Lab01

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1. Listing contents in a directory

- **ls:** List files and directories in the current directory.
- **ls -l:** List files and directories in long format, including permissions, owner, group, size, and modification time.

```
abhishek@hp in ~ took 216ms
❯ ls
'2023-07-10 19-56-34.mkv'   Documents               packettracer      Templates
'2023-07-10 20-05-32.mkv'   Downloads               Pictures          Videos
 anaconda3                  macchiato_squircle.png   Programs          vlc.sh
 Applications               Music                    Public            VPN
 browserify.log             neovide_backtraces.log   Sync
 Desktop                    Obsidian                 sysinfo.log
 Disk                       Oracle                   sysinfo.log.bak

abhishek@hp in ~ took 17ms
❯ ls -l
total 748
-rw-r--r-- 1 abhishek abhishek  89176 Jul 10 19:56 '2023-07-10 19-56-34.mkv'
-rw-r--r-- 1 abhishek abhishek  70731 Jul 10 20:05 '2023-07-10 20-05-32.mkv'
drwxr-xr-x 1 abhishek abhishek    398 Jul  5 01:36  anaconda3
drwxr-xr-x 1 abhishek abhishek    140 Jul 27 23:18  Applications
-rw-r--r-- 1 abhishek abhishek   8881 Jul 25 21:43  browserify.log
drwxr-xr-x 1 abhishek abhishek    108 Jun  9 23:05  Desktop
lrwxrwxrwx 1 abhishek abhishek      9 Jul  7 14:33  Disk → /mnt/Disk
drwxr-xr-x 1 abhishek abhishek   2732 Jul  9 11:14  Documents
drwxr-xr-x 1 abhishek abhishek    336 Jul 28 15:03  Downloads
-rw-r--r-- 1 abhishek abhishek   6098 Jul 27 22:23  macchiato_squircle.png
drwxr-xr-x 1 abhishek abhishek      8 Jul 21 11:46  Music
-rw-r--r-- 1 abhishek abhishek   2040 Jul  7 22:53  neovide_backtraces.log
drwxr-xr-x 1 abhishek abhishek     78 Mar  8 21:58  Obsidian
drwxr-xr-x 1 abhishek abhishek     42 Jun  8 00:25  Oracle
drwxr-xr-x 1 abhishek abhishek    110 Jul 26 17:04  packettracer
drwxr-xr-x 1 abhishek abhishek    776 Jul 21 15:39  Pictures
drwxr-xr-x 1 abhishek abhishek   3172 Jul 28 15:03  Programs
drwxr-xr-x 1 abhishek abhishek      0 Jun  7 15:58  Public
drwxr-xr-x 1 abhishek abhishek     18 Jul 19 19:30  Sync
-rw-r--r-- 1 abhishek abhishek 546258 Jul 28 15:03  sysinfo.log
-rw-r--r-- 1 abhishek abhishek  16858 Jul  5 01:55  sysinfo.log.bak
drwxr-xr-x 1 abhishek abhishek      0 Jun  7 15:58  Templates
drwxr-xr-x 1 abhishek abhishek      0 Jun  7 15:58  Videos
-rwxr-xr-x 1 abhishek abhishek   1173 Dec  5  2022  vlc.sh
drwxr-xr-x 1 abhishek abhishek    900 Jun 15 15:38  VPN
```

2. Reading files

- **cat:** Print the contents of a file to the screen.
- **more:** Display the contents of a file one page at a time.

- **less:** Display the contents of a file one page at a time, with the ability to move forward and backward in the file.

```
abhishek@hp in ~/Programs/OS/01-Lab took 1m20s
❯ cat file3.txt
This is inside file3.txt
Contents of the file
OS Lab 01 - 28 Jul 2023

abhishek@hp in ~/Programs/OS/01-Lab took 9ms
❯ more file3.txt
This is inside file3.txt
Contents of the file
OS Lab 01 - 28 Jul 2023

abhishek@hp in ~/Programs/OS/01-Lab took 22ms
❯ less file3.txt
```

```
This is inside file3.txt
Contents of the file
OS Lab 01 - 28 Jul 2023
file3.txt (END)
```

