Exercise 1 – The Inodes

Tasks to Perform on AlmaLinux and Ubuntu:

*Use your **user's account not root** and use **sudo** if necessary.*

1. For each of your partitions, how many **inodes** have been created? How many are used and how many are available?

ALMA LINUX

```
gkeymole@server07 ~ $ df -i
Filesystem       Inodes  IUsed    IFree IUse% Mounted on
devtmpfs         456608    469   456139    1% /dev
tmpfs            464140      1   464139    1% /dev/shm
tmpfs            819200    983   818217    1% /run
/dev/sda7      20968448 172242 20796206    1% /
/dev/sda2        524288    366   523922    1% /boot
/dev/sda3       4194304   2582  4191722    1% /var
/dev/sda5       3670016    165  3669851    1% /home
tmpfs             92828    124    92704    1% /run/user/1000
gkeymole@server07 ~ $ df -ih
Filesystem     Inodes IUsed IFree IUse% Mounted on
devtmpfs         446K   469  446K    1% /dev
tmpfs            454K     1  454K    1% /dev/shm
tmpfs            800K   983  800K    1% /run
/dev/sda7         20M  169K   20M    1% /
/dev/sda2        512K   366  512K    1% /boot
/dev/sda3        4.0M  2.6K  4.0M    1% /var
/dev/sda5        3.5M   165  3.5M    1% /home
tmpfs             91K   124   91K    1% /run/user/1000
gkeymole@server07 ~ $
```

UBUNTU

```
gkeymole@client07:~$ df -i
Filesystem      Inodes  IUsed   IFree IUse% Mounted on
tmpfs           495175    971  494204    1% /run
/dev/sda6      1466368 218723 1247645   15% /
tmpfs           495175      1  495174    1% /dev/shm
tmpfs           495175      4  495171    1% /run/lock
/dev/sda3        62592    607   61985    1% /boot
/dev/sda5       249984    168  249816    1% /home
/dev/sda2            0      0       0     - /boot/efi
tmpfs            99035    135   98900    1% /run/user/1000
gkeymole@client07:~$ df -ih
Filesystem     Inodes IUsed IFree IUse% Mounted on
tmpfs            484K   971  483K    1% /run
/dev/sda6        1.4M  214K  1.2M   15% /
tmpfs            484K     1  484K    1% /dev/shm
tmpfs            484K     4  484K    1% /run/lock
/dev/sda3         62K   607   61K    1% /boot
/dev/sda5        245K   168  244K    1% /home
/dev/sda2           0     0     0     - /boot/efi
tmpfs             97K   135   97K    1% /run/user/1000
gkeymole@client07:~$
```

Exercise 2 – Creating Physical Links

Tasks to Perform on AlmaLinux:

*Use your **user's account not root** and use **sudo** if necessary.*

2. Create an empty file: **test.txt** and list its **inode number**.

```
gkeymole@server07 ~ $ touch test.txt
gkeymole@server07 ~ $ ls -li test.txt
10884 -rw-r--r--. 1 gkeymole gkeymole 0 Mar 26 14:01 test.txt
gkeymole@server07 ~ $
```

3. Create two physical links called **phy1.txt** and **phy2.txt** for the **test.txt** file.

```
gkeymole@server07 ~ $ ln test.txt phy1.txt
gkeymole@server07 ~ $ ln test.txt phy2.txt
```

4. List the inode numbers of the 3 files: **phy1.txt**, **phy2.txt** and **test.txt**.

```
gkeymole@server07 ~ $ ls -li test.txt phy1.txt phy2.txt
10884 -rw-r--r--. 3 gkeymole gkeymole 0 Mar 26 14:01 phy1.txt
10884 -rw-r--r--. 3 gkeymole gkeymole 0 Mar 26 14:01 phy2.txt
10884 -rw-r--r--. 3 gkeymole gkeymole 0 Mar 26 14:01 test.txt
gkeymole@server07 ~ $
```

