Lab 2: Introduction to Linux -

Parth Kalkar

Exercise 3:

Q1. Identify how many CPUs are in your environment? What is a Linux kernel module?

- The number of CPUs can be checked by the list of following commands:
$ lscpu
$ lscpu | egrep 'Model name|Socket|Thread|NUMA|CPU\(s\)'
$ lscpu -p

```
parth@GL62M-7RDX:~/Desktop$ lscpu
Architecture:                    x86_64
CPU op-mode(s):                  32-bit, 64-bit
Byte Order:                      Little Endian
Address sizes:                   39 bits physical, 48 bits virtual
CPU(s):                          8
On-line CPU(s) list:             0-7
Thread(s) per core:              2
Core(s) per socket:              4
Socket(s):                       1
NUMA node(s):                    1
Vendor ID:                       GenuineIntel
CPU family:                      6
Model:                           158
Model name:                      Intel(R) Core(TM) i7-7700HQ CPU @ 2.80GHz
Stepping:                        9
CPU MHz:                         2800.000
CPU max MHz:                     3800.0000
CPU min MHz:                     800.0000
BogoMIPS:                        5599.85
Virtualization:                  VT-x
L1d cache:                       128 KiB
L1i cache:                       128 KiB
L2 cache:                        1 MiB
L3 cache:                        6 MiB
NUMA node0 CPU(s):               0-7
Vulnerability Itlb multihit:     KVM: Mitigation: VMX disabled
Vulnerability L1tf:              Mitigation; PTE Inversion; VMX conditional cach
                                 e flushes, SMT vulnerable
Vulnerability Mds:               Mitigation; Clear CPU buffers; SMT vulnerable
Vulnerability Meltdown:          Mitigation; PTI
Vulnerability Spec store bypass: Mitigation; Speculative Store Bypass disabled v
                                 ia prctl and seccomp
Vulnerability Spectre v1:        Mitigation; usercopy/swapgs barriers and __user
                                  pointer sanitization
Vulnerability Spectre v2:        Mitigation; Full generic retpoline, IBPB condit
                                 ional, IBRS_FW, STIBP conditional, RSB filling
Vulnerability Srbds:             Mitigation; Microcode
Vulnerability Tsx async abort:   Not affected
Flags:                           fpu vme de pse tsc msr pae mce cx8 apic sep mtr
                                 r pge mca cmov pat pse36 clflush dts acpi mmx f
                                 xsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rd
                                 tscp lm constant_tsc art arch_perfmon pebs bts
                                 rep_good nopl xtopology nonstop_tsc cpuid aperf
                                 mperf pni pclmulqdq dtes64 monitor ds_cpl vmx e
                                 st tm2 ssse3 sdbg fma cx16 xtpr pdcm pcid sse4_
                                 1 sse4_2 x2apic movbe popcnt tsc_deadline_timer
                                  aes xsave avx f16c rdrand lahf_lm abm 3dnowpre
                                 fetch cpuid_fault epb invpcid_single pti ssbd i
                                 brs ibpb stibp tpr_shadow vnmi flexpriority ept
                                  vpid ept_ad fsgsbase tsc_adjust bmi1 avx2 smep
                                  bmi2 erms invpcid mpx rdseed adx smap clflusho
                                 pt intel_pt xsaveopt xsavec xgetbv1 xsaves dthe
                                 rm ida arat pln pts hwp hwp_notify hwp_act_wind
                                 ow hwp_epp md_clear flush_l1d
```

```
parth@GL62M-7RDX:~/Desktop$ lscpu | egrep 'Model name|Socket|Thread|NUMA|CPU\(s\)'
CPU(s):                          8
On-line CPU(s) list:             0-7
Thread(s) per core:              2
Socket(s):                       1
NUMA node(s):                    1
Model name:                      Intel(R) Core(TM) i7-7700HQ CPU @ 2.80GHz
NUMA node0 CPU(s):               0-7
```

```
parth@GL62M-7RDX:~/Desktop$ lscpu -p
# The following is the parsable format, which can be fed to other
# programs. Each different item in every column has an unique ID
# starting from zero.
# CPU,Core,Socket,Node,,L1d,L1i,L2,L3
0,0,0,0,,0,0,0,0
1,1,0,0,,1,1,1,0
2,2,0,0,,2,2,2,0
3,3,0,0,,3,3,3,0
4,0,0,0,,0,0,0,0
5,1,0,0,,1,1,1,0
6,2,0,0,,2,2,2,0
7,3,0,0,,3,3,3,0
```

The output clearly indicates that my system has:

1. CPU model: 2.80 GHz - Intel Core i7-7700HQ
2. Socket: Single (1)
3. CPU Core: 8
4. Thread per core: 2

a. Kernel model is an object file that contains code that can extend the kernel functionality at runtime without the need to reboot the system. It can be loaded and unloaded into the kernel upon demand. When a kernel module is no longer needed, it can be unloaded. Most of the device drivers are used in the form of kernel modules.

b. For example, one type of module is the device driver, which allows the kernel to access hardware connected to the system.

c. Without modules, we would have to build monolithic kernels and add new functionality directly into the kernel image. Besides having larger kernels, this has the disadvantage of requiring us to rebuild and reboot the kernel every time we want new functionality.

Q2 Which command will show statistics about your free/used memory? Describe all fields from the output of the command (for example point the difference between free and available)?

- The following command can be used: *$ free -t -m*

```
parth@GL62M-7RDX:~/Desktop$ free -t -m
              total        used        free      shared  buff/cache   available
Mem:           7873        2544        2461         631        2868        4424
Swap:             0           0           0
Total:         7873        2544        2461
```

The row “Mem" has several columns. They contain the following information:

1. Total : The total amount of RAM installed in the system. In this case it is almost 8GB.
2. Used : The total amount of RAM being used. It is calculated as: Total – (free + buffers + cache). In this case it is almost 2.5GB
3. Free : The amount of unused or free memory for the apps. In this case it is almost 2.5GB
4. Shared : The amount of memory mostly used by the tmpfs file systems. In other words, Shmem in /proc/meminfo. In this case it is 631MB
5. Buff/cache : It is the sum of buffers and cache. Buff is the amount of memory used by the Linux kernel for buffers. Cache is memory used by the page cache and slabs. In this case it is 2.8GB
6. Available : This is an estimation of how much memory is available for starting new applications on a Linux system, without swapping. In this case it is 4.4GB

The row “Swap” was created while solving the lab exercises and deleted afterwards therefore it is empty.

Q3 If you list the content of a directory using for example “$ls -al” what do numbers in the column following after permissions information tell you?
- After running the command: $ *ls -al*, I get the following output:

```
parth@GL62M-7RDX:~/Desktop$ ls -al
total 28
drwxr-xr-x  4 parth parth  4096 Oct 25 19:44 .
drwxr-xr-x 32 parth parth  4096 Oct 25 19:10 ..
drwxrwxr-x  6 parth parth  4096 Oct 26 21:38 Big_Data
drwxrwxr-x  2 parth parth  4096 Oct 19 22:06 Learning_ruby
-rw-r--r--  1 parth parth 12288 Oct 25 19:04 .unique.txt.swp
```

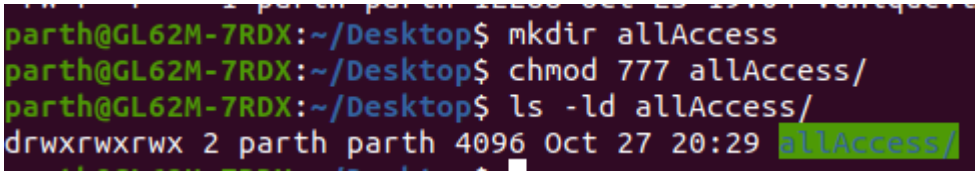
The numbers in the column after permission are of hard links to the file or directory.

a. For files, it is 1 ,unless you've created additional hard links to it with ln.
b. For directories, it is 2 + the number of subdirectories. This is because a directory can be referred to either by its name in the parent directory, ... in itself, or .. in each subdirectory.

Q4 What is the sticky bit? Show the file or directory with your configured sticky bit.
- A Sticky bit is a permission bit that is set on a file or a directory that lets only the owner of the file/directory or the root user to delete or rename the file. No other user is given privileges to delete the file created by some other user.

Setting sticky bit permission using the following steps:

1. Create a directory and provide all the users read-write-execute access to it: $ *mkdir allAccess* $ *chmod 777 allAccess/* $ *ls -ld allAccess/*

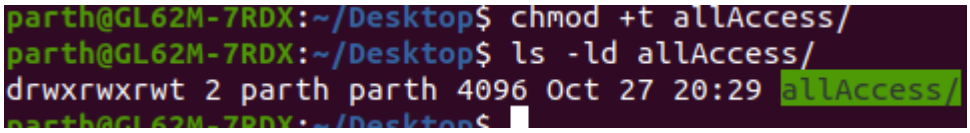
   Output :
   

   drwxrwxrwx 2 parth parth 4096 Oct 27 20:29 allAccess/
   So we see that a directory named 'allAccess' is created and read-write-execute access to this directory is given to all the users through the chmod command.