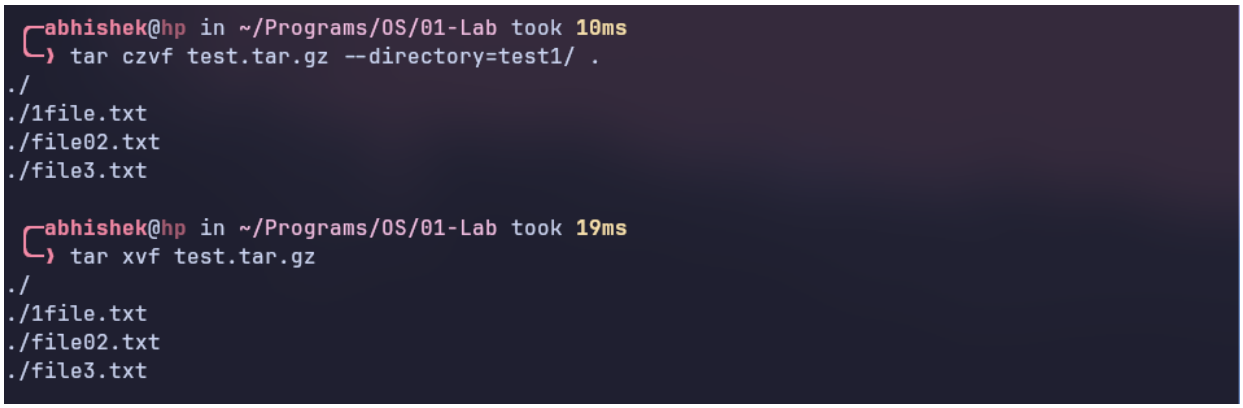
3. Manipulating files

- **touch:** Create an empty file with the specified name or update the timestamp of an existing file.
- **cp:** Copy files or directories from one location to another.
- **cp -R:** Recursively copy directories and their contents from one location to another.
- **rm:** Remove (delete) files or directories permanently.
- **mkdir:** Create a new directory with the specified name. files

4. Other common commands

- **tar:** Archive files together into a single file (tape archive) or extract files from a tar archive.
- **tar czvf:** Create a new tar archive (`c`), compress it using gzip (`z`), verbosely list the files being processed during archiving (`v`), and specify the filename of the new archive (`f`).

- **tar xvf:** Extract files from a tar archive (`x`), verbosely list the files being processed during extraction (`v`), and specify the filename of the archive to extract from (`f`).



- **ssh:** Securely connect to a remote server using the SSH (Secure Shell) protocol for encrypted communication.

- **ssh -p <port> <username>@<address> -i <keyfile.pem>:** Securely connect to a remote server at the specified <address> using the SSH (Secure Shell) protocol, with the <username> and the private key from the <keyfile.pem> for authentication, and optionally specifying a custom port number with `-p`.