5. Use the **echo** command to add the text "**Lab 3**" to the **phy1.txt** file. Check that the text has been added correctly.

```
gkeymole@server07 ~ $ echo "Lab3" > phy1.txt
gkeymole@server07 ~ $ cat phy1.txt
Lab3
gkeymole@server07 ~ $
```

6. List the contents of the other two files: **test.txt** and **phy2.txt**. Is the new text appear?

```
gkeymole@server07 ~ $ cat test.txt
Lab3
gkeymole@server07 ~ $ cat phy2.txt
Lab3
gkeymole@server07 ~ $
```

7. Delete the **test.txt** file.

```
gkeymole@server07 ~ $ rm test.txt
gkeymole@server07 ~ $
```

8. Does The other two files**: phy1.txt** and **phy2.txt** still exist?

```
gkeymole@server07 ~ $ ls phy1.txt phy2.txt
phy1.txt  phy2.txt
gkeymole@server07 ~ $ cat phy1.txt
Lab3
gkeymole@server07 ~ $
```

the data wasn't lost because the inode is still referenced by the remaining links.

9. Display the **number of links** for the **phy1.txt** and **phy2.txt** files.

```
gkeymole@server07 ~ $ ls -l phy1.txt phy2.txt
-rw-r--r--. 2 gkeymole gkeymole 5 Mar 26 14:05 phy1.txt
-rw-r--r--. 2 gkeymole gkeymole 5 Mar 26 14:05 phy2.txt
gkeymole@server07 ~ $
```

10. Delete both **phy1.txt** and **phy2.txt** files.

```
gkeymole@server07 ~ $ rm phy1.txt phy2.txt
gkeymole@server07 ~ $ ls -l
total 296
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Desktop
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Documents
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Downloads
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Music
-rw-r--r--. 1 gkeymole gkeymole 301148 Oct  3 07:20 net-tools-2.0-0.64.20160912git.el9.x86_64.rpm
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Pictures
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Public
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Templates
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Videos
gkeymole@server07 ~ $
```

Exercise 3 – Creating symbolic links

Tasks to Perform on AlmaLinux:

*Use your **user's account not root** and use **sudo** if necessary.*

1. Create the empty file **sym1.txt**.
2. Create a symbolic link called **sym2.txt** and link it to the **sym1.txt** file.
3. Use the **ls -l** command to check the newly created symbolic link.

```
gkeymole@server07 ~ $ touch sym1.txt
gkeymole@server07 ~ $ ln -s sym1.txt sym2.txt
gkeymole@server07 ~ $ ls -l sym2.txt
lrwxrwxrwx. 1 gkeymole gkeymole 8 Mar 26 15:47 sym2.txt -> sym1.txt
gkeymole@server07 ~ $
```

4. Use the **echo** command to add the text: "**Symbolic Link**" to the sym2.txt **file**. Check that the text has been added.

```
gkeymole@server07 ~ $ echo "Symbolic Link" > sym2.txt
gkeymole@server07 ~ $ cat sym2.txt
Symbolic Link
gkeymole@server07 ~ $
```

5. List the contents of the **sym1.txt** file. Is the new text appear?

```
gkeymole@server07 ~ $ cat sym1.txt
Symbolic Link
gkeymole@server07 ~ $
```

6. Delete the **sym2.txt** symbolic link and open the **sym1.txt** file, is the new text still present?

```
gkeymole@server07 ~ $ rm sym2.txt
gkeymole@server07 ~ $ cat sym1.txt
Symbolic Link
gkeymole@server07 ~ $
```

7. Recreate again a symbolic link called **sym2.txt** and link it to the **sym1.txt** file.
8. Use the **ls -l** command to verify the newly created symbolic link.

```
gkeymole@server07 ~ $ ln -s sym1.txt sym2.txt
gkeymole@server07 ~ $ ls -l sym2.txt
lrwxrwxrwx. 1 gkeymole gkeymole 8 Mar 26 15:50 sym2.txt -> sym1.txt
gkeymole@server07 ~ $
```

