

MODULE 1- LINUX

Basic Commands in Linux

1) Commands are actually files containing programs, often written in C. How will you find out in which directory does the file corresponding to the man command resides?

```
user@user-VirtualBox:~$ pwd
/home/user
user@user-VirtualBox:~$ which command
user@user-VirtualBox:~$ which man
/usr/bin/man
user@user-VirtualBox:~$
```

2) How will you find out what is the use of the ps command.

```
user@user-VirtualBox:~$ man ps
```

```
user@user-VirtualBox: ~
PS(1) User Commands PS(1)

NAME
  ps - report a snapshot of the current processes.

SYNOPSIS
  ps [options]

DESCRIPTION
  ps displays information about a selection of the active processes. If you want a repetitive update of the selection and the displayed information, use top instead.

  This version of ps accepts several kinds of options:

  1  UNIX options, which may be grouped and must be preceded by a dash.
  2  BSD options, which may be grouped and must not be used with a dash.
  3  GNU long options, which are preceded by two dashes.

  Options of different types may be freely mixed, but conflicts can appear. There are some synonymous options, which are functionally identical, due to the many standards and ps implementations that this ps is compatible with.

  Note that ps -aux is distinct from ps aux. The POSIX and UNIX standards require that ps -aux print all processes owned by a user named x, as well as printing all processes that would be selected by the -a option. If the user named x does not exist, this ps may interpret the command as ps aux instead and print a warning. This behavior is intended to aid in transitioning old scripts and habits. It is fragile, subject to change, and thus should not be relied upon.

  By default, ps selects all processes with the same effective user ID (euid=EUID) as the current user and associated with the same terminal as the invoker. It displays the process ID (pid=PID), the terminal associated with the process (tname=TTY), the cumulated CPU time in [DD-]hh:mm:ss format (time=TIME), and the executable name (ucmd=CMD). Output is unsorted by default.

  The use of BSD-style options will add process state (stat=STAT) to the default display and show the command args (args=COMMAND) instead of the executable name. You can override this with the PS_FORMAT environment variable. The use of BSD-style options will also change the process selection to include processes on other terminals (TTys) that are owned by you; alternately, this may be described as setting the selection to be the set of all processes filtered to exclude processes owned by other users or not on a terminal. These effects are not considered when options are described as being "identical" below, so -M will be considered identical to Z and so on.

  Except as described below, process selection options are additive. The default selection is discarded, and then the
Manual page ps(1) line 1 (press h for help or q to quit)
```

General Purpose Utilities in Linux

1) Display the calendar for the month of March 2012

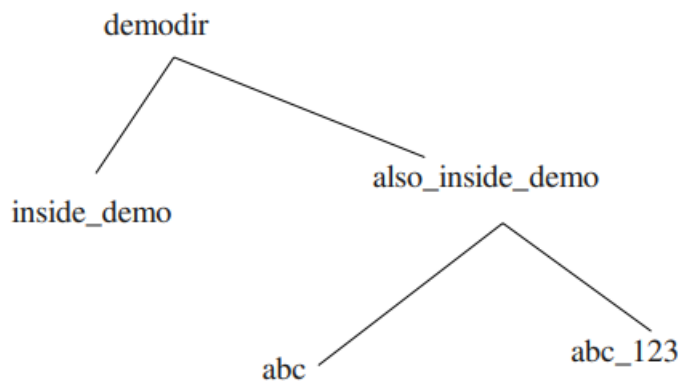
```
user@user-VirtualBox:~$ cal 3 2012
      March 2012
Su Mo Tu We Th Fr Sa
                1  2  3
 4  5  6  7  8  9 10
11 12 13 14 15 16 17
18 19 20 21 22 23 24
25 26 27 28 29 30 31
```