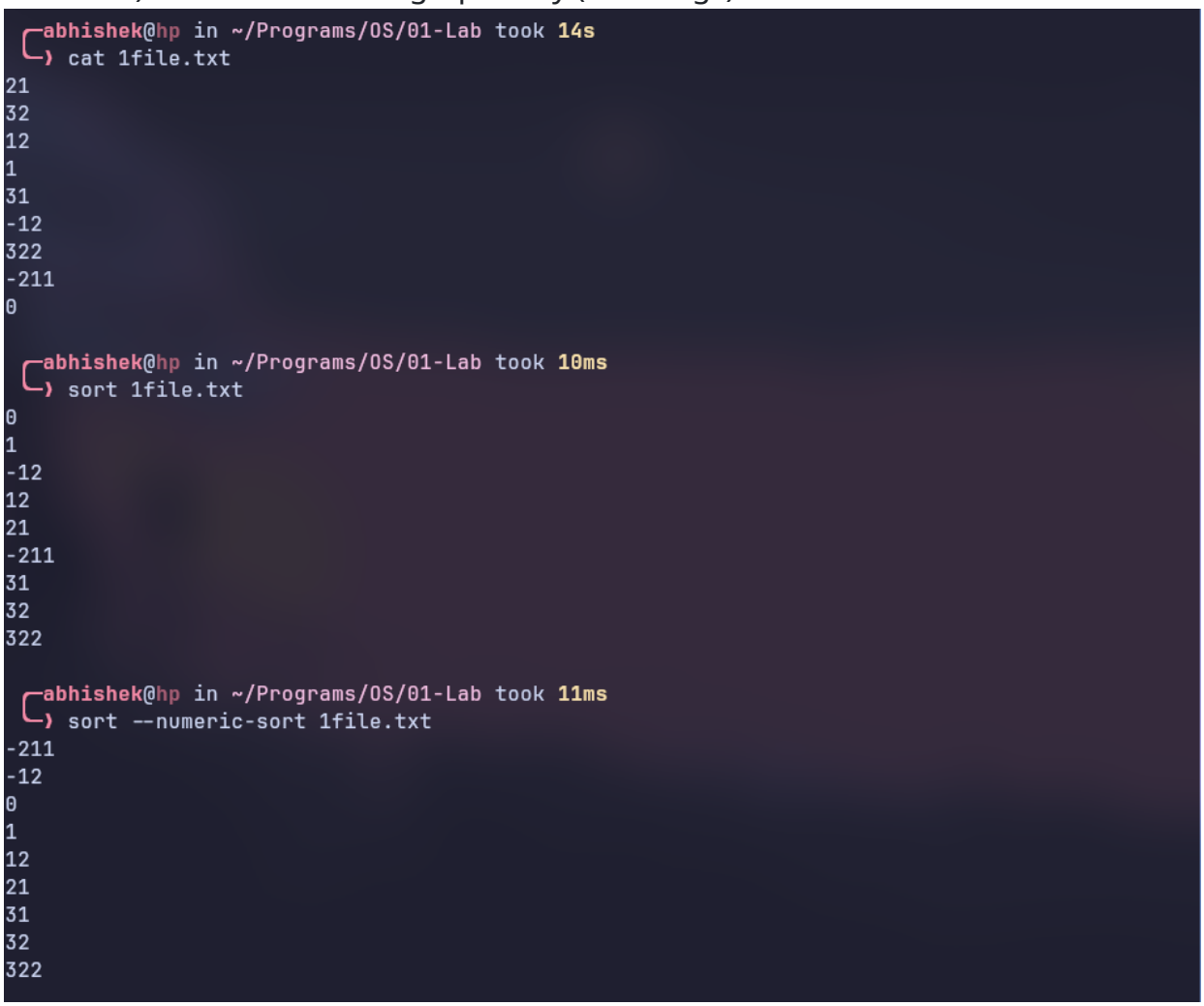
```
abhishek@hp in ~/Programs/OS/01-Lab took 13ms
❯ ssh -p 2222 azureuser@104.41.148.230 -i ~/Documents/Ubuntu-US_key.pem
Welcome to Ubuntu 22.04.2 LTS (GNU/Linux 5.15.0-1042-azure x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Fri Jul 28 10:08:19 AM UTC 2023

  System load:                      0.03564453125
  Usage of /:                       15.6% of 61.85GB
  Memory usage:                     68%
  Swap usage:                       0%
  Processes:                        151
  Users logged in:                  0
  IPv4 address for br-14c3bb4166a5: 172.19.0.1
  IPv4 address for br-34fb9591c5fb: 172.22.0.1
  IPv4 address for br-7468c47238c0: 172.21.0.1
  IPv4 address for br-9b30cbce6dfb: 172.18.0.1
  IPv4 address for br-a55d8050ef67: 172.20.0.1
  IPv4 address for docker0:         172.17.0.1
  IPv4 address for eth0:            10.1.1.4

 * Introducing Expanded Security Maintenance for Applications.
   Receive updates to over 25,000 software packages with your
   Ubuntu Pro subscription. Free for personal use.

     https://ubuntu.com/azure/pro

Expanded Security Maintenance for Applications is not enabled.

52 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

5 additional security updates can be applied with ESM Apps.
Learn more about enabling ESM Apps service at https://ubuntu.com/esm


Last login: Thu Jul 27 15:58:39 2023 from 115.244.99.162
azureuser@Ubuntu-US:~$
```

- **diff:** Compare and display the differences between two files line by line.

```
abhishek@hp in ~/Programs/OS/01-Lab took 22s
❯ diff file02.txt file3.txt
1c1
< This is inside file02.txt
---
> This is inside file3.txt
```

- **sort:** Sort lines of text in ascending order and display the result.

