./Templates
4 ./.gnupg/private-keys-v1.d
8 ./.gnupg
4 ./.mozilla/firefox/Crash Reports/events
12 ./.mozilla/firefox/Crash Reports
100 ./.mozilla/firefox/nh5fijj0.default/datareporting/archived/2017-02
104 ./.mozilla/firefox/nh5fijj0.default/datareporting/archived
128 ./.mozilla/firefox/nh5fijj0.default/datareporting

4 ./.mozilla/firefox/nh5fijj0.default/minidumps
1352 ./.mozilla/firefox/nh5fijj0.default/gmp-gmpopenh264/1.6
1356 ./.mozilla/firefox/nh5fijj0.default/gmp-gmpopenh264
4 ./.mozilla/firefox/nh5fijj0.default/storage/permanent/chrome/idb/2918063365piupsah.files
56 ./.mozilla/firefox/nh5fijj0.default/storage/permanent/chrome/idb
64 ./.mozilla/firefox/nh5fijj0.default/storage/permanent/chrome
68 ./.mozilla/firefox/nh5fijj0.default/storage/permanent
4
./.mozilla/firefox/nh5fijj0.default/storage/default/https+++drive.google.com/idb/830257170ceeglal
roo_ts.files
52 ./.mozilla/firefox/nh5fijj0.default/storage/default/https+++drive.google.com/idb
60 ./.mozilla/firefox/nh5fijj0.default/storage/default/https+++drive.google.com
64 ./.mozilla/firefox/nh5fijj0.default/storage/default
4 ./.mozilla/firefox/nh5fijj0.default/storage/temporary
140 ./.mozilla/firefox/nh5fijj0.default/storage
848 ./.mozilla/firefox/nh5fijj0.default/features/{5ff38c5e-cdd2-4eef-bd53-d7bfe35fd174}
852 ./.mozilla/firefox/nh5fijj0.default/features
4 ./.mozilla/firefox/nh5fijj0.default/crashes/events
12 ./.mozilla/firefox/nh5fijj0.default/crashes
8 ./.mozilla/firefox/nh5fijj0.default/webapps
52 ./.mozilla/firefox/nh5fijj0.default/sessionstore-backups
4 ./.mozilla/firefox/nh5fijj0.default/extensions
4 ./.mozilla/firefox/nh5fijj0.default/saved-telemetry-pings
4 ./.mozilla/firefox/nh5fijj0.default/gmp/Linux_x86_64-gcc3
8 ./.mozilla/firefox/nh5fijj0.default/gmp
8 ./.mozilla/firefox/nh5fijj0.default/bookmarkbackups
15468 ./.mozilla/firefox/nh5fijj0.default
15488 ./.mozilla/firefox
4 ./.mozilla/extensions
15496 ./.mozilla
4 ./Videos
4 ./Pictures
360 ./.cache/upstart
20 ./.cache/ibus/bus
24 ./.cache/ibus
1596 ./.cache/mozilla/firefox/nh5fijj0.default/startupCache
4 ./.cache/mozilla/firefox/nh5fijj0.default/cache2/doomed
25356 ./.cache/mozilla/firefox/nh5fijj0.default/cache2/entries
25396 ./.cache/mozilla/firefox/nh5fijj0.default/cache2
36 ./.cache/mozilla/firefox/nh5fijj0.default/thumbnails
8412 ./.cache/mozilla/firefox/nh5fijj0.default/safebrowsing
35452 ./.cache/mozilla/firefox/nh5fijj0.default
35456 ./.cache/mozilla/firefox

35460 ./.cache/mozilla
24 ./.cache/gnome-software/3.20/firmware
28 ./.cache/gnome-software/3.20
32 ./.cache/gnome-software
272 ./.cache/gstreamer-1.0
648 ./.cache/wallpaper
464 ./.cache/thumbnails/large
468 ./.cache/thumbnails
8 ./.cache/logrotate
128 ./.cache/compizconfig-1
4 ./.cache/evolution/tasks/trash
8 ./.cache/evolution/tasks
4 ./.cache/evolution/calendar/trash
8 ./.cache/evolution/calendar
4 ./.cache/evolution/sources/trash
8 ./.cache/evolution/sources
4 ./.cache/evolution/addressbook/trash
8 ./.cache/evolution/addressbook
4 ./.cache/evolution/mail/trash
8 ./.cache/evolution/mail
4 ./.cache/evolution/memos/trash
8 ./.cache/evolution/memos
52 ./.cache/evolution
37476 ./.cache
32 ./Downloads/Assignment 1
20868 ./Downloads/Assignment3
656 ./Downloads/ASEN4057Assignment2
39700 ./Downloads
4 ./Documents/ASEN4519
4 ./Documents/MATLAB
80 ./Documents
4 ./.matlab/R2016a/HtmlPanel
1336 ./.matlab/R2016a
1340 ./.matlab
4 ./.local/share/unity-settings-daemon
284 ./.local/share/zeitgeist/fts.index
1428 ./.local/share/zeitgeist
24 ./.local/share/mime/application
24 ./.local/share/mime/packages
80 ./.local/share/mime
12 ./.local/share/keyrings
4 ./.local/share/nautilus/scripts
8 ./.local/share/nautilus

4 ./.local/share/Trash/expunged
4 ./.local/share/Trash/info
4 ./.local/share/Trash/files
16 ./.local/share/Trash
4 ./.local/share/sounds
4 ./.local/share/previews
24 ./.local/share/icc
76 ./.local/share/gvfs-metadata
4 ./.local/share/evolution/tasks/trash
8 ./.local/share/evolution/tasks/system
16 ./.local/share/evolution/tasks
4 ./.local/share/evolution/calendar/trash
8 ./.local/share/evolution/calendar/system
16 ./.local/share/evolution/calendar
4 ./.local/share/evolution/addressbook/trash
4 ./.local/share/evolution/addressbook/system/photos
32 ./.local/share/evolution/addressbook/system
40 ./.local/share/evolution/addressbook
4 ./.local/share/evolution/mail/trash
8 ./.local/share/evolution/mail
4 ./.local/share/evolution/memos/trash
8 ./.local/share/evolution/memos
92 ./.local/share/evolution
4 ./.local/share/applications
1768 ./.local/share
1772 ./.local
592 ./Bui/Assignments/Assignment_2/Part_2/Submission
596 ./Bui/Assignments/Assignment_2/Part_2
68 ./Bui/Assignments/Assignment_2/Part_1/Submission
72 ./Bui/Assignments/Assignment_2/Part_1
672 ./Bui/Assignments/Assignment_2
4 ./Bui/Assignments/Assignment_4/Part_3/Submission
8 ./Bui/Assignments/Assignment_4/Part_3
4 ./Bui/Assignments/Assignment_4/Part_2/Submission
8 ./Bui/Assignments/Assignment_4/Part_2
20 ./Bui/Assignments/Assignment_4
20868 ./Bui/Assignments/Assignment_3/Submission
20872 ./Bui/Assignments/Assignment_3
32 ./Bui/Assignments/Assignment_1/Submission
36 ./Bui/Assignments/Assignment_1
21604 ./Bui/Assignments
8 ./Bui/.git/info
12 ./Bui/.git/logs/refs/remotes/origin

16 ./Bui/.git/logs/refs/remotes
8 ./Bui/.git/logs/refs/heads
28 ./Bui/.git/logs/refs
36 ./Bui/.git/logs
44 ./Bui/.git/hooks
8 ./Bui/.git/objects/3c
8 ./Bui/.git/objects/bc
8 ./Bui/.git/objects/d4
16 ./Bui/.git/objects/12
8 ./Bui/.git/objects/40
8 ./Bui/.git/objects/91
4 ./Bui/.git/objects/info
8 ./Bui/.git/objects/c6
8 ./Bui/.git/objects/da
8 ./Bui/.git/objects/a5
152 ./Bui/.git/objects/f0
8 ./Bui/.git/objects/4a
8 ./Bui/.git/objects/98
8544 ./Bui/.git/objects/db
8 ./Bui/.git/objects/99
8 ./Bui/.git/objects/fa
8 ./Bui/.git/objects/88
8 ./Bui/.git/objects/2e
16 ./Bui/.git/objects/ff
8 ./Bui/.git/objects/71
4 ./Bui/.git/objects/pack
8 ./Bui/.git/objects/75
492 ./Bui/.git/objects/b7
8 ./Bui/.git/objects/fc
8 ./Bui/.git/objects/54
8 ./Bui/.git/objects/26
8 ./Bui/.git/objects/6a
8 ./Bui/.git/objects/cd
12 ./Bui/.git/objects/69
8 ./Bui/.git/objects/5e
8 ./Bui/.git/objects/95
68 ./Bui/.git/objects/59
8 ./Bui/.git/objects/e9
8 ./Bui/.git/objects/3d
72 ./Bui/.git/objects/37
8 ./Bui/.git/objects/48
8 ./Bui/.git/objects/93
8 ./Bui/.git/objects/96

8 ./Bui/.git/objects/94
12 ./Bui/.git/objects/b4
8 ./Bui/.git/objects/9f
8 ./Bui/.git/objects/d1
8 ./Bui/.git/objects/79
8 ./Bui/.git/objects/0b
8976 ./Bui/.git/objects/d7
8 ./Bui/.git/objects/87
8 ./Bui/.git/objects/a6
18652 ./Bui/.git/objects
4 ./Bui/.git/refs/tags
12 ./Bui/.git/refs/remotes/origin
16 ./Bui/.git/refs/remotes
8 ./Bui/.git/refs/heads
32 ./Bui/.git/refs
4 ./Bui/.git/branches
18808 ./Bui/.git
40420 ./Bui
8 ./.gconf/desktop/gnome/url-handlers/ftp
8 ./.gconf/desktop/gnome/url-handlers/http
8 ./.gconf/desktop/gnome/url-handlers/https
8 ./.gconf/desktop/gnome/url-handlers/chrome
36 ./.gconf/desktop/gnome/url-handlers
40 ./.gconf/desktop/gnome
44 ./.gconf/desktop
48 ./.gconf
4 ./.subversion/auth/svn.ssl.client-passphrase
4 ./.subversion/auth/svn.username
4 ./.subversion/auth/svn.simple
4 ./.subversion/auth/svn.ssl.server
20 ./.subversion/auth
48 ./.subversion
136772 .