2) List all the files and directories of the directory /usr/lib on the terminal. Now put the same information in a file named results. Display the contents of the file results now.

```
user@user-VirtualBox: ~
user@user-VirtualBox:~$ ls /usr/lib
apg                               gnome-shell                     netplan                         software-properties
apparmor                          gnupg                           networkd-dispatcher            speech-dispatcher-modules
apt                               gnupg2                          NetworkManager                 ssl
aspell                            groff                            nvidia                         sysctl.d
binfmt.d                         grub                             openssh                        systemd
bluetooth                       grub-legacy                     openvpn                         sysusers.d
brltty                           gvfs                             os-prober                      tc
cnf-update-db                    hdparm                           os-probes                       terminfo
command-not-found                init                             os-release                     thunderbird
console-setup                     initramfs-tools                 pam.d                          thunderbird-addons
cpp                               ispell                          pcmciautils                    tmpfiles.d
crda                              kernel                          pkgconfig                      ubiquity
cups                             klibc                           pm-utils                       ubuntu-advantage
dbus-1.0                         klibc-K8e6D0mVI9JpyGMLR7qNe5lZeBk.so policykit-1                    ubuntu-release-upgrader
debug                             libreoffice                     polkit-1                       udev
dpkg                              linux                            pppd                           udisks2
emacsen-common                   linux-boot-probes               pulse-15.99.1+dfsg1           ufw
environment.d                    linux-sound-base                python2.7                      unity-settings-daemon-1.0
evolution-data-server            locale                           python3                         update-notifier
file                              lp_solve                        python3.10                      usrmerge
firewalld                        lsb                             python3.11                      valgrind
firmware                         man-db                           recovery-mode                   X11
gcc                               memtest86+                      rhythmbox                       x86_64-linux-gnu
girepository-1.0                 mime                             rsyslog                        xorg
gnome-session                    modprobe.d                      sasl2                          xserver-xorg-video-intel
gnome-settings-daemon-3.0         modules                          shim
gnome-settings-daemon-42         modules-load.d                  snapd
user@user-VirtualBox:~$ ls /usr/lib > result.txt
user@user-VirtualBox:~$ cat result.txt
apg
apparmor
apt
aspell
binfmt.d
bluetooth
brltty
cnf-update-db
command-not-found
console-setup
```

File Systems

1) Make a directory structure like this in your home directory



```
user@user-VirtualBox:~$ mkdir demodir
user@user-VirtualBox:~$ cd demodir
user@user-VirtualBox:~/demodir$ mkdir inside_demo
user@user-VirtualBox:~/demodir$ mkdir also_inside_demo
user@user-VirtualBox:~/demodir$ cd also_inside_demo
user@user-VirtualBox:~/demodir/also_inside_demo$ mkdir abc
user@user-VirtualBox:~/demodir/also_inside_demo$ mkdir abc_123
user@user-VirtualBox:~/demodir/also_inside_demo$
```

2) Remove the also_inside_demo directory

```
user@user-VirtualBox:~/demodir$ rm -r also_inside_demo
user@user-VirtualBox:~/demodir$ ls
inside_demo
user@user-VirtualBox:~/demodir$
```

File Attributes

1. Create a file abc.txt and change the ownership of this file to some other user on your machine and also change the group to family.

```
user@user-VirtualBox:~$ touch abc.txt
user@user-VirtualBox:~$ sudo useradd newuser
user@user-VirtualBox:~$ sudo chown newuser abc.txt
user@user-VirtualBox:~$ sudo usermod -g family newuser
usermod: group 'family' does not exist
user@user-VirtualBox:~$ sudo chgrp newuser abc.txt
user@user-VirtualBox:~$ ls
abc.txt
```

2. Create a file exercise.txt and make it executable.

```
user@user-VirtualBox:~$ touch exercise.txt
user@user-VirtualBox:~$ chmod +x exercise.txt
user@user-VirtualBox:~$ ls
abc.txt  exercise.txt  Pictures
user@user-VirtualBox:~$
```