9. Delete the original **sym1.txt** file.

10. Check if the **sym2.txt** exists, and try to list the contents of the file. Can you? Why?

```
gkeymole@server07 ~ $ rm sym1.txt
gkeymole@server07 ~ $ ls -l sym2.txt
lrwxrwxrwx. 1 gkeymole gkeymole 8 Mar 26 15:50 sym2.txt -> sym1.txt
gkeymole@server07 ~ $ cat sym2.txt
cat: sym2.txt: No such file or directory
gkeymole@server07 ~ $
```

A **symbolic link** just **points to the name** of another file. If that file is deleted, the link still exists but it points to **nothing**, so it becomes broken.

11. Delete symbolic link **sym2.txt**.

```
gkeymole@server07 ~ $ rm sym2.txt
gkeymole@server07 ~ $ ls -l
total 296
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Desktop
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Documents
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Downloads
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Music
-rw-r--r--. 1 gkeymole gkeymole 301148 Oct  3 07:20 net-tools-2.0-0.64.20160912git.el9.x86_64.rpm
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Pictures
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Public
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Templates
drwxr-xr-x. 2 gkeymole gkeymole      6 Mar 24 14:19 Videos
gkeymole@server07 ~ $
```

Exercise 4 – Adding and Mounting Disks

Tasks to Perform on Ubuntu:

*Use your **user's account not root** and use **sudo** if necessary.*

1. Add a **5 GB SATA** disk to your **Ubuntu** virtual machine.

2. Check that the disk is added correctly.

```
gkeymole@client07:~$ lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
sda      8:0    0   30G  0 disk
├─sda1   8:1    0    1M  0 part
├─sda2   8:2    0  977M  0 part /boot/efi
├─sda3   8:3    0  977M  0 part /boot
├─sda4   8:4    0  1.9G  0 part [SWAP]
├─sda5   8:5    0  3.8G  0 part /home
└─sda6   8:6    0 22.4G  0 part /
sdb      8:16   0    5G  0 disk
gkeymole@client07:~$ sudo fdisk -l
[sudo] password for gkeymole:
Disk /dev/sda: 30 GiB, 32212254720 bytes, 62914560 sectors
Disk model: VMware Virtual S
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: gpt
Disk identifier: 06F23CF9-7FBB-439A-A1A8-56885FE91425

Device        Start      End  Sectors  Size Type
/dev/sda1      2048     4095     2048    1M BIOS boot
/dev/sda2      4096  2004991  2000896  977M EFI System
/dev/sda3   2004992  4005887  2000896  977M Linux filesystem
/dev/sda4   4005888  8005631  3999744  1.9G Linux swap
/dev/sda5   8005632 16005119  7999488  3.8G Linux filesystem
/dev/sda6  16005120 62912511 46907392 22.4G Linux filesystem
```

3. On the new disk, create two partitions of **2 GB** each.

```
gkeymole@client07:~$ sudo fdisk /dev/sdb
```

```
Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p): p
Partition number (1-4, default 1): 1
First sector (2048-10485759, default 2048):
Last sector, +/-sectors or +/-size{K,M,G,T,P} (2048-10485759, default 10485759): 2G
Value out of range.
Last sector, +/-sectors or +/-size{K,M,G,T,P} (2048-10485759, default 10485759): +2G

Created a new partition 1 of type 'Linux' and of size 2 GiB.

Command (m for help): n
Partition type
   p   primary (1 primary, 0 extended, 3 free)
   e   extended (container for logical partitions)
Select (default p): p
Partition number (2-4, default 2): 2
First sector (4196352-10485759, default 4196352):
Last sector, +/-sectors or +/-size{K,M,G,T,P} (4196352-10485759, default 10485759): +2G

Created a new partition 2 of type 'Linux' and of size 2 GiB.

Command (m for help): w
```