5.
I:
ls /usr/bin/
man sleep
man date
man echo
man less
man cat
O:

SLEEP(1) User Commands SLEEP(1)

NAME

sleep - delay for a specified amount of time

SYNOPSIS

sleep NUMBER[SUFFIX]...
sleep OPTION

DESCRIPTION

Pause for NUMBER seconds. SUFFIX may be 's' for seconds (the default), 'm' for minutes,
'h' for hours or 'd' for days. Unlike most implementations that require NUMBER be an inte-
ger, here NUMBER may be an arbitrary floating point number. Given two or more arguments,
pause for the amount of time specified by the sum of their values.

--help display this help and exit

--version
output version information and exit

AUTHOR

Written by Jim Meyering and Paul Eggert.

REPORTING BUGS

GNU coreutils online help: <http://www.gnu.org/software/coreutils/>
Report sleep translation bugs to <http://translationproject.org/team/>

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to the extent permitted by law.

SEE ALSO

sleep(3)

Full documentation at: <http://www.gnu.org/software/coreutils/sleep>
or available locally via: info '(coreutils) sleep invocation'

NAME

date - print or set the system date and time

SYNOPSIS

date [OPTION]... [+FORMAT]
date [-u|--utc|--universal] [MMDDhhmm[[CC]YY][.ss]]

DESCRIPTION

Display the current time in the given FORMAT, or set the system date.

Mandatory arguments to long options are mandatory for short options too.

-d, --date=STRING
display time described by STRING, not 'now'

-f, --file=DATEFILE
like --date; once for each line of DATEFILE

-I[FMT], --iso-8601[=FMT]
output date/time in ISO 8601 format. FMT='date' for date only (the default), 'hours', 'minutes', 'seconds', or 'ns' for date and time to the indicated precision. Example: 2006-08-14T02:34:56-0600

-R, --rfc-2822
output date and time in RFC 2822 format. Example: Mon, 14 Aug 2006 02:34:56 -0600

--rfc-3339=FMT
output date/time in RFC 3339 format. FMT='date', 'seconds', or 'ns' for date and time to the indicated precision. Example: 2006-08-14 02:34:56-06:00

-r, --reference=FILE
display the last modification time of FILE

-s, --set=STRING
set time described by STRING

-u, --utc, --universal
print or set Coordinated Universal Time (UTC)

--help display this help and exit

--version
output version information and exit

FORMAT controls the output. Interpreted sequences are:

%% a literal %

%a locale's abbreviated weekday name (e.g., Sun)

%A locale's full weekday name (e.g., Sunday)

%b locale's abbreviated month name (e.g., Jan)

%B locale's full month name (e.g., January)

%c locale's date and time (e.g., Thu Mar 3 23:05:25 2005)

%C century; like %Y, except omit last two digits (e.g., 20)

%d day of month (e.g., 01)

%D date; same as %m/%d/%y

%e day of month, space padded; same as %_d

%F full date; same as %Y-%m-%d

%g last two digits of year of ISO week number (see %G)

%G year of ISO week number (see %V); normally useful only with %V

%h same as %b

%H hour (00..23)

%I hour (01..12)

%j day of year (001..366)

%k hour, space padded (0..23); same as %_H

%l	hour, space padded (1..12); same as %_I
%m	month (01..12)
%M	minute (00..59)
%n	a newline
%N	nanoseconds (000000000..999999999)
%p	locale's equivalent of either AM or PM; blank if not known
%P	like %p, but lower case
%r	locale's 12-hour clock time (e.g., 11:11:04 PM)
%R	24-hour hour and minute; same as %H:%M
%s	seconds since 1970-01-01 00:00:00 UTC
%S	second (00..60)
%t	a tab
%T	time; same as %H:%M:%S
%u	day of week (1..7); 1 is Monday
%U	week number of year, with Sunday as first day of week (00..53)
%V	ISO week number, with Monday as first day of week (01..53)
%w	day of week (0..6); 0 is Sunday
%W	week number of year, with Monday as first day of week (00..53)
%x	locale's date representation (e.g., 12/31/99)
%X	locale's time representation (e.g., 23:13:48)
%y	last two digits of year (00..99)
%Y	year

%z +hhmm numeric time zone (e.g., -0400)

%:z +hh:mm numeric time zone (e.g., -04:00)

%::z +hh:mm:ss numeric time zone (e.g., -04:00:00)

%:::z numeric time zone with : to necessary precision (e.g., -04, +05:30)

%Z alphabetic time zone abbreviation (e.g., EDT)

By default, date pads numeric fields with zeroes. The following optional flags may follow '%':

- (hyphen) do not pad the field

_ (underscore) pad with spaces

0 (zero) pad with zeros

^ use upper case if possible

use opposite case if possible

After any flags comes an optional field width, as a decimal number; then an optional modifier, which is either E to use the locale's alternate representations if available, or O to use the locale's alternate numeric symbols if available.

EXAMPLES

Convert seconds since the epoch (1970-01-01 UTC) to a date

$ date --date='@2147483647'

Show the time on the west coast of the US (use tzselect(1) to find TZ)

$ TZ='America/Los_Angeles' date

Show the local time for 9AM next Friday on the west coast of the US

$ date --date='TZ="America/Los_Angeles" 09:00 next Fri'

DATE STRING

The --date=STRING is a mostly free format human readable date string such as "Sun, 29 Feb 2004 16:21:42 -0800" or "2004-02-29 16:21:42" or even "next Thursday". A date string may contain items indicating calendar date, time of day, time zone, day of week, relative time, relative date, and numbers. An empty string indicates the beginning of the day. The date string format is more complex than is easily documented here but is fully described in the info documentation.

AUTHOR

Written by David MacKenzie.

REPORTING BUGS

GNU coreutils online help: <http://www.gnu.org/software/coreutils/>
Report date translation bugs to <http://translationproject.org/team/>

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SEE ALSO

Full documentation at: <http://www.gnu.org/software/coreutils/date>
or available locally via: info '(coreutils) date invocation'

NAME

echo - display a line of text

SYNOPSIS

echo [SHORT-OPTION]... [STRING]...
echo LONG-OPTION

DESCRIPTION

Echo the STRING(s) to standard output.

-n do not output the trailing newline

-e enable interpretation of backslash escapes

-E disable interpretation of backslash escapes (default)

--help display this help and exit

--version
output version information and exit

If -e is in effect, the following sequences are recognized:

\\ backslash

\a alert (BEL)

\b backspace

\c produce no further output

\e escape

\f form feed

\n new line

\r carriage return

\t horizontal tab

\v vertical tab

\0NNN byte with octal value NNN (1 to 3 digits)

\xHH byte with hexadecimal value HH (1 to 2 digits)

NOTE: your shell may have its own version of echo, which usually supersedes the version
described here. Please refer to your shell's documentation for details about the options it supports.

AUTHOR

Written by Brian Fox and Chet Ramey.

REPORTING BUGS

GNU coreutils online help: <http://www.gnu.org/software/coreutils/>
Report echo translation bugs to <http://translationproject.org/team/>

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SEE ALSO

Full documentation at: <http://www.gnu.org/software/coreutils/echo>
or available locally via: info '(coreutils) echo invocation'

NAME

less - opposite of more

SYNOPSIS

less -?
less --help
less -V
less --version
less [-[+]aABcCdeEfFgGiIJKLmMnNqQrRsSuUVwWX~]
[-b space] [-h lines] [-j line] [-k keyfile]
[-{oO} logfile] [-p pattern] [-P prompt] [-t tag]
[-T tagsfile] [-x tab,...] [-y lines] [-[z] lines]
[-# shift] [+[+]cmd] [--] [filename]...
(See the OPTIONS section for alternate option syntax with long option names.)

DESCRIPTION

Less is a program similar to more (1), but it has many more features. Less does not have
to read the entire input file before starting, so with large input files it starts up
faster than text editors like vi (1). Less uses termcap (or terminfo on some systems), so
it can run on a variety of terminals. There is even limited support for hardcopy termi-

nals. (On a hardcopy terminal, lines which should be printed at the top of the screen are prefixed with a caret.)

Commands are based on both more and vi. Commands may be preceded by a decimal number,
called N in the descriptions below. The number is used by some commands, as indicated.

COMMANDS

In the following descriptions, ^X means control-X. ESC stands for the ESCAPE key; for
example ESC-v means the two character sequence "ESCAPE", then "v".

h or H Help: display a summary of these commands. If you forget all the other commands,
remember this one.

SPACE or ^V or f or ^F
Scroll forward N lines, default one window (see option -z below). If N is more than the screen size, only the final screenful is displayed. Warning: some systems use ^V as a special literalization character.

z Like SPACE, but if N is specified, it becomes the new window size.

ESC-SPACE
Like SPACE, but scrolls a full screenful, even if it reaches end-of-file in the process.

ENTER or RETURN or ^N or e or ^E or j or ^J
Scroll forward N lines, default 1. The entire N lines are displayed, even if N is more than the screen size.

d or ^D
Scroll forward N lines, default one half of the screen size. If N is specified, it becomes the new default for subsequent d and u commands.

b or ^B or ESC-v
Scroll backward N lines, default one window (see option -z below). If N is more than the screen size, only the final screenful is displayed.

w Like ESC-v, but if N is specified, it becomes the new window size.

y or ^Y or ^P or k or ^K

Scroll backward N lines, default 1. The entire N lines are displayed, even if N is more than the screen size. Warning: some systems use ^Y as a special job control character.

u or ^U
Scroll backward N lines, default one half of the screen size. If N is specified, it becomes the new default for subsequent d and u commands.

J Like j, but continues to scroll beyond the end of the file.

K or Y Like k, but continues to scroll beyond the beginning of the file.