3. Create a file test.txt on your desktop and identify its inode number, also create a soft link for test.txt in your home.

```
user@user-VirtualBox:~/desktop$ touch test.txt
user@user-VirtualBox:~/desktop$ ls -li test.txt
1507463 test.txt
user@user-VirtualBox:~/desktop$
user@user-VirtualBox:~/desktop$ ln -s home/user/desktop/test.txt ~/test_link.txt
user@user-VirtualBox:~/desktop$ ls -li home/user/desktop ~/test_link.txt
ls: cannot access 'home/user/desktop': No such file or directory
1507465 lrwxrwxrwx 1 user user 26 Sep 28 11:20 /home/user/test_link.txt -> home/user/desktop/test.txt
```

Redirection of Pipes

1. Create a file name error_log in your current directory. Suppose you do not have any file named aa11 in your current directory. How can you redirect the error message to the file error_log when we apply the command "wc -l aa11" ? How can you ensure that all the error log are appended to the error_log file?

```
user@user-VirtualBox:~/desktop$ touch error_log
user@user-VirtualBox:~/desktop$ wc aa11
wc: aa11: No such file or directory
user@user-VirtualBox:~/desktop$ wc aa11 2> error_log.txt
user@user-VirtualBox:~/desktop$ cat error_log.txt
wc: aa11: No such file or directory
user@user-VirtualBox:~/desktop$
```

2. Create files named test1, test2, testa, testb
How can you count the number of files starting with test and then having only one digit in their name using only a single line command ?

```
user@user-VirtualBox:~/testtest$ touch testa.txt
user@user-VirtualBox:~/testtest$ touch testb.txt
user@user-VirtualBox:~/testtest$ touch test1.txt
user@user-VirtualBox:~/testtest$ touch test2.txt
user@user-VirtualBox:~/testtest$ ls -l test* | wc -l
4
user@user-VirtualBox:~/testtest$
```

Linux process

1. Open a terminal. Now spawn three shell processes one after another i.e. first spawn one shell, then from the spawned shell, spawn one new shell and so on. Now, how can you see the PID of the current shell ? How can you see the PID of the shell which is the grandparent of the current shell?

```

user@user-VirtualBox:~$ echo $$
21333
user@user-VirtualBox:~$ sh
$
$ pwd
/home/user
$ echo "Hello world"
Hello world
$ ls
  ASSIGN_LINUX1.odt      desktop  info.txt  'MODULE 5.odt'  qwerty  snap  test1.txt  testa.txt  test.sh
'ASSIGN_LINUX1 word.docx' files    'MODULE 3.odt'  Pictures      redir.sh  test  test2.txt  testb.txt  testtest
$ echo $$
22415
$ ps
$ ps -f

```

UID	PID	PPID	C	STIME	TTY	TIME	CMD
user	21333	19271	0	14:40	pts/1	00:00:00	bash
user	22415	21333	0	15:08	pts/1	00:00:00	sh
user	22486	22415	0	15:10	pts/1	00:00:00	ps -f

PID	PPID
21333	19271
22415	21333
22486	22415

PPID of the current shell is given by the PID of the previous shell. This makes the first shell as the grandparent, second shell as parent and third shell as child.

2. How can you see all the processes (both system & user processes) in your computer?

```

Oct 12 15:15
user@user-VirtualBox: ~
$ ps -e