4. Check that both partitions are created correctly.

```
gkeymole@client07:~$ lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
sda      8:0    0   30G  0 disk
├─sda1   8:1    0    1M  0 part
├─sda2   8:2    0  977M  0 part /boot/efi
├─sda3   8:3    0  977M  0 part /boot
├─sda4   8:4    0  1.9G  0 part [SWAP]
├─sda5   8:5    0  3.8G  0 part /home
└─sda6   8:6    0 22.4G  0 part /
sdb      8:16   0    5G  0 disk
├─sdb1   8:17   0    2G  0 part
└─sdb2   8:18   0    2G  0 part
gkeymole@client07:~$
```

```
Disk /dev/sdb: 5 GiB, 5368709120 bytes, 10485760 sectors
Disk model: VMware Virtual S
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0xfd08f8da

Device     Boot   Start     End Sectors Size Id Type
/dev/sdb1          2048 4196351 4194304   2G 83 Linux
/dev/sdb2       4196352 8390655 4194304   2G 83 Linux
gkeymole@client07:~$
```

5. Format the 1st partition with the **xfs** file system.

```
gkeymole@client07:~$ sudo apt install xfsprogs
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Suggested packages:
  xfsdump attr quota
The following NEW packages will be installed:
  xfsprogs
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
```

```
gkeymole@client07:~$ sudo mkfs.xfs /dev/sdb1
meta-data=/dev/sdb1              isize=512    agcount=4, agsize=131072 blks
         =                       sectsz=512   attr=2, projid32bit=1
         =                       crc=1        finobt=1, sparse=1, rmapbt=0
         =                       reflink=1    bigtime=0 inobtcount=0
data     =                       bsize=4096   blocks=524288, imaxpct=25
         =                       sunit=0      swidth=0 blks
naming   =version 2              bsize=4096   ascii-ci=0, ftype=1
log      =internal log           bsize=4096   blocks=2560, version=2
         =                       sectsz=512   sunit=0 blks, lazy-count=1
realtime =none                   extsz=4096   blocks=0, rtextents=0
gkeymole@client07:~$
```

6. Format the 2nd partition with the **ext4** file system.

```
gkeymole@client07:~$ sudo mkfs.ext4 /dev/sdb2
mke2fs 1.46.5 (30-Dec-2021)
Creating filesystem with 524288 4k blocks and 131072 inodes
Filesystem UUID: ac016c86-5551-4137-83b1-5360a8dcde34
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912

Allocating group tables: done
Writing inode tables: done
Creating journal (16384 blocks): done
Writing superblocks and filesystem accounting information: done

gkeymole@client07:~$
```

7. Verify that both partitions are properly formatted with the correct file system.

```
gkeymole@client07:~$ lsblk -f
NAME   FSTYPE FSVER LABEL UUID                                 FSAVAIL FSUSE% MOUNTPOINTS
sda
├─sda1
├─sda2 vfat   FAT32       073C-6051                             969M     1% /boot/efi
├─sda3 ext4   1.0         d3125053-effc-4511-ab2b-b47eb7b9ea16  677.7M    21% /boot
├─sda4 swap   1           8dc32956-6daf-4115-9ad5-dd67164d40ad              [SWAP]
├─sda5 ext4   1.0         2ecfa537-c843-426b-b841-cdbbdf8da8f0    3.4G     3% /home
└─sda6 ext4   1.0         9c065ed5-240c-4c12-b9a8-d0fdc0425044   13.3G    34% /
sdb
├─sdb1 xfs                106f67f4-460b-4ed0-9771-c44d2b169fa3
└─sdb2 ext4   1.0         ac016c86-5551-4137-83b1-5360a8dcde34
gkeymole@client07:~$
```

8. Create directory**/home/*<your_user>*/partition1.**

```
gkeymole@client07:~$ mkdir /home/gkeymole/partition1
gkeymole@client07:~$
```

9. Manually mount the **first new partition** of the new disk in**/home/*<your_user>*/partition1.**

```
gkeymole@client07:~$ sudo mount /dev/sdb1 /home/gkeymole/partition1
gkeymole@client07:~$
```