ESC-) or RIGHTARROW
Scroll horizontally right N characters, default half the screen width (see the -# option). If a number N is specified, it becomes the default for future RIGHTARROW and LEFTARROW commands. While the text is scrolled, it acts as though the -S option (chop lines) were in effect.

ESC-(or LEFTARROW
Scroll horizontally left N characters, default half the screen width (see the -# option). If a number N is specified, it becomes the default for future RIGHTARROW and LEFTARROW commands.

r or ^R or ^L
Repaint the screen.

R Repaint the screen, discarding any buffered input. Useful if the file is changing while it is being viewed.

F Scroll forward, and keep trying to read when the end of file is reached. Normally
this command would be used when already at the end of the file. It is a way to monitor the tail of a file which is growing while it is being viewed. (The behavior is similar to the "tail -f" command.)

ESC-F Like F, but as soon as a line is found which matches the last search pattern, the
terminal bell is rung and forward scrolling stops.

g or < or ESC-<
Go to line N in the file, default 1 (beginning of file). (Warning: this may be slow if N is large.)

G or > or ESC->
Go to line N in the file, default the end of the file. (Warning: this may be slow if N is large, or if N is not specified and standard input, rather than a file, is being read.)

ESC-G Same as G, except if no number N is specified and the input is standard input, goes to the last line which is currently buffered.

p or % Go to a position N percent into the file. N should be between 0 and 100, and may contain a decimal point.

P Go to the line containing byte offset N in the file.

{ If a left curly bracket appears in the top line displayed on the screen, the { command will go to the matching right curly bracket. The matching right curly bracket is positioned on the bottom line of the screen. If there is more than one left curly bracket on the top line, a number N may be used to specify the N-th bracket on the line.

} If a right curly bracket appears in the bottom line displayed on the screen, the } command will go to the matching left curly bracket. The matching left curly bracket is positioned on the top line of the screen. If there is more than one right curly bracket on the top line, a number N may be used to specify the N-th bracket on the line.

(Like {, but applies to parentheses rather than curly brackets.

) Like }, but applies to parentheses rather than curly brackets.

[Like {, but applies to square brackets rather than curly brackets.

] Like }, but applies to square brackets rather than curly brackets.

ESC-^F Followed by two characters, acts like {, but uses the two characters as open and close brackets, respectively. For example, "ESC ^F < >" could be used to go forward to the > which matches the < in the top displayed line.

ESC-^B Followed by two characters, acts like }, but uses the two characters as open and close brackets, respectively. For example, "ESC ^B < >" could be used to go back-

ward to the < which matches the > in the bottom displayed line.

m Followed by any lowercase letter, marks the current position with that letter.

' (Single quote.) Followed by any lowercase letter, returns to the position which was
previously marked with that letter. Followed by another single quote, returns to the position at which the last "large" movement command was executed. Followed by a ^ or $, jumps to the beginning or end of the file respectively. Marks are preserved when a new file is examined, so the ' command can be used to switch between input files.

^X^X Same as single quote.

/pattern
Search forward in the file for the N-th line containing the pattern. N defaults to 1. The pattern is a regular expression, as recognized by the regular expression library supplied by your system. The search starts at the first line displayed (but see the -a and -j options, which change this).

Certain characters are special if entered at the beginning of the pattern; they modify the type of search rather than become part of the pattern:

^N or !
Search for lines which do NOT match the pattern.

^E or *
Search multiple files. That is, if the search reaches the END of the current file without finding a match, the search continues in the next file in the command line list.

^F or @
Begin the search at the first line of the FIRST file in the command line list, regardless of what is currently displayed on the screen or the settings of the -a or -j options.

^K Highlight any text which matches the pattern on the current screen, but don't move to the first match (KEEP current position).

^R Don't interpret regular expression metacharacters; that is, do a simple textual comparison.

?pattern

Search backward in the file for the N-th line containing the pattern. The search starts at the last line displayed (but see the -a and -j options, which change this).

Certain characters are special as in the / command:

^N or !
Search for lines which do NOT match the pattern.

^E or *
Search multiple files. That is, if the search reaches the beginning of the current file without finding a match, the search continues in the previous file in the command line list.

^F or @
Begin the search at the last line of the last file in the command line list, regardless of what is currently displayed on the screen or the settings of the -a or -j options.

^K As in forward searches.

^R As in forward searches.

ESC-/pattern
Same as "/*".

ESC-?pattern
Same as "?*".

n Repeat previous search, for N-th line containing the last pattern. If the previous search was modified by ^N, the search is made for the N-th line NOT containing the pattern. If the previous search was modified by ^E, the search continues in the next (or previous) file if not satisfied in the current file. If the previous search was modified by ^R, the search is done without using regular expressions. There is no effect if the previous search was modified by ^F or ^K.

N Repeat previous search, but in the reverse direction.

ESC-n Repeat previous search, but crossing file boundaries. The effect is as if the previous search were modified by *.

ESC-N Repeat previous search, but in the reverse direction and crossing file boundaries.

ESC-u Undo search highlighting. Turn off highlighting of strings matching the current search pattern. If highlighting is already off because of a previous ESC-u command, turn highlighting back on. Any search command will also turn highlighting back on. (Highlighting can also be disabled by toggling the -G option; in that case search commands do not turn highlighting back on.)

&pattern
Display only lines which match the pattern; lines which do not match the pattern are not displayed. If pattern is empty (if you type & immediately followed by ENTER), any filtering is turned off, and all lines are displayed. While filtering is in effect, an ampersand is displayed at the beginning of the prompt, as a reminder that some lines in the file may be hidden.

Certain characters are special as in the / command:

^N or !
Display only lines which do NOT match the pattern.

^R Don't interpret regular expression metacharacters; that is, do a simple textual comparison.

:e [filename]
Examine a new file. If the filename is missing, the "current" file (see the :n and :p commands below) from the list of files in the command line is re-examined. A percent sign (%) in the filename is replaced by the name of the current file. A pound sign (#) is replaced by the name of the previously examined file. However, two consecutive percent signs are simply replaced with a single percent sign. This allows you to enter a filename that contains a percent sign in the name. Similarly, two consecutive pound signs are replaced with a single pound sign. The filename is inserted into the command line list of files so that it can be seen by subsequent :n and :p commands. If the filename consists of several files, they are all inserted into the list of files and the first one is examined. If the filename contains one or more spaces, the entire filename should be enclosed in double quotes (also see the -" option).

^X^V or E
Same as :e. Warning: some systems use ^V as a special literalization character. On such systems, you may not be able to use ^V.

:n Examine the next file (from the list of files given in the command line). If a number N is specified, the N-th next file is examined.

:p Examine the previous file in the command line list. If a number N is specified, the N-th previous file is examined.

:x Examine the first file in the command line list. If a number N is specified, the N-th file in the list is examined.

:d Remove the current file from the list of files.

t Go to the next tag, if there were more than one matches for the current tag. See the -t option for more details about tags.

T Go to the previous tag, if there were more than one matches for the current tag.

= or ^G or :f
Prints some information about the file being viewed, including its name and the line number and byte offset of the bottom line being displayed. If possible, it also prints the length of the file, the number of lines in the file and the percent of the file above the last displayed line.

- Followed by one of the command line option letters (see OPTIONS below), this will change the setting of that option and print a message describing the new setting. If a ^P (CONTROL-P) is entered immediately after the dash, the setting of the option is changed but no message is printed. If the option letter has a numeric value (such as -b or -h), or a string value (such as -P or -t), a new value may be entered after the option letter. If no new value is entered, a message describing the current setting is printed and nothing is changed.

-- Like the - command, but takes a long option name (see OPTIONS below) rather than a single option letter. You must press ENTER or RETURN after typing the option name. A ^P immediately after the second dash suppresses printing of a message describing the new setting, as in the - command.

-+ Followed by one of the command line option letters this will reset the option to its default setting and print a message describing the new setting. (The "-+X" command does the same thing as "-+X" on the command line.) This does not work for string-valued options.

--+ Like the -+ command, but takes a long option name rather than a single option letter.

-! Followed by one of the command line option letters, this will reset the option to the "opposite" of its default setting and print a message describing the new setting. This does not work for numeric or string-valued options.

--! Like the -! command, but takes a long option name rather than a single option letter.

_ (Underscore.) Followed by one of the command line option letters, this will print a message describing the current setting of that option. The setting of the option is not changed.

__ (Double underscore.) Like the _ (underscore) command, but takes a long option name rather than a single option letter. You must press ENTER or RETURN after typing the option name.

+cmd Causes the specified cmd to be executed each time a new file is examined. For example, +G causes less to initially display each file starting at the end rather than the beginning.

V Prints the version number of less being run.

q or Q or :q or :Q or ZZ
Exits less.

The following four commands may or may not be valid, depending on your particular installation.

v Invokes an editor to edit the current file being viewed. The editor is taken from the environment variable VISUAL if defined, or EDITOR if VISUAL is not defined, or defaults to "vi" if neither VISUAL nor EDITOR is defined. See also the discussion of LESSEDIT under the section on PROMPTS below.

! shell-command
Invokes a shell to run the shell-command given. A percent sign (%) in the command is replaced by the name of the current file. A pound sign (#) is replaced by the name of the previously examined file. "!!" repeats the last shell command. "!" with no shell command simply invokes a shell. On Unix systems, the shell is taken

from the environment variable SHELL, or defaults to "sh". On MS-DOS and OS/2 systems, the shell is the normal command processor.

| <m> shell-command
<m> represents any mark letter. Pipes a section of the input file to the given shell command. The section of the file to be piped is between the first line on the current screen and the position marked by the letter. <m> may also be ^ or $ to indicate beginning or end of file respectively. If <m> is . or newline, the current screen is piped.

s filename
Save the input to a file. This only works if the input is a pipe, not an ordinary file.

OPTIONS

Command line options are described below. Most options may be changed while less is running, via the "-" command.