```

PID	TTY	TIME	CMD
1	?	00:00:01	systemd
2	?	00:00:00	kthreadd
3	?	00:00:00	rcu_gp
4	?	00:00:00	rcu_par_gp
5	?	00:00:00	slub_flushwq
6	?	00:00:00	netns
8	?	00:00:00	kworker/0:0H-kblockd
10	?	00:00:00	mm_percpu_wq
11	?	00:00:00	rcu_tasks_kthread
12	?	00:00:00	rcu_tasks_rude_kthread
13	?	00:00:00	rcu_tasks_trace_kthread
14	?	00:00:01	ksoftirqd/0
15	?	00:00:05	rcu_preempt
16	?	00:00:00	migration/0
17	?	00:00:00	idle_inject/0
19	?	00:00:00	cpuhp/0
20	?	00:00:00	kdevtmpfs
21	?	00:00:00	inet_frag_wq
22	?	00:00:00	kauditd
23	?	00:00:00	khungtaskd
24	?	00:00:00	oom_reaper
27	?	00:00:00	writeback
28	?	00:00:02	kcompactd0
29	?	00:00:00	ksmd
30	?	00:00:00	khugepaged
31	?	00:00:00	kintegrityd
32	?	00:00:00	kblockd
33	?	00:00:00	blkcg_punt_bio
34	?	00:00:00	tpm_dev_wq
35	?	00:00:00	ata_sff
36	?	00:00:00	md
37	?	00:00:00	edac-poller
38	?	00:00:00	devfreq_wq
39	?	00:00:00	watchdogd
41	?	00:00:12	kswapd0
42	?	00:00:00	ecryptfs-kthread
43	?	00:00:00	kthrotld

```

Oct 12 15:16
user@user-VirtualBox: ~

44 ?      00:00:00 acpi_thermal_pm
45 ?      00:00:00 xenbus_probe
46 ?      00:00:00 scsi_ah_0
47 ?      00:00:00 scsi_tm_0
48 ?      00:00:00 scsi_ah_1
49 ?      00:00:00 scsi_tm_1
53 ?      00:00:00 nld
54 ?      00:00:00 ipv6_addrconf
62 ?      00:00:00 kstrp
64 ?      00:00:00 zswap-shrink
65 ?      00:00:00 kworker/u3:0
69 ?      00:00:00 charger_manager
110 ?     00:00:00 scsi_ah_2
111 ?     00:00:00 scsi_tm_2
121 ?     00:00:05 kworker/0:2H-kblockd
142 ?     00:00:01 jbd2/sda3-8
143 ?     00:00:00 ext4-rsv-conver
221 ?     00:00:09 irq/18-vmmgfx
228 ?     00:00:00 systemd-udevd
267 ?     00:00:00 cryptd
347 ?     00:00:00 systemd-resolve
348 ?     00:00:00 systemd-timesyn
546 ?     00:00:00 accounts-daemon
547 ?     00:00:01 acpid
550 ?     00:00:00 avahi-daemon
552 ?     00:00:00 cron
554 ?     00:00:01 dbus-daemon
555 ?     00:00:01 NetworkManager
568 ?     00:00:00 networkd-dispat
577 ?     00:00:01 polkitd
578 ?     00:00:00 power-profiles-
579 ?     00:00:00 rsyslogd
583 ?     00:00:00 switcheroo-cont
584 ?     00:00:00 systemd-logind
585 ?     00:00:00 udisksd
586 ?     00:00:00 wpa_supplicant
606 ?     00:00:00 avahi-daemon
635 ?     00:00:00 ModemManager
641 ?     00:00:00 cupsd
665 ?     00:00:00 unattended-upgr

606 ?     00:00:00 avahi-daemon
635 ?     00:00:00 ModemManager
641 ?     00:00:00 cupsd
665 ?     00:00:00 unattended-upgr
673 ?     00:00:00 gdm3
676 ?     00:00:00 dbus
709 ?     00:00:00 cups-browsed
723 ?     00:00:00 kerneloops
729 ?     00:00:00 kerneloops
772 ?     00:00:00 rtkit-daemon
948 ?     00:00:00 upowerd
983 ?     00:00:12 packagekitd
1136 ?    00:00:00 colord
1194 ?    00:00:00 gdm-session-wor
1205 ?    00:00:01 systemd
1206 ?    00:00:00 (sd-pam)
1212 ?    00:00:00 pipewire
1214 ?    00:00:00 pipewire-media-
1215 ?    00:00:02 pulseaudio
1217 ?    00:00:00 gnome-keyring-d
1220 ?    00:00:00 snapd-desktop-i
1226 ?    00:00:02 dbus-daemon
1232 ?    00:00:00 gvfsd
1237 ?    00:00:00 gvfsd-fuse
1250 ?    00:00:00 xdg-document-po
1253 ?    00:00:00 xdg-permission-
1259 ?    00:00:00 fusermount3
1263 tty2  00:00:00 gdm-wayland-ses
1266 tty2  00:00:00 gnome-session-b
1300 ?    00:00:03 tracker-miner-f
1318 ?    00:00:00 gnome-session-c
1332 ?    00:00:00 gnome-session-b
1353 ?    00:08:34 gnome-shell
1355 ?    00:00:00 at-spl-bus-laun
1357 ?    00:00:00 gvfs-udisks2-vo
1369 ?    00:00:00 dbus-daemon
1370 ?    00:00:00 gvfs-gphoto2-vo
1375 ?    00:00:00 gvfs-goa-volume
1379 ?    00:00:02 goa-daemon
1399 ?    00:00:00 goa-identity-se