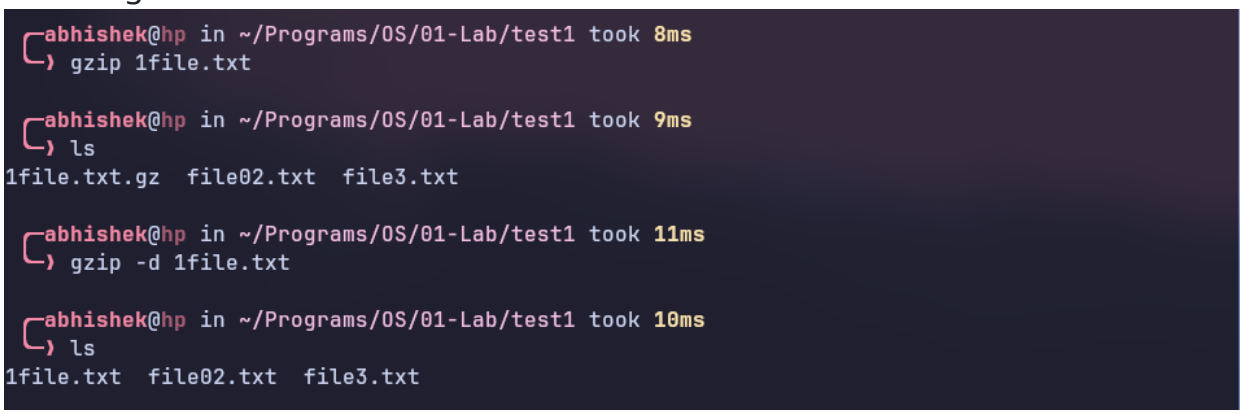
- **sort --numeric-sort:** Sort lines of text in ascending order numerically (as numbers) rather than lexicographically (as strings).



- **pwd:** Print the working directory, i.e., the current directory that you are in.

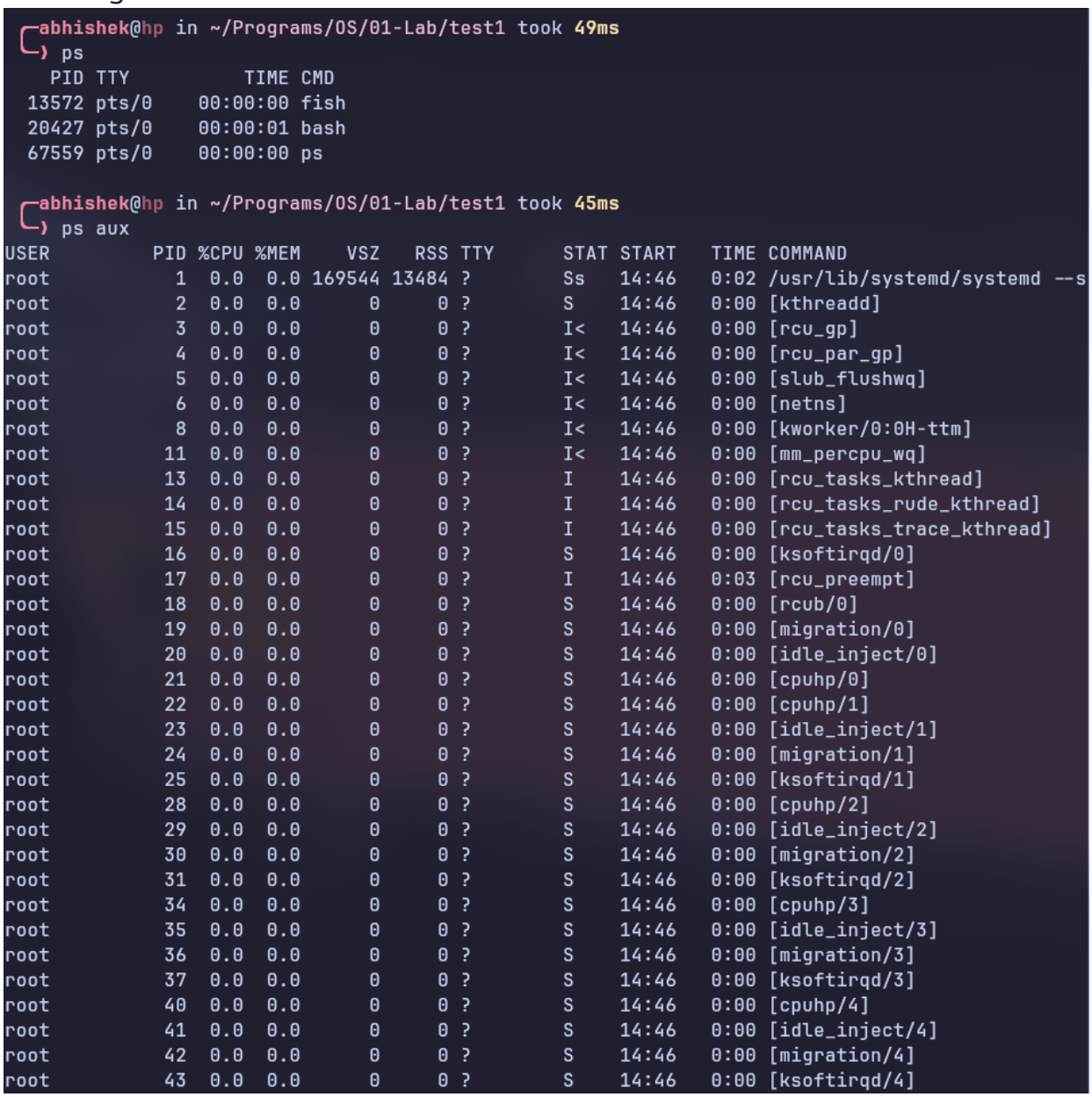
- **gzip:** Compress files using the gzip compression algorithm, creating a new file with a `.gz` extension.