10. Check that the partition is mounted correctly.

```
gkeymole@client07:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
tmpfs           387M  1.9M  386M   1% /run
/dev/sda6        22G  7.5G   14G  36% /
tmpfs           1.9G     0  1.9G   0% /dev/shm
tmpfs           5.0M  4.0K  5.0M   1% /run/lock
/dev/sda5       3.7G  123M  3.4G   4% /home
/dev/sda3       944M  201M  678M  23% /boot
/dev/sda2       976M  6.1M  969M   1% /boot/efi
tmpfs           387M  100K  387M   1% /run/user/1000
/dev/sdb1       2.0G   47M  2.0G   3% /home/gkeymole/partition1
gkeymole@client07:~$
```

11. Create the folder **/Test.**

```
gkeymole@client07:~$ sudo mkdir /Test
gkeymole@client07:~$
```

12. Edit the**/etc/fstab** file to mount the **second new partition** of the new disk in the**/Test** directory and make it permanent.

```
gkeymole@client07:~$ lsblk -f /dev/sdb2
NAME FSTYPE FSVER LABEL UUID                                 FSAVAIL FSUSE% MOUNTPOINTS
sdb2 ext4   1.0         ac016c86-5551-4137-83b1-5360a8dcde34
gkeymole@client07:~$
```

```
gkeymole@client07:~$ sudo nano /etc/fstab
```

```
# / was on /dev/sda6 during installation
UUID=9c065ed5-240c-4c12-b9a8-d0fdc0425044 /               ext4    errors=remount-ro 0       1
# /boot was on /dev/sda3 during installation
UUID=d3125053-effc-4511-ab2b-b47eb7b9ea16 /boot           ext4    defaults        0       2
# /boot/efi was on /dev/sda2 during installation
UUID=073C-6051  /boot/efi       vfat    umask=0077      0       1
# /home was on /dev/sda5 during installation
UUID=2ecfa537-c843-426b-b841-cdbbdf8da8f0 /home           ext4    defaults        0       2
# swap was on /dev/sda4 during installation
UUID=8dc32956-6daf-4115-9ad5-dd67164d40ad none            swap    sw              0       0
UUID=ac016c86-5551-4137-83b1-5360a8dcde34 /Test           ext4    defaults        0       0
```

13. Test permanent mounting with the command: **mount -a.**

```
gkeymole@client07:~$ sudo mount -a
gkeymole@client07:~$
```

14. Check that the partition is mounted correctly.

```
gkeymole@client07:~$ df -h | grep Test
/dev/sdb2       2.0G   24K  1.8G   1% /Test
gkeymole@client07:~$
```

15. Restart the machine.

```
gkeymole@client07:~$ sudo reboot
```

16. Check that the mount**/Test** is still properly mounted on the new disk, and that the mount point **/home/*<your_user>*/partition1** is no longer mounted.

```
gkeymole@client07:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
tmpfs           387M  1.9M  385M   1% /run
/dev/sda6        22G  7.5G   14G  36% /
tmpfs           1.9G     0  1.9G   0% /dev/shm
tmpfs           5.0M  4.0K  5.0M   1% /run/lock
/dev/sda5       3.7G  123M  3.4G   4% /home
/dev/sda3       944M  201M  678M  23% /boot
/dev/sda2       976M  6.1M  969M   1% /boot/efi
/dev/sdb2       2.0G   24K  1.8G   1% /Test
tmpfs           387M   96K  387M   1% /run/user/1000
```

```
gkeymole@client07:~$ lsblk -f
NAME   FSTYPE FSVER LABEL UUID                                 FSAVAIL FSUSE% MOUNTPOINTS
sda
├─sda1
├─sda2 vfat   FAT32       073C-6051                             969M     1% /boot/efi
├─sda3 ext4   1.0         d3125053-effc-4511-ab2b-b47eb7b9ea16  677.7M    21% /boot
├─sda4 swap   1           8dc32956-6daf-4115-9ad5-dd67164d40ad                [SWAP]
├─sda5 ext4   1.0         2ecfa537-c843-426b-b841-cdbbdf8da8f0    3.4G     3% /home
└─sda6 ext4   1.0         9c065ed5-240c-4c12-b9a8-d0fdc0425044   13.3G    34% /
sdb
├─sdb1 xfs                106f67f4-460b-4ed0-9771-c44d2b169fa3
└─sdb2 ext4   1.0         ac016c86-5551-4137-83b1-5360a8dcde34    1.8G     0% /Test
```