```

```

Oct 12 15:17
user@user-VirtualBox: ~

1508 ?      00:00:00 gvfsd-metadata
1518 ?      00:00:02 evolution-calen
1535 ?      00:00:00 evolution-addre
1548 ?      00:00:00 gvfsd-trash
1570 ?      00:00:00 at-spi2-registr
1574 ?      00:00:00 gjs
1579 ?      00:00:00 sh
1582 ?      00:00:13 ibus-daemon
1583 ?      00:00:00 gsd-a11y-settin
1584 ?      00:00:00 gsd-color
1587 ?      00:00:00 gsd-datetime
1591 ?      00:00:00 gsd-housekeepin
1598 ?      00:00:00 gsd-keyboard
1599 ?      00:00:00 gsd-media-keys
1600 ?      00:00:00 gsd-power
1610 ?      00:00:00 gsd-print-notif
1614 ?      00:00:00 gsd-rfkill
1616 ?      00:00:00 gsd-screensaver
1617 ?      00:00:00 gsd-sharing
1624 ?      00:00:00 gsd-smartcard
1629 ?      00:00:00 gsd-sound
1636 ?      00:00:00 gsd-wacom
1660 ?      00:00:00 ibus-dconf
1661 ?      00:00:02 ibus-extension-
1667 ?      00:00:00 gsd-disk-utilit
1668 ?      00:00:00 evolution-alarm
1678 ?      00:00:00 ibus-portal
1696 ?      00:00:00 gsd-printer
1745 ?      00:00:06 snap-store
1754 ?      00:00:04 ibus-engine-sim
1828 ?      00:00:00 xdg-desktop-por
1876 ?      00:00:00 gjs
1997 ?      00:00:29 Xwayland
2005 ?      00:00:00 gsd-xsettings
2036 ?      00:00:00 ibus-x11
3461 ?      00:00:00 update-notifier
3624 ?      00:00:00 gvfsd-network
3657 ?      00:00:00 gvfsd-dnssd
16353 ?     00:02:05 firefox
16496 ?     00:00:00 Socket Process