2. Now, we create multiple files in this directory (with different users) such that all users have read-write-execute access to them: $ *ls -l allAccess/* - total 0
   Output: -rwxrwxrwx 1 parth parth 0 Oct 27 20:30 user1
   -rwxrwxrwx 1 david david 0 Oct 27 20:31 user_file_0
   -rwxrwxrwx 1 paul paul 0 Oct 27 20:33 user_file_1

   The files user_file_0 and user_file_1 are created by different users but have read-write-execute access on for all the users. This means that the 'david' can delete or rename the file created by user 'paul'.

3. To prevent such a situation, a sticky bit can be set on the directory allAccess. We turn ON the sticky bit on the directory by using +t flag of chmod command. $ *chmod +t allAccess/*, $ *ls -ld allAccess/*

   Output:
   

   drwxrwxrwt 2 parth parth 4096 Oct 27 20:29 allAccess/

   As a result, a permission bit 't' is introduced in the permission bits of the directory.

Q5 Which command will show the available disk space on the Unix/Linux system?

- df command – The df command stands for *disk free*, and it shows you the amount of space taken up by different drives. By default, df displays values in 1-kilobyte blocks.

```
parth@GL62M-7RDX:~/Desktop$ df
Filesystem     1K-blocks     Used Available Use% Mounted on
udev             3998960        0   3998960   0% /dev
tmpfs             806292     2236    804056   1% /run
/dev/sda1      960379920 29817364 881708132   4% /
tmpfs            4031456    97096   3934360   3% /dev/shm
tmpfs               5120        4      5116   1% /run/lock
tmpfs            4031456        0   4031456   0% /sys/fs/cgroup
/dev/loop3           128      128         0 100% /snap/bare/5
/dev/loop0        257408   257408         0 100% /snap/brave/134
/dev/loop5         56832    56832         0 100% /snap/core18/2128
/dev/loop2        101888   101888         0 100% /snap/core/11993
/dev/loop6         66816    66816         0 100% /snap/gtk-common-themes/1519
/dev/loop4         56832    56832         0 100% /snap/core18/2246
/dev/loop1        101888   101888         0 100% /snap/core/11798
/dev/loop7         52352    52352         0 100% /snap/snap-store/518
/dev/loop8         33152    33152         0 100% /snap/ruby/232
/dev/loop9        224256   224256         0 100% /snap/gnome-3-34-1804/72
/dev/loop10       224256   224256         0 100% /snap/gnome-3-34-1804/66
/dev/loop11        33280    33280         0 100% /snap/snapd/13270
/dev/loop13        33280    33280         0 100% /snap/snapd/13640
/dev/loop12        36864    36864         0 100% /snap/gh/416
/dev/loop14        66688    66688         0 100% /snap/gtk-common-themes/1515
/dev/loop16        63360    63360         0 100% /snap/core20/1169
/dev/loop17        52224    52224         0 100% /snap/snap-store/547
/dev/loop15       263296   263296         0 100% /snap/zoom-client/159
/dev/loop19       254592   254592         0 100% /snap/zoom-client/160
/dev/loop18        37504    37504         0 100% /snap/gh/448
/dev/nvme0n1p1     98304    30879     67425  32% /boot/efi
tmpfs             806288       40    806248   1% /run/user/1000
parth@GL62M-7RDX:~/Desktop$
```

You can display disk usage in a more human-readable format by adding the `-h` option: *$ df -h*. This displays the size in kilobytes (K), megabytes (M), and gigabytes (G).

```
parth@GL62M-7RDX:~/Desktop$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            3.9G     0  3.9G   0% /dev
tmpfs           788M  2.2M  786M   1% /run
/dev/sda1       916G   29G  841G   4% /
tmpfs           3.9G   96M  3.8G   3% /dev/shm
tmpfs           5.0M  4.0K  5.0M   1% /run/lock
tmpfs           3.9G     0  3.9G   0% /sys/fs/cgroup
/dev/loop3      128K  128K     0 100% /snap/bare/5
/dev/loop0      252M  252M     0 100% /snap/brave/134
/dev/loop5       56M   56M     0 100% /snap/core18/2128
/dev/loop2      100M  100M     0 100% /snap/core/11993
/dev/loop6       66M   66M     0 100% /snap/gtk-common-themes/1519
/dev/loop4       56M   56M     0 100% /snap/core18/2246
/dev/loop1      100M  100M     0 100% /snap/core/11798
/dev/loop7       52M   52M     0 100% /snap/snap-store/518
/dev/loop8       33M   33M     0 100% /snap/ruby/232
/dev/loop9      219M  219M     0 100% /snap/gnome-3-34-1804/72
/dev/loop10     219M  219M     0 100% /snap/gnome-3-34-1804/66
/dev/loop11      33M   33M     0 100% /snap/snapd/13270
/dev/loop13      33M   33M     0 100% /snap/snapd/13640
/dev/loop12      36M   36M     0 100% /snap/gh/416
/dev/loop14      66M   66M     0 100% /snap/gtk-common-themes/1515
/dev/loop16      62M   62M     0 100% /snap/core20/1169
/dev/loop17      51M   51M     0 100% /snap/snap-store/547
/dev/loop15     258M  258M     0 100% /snap/zoom-client/159
/dev/loop19     249M  249M     0 100% /snap/zoom-client/160
/dev/loop18      37M   37M     0 100% /snap/gh/448
/dev/nvme0n1p1   96M   31M   66M  32% /boot/efi
tmpfs           788M   40K  788M   1% /run/user/1000
```

Q6 How to add a new system user without a home directory and login?
- We can use the Adduser or useradd for this task. The useradd is a command used for creating a user in any Linux-based operating system. It is a low-level or less secure command for creating a user because it only creates a user until we specify a flag. This command does not automatically create a home directory until a -m flag is specified.

a. -M for creating a user without a Home directory
b. –no-create-home is also used for not creating a home directory of a user

For example:

1. *$ useradd -M <username>* OR *$ useradd --no-create-home <username>*

2. *$ adduser --no-create-home <username>*

Q7 Explain the differences among the following umask values: 000, 002, 022, 027, 077, and 277.
- When a new file or directory is created it is restricted in a specific way by applying a permissions “mask” called the umask. The umask command basically sets the default permission or base permissions to the newly created files or folders on a Linux machine. Most of the Linux distros give 022 (0022) as default UMASK. The umask command is used to set this mask, or to show you its current value.

Following table will help clear this concept:

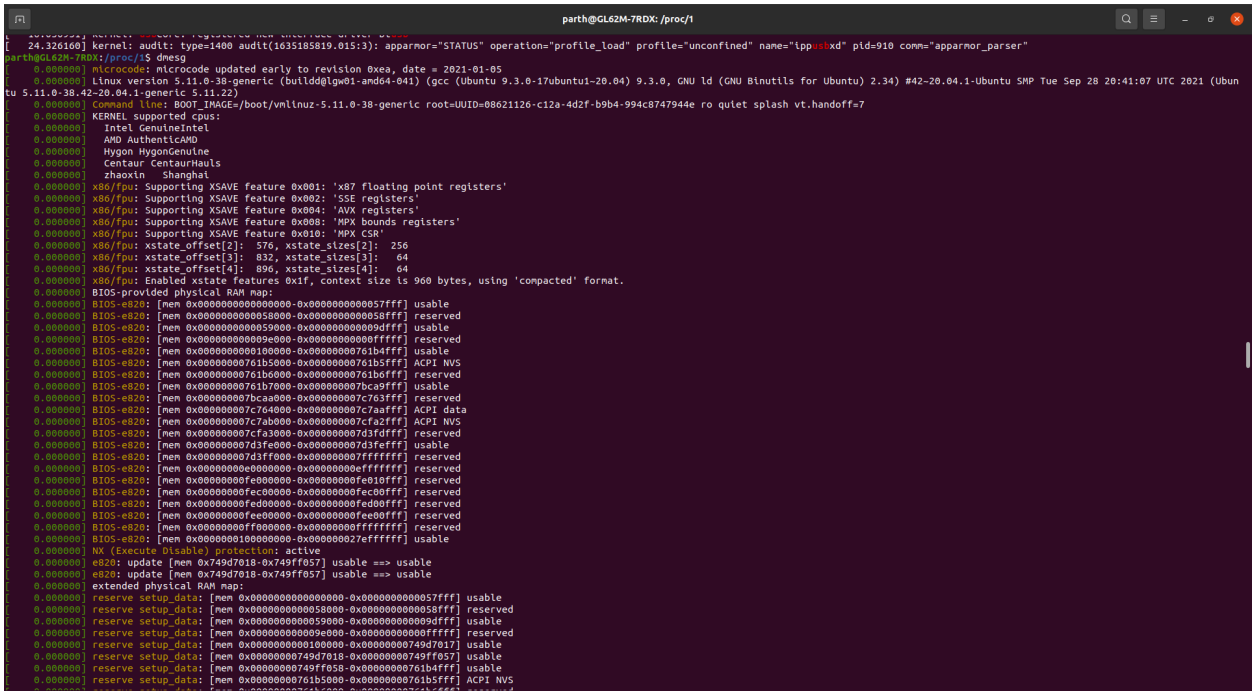
Unmask	File Result	Directory Result
000	666 rw- rw- rw-	777 rwx rwx rwx
002	664 rw- rw- r–	775 rwx rwx r-x
022	644 rw- r– r–	755 rwx r-x r-x
027	640 rw- r– —	750 rwx r-x —
077	600 rw—- —	700 rwx — —
277	400 r– — —	500 r-x — —