17. Unmount **/Test.**

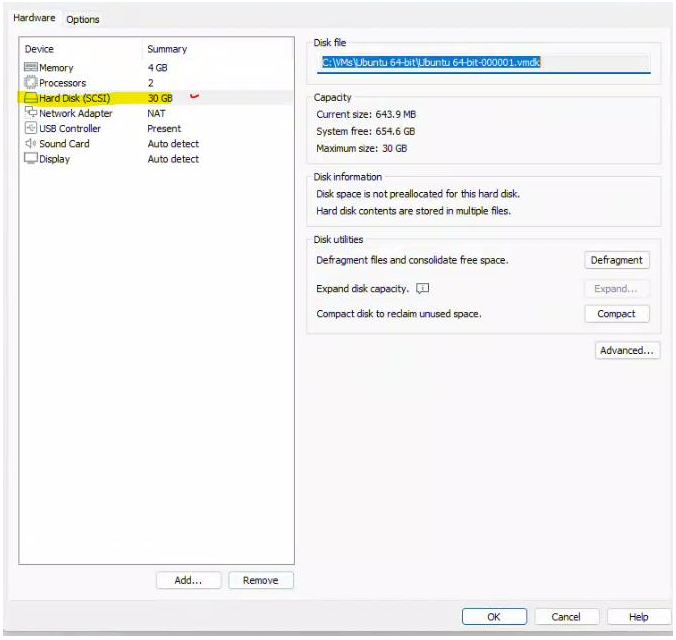
```
gkeymole@client07:~$ sudo umount /Test
gkeymole@client07:~$
```

18. Edit the**/etc/fstab file** and delete the mount point **/Test**.

```
gkeymole@client07:~$ sudo nano /etc/fstab
gkeymole@client07:~$
```

```
UUID=2ecfa537-c843-426b-b841-cdbbdf8da8f0 /home           ext4    defaults        0       2
# swap was on /dev/sda4 during installation
UUID=8dc32956-6daf-4115-9ad5-dd67164d40ad none            swap    sw              0       0
```

19. Stop the virtual machine and remove the new disk from the Ubuntu VM.




```
gkeymole@client07:~$ lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
sda      8:0    0   30G  0 disk
├─sda1   8:1    0    1M  0 part
├─sda2   8:2    0  977M  0 part /boot/efi
├─sda3   8:3    0  977M  0 part /boot
├─sda4   8:4    0  1.9G  0 part [SWAP]
├─sda5   8:5    0  3.8G  0 part /home
└─sda6   8:6    0 22.4G  0 part /
gkeymole@client07:~$ lsblk -f
NAME FSTYPE FSVER LABEL UUID                                 FSAVAIL FSUSE% MOUNTPOINTS
sda
├─sda1
│
├─sda2
│  vfat   FAT32       073C-6051                               969M     1% /boot/efi
├─sda3
│  ext4   1.0         d3125053-effc-4511-ab2b-b47eb7b9ea16  677.7M    21% /boot
├─sda4
│  swap   1           8dc32956-6daf-4115-9ad5-dd67164d40ad                [SWAP]
├─sda5
│  ext4   1.0         2ecfa537-c843-426b-b841-cdbbdf8da8f0    3.4G     3% /home
└─sda6
   ext4   1.0         9c065ed5-240c-4c12-b9a8-d0fdc0425044   13.3G    34% /
gkeymole@client07:~$
```