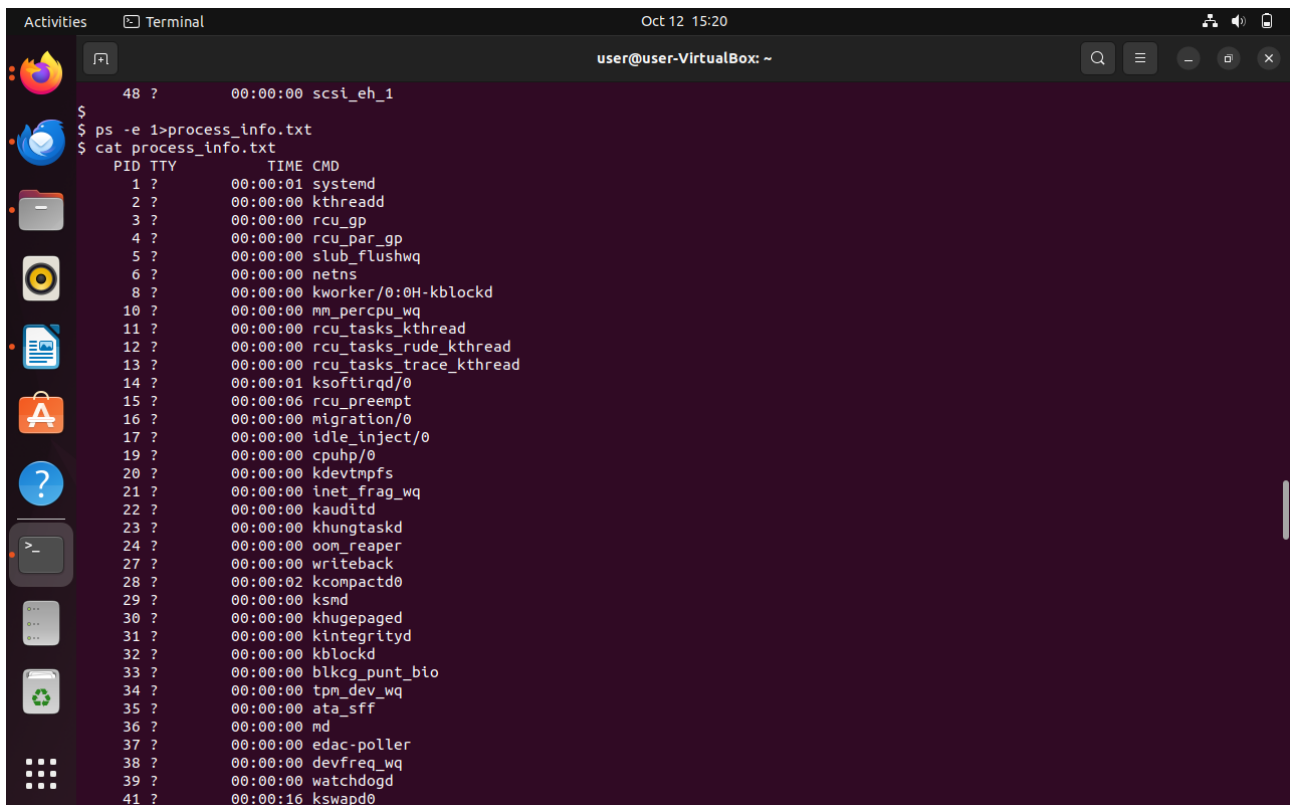
1745 ?      00:00:06 snap-store
1754 ?      00:00:04 ibus-engine-sim
1828 ?      00:00:00 xdg-desktop-por
1876 ?      00:00:00 gjs
1997 ?      00:00:29 Xwayland
2005 ?      00:00:00 gsd-xsettings
2036 ?      00:00:00 ibus-x11
3461 ?      00:00:00 update-notifier
3624 ?      00:00:00 gvfsd-network
3657 ?      00:00:00 gvfsd-dnssd
16353 ?     00:02:05 firefox
16496 ?     00:00:00 Socket Process
16547 ?     00:00:06 Privileged Cont
16585 ?     00:00:00 snap
16719 ?     00:00:00 WebExtensions
16993 ?     00:00:00 Utility Process
17157 ?     00:01:33 Isolated Web Co
17186 ?     00:00:35 Isolated Web Co
17219 ?     00:00:00 RDD Process
17849 ?     00:00:17 systemd-oomd
18033 ?     00:00:00 oosplash
18050 ?     00:00:37 soffice.bin
19155 ?     00:00:09 nautilus
19271 ?     00:00:10 gnome-terminal-
20031 ?     00:00:02 snapd
20079 ?     00:00:00 systemd-journal
21252 ?     00:00:02 gjs
21325 ?     00:00:00 gnome-terminal
21328 ?     00:00:00 gnome-terminal.
21333 pts/1    00:00:00 bash
21575 ?     00:00:01 kworker/u2:2-events_unbound
21858 ?     00:00:01 kworker/u2:3-events_unbound
22172 ?     00:00:00 kworker/u2:4-flush-8:0
22207 ?     00:00:00 kworker/0:0-events
22390 ?     00:00:00 kworker/0:2-events
22424 ?     00:00:00 fwupd
22468 ?     00:00:00 Web Content
22494 ?     00:00:00 Web Content
22535 ?     00:00:00 kworker/u2:0-events_unbound
22536 ?     00:00:00 Web Content