- **gzip -d:** Decompress files that were compressed using gzip, restoring them to their original form.



- **ps:** Display a snapshot of the current processes running on the system.

- **ps aux:** Display detailed information about all processes running on the system, including the ones from all users.



```
abhishek@hp in ~/Programs/OS/01-Lab/test1 took 49ms
❯ ps
    PID TTY          TIME CMD
  13572 pts/0    00:00:00 fish
  20427 pts/0    00:00:01 bash
  67559 pts/0    00:00:00 ps

abhishek@hp in ~/Programs/OS/01-Lab/test1 took 45ms
❯ ps aux
USER         PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root           1  0.0  0.0 169544 13484 ?        Ss   14:46   0:02 /usr/lib/systemd/systemd --s
root           2  0.0  0.0      0     0 ?        S    14:46   0:00 [kthreadd]
root           3  0.0  0.0      0     0 ?        I<   14:46   0:00 [rcu_gp]
root           4  0.0  0.0      0     0 ?        I<   14:46   0:00 [rcu_par_gp]
root           5  0.0  0.0      0     0 ?        I<   14:46   0:00 [slub_flushwq]
root           6  0.0  0.0      0     0 ?        I<   14:46   0:00 [netns]
root           8  0.0  0.0      0     0 ?        I<   14:46   0:00 [kworker/0:0H-ttm]
root          11  0.0  0.0      0     0 ?        I<   14:46   0:00 [mm_percpu_wq]
root          13  0.0  0.0      0     0 ?        I    14:46   0:00 [rcu_tasks_kthread]
root          14  0.0  0.0      0     0 ?        I    14:46   0:00 [rcu_tasks_rude_kthread]
root          15  0.0  0.0      0     0 ?        I    14:46   0:00 [rcu_tasks_trace_kthread]
root          16  0.0  0.0      0     0 ?        S    14:46   0:00 [ksoftirqd/0]
root          17  0.0  0.0      0     0 ?        I    14:46   0:03 [rcu_preempt]
root          18  0.0  0.0      0     0 ?        S    14:46   0:00 [rcub/0]
root          19  0.0  0.0      0     0 ?        S    14:46   0:00 [migration/0]
root          20  0.0  0.0      0     0 ?        S    14:46   0:00 [idle_inject/0]
root          21  0.0  0.0      0     0 ?        S    14:46   0:00 [cpuhp/0]
root          22  0.0  0.0      0     0 ?        S    14:46   0:00 [cpuhp/1]
root          23  0.0  0.0      0     0 ?        S    14:46   0:00 [idle_inject/1]
root          24  0.0  0.0      0     0 ?        S    14:46   0:00 [migration/1]
root          25  0.0  0.0      0     0 ?        S    14:46   0:00 [ksoftirqd/1]
root          28  0.0  0.0      0     0 ?        S    14:46   0:00 [cpuhp/2]
root          29  0.0  0.0      0     0 ?        S    14:46   0:00 [idle_inject/2]
root          30  0.0  0.0      0     0 ?        S    14:46   0:00 [migration/2]
root          31  0.0  0.0      0     0 ?        S    14:46   0:00 [ksoftirqd/2]
root          34  0.0  0.0      0     0 ?        S    14:46   0:00 [cpuhp/3]
root          35  0.0  0.0      0     0 ?        S    14:46   0:00 [idle_inject/3]
root          36  0.0  0.0      0     0 ?        S    14:46   0:00 [migration/3]
root          37  0.0  0.0      0     0 ?        S    14:46   0:00 [ksoftirqd/3]
root          40  0.0  0.0      0     0 ?        S    14:46   0:00 [cpuhp/4]
root          41  0.0  0.0      0     0 ?        S    14:46   0:00 [idle_inject/4]
root          42  0.0  0.0      0     0 ?        S    14:46   0:00 [migration/4]
root          43  0.0  0.0      0     0 ?        S    14:46   0:00 [ksoftirqd/4]
```

- **free:** Display the amount of free and used memory (RAM) on the system, including buffers and cache.