Most options may be given in one of two forms: either a dash followed by a single letter, or two dashes followed by a long option name. A long option name may be abbreviated as long as the abbreviation is unambiguous. For example, --quit-at-eof may be abbreviated --quit, but not --qui, since both --quit-at-eof and --quiet begin with --qui. Some long option names are in uppercase, such as --QUIT-AT-EOF, as distinct from --quit-at-eof. Such option names need only have their first letter capitalized; the remainder of the name may be in either case. For example, --Quit-at-eof is equivalent to --QUIT-AT-EOF.

Options are also taken from the environment variable "LESS". For example, to avoid typing "less -options ..." each time less is invoked, you might tell csh:

setenv LESS "-options"

or if you use sh:

LESS="-options"; export LESS

On MS-DOS, you don't need the quotes, but you should replace any percent signs in the

options string by double percent signs.

The environment variable is parsed before the command line, so command line options override the LESS environment variable. If an option appears in the LESS variable, it can be reset to its default value on the command line by beginning the command line option with "-+".

Some options like -k or -D require a string to follow the option letter. The string for that option is considered to end when a dollar sign ($) is found. For example, you can set two -D options on MS-DOS like this:

LESS="Dn9.1$Ds4.1"

If the --use-backslash option appears earlier in the options, then a dollar sign or backslash may be included literally in an option string by preceding it with a backslash. If the --use-backslash option is not in effect, then backslashes are not treated specially, and there is no way to include a dollar sign in the option string.

-? or --help
This option displays a summary of the commands accepted by less (the same as the h command). (Depending on how your shell interprets the question mark, it may be necessary to quote the question mark, thus: "-\?".)

-a or --search-skip-screen
By default, forward searches start at the top of the displayed screen and backwards searches start at the bottom of the displayed screen (except for repeated searches invoked by the n or N commands, which start after or before the "target" line respectively; see the -j option for more about the target line). The -a option causes forward searches to instead start at the bottom of the screen and backward searches to start at the top of the screen, thus skipping all lines displayed on the screen.

-A or --SEARCH-SKIP-SCREEN
Causes all forward searches (not just non-repeated searches) to start just after the target line, and all backward searches to start just before the target line. Thus, forward searches will skip part of the displayed screen (from the first line up to and including the target line). Similarly backwards searches will skip the displayed screen from the last line up to and including the target line. This was the default behavior in less versions prior to 441.

-bn or --buffers=n
Specifies the amount of buffer space less will use for each file, in units of kilo-bytes (1024 bytes). By default 64 K of buffer space is used for each file (unless the file is a pipe; see the -B option). The -b option specifies instead that n kilobytes of buffer space should be used for each file. If n is -1, buffer space is unlimited; that is, the entire file can be read into memory.

-B or --auto-buffers
By default, when data is read from a pipe, buffers are allocated automatically as needed. If a large amount of data is read from the pipe, this can cause a large amount of memory to be allocated. The -B option disables this automatic allocation of buffers for pipes, so that only 64 K (or the amount of space specified by the -b option) is used for the pipe. Warning: use of -B can result in erroneous display, since only the most recently viewed part of the piped data is kept in memory; any earlier data is lost.

-c or --clear-screen
Causes full screen repaints to be painted from the top line down. By default, full screen repaints are done by scrolling from the bottom of the screen.

-C or --CLEAR-SCREEN
Same as -c, for compatibility with older versions of less.

-d or --dumb
The -d option suppresses the error message normally displayed if the terminal is dumb; that is, lacks some important capability, such as the ability to clear the screen or scroll backward. The -d option does not otherwise change the behavior of less on a dumb terminal.

-Dxcolor or --color=xcolor
[MS-DOS only] Sets the color of the text displayed. x is a single character which selects the type of text whose color is being set: n=normal, s=standout, d=bold, u=underlined, k=blink. color is a pair of numbers separated by a period. The first number selects the foreground color and the second selects the background color of the text. A single number N is the same as N.M, where M is the normal background color.

-e or --quit-at-eof
Causes less to automatically exit the second time it reaches end-of-file. By default, the only way to exit less is via the "q" command.

-E or --QUIT-AT-EOF

Causes less to automatically exit the first time it reaches end-of-file.

-f or --force
Forces non-regular files to be opened. (A non-regular file is a directory or a device special file.) Also suppresses the warning message when a binary file is opened. By default, less will refuse to open non-regular files. Note that some operating systems will not allow directories to be read, even if -f is set.

-F or --quit-if-one-screen
Causes less to automatically exit if the entire file can be displayed on the first screen.

-g or --hilite-search
Normally, less will highlight ALL strings which match the last search command. The -g option changes this behavior to highlight only the particular string which was found by the last search command. This can cause less to run somewhat faster than the default.

-G or --HILITE-SEARCH
The -G option suppresses all highlighting of strings found by search commands.

-hn or --max-back-scroll=n
Specifies a maximum number of lines to scroll backward. If it is necessary to scroll backward more than n lines, the screen is repainted in a forward direction instead. (If the terminal does not have the ability to scroll backward, -h0 is implied.)

-i or --ignore-case
Causes searches to ignore case; that is, uppercase and lowercase are considered identical. This option is ignored if any uppercase letters appear in the search pattern; in other words, if a pattern contains uppercase letters, then that search does not ignore case.

-I or --IGNORE-CASE
Like -i, but searches ignore case even if the pattern contains uppercase letters.

-jn or --jump-target=n
Specifies a line on the screen where the "target" line is to be positioned. The target line is the line specified by any command to search for a pattern, jump to a line number, jump to a file percentage or jump to a tag. The screen line may be specified by a number: the top line on the screen is 1, the next is 2, and so on. The number may be negative to specify a line relative to the bottom of the screen: the bottom line on the screen is -1, the second to the bottom is -2, and so on.

Alternately, the screen line may be specified as a fraction of the height of the screen, starting with a decimal point: .5 is in the middle of the screen, .3 is three tenths down from the first line, and so on. If the line is specified as a fraction, the actual line number is recalculated if the terminal window is resized, so that the target line remains at the specified fraction of the screen height. If any form of the -j option is used, repeated forward searches (invoked with "n" or "N") begin at the line immediately after the target line, and repeated backward searches begin at the target line, unless changed by -a or -A. For example, if "-j4" is used, the target line is the fourth line on the screen, so forward searches begin at the fifth line on the screen. However nonrepeated searches (invoked with "/" or "?") always begin at the start or end of the current screen respectively.

-J or --status-column
Displays a status column at the left edge of the screen. The status column shows the lines that matched the current search. The status column is also used if the -w or -W option is in effect.

-kfilename or --lesskey-file=filename
Causes less to open and interpret the named file as a lesskey (1) file. Multiple -k options may be specified. If the LESSKEY or LESSKEY_SYSTEM environment variable is
set, or if a lesskey file is found in a standard place (see KEY BINDINGS), it is also used as a lesskey file.

-K or --quit-on-intr
Causes less to exit immediately (with status 2) when an interrupt character (usually ^C) is typed. Normally, an interrupt character causes less to stop whatever it is doing and return to its command prompt. Note that use of this option makes it impossible to return to the command prompt from the "F" command.

-L or --no-lessopen
Ignore the LESSOPEN environment variable (see the INPUT PREPROCESSOR section below).
This option can be set from within less, but it will apply only to files opened subsequently, not to the file which is currently open.

-m or --long-prompt
Causes less to prompt verbosely (like more), with the percent into the file. By default, less prompts with a colon.

-M or --LONG-PROMPT
Causes less to prompt even more verbosely than more.

-n or --line-numbers
Suppresses line numbers. The default (to use line numbers) may cause less to run more slowly in some cases, especially with a very large input file. Suppressing line numbers with the -n option will avoid this problem. Using line numbers means: the line number will be displayed in the verbose prompt and in the = command, and the v command will pass the current line number to the editor (see also the discussion of LESSEDIT in PROMPTS below).

-N or --LINE-NUMBERS
Causes a line number to be displayed at the beginning of each line in the display.

-ofilename or --log-file=filename
Causes less to copy its input to the named file as it is being viewed. This applies only when the input file is a pipe, not an ordinary file. If the file already exists, less will ask for confirmation before overwriting it.

-Ofilename or --LOG-FILE=filename
The -O option is like -o, but it will overwrite an existing file without asking for confirmation.

If no log file has been specified, the -o and -O options can be used from within less to specify a log file. Without a file name, they will simply report the name of the log file. The "s" command is equivalent to specifying -o from within less.

-ppattern or --pattern=pattern
The -p option on the command line is equivalent to specifying +/pattern; that is, it tells less to start at the first occurrence of pattern in the file.

-Pprompt or --prompt=prompt
Provides a way to tailor the three prompt styles to your own preference. This option would normally be put in the LESS environment variable, rather than being typed in with each less command. Such an option must either be the last option in the LESS variable, or be terminated by a dollar sign.
-Ps followed by a string changes the default (short) prompt to that string.
-Pm changes the medium (-m) prompt.
-PM changes the long (-M) prompt.
-Ph changes the prompt for the help screen.
-P= changes the message printed by the = command.
-Pw changes the message printed while waiting for data (in the F command). All prompt strings consist of a sequence of letters and special escape sequences. See the section on PROMPTS for more details.

-q or --quiet or --silent

Causes moderately "quiet" operation: the terminal bell is not rung if an attempt is made to scroll past the end of the file or before the beginning of the file. If the terminal has a "visual bell", it is used instead. The bell will be rung on certain other errors, such as typing an invalid character. The default is to ring the terminal bell in all such cases.

-Q or --QUIET or --SILENT
Causes totally "quiet" operation: the terminal bell is never rung.

-r or --raw-control-chars
Causes "raw" control characters to be displayed. The default is to display control characters using the caret notation; for example, a control-A (octal 001) is displayed as "^A". Warning: when the -r option is used, less cannot keep track of the actual appearance of the screen (since this depends on how the screen responds to each type of control character). Thus, various display problems may result, such as long lines being split in the wrong place.