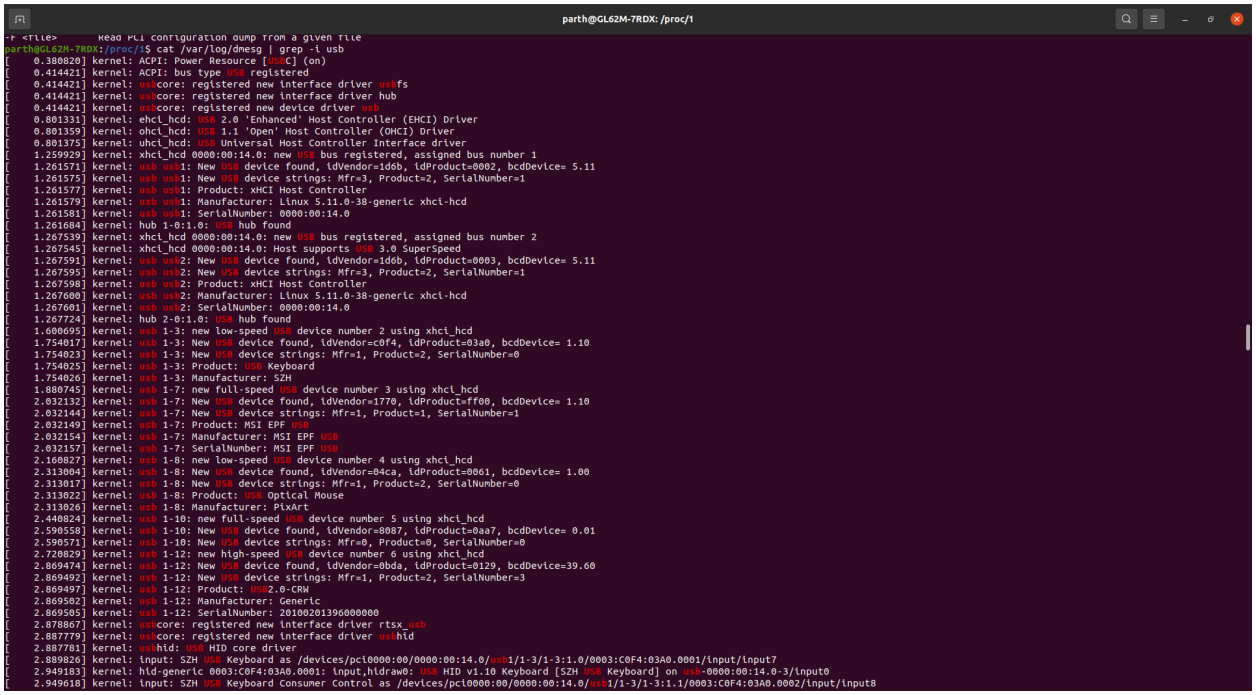
Q8 You have already configured swap in the exercise and the next step to increase or resize you swap space x2. Provide steps to do so.
-

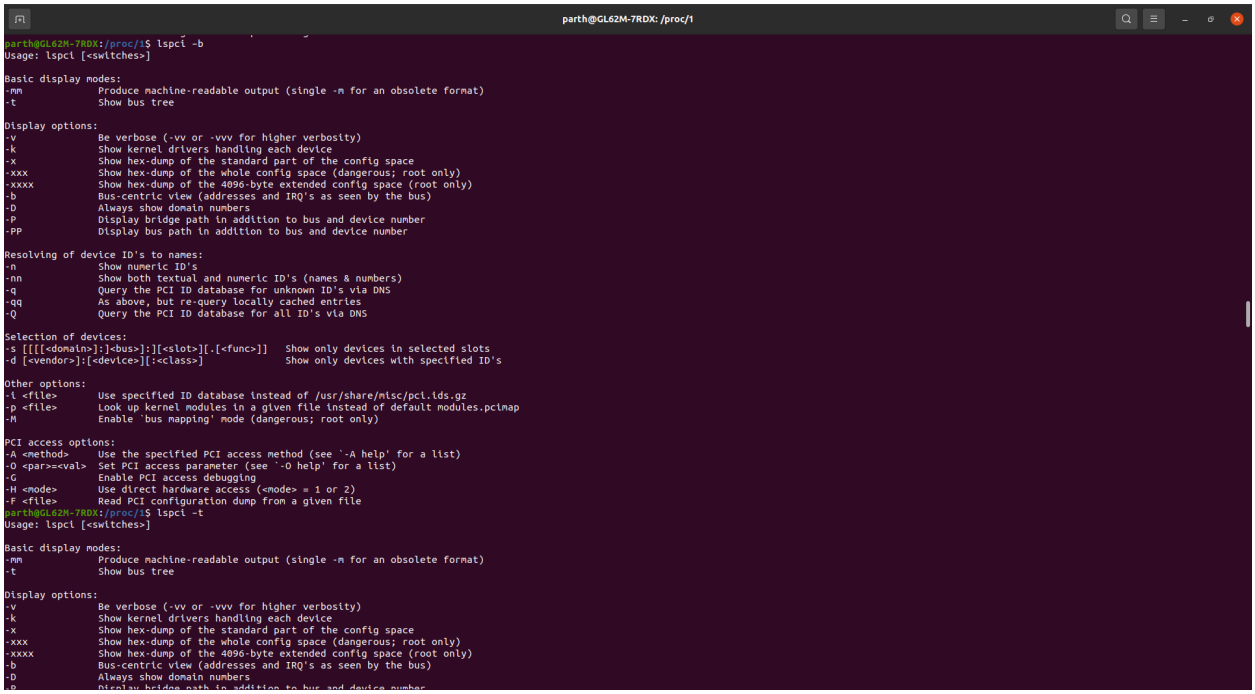
1. Make swapoff: *$ sudo swapoff /swapfile*
2. Resize: *$ sudo dd if=/dev/zero of=/swapfile bs=1M count=2048 oflag=append conv=notrunc*
   The above command will append 2GB of zero bytes at the end of your swap file.
3. Setup the file: *$ sudo mkswap /swapfile*
4. Make swapon: *$ sudo swapon /swapfile*

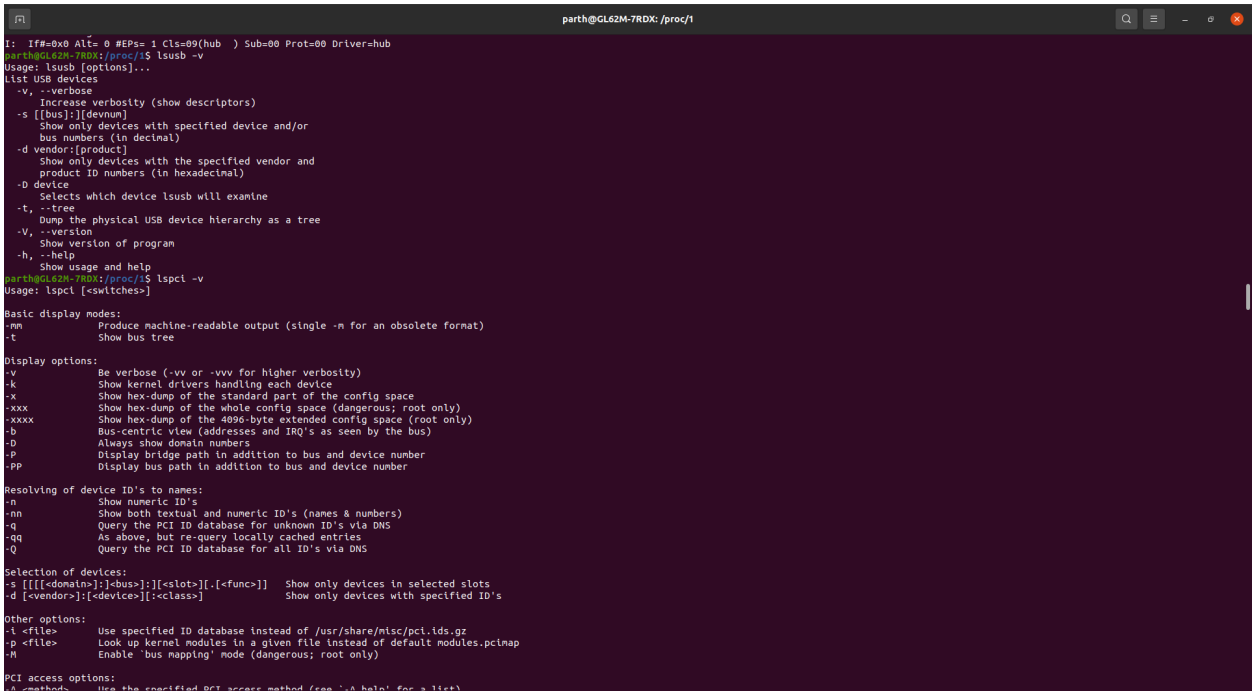
Screenshot of Lab exercises:

1. Linux OS hardware drivers






parth@GL62M-7RDX: /proc/1
parth@GL62M-7RDX:/proc/1$ lspci -b
Usage: lspci [<switches>]
Basic display modes:
-mm Produce machine-readable output (single -m for an obsolete format)
-t Show bus tree
Display options:
-v Be verbose (-vv or -vvv for higher verbosity)
-k Show kernel drivers handling each device
-x Show hex-dump of the standard part of the config space
-xxx Show hex-dump of the whole config space (dangerous; root only)
-xxxx Show hex-dump of the 4096-byte extended config space (root only)
-b Bus-centric view (addresses and IRQ's as seen by the bus)
-D Always show domain numbers
-P Display bridge path in addition to bus and device number
-PP Display bus path in addition to bus and device number
Resolving of device ID's to names:
-n Show numeric ID's
-nn Show both textual and numeric ID's (names & numbers)
-q Query the PCI ID database for unknown ID's via DNS
-qq As above, but re-query locally cached entries
-Q Query the PCI ID database for all ID's via DNS
Selection of devices:
-s [[[[<domain>]:]<bus>]:][<slot>][.[<func>]] Show only devices in selected slots
-d [<vendor>]:[<device>][:<class>] Show only devices with specified ID's
Other options:
-i <file> Use specified ID database instead of /usr/share/misc/pci.ids.gz
-p <file> Look up kernel modules in a given file instead of default modules.pcimap
-M Enable `bus mapping' mode (dangerous; root only)
PCI access options:
-A <method> Use the specified PCI access method (see `-A help' for a list)
-O <par>=<val> Set PCI access parameter (see `-O help' for a list)
-G Enable PCI access debugging
-H <mode> Use direct hardware access (<mode> = 1 or 2)
-F <file> Read PCI configuration dump from a given file
parth@GL62M-7RDX:/proc/1$ lspci -t
Usage: lspci [<switches>]
Basic display modes:
-mm Produce machine-readable output (single -m for an obsolete format)
-t Show bus tree
Display options:
-v Be verbose (-vv or -vvv for higher verbosity)
-k Show kernel drivers handling each device
-x Show hex-dump of the standard part of the config space
-xxx Show hex-dump of the whole config space (dangerous; root only)
-xxxx Show hex-dump of the 4096-byte extended config space (root only)
-b Bus-centric view (addresses and IRQ's as seen by the bus)
-D Always show domain numbers