- **free -g|m|h:** Display the amount of free and used memory (RAM) on the system, with the memory sizes shown in gigabytes (`-g`), megabytes (`-m`), or human-readable format (`-h`).

```
abhishek@hp in ~/Programs/OS/01-Lab/test1 took 48ms
❯ free
               total        used        free      shared  buff/cache   available
Mem:        15681672     4283736     6621000      302328     5379732    11397936
Swap:       32444408           0    32444408

abhishek@hp in ~/Programs/OS/01-Lab/test1 took 14ms
❯ free -g
               total        used        free      shared  buff/cache   available
Mem:              14           4           6           0           5          10
Swap:             30           0          30

abhishek@hp in ~/Programs/OS/01-Lab/test1 took 14ms
❯ free -m
               total        used        free      shared  buff/cache   available
Mem:           15314        4186        6462         295        5253       11127
Swap:          31683           0       31683

abhishek@hp in ~/Programs/OS/01-Lab/test1 took 14ms
❯ free -h
               total        used        free      shared  buff/cache   available
Mem:            14Gi       4.1Gi       6.3Gi       295Mi       5.1Gi        10Gi
Swap:           30Gi          0B        30Gi
```

- **kill:** Terminate a process or send a signal to a process, allowing you to control its behavior or stop it.

```
abhishek@hp in ~ took 3ms
❯ ps --pid 72117
    PID TTY          TIME CMD
  72117 ?        00:00:12 firedragon

abhishek@hp in ~ took 38ms
❯ kill 72117

abhishek@hp in ~ took 2ms
❯ ps --pid 72117
    PID TTY          TIME CMD
```

5. Changing Permissions

- **chmod:** Change the permissions of a file or directory.
- **chmod go+w:** Set write permission for the group and others on a file or directory.
- **chmod o=wx:** Set execute (search) permission for others on a file or directory, and remove write permission for others.
- **chmod u-rw:** Remove read and write permissions for the owner of a file or directory.
- **chmod +x:** Add execute (search) permission for the owner, group, and others on a file or directory.

```
 ┌─abhishek@hp in ~/Programs/OS/01-Lab took 1s
[▓] × ls -l
total 88
-rw-r--r-- 1 abhishek abhishek    29 Jul 28 15:47 1file.txt
-rw-r--r-- 1 abhishek abhishek 72439 Jul 28 15:02 CS3003_Assignment-1.pdf
-rw-r--r-- 1 abhishek abhishek    71 Jul 28 15:43 file02.txt
-rw-r--r-- 1 abhishek abhishek    70 Jul 28 15:43 file3.txt
drwxr-xr-x 1 abhishek abhishek    56 Jul 28 15:49 test1
-rw-r--r-- 1 abhishek abhishek   168 Jul 28 15:34 test.tar.gz

 ┌─abhishek@hp in ~/Programs/OS/01-Lab took 14ms
 └─) chmod go+w 1file.txt

 ┌─abhishek@hp in ~/Programs/OS/01-Lab took 8ms
 └─) chmod o=wx file02.txt

 ┌─abhishek@hp in ~/Programs/OS/01-Lab took 9ms
 └─) chmod u-rw file3.txt

 ┌─abhishek@hp in ~/Programs/OS/01-Lab took 9ms
 └─) chmod +x test.tar.gz

 ┌─abhishek@hp in ~/Programs/OS/01-Lab took 9ms
 └─) chmod 400 test1/

 ┌─abhishek@hp in ~/Programs/OS/01-Lab took 8ms
 └─) ls -l
total 88
-rw-rw-rw- 1 abhishek abhishek    29 Jul 28 15:47 1file.txt
-rw-r--r-- 1 abhishek abhishek 72439 Jul 28 15:02 CS3003_Assignment-1.pdf
-rw-r---wx 1 abhishek abhishek    71 Jul 28 15:43 file02.txt
----r--r-- 1 abhishek abhishek    70 Jul 28 15:43 file3.txt
dr-------- 1 abhishek abhishek    56 Jul 28 15:49 test1
-rwxr-xr-x 1 abhishek abhishek   168 Jul 28 15:34 test.tar.gz
```