-R or --RAW-CONTROL-CHARS
Like -r, but only ANSI "color" escape sequences are output in "raw" form. Unlike -r, the screen appearance is maintained correctly in most cases. ANSI "color" escape sequences are sequences of the form:

ESC [... m

where the "..." is zero or more color specification characters For the purpose of keeping track of screen appearance, ANSI color escape sequences are assumed to not move the cursor. You can make less think that characters other than "m" can end ANSI color escape sequences by setting the environment variable LESSANSIENDCHARS to
the list of characters which can end a color escape sequence. And you can make less think that characters other than the standard ones may appear between the ESC and the m by setting the environment variable LESSANSIMIDCHARS to the list of characters which can appear.

-s or --squeeze-blank-lines
Causes consecutive blank lines to be squeezed into a single blank line. This is useful when viewing nroff output.

-S or --chop-long-lines
Causes lines longer than the screen width to be chopped (truncated) rather than wrapped. That is, the portion of a long line that does not fit in the screen width is not shown. The default is to wrap long lines; that is, display the remainder on the next line.

-ttag or --tag=tag
The -t option, followed immediately by a TAG, will edit the file containing that tag. For this to work, tag information must be available; for example, there may be a file in the current directory called "tags", which was previously built by ctags (1) or an equivalent command. If the environment variable LESSGLOBALTAGS is set, it is taken to be the name of a command compatible with global (1), and that command is executed to find the tag. (See http://www.gnu.org/software/global/global.html). The -t option may also be specified from within less (using the - command) as a way of examining a new file. The command ":t" is equivalent to specifying -t from within less.

-Ttagsfile or --tag-file=tagsfile
Specifies a tags file to be used instead of "tags".

-u or --underline-special
Causes backspaces and carriage returns to be treated as printable characters; that is, they are sent to the terminal when they appear in the input.

-U or --UNDERLINE-SPECIAL
Causes backspaces, tabs and carriage returns to be treated as control characters; that is, they are handled as specified by the -r option.

By default, if neither -u nor -U is given, backspaces which appear adjacent to an underscore character are treated specially: the underlined text is displayed using the terminal's hardware underlining capability. Also, backspaces which appear between two identical characters are treated specially: the overstruck text is printed using the terminal's hardware boldface capability. Other backspaces are deleted, along with the preceding character. Carriage returns immediately followed by a newline are deleted. Other carriage returns are handled as specified by the -r option. Text which is overstruck or underlined can be searched for if neither -u nor -U is in effect.

-V or --version
Displays the version number of less.

-w or --hilite-unread
Temporarily highlights the first "new" line after a forward movement of a full page. The first "new" line is the line immediately following the line previously at the bottom of the screen. Also highlights the target line after a g or p command. The highlight is removed at the next command which causes movement. The entire line is highlighted, unless the -J option is in effect, in which case only the status column is highlighted.

-W or --HILITE-UNREAD
Like -w, but temporarily highlights the first new line after any forward movement command larger than one line.

-xn,... or --tabs=n,...
Sets tab stops. If only one n is specified, tab stops are set at multiples of n. If multiple values separated by commas are specified, tab stops are set at those positions, and then continue with the same spacing as the last two. For example, -x9,17 will set tabs at positions 9, 17, 25, 33, etc. The default for n is 8.

-X or --no-init
Disables sending the termcap initialization and deinitialization strings to the terminal. This is sometimes desirable if the deinitialization string does something unnecessary, like clearing the screen.

-yn or --max-forw-scroll=n
Specifies a maximum number of lines to scroll forward. If it is necessary to scroll forward more than n lines, the screen is repainted instead. The -c or -C option may be used to repaint from the top of the screen if desired. By default, any forward movement causes scrolling.

-[z]n or --window=n
Changes the default scrolling window size to n lines. The default is one screenful. The z and w commands can also be used to change the window size. The "z" may be omitted for compatibility with some versions of more. If the number n is negative, it indicates n lines less than the current screen size. For example, if the screen is 24 lines, -z-4 sets the scrolling window to 20 lines. If the screen is resized to 40 lines, the scrolling window automatically changes to 36 lines.

-"cc or --quotes=cc
Changes the filename quoting character. This may be necessary if you are trying to name a file which contains both spaces and quote characters. Followed by a single character, this changes the quote character to that character. Filenames containing a space should then be surrounded by that character rather than by double quotes. Followed by two characters, changes the open quote to the first character, and the close quote to the second character. Filenames containing a space should then be preceded by the open quote character and followed by the close quote character. Note that even after the quote characters are changed, this option remains -" (a dash followed by a double quote).

-~ or --tilde
Normally lines after end of file are displayed as a single tilde (~). This option

causes lines after end of file to be displayed as blank lines.

-# or --shift
Specifies the default number of positions to scroll horizontally in the RIGHTARROW and LEFTARROW commands. If the number specified is zero, it sets the default number of positions to one half of the screen width. Alternately, the number may be specified as a fraction of the width of the screen, starting with a decimal point: .5 is half of the screen width, .3 is three tenths of the screen width, and so on. If the number is specified as a fraction, the actual number of scroll positions is recalculated if the terminal window is resized, so that the actual scroll remains at the specified fraction of the screen width.

--follow-name
Normally, if the input file is renamed while an F command is executing, less will continue to display the contents of the original file despite its name change. If --follow-name is specified, during an F command less will periodically attempt to reopen the file by name. If the reopen succeeds and the file is a different file from the original (which means that a new file has been created with the same name as the original (now renamed) file), less will display the contents of that new file.

--no-keypad
Disables sending the keypad initialization and deinitialization strings to the terminal. This is sometimes useful if the keypad strings make the numeric keypad behave in an undesirable manner.

--use-backslash
This option changes the interpretations of options which follow this one. After the --use-backslash option, any backslash in an option string is removed and the following character is taken literally. This allows a dollar sign to be included in option strings.

-- A command line argument of "--" marks the end of option arguments. Any arguments following this are interpreted as filenames. This can be useful when viewing a file whose name begins with a "-" or "+".

+ If a command line option begins with +, the remainder of that option is taken to be an initial command to less. For example, +G tells less to start at the end of the file rather than the beginning, and +/xyz tells it to start at the first occurrence of "xyz" in the file. As a special case, +<number> acts like +<number>g; that is,

it starts the display at the specified line number (however, see the caveat under the "g" command above). If the option starts with ++, the initial command applies to every file being viewed, not just the first one. The + command described previously may also be used to set (or change) an initial command for every file.

LINE EDITING

When entering command line at the bottom of the screen (for example, a filename for the :e command, or the pattern for a search command), certain keys can be used to manipulate the command line. Most commands have an alternate form in [brackets] which can be used if a key does not exist on a particular keyboard. (Note that the forms beginning with ESC do not work in some MS-DOS and Windows systems because ESC is the line erase character.) Any of these special keys may be entered literally by preceding it with the "literal" character, either ^V or ^A. A backslash itself may also be entered literally by entering two backslashes.

LEFTARROW [ESC-h]
Move the cursor one space to the left.

RIGHTARROW [ESC-l]
Move the cursor one space to the right.

^LEFTARROW [ESC-b or ESC-LEFTARROW]
(That is, CONTROL and LEFTARROW simultaneously.) Move the cursor one word to the left.

^RIGHTARROW [ESC-w or ESC-RIGHTARROW]
(That is, CONTROL and RIGHTARROW simultaneously.) Move the cursor one word to the right.

HOME [ESC-0]
Move the cursor to the beginning of the line.

END [ESC-$]
Move the cursor to the end of the line.

BACKSPACE

Delete the character to the left of the cursor, or cancel the command if the command line is empty.

DELETE or [ESC-x]
Delete the character under the cursor.

^BACKSPACE [ESC-BACKSPACE]
(That is, CONTROL and BACKSPACE simultaneously.) Delete the word to the left of the cursor.

^DELETE [ESC-X or ESC-DELETE]
(That is, CONTROL and DELETE simultaneously.) Delete the word under the cursor.

UPARROW [ESC-k]
Retrieve the previous command line. If you first enter some text and then press UPARROW, it will retrieve the previous command which begins with that text.

DOWNARROW [ESC-j]
Retrieve the next command line. If you first enter some text and then press DOWNAR-ROW, it will retrieve the next command which begins with that text.

TAB Complete the partial filename to the left of the cursor. If it matches more than one filename, the first match is entered into the command line. Repeated TABs will cycle thru the other matching filenames. If the completed filename is a directory, a "/" is appended to the filename. (On MS-DOS systems, a "\" is appended.) The environment variable LESSSEPARATOR can be used to specify a different character to append to a directory name.

BACKTAB [ESC-TAB]
Like, TAB, but cycles in the reverse direction thru the matching filenames.

^L Complete the partial filename to the left of the cursor. If it matches more than one filename, all matches are entered into the command line (if they fit).

^U (Unix and OS/2) or ESC (MS-DOS)
Delete the entire command line, or cancel the command if the command line is empty. If you have changed your line-kill character in Unix to something other than ^U, that character is used instead of ^U.

^G Delete the entire command line and return to the main prompt.

KEY BINDINGS

You may define your own less commands by using the program lesskey (1) to create a lesskey file. This file specifies a set of command keys and an action associated with each key. You may also use lesskey to change the line-editing keys (see LINE EDITING), and to set environment variables. If the environment variable LESSKEY is set, less uses that as the name of the lesskey file. Otherwise, less looks in a standard place for the lesskey file: On Unix systems, less looks for a lesskey file called "$HOME/.less". On MS-DOS and Windows systems, less looks for a lesskey file called "$HOME/_less", and if it is not found there, then looks for a lesskey file called "_less" in any directory specified in the PATH environment variable. On OS/2 systems, less looks for a lesskey file called "$HOME/less.ini", and if it is not found, then looks for a lesskey file called "less.ini" in any directory specified in the INIT environment variable, and if it not found there, then looks for a lesskey file called "less.ini" in any directory specified in the PATH environment variable. See the lesskey manual page for more details.