parth@GL62M-7RDX: /proc/1
I: If#=0x0 Alt= 0 #EPs= 1 Cls=09(hub) Sub=00 Prot=00 Driver=hub
parth@GL62M-7RDX:/proc/1$ lsusb -v
Usage: lsusb [options]...
List USB devices
-v, --verbose
Increase verbosity (show descriptors)
-s [[bus]:][devnum]
Show only devices with specified device and/or
bus numbers (in decimal)
-d vendor:[product]
Show only devices with the specified vendor and
product ID numbers (in hexadecimal)
-D device
Selects which device lsusb will examine
-t, --tree
Dump the physical USB device hierarchy as a tree
-V, --version
Show version of program
-h, --help
Show usage and help
parth@GL62M-7RDX:/proc/1$ lspci -v
Usage: lspci [<switches>]
Basic display modes:
-mm Produce machine-readable output (single -m for an obsolete format)
-t Show bus tree
Display options:
-v Be verbose (-vv or -vvv for higher verbosity)
-k Show kernel drivers handling each device
-x Show hex-dump of the standard part of the config space
-xxx Show hex-dump of the whole config space (dangerous; root only)
-xxxx Show hex-dump of the 4096-byte extended config space (root only)
-b Bus-centric view (addresses and IRQ's as seen by the bus)
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-P Display bridge path in addition to bus and device number
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Resolving of device ID's to names:
-n Show numeric ID's
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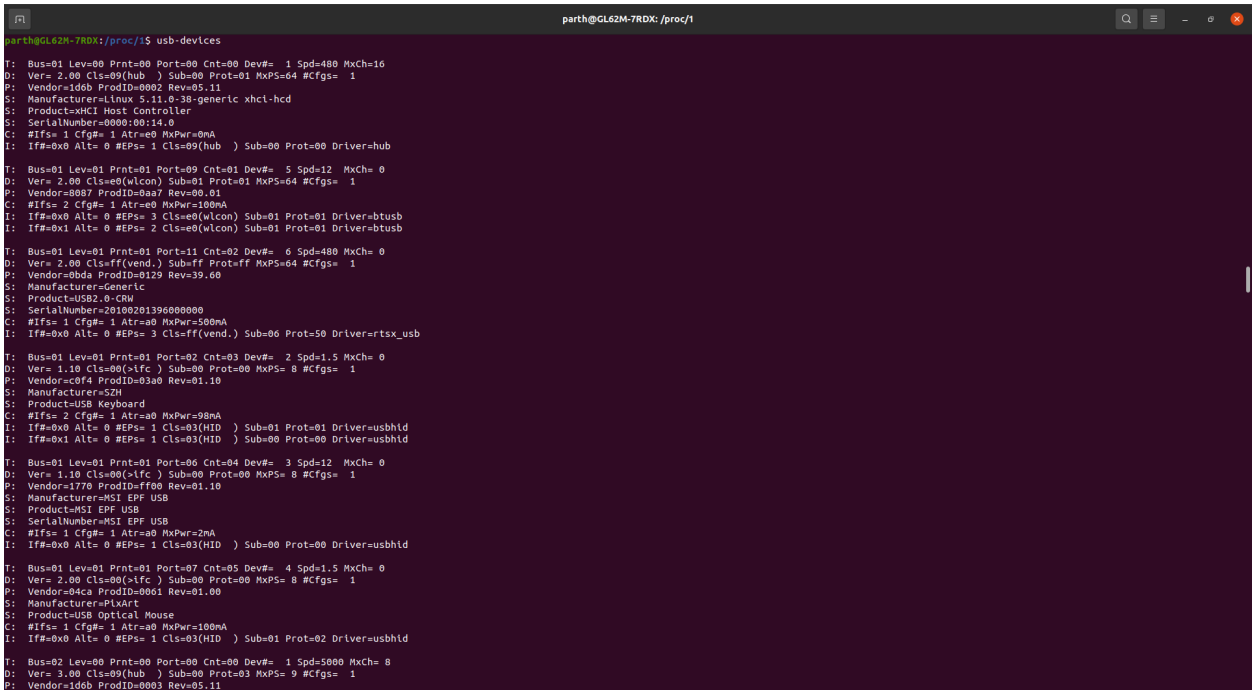
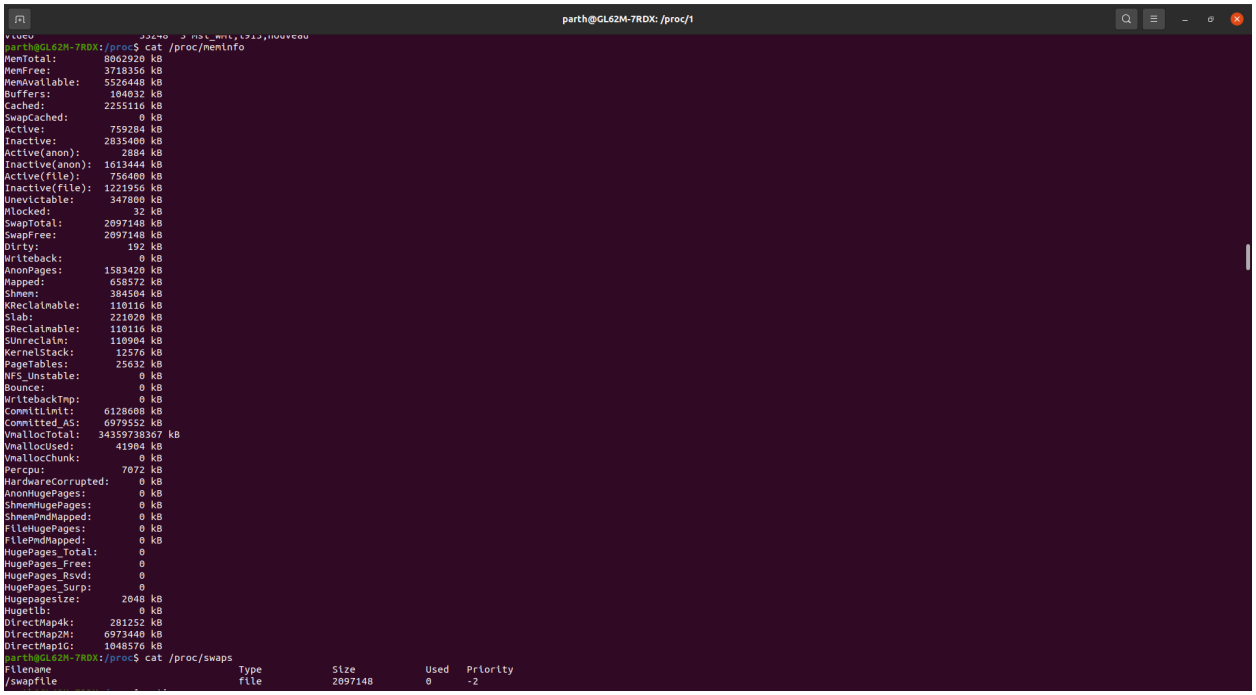
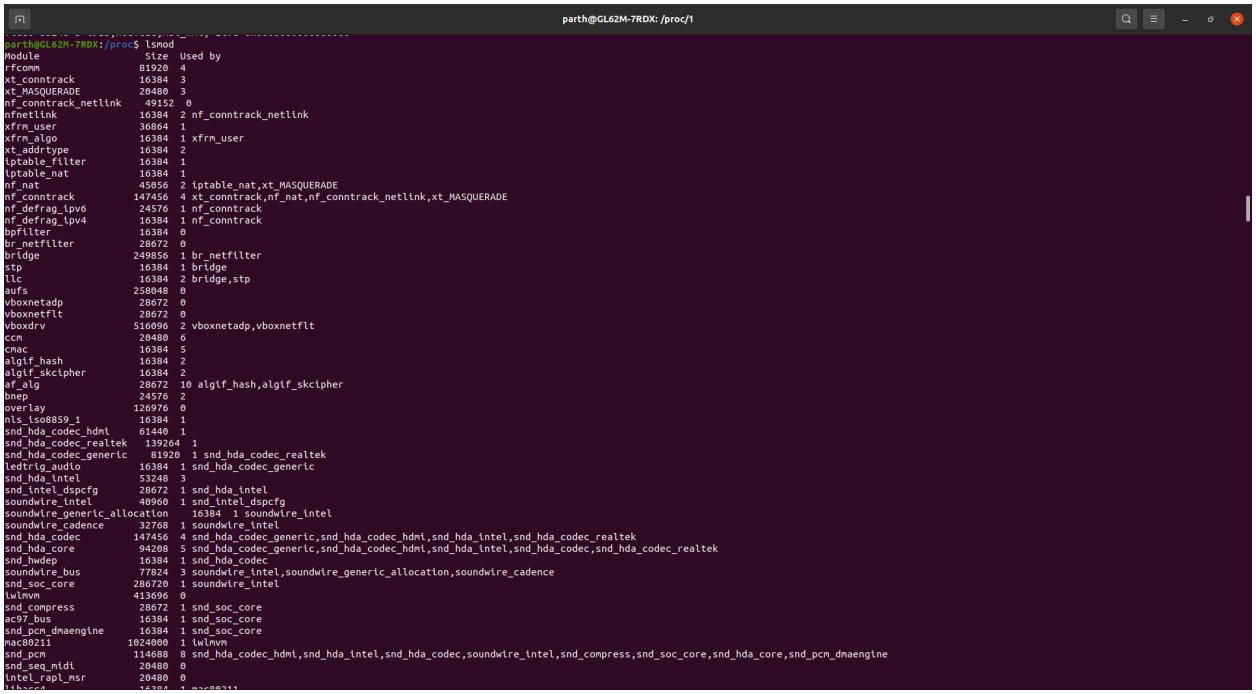
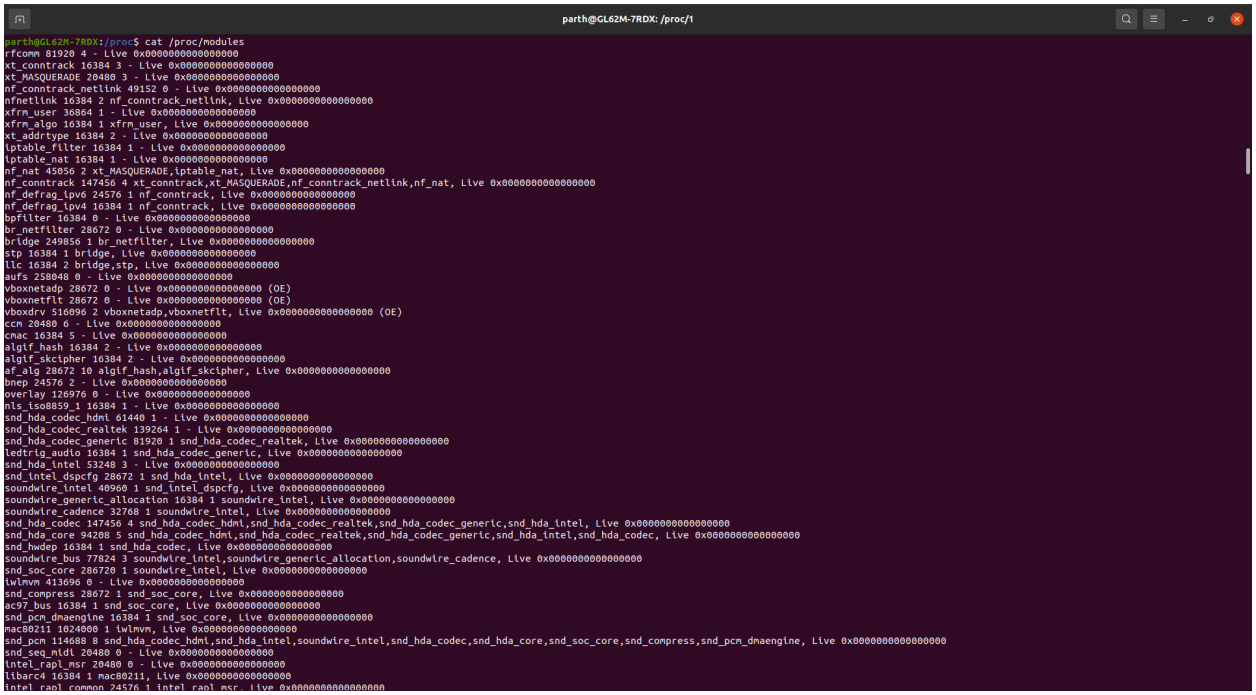
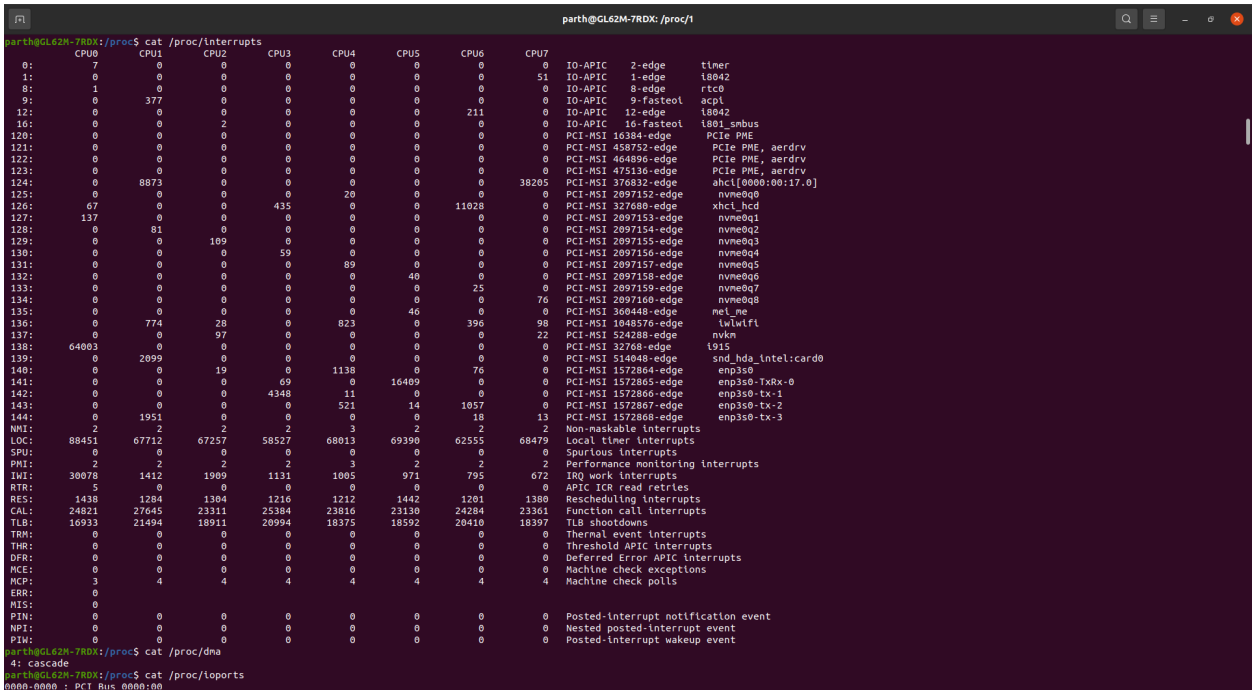
-q Query the PCI ID database for unknown ID's via DNS
-qq As above, but re-query locally cached entries
-Q Query the PCI ID database for all ID's via DNS
Selection of devices:
-s [[[[<domain>]:]<bus>]:][<slot>][.[<func>]] Show only devices in selected slots
-d [<vendor>]:[<device>][:<class>] Show only devices with specified ID's
Other options:
-i <file> Use specified ID database instead of /usr/share/misc/pci.ids.gz
-p <file> Look up kernel modules in a given file instead of default modules.pcimap
-M Enable `bus mapping' mode (dangerous; root only)
PCI access options:

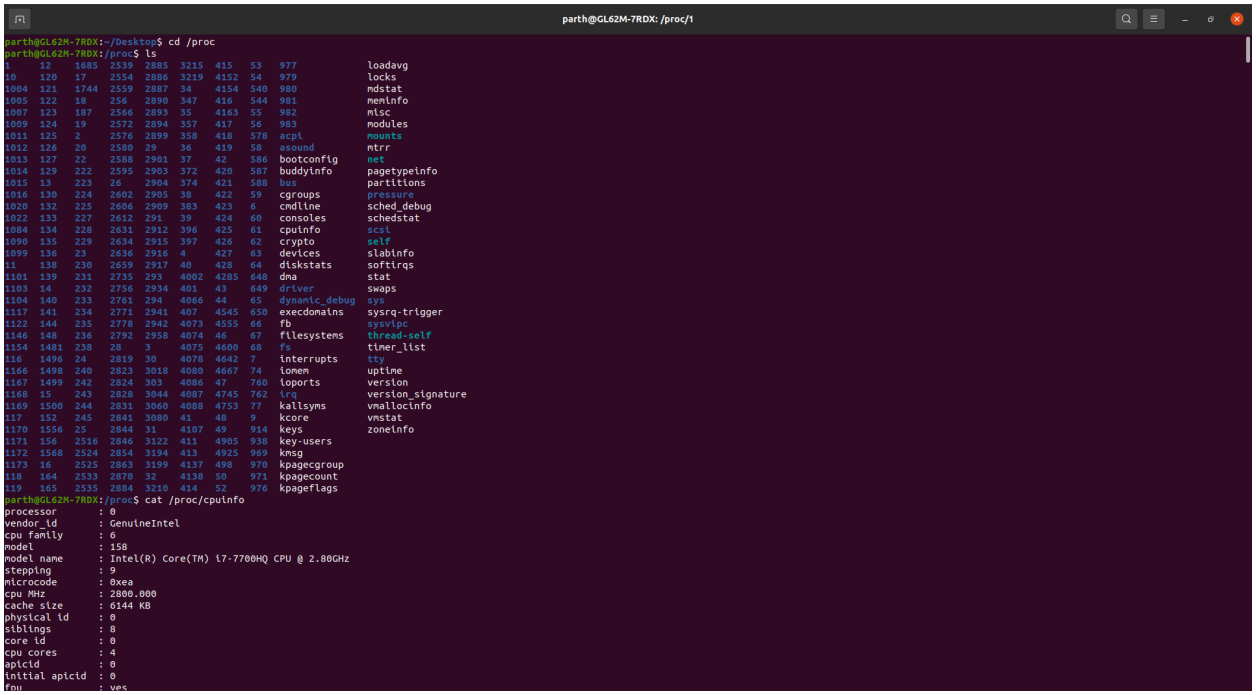

parth@GL62M-7RDX: /proc/1
parth@GL62M-7RDX:/proc/1$ usb-devices
T: Bus=01 Lev=00 Prnt=00 Port=00 Cnt=00 Dev#= 1 Spd=480 MxCh=16
D: Ver= 2.00 Cls=09(hub) Sub=00 Prot=01 MxPS=64 #Cfgs= 1
P: Vendor=1d6b ProdID=0002 Rev=05.11
S: Manufacturer=Linux 5.11.0-38-generic xhci-hcd
S: Product=xHCI Host Controller
S: SerialNumber=0000:00:14.0
C: #Ifs= 1 Cfg#= 1 Atr=e0 MxPwr=0mA
I: If#=0x0 Alt= 0 #EPs= 1 Cls=09(hub) Sub=00 Prot=00 Driver=hub
T: Bus=01 Lev=01 Prnt=01 Port=09 Cnt=01 Dev#= 5 Spd=12 MxCh= 0
D: Ver= 2.00 Cls=e0(wlcon) Sub=01 Prot=01 MxPS=64 #Cfgs= 1
P: Vendor=8087 ProdID=0aa7 Rev=00.01
C: #Ifs= 2 Cfg#= 1 Atr=e0 MxPwr=100mA
I: If#=0x0 Alt= 0 #EPs= 3 Cls=e0(wlcon) Sub=01 Prot=01 Driver=btusb
I: If#=0x1 Alt= 0 #EPs= 2 Cls=e0(wlcon) Sub=01 Prot=01 Driver=btusb
T: Bus=01 Lev=01 Prnt=01 Port=11 Cnt=02 Dev#= 6 Spd=480 MxCh= 0
D: Ver= 2.00 Cls=ff(vend.) Sub=ff Prot=ff MxPS=64 #Cfgs= 1
P: Vendor=0bda ProdID=0129 Rev=39.60
S: Manufacturer=Generic
S: Product=USB2.0-CRW
S: SerialNumber=20100201396000000
C: #Ifs= 1 Cfg#= 1 Atr=a0 MxPwr=500mA
I: If#=0x0 Alt= 0 #EPs= 3 Cls=ff(vend.) Sub=06 Prot=50 Driver=rtsx_usb
T: Bus=01 Lev=01 Prnt=01 Port=02 Cnt=03 Dev#= 2 Spd=1.5 MxCh= 0
D: Ver= 1.10 Cls=00(>ifc) Sub=00 Prot=00 MxPS= 8 #Cfgs= 1
P: Vendor=c0f4 ProdID=03a0 Rev=01.10
S: Manufacturer=SZH
S: Product=USB Keyboard
C: #Ifs= 2 Cfg#= 1 Atr=a0 MxPwr=98mA
I: If#=0x0 Alt= 0 #EPs= 1 Cls=03(HID) Sub=01 Prot=01 Driver=usbhid
I: If#=0x1 Alt= 0 #EPs= 1 Cls=03(HID) Sub=00 Prot=00 Driver=usbhid
T: Bus=01 Lev=01 Prnt=01 Port=06 Cnt=04 Dev#= 3 Spd=12 MxCh= 0
D: Ver= 1.10 Cls=00(>ifc) Sub=00 Prot=00 MxPS= 8 #Cfgs= 1
P: Vendor=1770 ProdID=ff00 Rev=01.10
S: Manufacturer=MSI EPF USB
S: Product=MSI EPF USB
S: SerialNumber=MSI EPF USB
C: #Ifs= 1 Cfg#= 1 Atr=a0 MxPwr=2mA
I: If#=0x0 Alt= 0 #EPs= 1 Cls=03(HID) Sub=00 Prot=00 Driver=usbhid
T: Bus=01 Lev=01 Prnt=01 Port=07 Cnt=05 Dev#= 4 Spd=1.5 MxCh= 0
D: Ver= 2.00 Cls=00(>ifc) Sub=00 Prot=00 MxPS= 8 #Cfgs= 1
P: Vendor=04ca ProdID=0061 Rev=01.00
S: Manufacturer=PixArt
S: Product=USB Optical Mouse
C: #Ifs= 1 Cfg#= 1 Atr=a0 MxPwr=100mA
I: If#=0x0 Alt= 0 #EPs= 1 Cls=03(HID) Sub=01 Prot=02 Driver=usbhid
T: Bus=02 Lev=00 Prnt=00 Port=00 Cnt=00 Dev#= 1 Spd=5000 MxCh= 8
D: Ver= 3.00 Cls=09(hub) Sub=00 Prot=03 MxPS= 9 #Cfgs= 1
P: Vendor=1d6b ProdID=0003 Rev=05.11