```


The output can be quite large. How can you view the output as multipage output?

```
$ ps -e | more
  PID TTY          TIME CMD
   1 ?        00:00:01 systemd
   2 ?        00:00:00 kthreadd
   3 ?        00:00:00 rcu_gp
   4 ?        00:00:00 rcu_par_gp
   5 ?        00:00:00 slub_flushwq
   6 ?        00:00:00 netns
   8 ?        00:00:00 kworker/0:0H-kblockd
  10 ?        00:00:00 mm_percpu_wq
  11 ?        00:00:00 rcu_tasks_kthread
  12 ?        00:00:00 rcu_tasks_rude_kthread
  13 ?        00:00:00 rcu_tasks_trace_kthread
  14 ?        00:00:01 ksoftirqd/0
  15 ?        00:00:05 rcu_preempt
  16 ?        00:00:00 migration/0
  17 ?        00:00:00 idle_inject/0
  19 ?        00:00:00 cpuhp/0
  20 ?        00:00:00 kdevtmpfs
  21 ?        00:00:00 inet_frag_wq
  22 ?        00:00:00 kauditd
  23 ?        00:00:00 khungtaskd
  24 ?        00:00:00 oom_reaper
  27 ?        00:00:00 writeback
  28 ?        00:00:02 kcompactd0
  29 ?        00:00:00 ksm
  30 ?        00:00:00 khugepaged
  31 ?        00:00:00 kintegrityd
  32 ?        00:00:00 kblockd
  33 ?        00:00:00 blkcg_punt_bio
  34 ?        00:00:00 tpm_dev_wq
  35 ?        00:00:00 ata_sff
  36 ?        00:00:00 md
  37 ?        00:00:00 edac-poller
  38 ?        00:00:00 devfreq_wq
  39 ?        00:00:00 watchdogd
  41 ?        00:00:12 kswapd0
  42 ?        00:00:00 ecryptfs-kthread
  43 ?        00:00:00 kthrotld
  44 ?        00:00:00 acpi_thermal_pn
--More--
```

How can you store the output in a file named process_info?



```

Oct 12 15:20
user@user-VirtualBox: ~
$ ps -e 1>process_info.txt
$ cat process_info.txt
  PID TTY          TIME CMD
   1 ?        00:00:01 systemd
   2 ?        00:00:00 kthreadd
   3 ?        00:00:00 rcu_gp
   4 ?        00:00:00 rcu_par_gp
   5 ?        00:00:00 slub_flushwq
   6 ?        00:00:00 netns
   8 ?        00:00:00 kworker/0:0H-kblockd
  10 ?        00:00:00 mm_percpu_wq
  11 ?        00:00:00 rcu_tasks_kthread
  12 ?        00:00:00 rcu_tasks_rude_kthread
  13 ?        00:00:00 rcu_tasks_trace_kthread
  14 ?        00:00:01 ksoftirqd/0
  15 ?        00:00:06 rcu_preempt
  16 ?        00:00:00 migration/0
  17 ?        00:00:00 idle_inject/0
  19 ?        00:00:00 cpuhp/0
  20 ?        00:00:00 kdevtmpfs
  21 ?        00:00:00 inet_frag_wq
  22 ?        00:00:00 kauditd
  23 ?        00:00:00 khungtaskd
  24 ?        00:00:00 oom_reaper
  27 ?        00:00:00 writeback
  28 ?        00:00:02 kcompactd0
  29 ?        00:00:00 ksm
  30 ?        00:00:00 khugepaged
  31 ?        00:00:00 kintegrityd
  32 ?        00:00:00 kblockd
  33 ?        00:00:00 blkcg_punt_bio
  34 ?        00:00:00 tpm_dev_wq
  35 ?        00:00:00 ata_sff
  36 ?        00:00:00 md
  37 ?        00:00:00 edac-poller
  38 ?        00:00:00 devfreq_wq
  39 ?        00:00:00 watchdogd
  41 ?        00:00:16 kswapd0

```