A system-wide lesskey file may also be set up to provide key bindings. If a key is defined in both a local lesskey file and in the system-wide file, key bindings in the local file take precedence over those in the system-wide file. If the environment variable LESSKEY_SYSTEM is set, less uses that as the name of the system-wide lesskey file. Otherwise, less looks in a standard place for the system-wide lesskey file: On Unix systems, the system-wide lesskey file is /usr/local/etc/sysless. (However, if less was built with a different sysconf directory than /usr/local/etc, that directory is where the sysless file is found.) On MS-DOS and Windows systems, the system-wide lesskey file is c:_sysless. On OS/2 systems, the system-wide lesskey file is c:\sysless.ini.

INPUT PREPROCESSOR

You may define an "input preprocessor" for less. Before less opens a file, it first gives your input preprocessor a chance to modify the way the contents of the file are displayed.

An input preprocessor is simply an executable program (or shell script), which writes the contents of the file to a different file, called the replacement file. The contents of the replacement file are then displayed in place of the contents of the original file. However, it will appear to the user as if the original file is opened; that is, less will dis-

play the original filename as the name of the current file.

An input preprocessor receives one command line argument, the original filename, as entered by the user. It should create the replacement file, and when finished, print the name of the replacement file to its standard output. If the input preprocessor does not output a replacement filename, less uses the original file, as normal. The input preprocessor is not called when viewing standard input. To set up an input preprocessor, set the LESSOPEN environment variable to a command line which will invoke your input preprocessor. This command line should include one occurrence of the string "%s", which will be replaced by the filename when the input preprocessor command is invoked.

When less closes a file opened in such a way, it will call another program, called the input postprocessor, which may perform any desired clean-up action (such as deleting the replacement file created by LESSOPEN). This program receives two command line arguments, the original filename as entered by the user, and the name of the replacement file. To set up an input postprocessor, set the LESSCLOSE environment variable to a command line which will invoke your input postprocessor. It may include two occurrences of the string "%s"; the first is replaced with the original name of the file and the second with the name of the replacement file, which was output by LESSOPEN.

For example, on many Unix systems, these two scripts will allow you to keep files in com-pressed format, but still let less view them directly:

lessopen.sh:

```
#! /bin/sh
case "$1" in
*.Z) uncompress -c $1  >/tmp/less.$$  2>/dev/null
        if [ -s /tmp/less.$$ ]; then
        echo /tmp/less.$$
        else
        rm -f /tmp/less.$$
        fi
        ;;
esac
```

lessclose.sh:
#! /bin/sh
rm $2

To use these scripts, put them both where they can be executed and set LESSOPEN="lessopen.sh %s", and LESSCLOSE="lessclose.sh %s %s". More complex LESSOPEN and LESSCLOSE scripts may be written to accept other types of compressed files, and so on.

It is also possible to set up an input preprocessor to pipe the file data directly to less, rather than putting the data into a replacement file. This avoids the need to decompress the entire file before starting to view it. An input preprocessor that works this way is called an input pipe. An input pipe, instead of writing the name of a replacement file on its standard output, writes the entire contents of the replacement file on its standard output. If the input pipe does not write any characters on its standard output, then there is no replacement file and less uses the original file, as normal. To use an input pipe, make the first character in the LESSOPEN environment variable a vertical bar (|) to signify that the input preprocessor is an input pipe.

For example, on many Unix systems, this script will work like the previous example scripts:

```
lesspipe.sh:
#! /bin/sh
case "$1" in
*.Z) uncompress -c $1  2>/dev/null
*)   exit 1
          ;;
esac
exit $?
```

To use this script, put it where it can be executed and set LESSOPEN="|lesspipe.sh %s".

Note that a preprocessor cannot output an empty file, since that is interpreted as meaning there is no replacement, and the original file is used. To avoid this, if LESSOPEN starts with two vertical bars, the exit status of the script becomes meaningful. If the exit status is zero, the output is considered to be replacement text, even if it empty. If the

exit status is nonzero, any output is ignored and the original file is used. For compatibility with previous versions of less, if LESSOPEN starts with only one vertical bar, the exit status of the preprocessor is ignored.

When an input pipe is used, a LESSCLOSE postprocessor can be used, but it is usually not necessary since there is no replacement file to clean up. In this case, the replacement file name passed to the LESSCLOSE postprocessor is "-".

For compatibility with previous versions of less, the input preprocessor or pipe is not used if less is viewing standard input. However, if the first character of LESSOPEN is a dash (-), the input preprocessor is used on standard input as well as other files. In this case, the dash is not considered to be part of the preprocessor command. If standard input is being viewed, the input preprocessor is passed a file name consisting of a single dash.

Similarly, if the first two characters of LESSOPEN are vertical bar and dash (|-) or two vertical bars and a dash (||-), the input pipe is used on standard input as well as other files. Again, in this case the dash is not considered to be part of the input pipe command.

NATIONAL CHARACTER SETS

There are three types of characters in the input file:

normal characters
can be displayed directly to the screen.

control characters
should not be displayed directly, but are expected to be found in ordinary text files (such as backspace and tab).

binary characters
should not be displayed directly and are not expected to be found in text files.

A "character set" is simply a description of which characters are to be considered normal, control, and binary. The LESSCHARSET environment variable may be used to select a character set. Possible values for LESSCHARSET are:

ascii BS, TAB, NL, CR, and formfeed are control characters, all chars with values between 32 and 126 are normal, and all others are binary.

iso8859
Selects an ISO 8859 character set. This is the same as ASCII, except characters between 160 and 255 are treated as normal characters.

latin1 Same as iso8859.

latin9 Same as iso8859.

dos Selects a character set appropriate for MS-DOS.

ebcdic Selects an EBCDIC character set.

IBM-1047
Selects an EBCDIC character set used by OS/390 Unix Services. This is the EBCDIC analogue of latin1. You get similar results by setting either LESSCHARSET=IBM-1047 or LC_CTYPE=en_US in your environment.

koi8-r Selects a Russian character set.

next Selects a character set appropriate for NeXT computers.

utf-8 Selects the UTF-8 encoding of the ISO 10646 character set. UTF-8 is special in that
it supports multi-byte characters in the input file. It is the only character set that supports multi-byte characters.

windows
Selects a character set appropriate for Microsoft Windows (cp 1251).

In rare cases, it may be desired to tailor less to use a character set other than the ones definable by LESSCHARSET. In this case, the environment variable LESSCHARDEF can be used
to define a character set. It should be set to a string where each character in the string represents one character in the character set. The character "." is used for a normal character, "c" for control, and "b" for binary. A decimal number may be used for repetition. For example, "bccc4b." would mean character 0 is binary, 1, 2 and 3 are control, 4,
5, 6 and 7 are binary, and 8 is normal. All characters after the last are taken to be the same as the last, so characters 9 through 255 would be normal. (This is an example, and
does not necessarily represent any real character set.)

This table shows the value of LESSCHARDEF which is equivalent to each of the possible val-
ues for LESSCHARSET:

```
ascii     8bcccbcc18b95.b
dos       8bcccbcc12bc5b95.b.
ebcdic    5bc6bcc7bcc41b.9b7.9b5.b..8b6.10b6.b9.7b
          9.8b8.17b3.3b9.7b9.8b8.6b10.b.b.b.
IBM-1047  4cbcbc3b9cbccbccbb4c6bcc5b3cbbc4bc4bccbc
          191.b
iso8859   8bcccbcc18b95.33b.
koi8-r    8bcccbcc18b95.b128.
latin1    8bcccbcc18b95.33b.
next      8bcccbcc18b95.bb125.bb
```

If neither LESSCHARSET nor LESSCHARDEF is set, but any of the strings "UTF-8", "UTF8",
"utf-8" or "utf8" is found in the LC_ALL, LC_CTYPE or LANG environment variables, then the
default character set is utf-8.

If that string is not found, but your system supports the setlocale interface, less will use setlocale to determine the character set. setlocale is controlled by setting the LANG or LC_CTYPE environment variables.

Finally, if the setlocale interface is also not available, the default character set is latin1.

Control and binary characters are displayed in standout (reverse video). Each such charac-
ter is displayed in caret notation if possible (e.g. ^A for control-A). Caret notation is used only if inverting the 0100 bit results in a normal printable character. Otherwise, the character is displayed as a hex number in angle brackets. This format can be changed
by setting the LESSBINFMT environment variable. LESSBINFMT may begin with a "*" and one
character to select the display attribute: "*k" is blinking, "*d" is bold, "*u" is under-
lined, "*s" is standout, and "*n" is normal. If LESSBINFMT does not begin with a "*", nor-
mal attribute is assumed. The remainder of LESSBINFMT is a string which may include one
printf-style escape sequence (a % followed by x, X, o, d, etc.). For example, if LESS-

BINFMT is "*u[%x]", binary characters are displayed in underlined hexadecimal surrounded by brackets. The default if no LESSBINFMT is specified is "*s<%02X>". Warning: the result of expanding the character via LESSBINFMT must be less than 31 characters.

When the character set is utf-8, the LESSUTFBINFMT environment variable acts similarly to LESSBINFMT but it applies to Unicode code points that were successfully decoded but are unsuitable for display (e.g., unassigned code points). Its default value is "<U+%04lX>". Note that LESSUTFBINFMT and LESSBINFMT share their display attribute setting ("*x") so specifying one will affect both; LESSUTFBINFMT is read after LESSBINFMT so its setting, if any, will have priority. Problematic octets in a UTF-8 file (octets of a truncated sequence, octets of a complete but non-shortest form sequence, illegal octets, and stray trailing octets) are displayed individually using LESSBINFMT so as to facilitate diagnostic of how the UTF-8 file is ill-formed.

PROMPTS

The -P option allows you to tailor the prompt to your preference. The string given to the -P option replaces the specified prompt string. Certain characters in the string are interpreted specially. The prompt mechanism is rather complicated to provide flexibility, but the ordinary user need not understand the details of constructing personalized prompt strings.

A percent sign followed by a single character is expanded according to what the following character is:

%bX Replaced by the byte offset into the current input file. The b is followed by a single character (shown as X above) which specifies the line whose byte offset is to be used. If the character is a "t", the byte offset of the top line in the display is used, an "m" means use the middle line, a "b" means use the bottom line, a "B" means use the line just after the bottom line, and a "j" means use the "target" line, as specified by the -j option.