parth@GL62M-7RDX: /proc/1
parth@GL62M-7RDX:/proc$ cat /proc/meminfo
MemTotal: 8062920 kB
MemFree: 3718356 kB
MemAvailable: 5526448 kB
Buffers: 104032 kB
Cached: 2255116 kB
SwapCached: 0 kB
Active: 759284 kB
Inactive: 2835400 kB
Active(anon):   2884 kB
Inactive(anon): 1613444 kB
Active(file):   756400 kB
Inactive(file): 1221956 kB
Unevictable: 347800 kB
Mlocked: 32 kB
SwapTotal: 2097148 kB
SwapFree: 2097148 kB
Dirty: 192 kB
Writeback: 0 kB
AnonPages: 1583420 kB
Mapped: 658572 kB
Shmem: 384504 kB
KReclaimable: 110116 kB
Slab: 221020 kB
SReclaimable: 110116 kB
SUnreclaim: 110904 kB
KernelStack: 12576 kB
PageTables: 25632 kB
NFS_Unstable: 0 kB
Bounce: 0 kB
WritebackTmp: 0 kB
CommitLimit: 6128608 kB
Committed_AS: 6979552 kB
VmallocTotal: 34359738367 kB
VmallocUsed: 41904 kB
VmallocChunk: 0 kB
Percpu: 7072 kB
HardwareCorrupted: 0 kB
AnonHugePages: 0 kB
ShmemHugePages: 0 kB
ShmemPmdMapped: 0 kB
FileHugePages: 0 kB
FilePmdMapped: 0 kB
HugePages_Total: 0
HugePages_Free: 0
HugePages_Rsvd: 0
HugePages_Surp: 0
Hugepagesize: 2048 kB
Hugetlb: 0 kB
DirectMap4k: 281252 kB
DirectMap2M: 6973440 kB
DirectMap1G: 1048576 kB
parth@GL62M-7RDX:/proc$ cat /proc/swaps
Filename   Type   Size   Used   Priority
/swapfile   file   2097148   0   -2

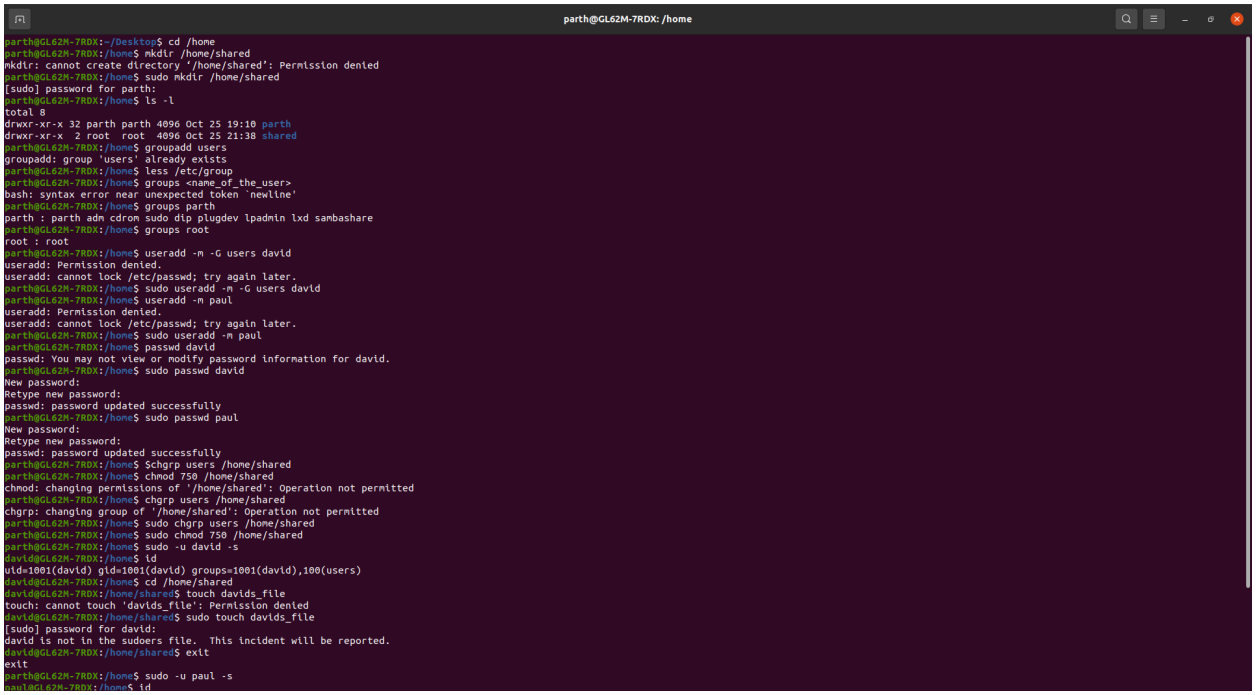

parth@GL62M-7RDX: /proc/1
parth@GL62M-7RDX:/proc$ lsmod
Module Size Used by
rfcomm 81920 4
xt_conntrack 16384 3
xt_MASQUERADE 20480 3
nf_conntrack_netlink 49152 0
nfnetlink 16384 2 nf_conntrack_netlink
xfrm_user 36864 1
xfrm_algo 16384 1 xfrm_user
xt_addrtype 16384 2
iptable_filter 16384 1
iptable_nat 16384 1
nf_nat 45056 2 iptable_nat,xt_MASQUERADE
nf_conntrack 147456 4 xt_conntrack,nf_nat,nf_conntrack_netlink,xt_MASQUERADE
nf_defrag_ipv6 24576 1 nf_conntrack
nf_defrag_ipv4 16384 1 nf_conntrack
bpfilter 16384 0
br_netfilter 28672 0
bridge 249856 1 br_netfilter
stp 16384 1 bridge
llc 16384 2 bridge,stp
aufs 258048 0
vboxnetadp 28672 0
vboxnetflt 28672 0
vboxdrv 516096 2 vboxnetadp,vboxnetflt
ccm 20480 6
cmac 16384 5
algif_hash 16384 2
algif_skcipher 16384 2
af_alg 28672 10 algif_hash,algif_skcipher
bnep 24576 2
overlay 126976 0
nls_iso8859_1 16384 1
snd_hda_codec_hdmi 61440 1
snd_hda_codec_realtek 139264 1
snd_hda_codec_generic 81920 1 snd_hda_codec_realtek
ledtrig_audio 16384 1 snd_hda_codec_generic
snd_hda_intel 53248 3
snd_intel_dspcfg 28672 1 snd_hda_intel
soundwire_intel 40960 1 snd_intel_dspcfg
soundwire_generic_allocation 16384 1 soundwire_intel
soundwire_cadence 32768 1 soundwire_intel
snd_hda_codec 147456 4 snd_hda_codec_generic,snd_hda_codec_hdmi,snd_hda_intel,snd_hda_codec_realtek
snd_hda_core 94208 5 snd_hda_codec_generic,snd_hda_codec_hdmi,snd_hda_intel,snd_hda_codec,snd_hda_codec_realtek
snd_hwdep 16384 1 snd_hda_codec
soundwire_bus 77824 3 soundwire_intel,soundwire_generic_allocation,soundwire_cadence
snd_soc_core 286720 1 soundwire_intel
iwlmvm 413696 0
snd_compress 28672 1 snd_soc_core
ac97_bus 16384 1 snd_soc_core
snd_pcm_dmaengine 16384 1 snd_soc_core
mac80211 1024000 1 iwlmvm
snd_pcm 114688 8 snd_hda_codec_hdmi,snd_hda_intel,snd_hda_codec,soundwire_intel,snd_compress,snd_soc_core,snd_hda_core,snd_pcm_dmaengine
snd_seq_midi 20480 0
intel_rapl_msr 20480 0