6. Some more example commands

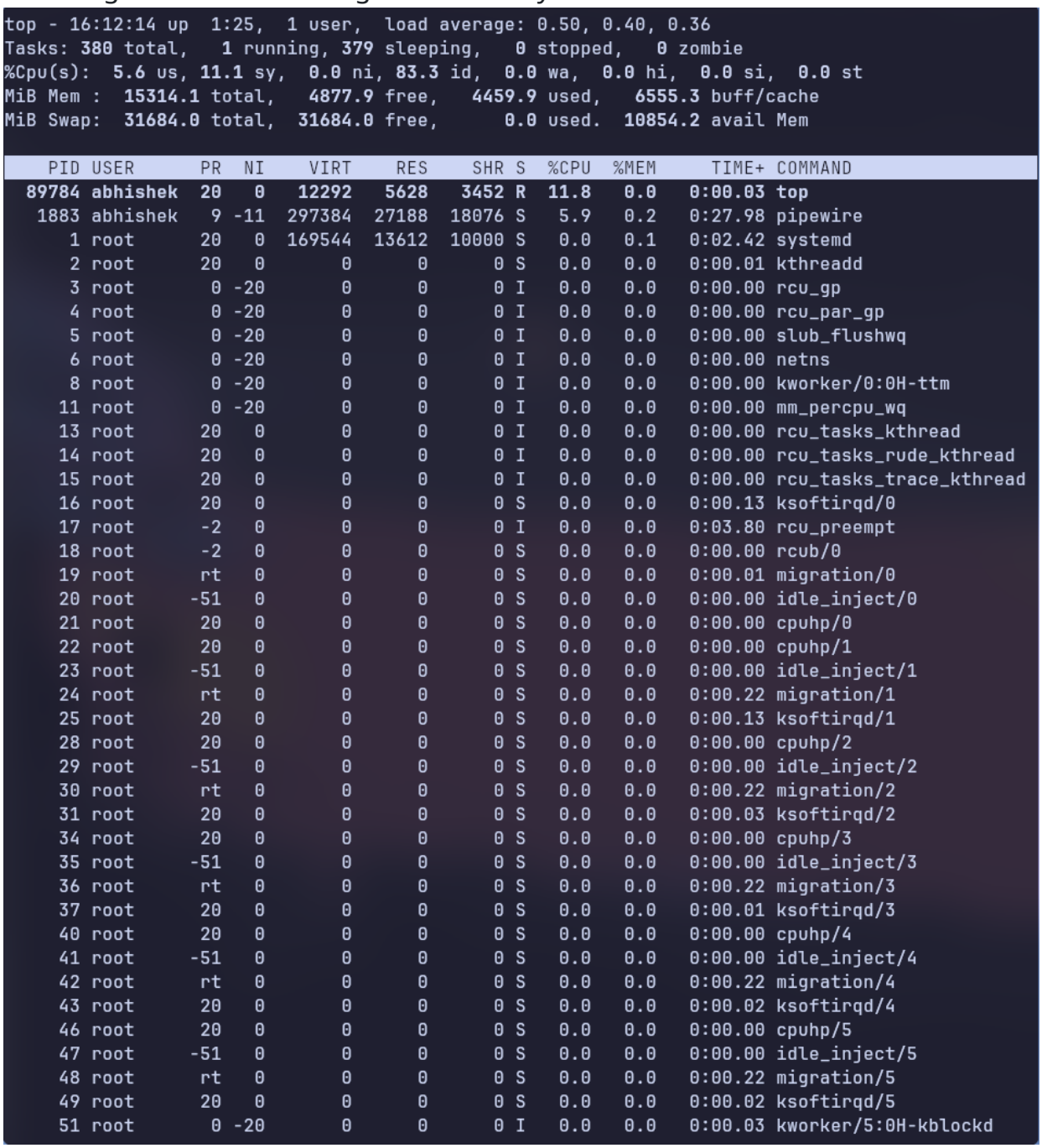
a. `time` and `who` commands

- **time who > myfile.txt:** Run the `who` command to display the currently logged-in users, measure the execution time of the command, and redirect the output to the file `myfile.txt`.

```
 ┌─abhishek@hp in ~/Programs/OS/01-Lab took 8ms
 └─) time who > myfile.txt

real    0m0.009s
user    0m0.002s
sys     0m0.009s

 ┌─abhishek@hp in ~/Programs/OS/01-Lab took 9ms
 └─) cat myfile.txt
abhishek tty2         2023-07-28 14:46 (:0)
```