%B Replaced by the size of the current input file.

%c Replaced by the column number of the text appearing in the first column of the screen.

%dX Replaced by the page number of a line in the input file. The line to be used is determined by the X, as with the %b option.

%D Replaced by the number of pages in the input file, or equivalently, the page number of the last line in the input file.

%E Replaced by the name of the editor (from the VISUAL environment variable, or the EDITOR environment variable if VISUAL is not defined). See the discussion of the LESSEDIT feature below.

%f Replaced by the name of the current input file.

%F Replaced by the last component of the name of the current input file.

%i Replaced by the index of the current file in the list of input files.

%lX Replaced by the line number of a line in the input file. The line to be used is determined by the X, as with the %b option.

%L Replaced by the line number of the last line in the input file.

%m Replaced by the total number of input files.

%pX Replaced by the percent into the current input file, based on byte offsets. The line used is determined by the X as with the %b option.

%PX Replaced by the percent into the current input file, based on line numbers. The line used is determined by the X as with the %b option.

%s Same as %B.

%t Causes any trailing spaces to be removed. Usually used at the end of the string, but may appear anywhere.

%T Normally expands to the word "file". However if viewing files via a tags list using

the -t option, it expands to the word "tag".

%x Replaced by the name of the next input file in the list.

If any item is unknown (for example, the file size if input is a pipe), a question mark is printed instead.

The format of the prompt string can be changed depending on certain conditions. A question mark followed by a single character acts like an "IF": depending on the following character, a condition is evaluated. If the condition is true, any characters following the question mark and condition character, up to a period, are included in the prompt. If the condition is false, such characters are not included. A colon appearing between the question mark and the period can be used to establish an "ELSE": any characters between the colon and the period are included in the string if and only if the IF condition is false. Condition characters (which follow a question mark) may be:

?a True if any characters have been included in the prompt so far.

?bX True if the byte offset of the specified line is known.

?B True if the size of current input file is known.

?c True if the text is horizontally shifted (%c is not zero).

?dX True if the page number of the specified line is known.

?e True if at end-of-file.

?f True if there is an input filename (that is, if input is not a pipe).

?lX True if the line number of the specified line is known.

?L True if the line number of the last line in the file is known.

?m True if there is more than one input file.

?n True if this is the first prompt in a new input file.

?pX True if the percent into the current input file, based on byte offsets, of the spec-

ified line is known.

?PX True if the percent into the current input file, based on line numbers, of the specified line is known.

?s Same as "?B".

?x True if there is a next input file (that is, if the current input file is not the last one).

Any characters other than the special ones (question mark, colon, period, percent, and backslash) become literally part of the prompt. Any of the special characters may be included in the prompt literally by preceding it with a backslash.

Some examples:

?f%f:Standard input.

This prompt prints the filename, if known; otherwise the string "Standard input".

?f%f .?ltLine %lt:?pt%pt\%:?btByte %bt:-...

This prompt would print the filename, if known. The filename is followed by the line number, if known, otherwise the percent if known, otherwise the byte offset if known. Otherwise, a dash is printed. Notice how each question mark has a matching period, and how the % after the %pt is included literally by escaping it with a backslash.

?n?f%f .?m(%T %i of %m) ..?e(END) ?x- Next\: %x..%t";

This prints the filename if this is the first prompt in a file, followed by the "file N of N" message if there is more than one input file. Then, if we are at end-of-file, the string "(END)" is printed followed by the name of the next file, if there is one. Finally, any trailing spaces are truncated. This is the default prompt. For reference, here are the defaults for the other two prompts (-m and -M respectively). Each is broken into two lines here for readability only.

?n?f%f .?m(%T %i of %m) ..?e(END) ?x- Next\: %x.:
?pB%pB\%:byte %bB?s/%s...%t

?f%f .?n?m(%T %i of %m) ..?ltlines %lt-%lb?L/%L. :
byte %bB?s/%s. .?e(END) ?x- Next\: %x.:?pB%pB\%..%t

And here is the default message produced by the = command:

?f%f .?m(%T %i of %m) .?ltlines %lt-%lb?L/%L. .
byte %bB?s/%s. ?e(END) :?pB%pB\%..%t

The prompt expansion features are also used for another purpose: if an environment variable
LESSEDIT is defined, it is used as the command to be executed when the v command is
invoked. The LESSEDIT string is expanded in the same way as the prompt strings. The
default value for LESSEDIT is:

%E ?lm+%lm. %f

Note that this expands to the editor name, followed by a + and the line number, followed by
the file name. If your editor does not accept the "+linenumber" syntax, or has other dif-
ferences in invocation syntax, the LESSEDIT variable can be changed to modify this default.

SECURITY

When the environment variable LESSSECURE is set to 1, less runs in a "secure" mode. This
means these features are disabled:

! the shell command

| the pipe command

:e the examine command.

v the editing command

s -o log files

-k use of lesskey files

-t use of tags files

metacharacters in filenames, such as *

filename completion (TAB, ^L)

Less can also be compiled to be permanently in "secure" mode.

COMPATIBILITY WITH MORE

If the environment variable LESS_IS_MORE is set to 1, or if the program is invoked via a file link named "more", less behaves (mostly) in conformance with the POSIX "more" command specification. In this mode, less behaves differently in these ways:

The -e option works differently. If the -e option is not set, less behaves as if the -e option were set. If the -e option is set, less behaves as if the -E option were set.

The -m option works differently. If the -m option is not set, the medium prompt is used, and it is prefixed with the string "--More--". If the -m option is set, the short prompt is used.

The -n option acts like the -z option. The normal behavior of the -n option is unavailable in this mode.

The parameter to the -p option is taken to be a less command rather than a search pattern.

The LESS environment variable is ignored, and the MORE environment variable is used in its place.

ENVIRONMENT VARIABLES

Environment variables may be specified either in the system environment as usual, or in a lesskey (1) file. If environment variables are defined in more than one place, variables defined in a local lesskey file take precedence over variables defined in the system environment, which take precedence over variables defined in the system-wide lesskey file.

COLUMNS

Sets the number of columns on the screen. Takes precedence over the number of columns specified by the TERM variable. (But if you have a windowing system which supports TIOCGWINSZ or WIOCGETD, the window system's idea of the screen size takes

precedence over the LINES and COLUMNS environment variables.)

EDITOR The name of the editor (used for the v command).

HOME Name of the user's home directory (used to find a lesskey file on Unix and OS/2 systems).

HOMEDRIVE, HOMEPATH
Concatenation of the HOMEDRIVE and HOMEPATH environment variables is the name of the user's home directory if the HOME variable is not set (only in the Windows version).

INIT Name of the user's init directory (used to find a lesskey file on OS/2 systems).

LANG Language for determining the character set.

LC_CTYPE
Language for determining the character set.

LESS Options which are passed to less automatically.

LESSANSIENDCHARS
Characters which may end an ANSI color escape sequence (default "m").

LESSANSIMIDCHARS
Characters which may appear between the ESC character and the end character in an ANSI color escape sequence (default "0123456789:;[?!"'#%()*+ ".

LESSBINFMT
Format for displaying non-printable, non-control characters.

LESSCHARDEF
Defines a character set.

LESSCHARSET
Selects a predefined character set.

LESSCLOSE
Command line to invoke the (optional) input-postprocessor.

LESSECHO
Name of the lessecho program (default "lessecho"). The lessecho program is needed

to expand metacharacters, such as * and ?, in filenames on Unix systems.

LESSEDIT
Editor prototype string (used for the v command). See discussion under PROMPTS.

LESSGLOBALTAGS
Name of the command used by the -t option to find global tags. Normally should be set to "global" if your system has the global (1) command. If not set, global tags are not used.

LESSHISTFILE
Name of the history file used to remember search commands and shell commands between invocations of less. If set to "-" or "/dev/null", a history file is not used. The default is "$HOME/.lesshst" on Unix systems, "$HOME/_lesshst" on DOS and Windows systems, or "$HOME/lesshst.ini" or "$INIT/lesshst.ini" on OS/2 systems.

LESSHISTSIZE
The maximum number of commands to save in the history file. The default is 100.

LESSKEY
Name of the default lesskey(1) file.

LESSKEY_SYSTEM
Name of the default system-wide lesskey(1) file.

LESSMETACHARS
List of characters which are considered "metacharacters" by the shell.

LESSMETAESCAPE
Prefix which less will add before each metacharacter in a command sent to the shell. If LESSMETAESCAPE is an empty string, commands containing metacharacters will not be passed to the shell.

LESSOPEN
Command line to invoke the (optional) input-preprocessor.

LESSSECURE
Runs less in "secure" mode. See discussion under SECURITY.

LESSSEPARATOR

String to be appended to a directory name in filename completion.

LESSUTFBINFMT
Format for displaying non-printable Unicode code points.

LESS_IS_MORE
Emulate the more (1) command.

LINES Sets the number of lines on the screen. Takes precedence over the number of lines
specified by the TERM variable. (But if you have a windowing system which supports
TIOCGWINSZ or WIOCGETD, the window system's idea of the screen size takes precedence
over the LINES and COLUMNS environment variables.)

MORE Options which are passed to less automatically when running in more compatible mode.

PATH User's search path (used to find a lesskey file on MS-DOS and OS/2 systems).

SHELL The shell used to execute the ! command, as well as to expand filenames.

TERM The type of terminal on which less is being run.

VISUAL The name of the editor (used for the v command).

SEE ALSO
lesskey(1)

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AUTHOR

Mark Nudelman
Send bug reports or comments to <bug-less@gnu.org>
See http://www.greenwoodsoftware.com/less/bugs.html for the latest list of known bugs in
less.
For more information, see the less homepage at
http://www.greenwoodsoftware.com/less.

NAME

cat - concatenate files and print on the standard output

SYNOPSIS

cat [OPTION]... [FILE]...