b. Other process management commands

- **top:** Display a real-time dynamic view of the processes running on the system, including their resource usage and other system information.



```
top - 16:12:14 up  1:25,  1 user,  load average: 0.50, 0.40, 0.36
Tasks: 380 total,   1 running, 379 sleeping,   0 stopped,   0 zombie
%Cpu(s):  5.6 us, 11.1 sy,  0.0 ni, 83.3 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
MiB Mem :  15314.1 total,   4877.9 free,   4459.9 used,   6555.3 buff/cache
MiB Swap:  31684.0 total,  31684.0 free,      0.0 used.  10854.2 avail Mem

    PID USER      PR  NI    VIRT    RES    SHR S  %CPU  %MEM     TIME+ COMMAND
  89784 abhishek  20   0   12292   5628   3452 R  11.8   0.0   0:00.03 top
   1883 abhishek   9 -11  297384  27188  18076 S   5.9   0.2   0:27.98 pipewire
      1 root      20   0  169544  13612  10000 S   0.0   0.1   0:02.42 systemd
      2 root      20   0       0      0      0 S   0.0   0.0   0:00.01 kthreadd
      3 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 rcu_gp
      4 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 rcu_par_gp
      5 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 slub_flushwq
      6 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 netns
      8 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/0:0H-ttm
     11 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 mm_percpu_wq
     13 root      20   0       0      0      0 I   0.0   0.0   0:00.00 rcu_tasks_kthread
     14 root      20   0       0      0      0 I   0.0   0.0   0:00.00 rcu_tasks_rude_kthread
     15 root      20   0       0      0      0 I   0.0   0.0   0:00.00 rcu_tasks_trace_kthread
     16 root      20   0       0      0      0 S   0.0   0.0   0:00.13 ksoftirqd/0
     17 root      -2   0       0      0      0 I   0.0   0.0   0:03.80 rcu_preempt
     18 root      -2   0       0      0      0 S   0.0   0.0   0:00.00 rcub/0
     19 root      rt   0       0      0      0 S   0.0   0.0   0:00.01 migration/0
     20 root     -51   0       0      0      0 S   0.0   0.0   0:00.00 idle_inject/0
     21 root      20   0       0      0      0 S   0.0   0.0   0:00.00 cpuhp/0
     22 root      20   0       0      0      0 S   0.0   0.0   0:00.00 cpuhp/1
     23 root     -51   0       0      0      0 S   0.0   0.0   0:00.00 idle_inject/1
     24 root      rt   0       0      0      0 S   0.0   0.0   0:00.22 migration/1
     25 root      20   0       0      0      0 S   0.0   0.0   0:00.13 ksoftirqd/1
     28 root      20   0       0      0      0 S   0.0   0.0   0:00.00 cpuhp/2
     29 root     -51   0       0      0      0 S   0.0   0.0   0:00.00 idle_inject/2
     30 root      rt   0       0      0      0 S   0.0   0.0   0:00.22 migration/2
     31 root      20   0       0      0      0 S   0.0   0.0   0:00.03 ksoftirqd/2
     34 root      20   0       0      0      0 S   0.0   0.0   0:00.00 cpuhp/3
     35 root     -51   0       0      0      0 S   0.0   0.0   0:00.00 idle_inject/3
     36 root      rt   0       0      0      0 S   0.0   0.0   0:00.22 migration/3
     37 root      20   0       0      0      0 S   0.0   0.0   0:00.01 ksoftirqd/3
     40 root      20   0       0      0      0 S   0.0   0.0   0:00.00 cpuhp/4
     41 root     -51   0       0      0      0 S   0.0   0.0   0:00.00 idle_inject/4
     42 root      rt   0       0      0      0 S   0.0   0.0   0:00.22 migration/4
     43 root      20   0       0      0      0 S   0.0   0.0   0:00.02 ksoftirqd/4
     46 root      20   0       0      0      0 S   0.0   0.0   0:00.00 cpuhp/5
     47 root     -51   0       0      0      0 S   0.0   0.0   0:00.00 idle_inject/5
     48 root      rt   0       0      0      0 S   0.0   0.0   0:00.22 migration/5
     49 root      20   0       0      0      0 S   0.0   0.0   0:00.02 ksoftirqd/5
     51 root       0 -20       0      0      0 I   0.0   0.0   0:00.03 kworker/5:0H-kblockd
```

- **pgrep:** List the process IDs (PIDs) of processes that match the specified criteria (process name or other attributes).

- **pkill:** Terminate or signal processes based on their names or other attributes. It sends a signal to processes that match the specified criteria, effectively terminating them or controlling their behavior.