DESCRIPTION

Concatenate FILE(s) to standard output.

With no FILE, or when FILE is -, read standard input.

-A, --show-all
equivalent to -vET

-b, --number-nonblank
number nonempty output lines, overrides -n

-e equivalent to -vE

-E, --show-ends
display $ at end of each line

-n, --number
number all output lines

-s, --squeeze-blank
suppress repeated empty output lines

-t equivalent to -vT

-T, --show-tabs
display TAB characters as ^I

-u (ignored)

-v, --show-nonprinting
use ^ and M- notation, except for LFD and TAB

--help display this help and exit

--version
output version information and exit

EXAMPLES

cat f - g
Output f's contents, then standard input, then g's contents.

cat Copy standard input to standard output.

AUTHOR

Written by Torbjorn Granlund and Richard M. Stallman.

REPORTING BUGS

GNU coreutils online help: <http://www.gnu.org/software/coreutils/>
Report cat translation bugs to <http://translationproject.org/team/>

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SEE ALSO

tac(1)

Full documentation at: <http://www.gnu.org/software/coreutils/cat>
or available locally via: info '(coreutils) cat invocation'

GNU coreutils 8.25 February 2016 CAT(1)

6. Complete the following tasks:

```
cd Documents/
mkdir ASEN4519
touch asen4519test.txt
nano asen4519test.txt
chmod 755 asen4519test.txt
ls -al
total 8
drwxrwxr-x 2 cong cong 4096 Feb 25 13:23 .
drwxr-xr-x 5 cong cong 4096 Feb 25 13:22 ..
-rwxr-xr-x 1 cong cong    0 Feb 25 13:23 asen4519test.txt

cat asen4519test.txt
Dylan Reed-2018-Shawshank Redemption
Thanh Cong Bui-2018-Inception

sudo mv asen4519test.txt /home/
cd /home/
ls
asen4519test.txt  cong

sudo mv asen4519test.txt asen4519.txt
ls
asen4519.txt  cong

sudo rm asen4519.txt
ls
cong
```

7. Start MATLAB from the command line as a background process.

```
matlab &
[1] 4025
cong@cong-VirtualBox:~$ MATLAB is selecting SOFTWARE OPENGL rendering.

top
top - 13:39:47 up 39 min,  1 user,  load average: 1.27, 1.17, 0.78
Tasks: 196 total,   1 running, 195 sleeping,   0 stopped,   0 zombie
%Cpu(s): 20.8 us,  4.0 sy,  0.0 ni, 75.2 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
```

KiB Mem : 10284712 total, 7390704 free, 1715344 used, 1178664 buff/cache
KiB Swap: 8385532 total, 8385532 free,   0 used. 8254024 avail Mem

  PID USER   PR NI VIRT   RES   SHR S %CPU %MEM   TIME+ COMMAND

 2727 cong   20   0 1374464 234528 72700 S 58.8 2.3   8:57.53 compiz
 2153 root   20   0 432392 146184 55544 S   5.9 1.4   1:49.53 /usr/lib/xorg/Xorg -core :0
-se+
    7 root   20   0   0   0   0 S   2.9 0.0   0:00.83 [rcu_sched]
 2579 cong   20   0 365556   8884   7120 S   2.9 0.1   0:03.44 /usr/bin/ibus-daemon
--daemoniz+
 3495 cong   20   0 663628 36608 28388 S   2.9 0.4   0:08.76
/usr/lib/gnome-terminal/gnome-t+
 4025 cong   20   0 3078292 576280 164824 S   2.9 5.6   1:43.85
/usr/local/MATLAB/R2016a/bin/gl+
 4213 cong   20   0   48920   3852   3196 R   2.9 0.0   0:00.18 top
    1 root   20   0 119624   5868   4076 S   0.0 0.1   0:02.95 /sbin/init splash
    2 root   20   0   0   0   0 S   0.0 0.0   0:00.01 [kthreadd]
    3 root   20   0   0   0   0 S   0.0 0.0   0:00.06 [ksoftirqd/0]
    5 root   0 -20   0   0   0 S   0.0 0.0   0:00.00 [kworker/0:0H]
    8 root   20   0   0   0   0 S   0.0 0.0   0:00.00 [rcu_bh]
    9 root   rt   0   0   0   0 S   0.0 0.0   0:00.01 [migration/0]
   10 root   rt   0   0   0   0 S   0.0 0.0   0:00.02 [watchdog/0]
   11 root   rt   0   0   0   0 S   0.0 0.0   0:00.02 [watchdog/1]
   12 root   rt   0   0   0   0 S   0.0 0.0   0:00.01 [migration/1]
   13 root   20   0   0   0   0 S   0.0 0.0   0:00.19 [ksoftirqd/1]
   15 root   0 -20   0   0   0 S   0.0 0.0   0:00.00 [kworker/1:0H]
   16 root   rt   0   0   0   0 S   0.0 0.0   0:00.01 [watchdog/2]
   17 root   rt   0   0   0   0 S   0.0 0.0   0:00.01 [migration/2]
   18 root   20   0   0   0   0 S   0.0 0.0   0:00.08 [ksoftirqd/2]
   19 root   20   0   0   0   0 S   0.0 0.0   0:00.39 [kworker/2:0]
   20 root   0 -20   0   0   0 S   0.0 0.0   0:00.00 [kworker/2:0H]
   21 root   20   0   0   0   0 S   0.0 0.0   0:00.00 [kdevtmpfs]
   22 root   0 -20   0   0   0 S   0.0 0.0   0:00.00 [netns]
   23 root   0 -20   0   0   0 S   0.0 0.0   0:00.00 [perf]
   24 root   20   0   0   0   0 S   0.0 0.0   0:00.00 [khungtaskd]
   25 root   0 -20   0   0   0 S   0.0 0.0   0:00.00 [writeback]
   26 root   25   5   0   0   0 S   0.0 0.0   0:00.00 [ksmd]
   27 root   39 19   0   0   0 S   0.0 0.0   0:02.72 [khugepaged]
   28 root   0 -20   0   0   0 S   0.0 0.0   0:00.00 [crypto]
   29 root   0 -20   0   0   0 S   0.0 0.0   0:00.00 [kintegrityd]
   30 root   0 -20   0   0   0 S   0.0 0.0   0:00.00 [bioset]
   31 root   0 -20   0   0   0 S   0.0 0.0   0:00.00 [kblockd]

```
 32 root      0 -20    0        0        0 S   0.0  0.0   0:00.00 [ata_sff]
 33 root      0 -20    0        0        0 S   0.0  0.0   0:00.00 [md]
 34 root      0 -20    0        0        0 S   0.0  0.0   0:00.00 [devfreq_wq]
 40 root      20   0        0        0        0 S   0.0  0.0   0:00.00 [kswapd0]
 41 root      0 -20    0        0        0 S   0.0  0.0   0:00.00 [vmstat]
 42 root      20   0        0        0        0 S   0.0  0.0   0:00.00 [fsnotify_mark]
 43 root      20   0        0        0        0 S   0.0  0.0   0:00.00 [ecryptfs-kthrea]
 59 root      0 -20    0        0        0 S   0.0  0.0   0:00.00 [kthrotld]
 60 root      0 -20    0        0        0 S   0.0  0.0   0:00.00 [acpi_thermal_pm]
 61 root      0 -20    0        0        0 S   0.0  0.0   0:00.00 [bioset]
 62 root      0 -20    0        0        0 S   0.0  0.0   0:00.00 [bioset]
```

Once MATLAB has started, return to the command line and use the top command to assess the most computationally expensive processes running on your VM. List what percentage of the CPU and memory MATLAB is utilizing. For this last task, you may need to wait for top to refresh.

Compiz:

```
  PID USER      PR  NI VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
2723 cong      20   0 1257568 209780  72708 S 22.6  5.2   4:54.39 compiz
```

MATLAB:

```
  PID USER      PR  NI VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
4025 cong      20   0 3078292 578332 164824 S   0.3  5.6   1:47.10 MATLAB
```

Return to the MATLAB session and enter the following at the command line:
\tic; a = rand(9973); b = fft(a); toc" List what percentage of the CPU and memory MATLAB is utilizing while MATLAB processing that line, and list the time it takes for MATLAB to run the commands. Once MATLAB completes the computation, list what percentage of the CPU and memory MATLAB is now utilizing.

```
  PID USER      PR  NI VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
 4025 cong      20   0 3682140 1.111g 169216 S  91.4 11.3   2:00.64 MATLAB
Elapsed time is 1.661751 seconds.
```

```
  PID USER      PR  NI VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
 4025 cong      20   0 3682140 1.112g 169220 S   1.0 11.3   2:04.78 MATLAB
```

Quit MATLAB and restart MATLAB as a background process using the nice command with a nice argument of \-15". Verify MATLAB is running with a nice value of -15.

```
sudo nice -n -15 matlab &
[sudo] password for cong:
MATLAB is selecting SOFTWARE OPENGL rendering.
```

Within the \nice'd" MATLAB session, again enter the commands:

\tic; a = rand(9973); b = fft(a); toc"
List how long it takes MATLAB to run the commands. How does this compare
to the run without nice? Is this what you expect? Why?
Elapsed time is 1.392568 seconds.
This was a lot faster than when I ran it without nice. This is what I expect because MATLAB is higher prioritized by the operating system.

8. Where is the actual executable for MATLAB? Why can you start it without full path?
/usr/local/MATLAB/R2016a/bin
Because we used symbolic link and this creates an alias in a local bin folder, so shell can find matlab alias by going to its default bins
9. In what directories does shell search for programs to run? Where is that information stored? Can it be changed?
echo $PATH
/home/cong/bin:/home/cong/.local/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin
This information is stored in environment variable $PATH. $PATH can be changed using:
export PATH=[input]

10.
ls /bin /usr/bin | sort -o ~/Documents/usefulprograms.txt
11.
echo $TERM
Xterm-256color
The environment variable storing this info is $TERM.
It can be seen using the command:
env
12.
echo $EDITOR

export EDITOR=nano
echo $EDITOR
nano