parth@GL62M-7RDX: /proc/1
parth@GL62M-7RDX:/proc$ cat /proc/modules
rfcomm 81920 4 - Live 0x0000000000000000
xt_conntrack 16384 3 - Live 0x0000000000000000
xt_MASQUERADE 20480 3 - Live 0x0000000000000000
nf_conntrack_netlink 49152 0 - Live 0x0000000000000000
nfnetlink 16384 2 nf_conntrack_netlink, Live 0x0000000000000000
xfrm_user 36864 1 - Live 0x0000000000000000
xfrm_algo 16384 1 xfrm_user, Live 0x0000000000000000
xt_addrtype 16384 2 - Live 0x0000000000000000
iptable_filter 16384 1 - Live 0x0000000000000000
iptable_nat 16384 1 - Live 0x0000000000000000
nf_nat 45056 2 xt_MASQUERADE,iptable_nat, Live 0x0000000000000000
nf_conntrack 147456 4 xt_conntrack,xt_MASQUERADE,nf_conntrack_netlink,nf_nat, Live 0x0000000000000000
nf_defrag_ipv6 24576 1 nf_conntrack, Live 0x0000000000000000
nf_defrag_ipv4 16384 1 nf_conntrack, Live 0x0000000000000000
bpfilter 16384 0 - Live 0x0000000000000000
br_netfilter 28672 0 - Live 0x0000000000000000
bridge 249856 1 br_netfilter, Live 0x0000000000000000
stp 16384 1 bridge, Live 0x0000000000000000
llc 16384 2 bridge,stp, Live 0x0000000000000000
aufs 258048 0 - Live 0x0000000000000000
vboxnetadp 28672 0 - Live 0x0000000000000000 (OE)
vboxnetflt 28672 0 - Live 0x0000000000000000 (OE)
vboxdrv 516096 2 vboxnetadp,vboxnetflt, Live 0x0000000000000000 (OE)
ccm 20480 6 - Live 0x0000000000000000
cmac 16384 5 - Live 0x0000000000000000
algif_hash 16384 2 - Live 0x0000000000000000
algif_skcipher 16384 2 - Live 0x0000000000000000
af_alg 28672 10 algif_hash,algif_skcipher, Live 0x0000000000000000
bnep 24576 2 - Live 0x0000000000000000
overlay 126976 0 - Live 0x0000000000000000
nls_iso8859_1 16384 1 - Live 0x0000000000000000
snd_hda_codec_hdmi 61440 1 - Live 0x0000000000000000
snd_hda_codec_realtek 139264 1 - Live 0x0000000000000000
snd_hda_codec_generic 81920 1 snd_hda_codec_realtek, Live 0x0000000000000000
ledtrig_audio 16384 1 snd_hda_codec_generic, Live 0x0000000000000000
snd_hda_intel 53248 3 - Live 0x0000000000000000
snd_intel_dspcfg 28672 1 snd_hda_intel, Live 0x0000000000000000
soundwire_intel 40960 1 snd_intel_dspcfg, Live 0x0000000000000000
soundwire_generic_allocation 16384 1 soundwire_intel, Live 0x0000000000000000
soundwire_cadence 32768 1 soundwire_intel, Live 0x0000000000000000
snd_hda_codec 147456 4 snd_hda_codec_hdmi,snd_hda_codec_realtek,snd_hda_codec_generic,snd_hda_intel, Live 0x0000000000000000
snd_hda_core 94208 5 snd_hda_codec_hdmi,snd_hda_codec_realtek,snd_hda_codec_generic,snd_hda_intel,snd_hda_codec, Live 0x0000000000000000
snd_hwdep 16384 1 snd_hda_codec, Live 0x0000000000000000
soundwire_bus 77824 3 soundwire_intel,soundwire_generic_allocation,soundwire_cadence, Live 0x0000000000000000
snd_soc_core 286720 1 soundwire_intel, Live 0x0000000000000000
iwlmvm 413696 0 - Live 0x0000000000000000
snd_compress 28672 1 snd_soc_core, Live 0x0000000000000000
ac97_bus 16384 1 snd_soc_core, Live 0x0000000000000000
snd_pcm_dmaengine 16384 1 snd_soc_core, Live 0x0000000000000000
mac80211 1024000 1 iwlmvm, Live 0x0000000000000000
snd_pcm 114688 8 snd_hda_codec_hdmi,snd_hda_intel,soundwire_intel,snd_hda_codec,snd_hda_core,snd_soc_core,snd_compress,snd_pcm_dmaengine, Live 0x0000000000000000
snd_seq_midi 20480 0 - Live 0x0000000000000000
intel_rapl_msr 20480 0 - Live 0x0000000000000000
libarc4 16384 1 mac80211, Live 0x0000000000000000
intel_rapl_common 24576 1 intel_rapl_msr, Live 0x0000000000000000

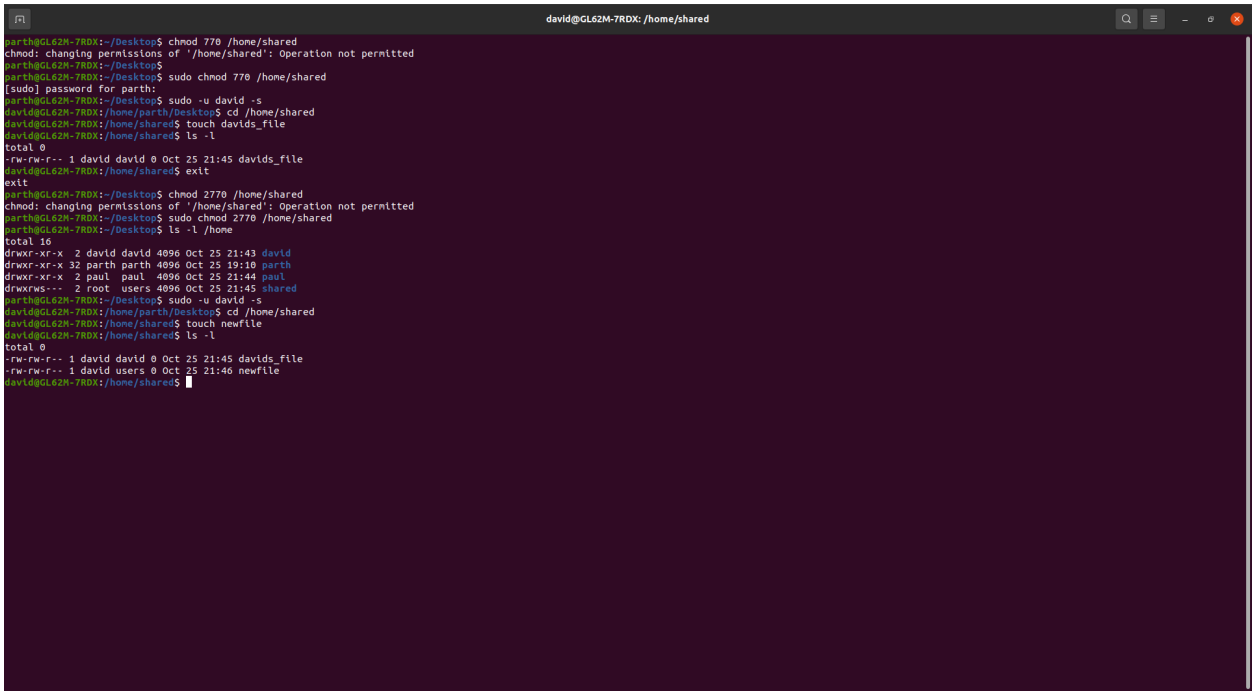

parth@GL62M-7RDX: /proc/1
parth@GL62M-7RDX:/proc$ cat /proc/interrupts
CPU0 CPU1 CPU2 CPU3 CPU4 CPU5 CPU6 CPU7
0: 7 0 0 0 0 0 0 0 IO-APIC 2-edge timer
1: 0 0 0 0 0 0 0 51 IO-APIC 1-edge i8042
8: 1 0 0 0 0 0 0 0 IO-APIC 8-edge rtc0
9: 0 377 0 0 0 0 0 0 IO-APIC 9-fasteoi acpi
12: 0 0 0 0 0 0 211 0 IO-APIC 12-edge i8042
16: 0 0 2 0 0 0 0 0 IO-APIC 16-fasteoi i801_smbus
120: 0 0 0 0 0 0 0 0 PCI-MSI 16384-edge PCIe PME
121: 0 0 0 0 0 0 0 0 PCI-MSI 458752-edge PCIe PME, aerdrv
122: 0 0 0 0 0 0 0 0 PCI-MSI 464896-edge PCIe PME, aerdrv
123: 0 0 0 0 0 0 0 0 PCI-MSI 475136-edge PCIe PME, aerdrv
124: 0 8873 0 0 0 0 0 38205 PCI-MSI 376832-edge ahci[0000:00:17.0]
125: 0 0 0 0 20 0 0 0 PCI-MSI 2097152-edge nvme0q0
126: 67 0 0 435 0 0 11028 0 PCI-MSI 327680-edge xhci_hcd
127: 137 0 0 0 0 0 0 0 PCI-MSI 2097153-edge nvme0q1
128: 0 81 0 0 0 0 0 0 PCI-MSI 2097154-edge nvme0q2
129: 0 0 109 0 0 0 0 0 PCI-MSI 2097155-edge nvme0q3
130: 0 0 0 59 0 0 0 0 PCI-MSI 2097156-edge nvme0q4
131: 0 0 0 0 89 0 0 0 PCI-MSI 2097157-edge nvme0q5
132: 0 0 0 0 0 40 0 0 PCI-MSI 2097158-edge nvme0q6
133: 0 0 0 0 0 0 25 0 PCI-MSI 2097159-edge nvme0q7
134: 0 0 0 0 0 0 0 76 PCI-MSI 2097160-edge nvme0q8
135: 0 0 0 0 0 46 0 0 PCI-MSI 360448-edge mei_me
136: 0 774 28 0 823 0 396 98 PCI-MSI 1048576-edge iwlwifi
137: 0 0 97 0 0 0 0 22 PCI-MSI 524288-edge nvkm
138: 64003 0 0 0 0 0 0 0 PCI-MSI 32768-edge i915
139: 0 2099 0 0 0 0 0 0 PCI-MSI 514048-edge snd_hda_intel:card0
140: 0 0 19 0 1138 0 76 0 PCI-MSI 1572864-edge enp3s0
141: 0 0 0 69 0 16409 0 0 PCI-MSI 1572865-edge enp3s0-TxRx-0
142: 0 0 0 4348 11 0 0 0 PCI-MSI 1572866-edge enp3s0-tx-1
143: 0 0 0 0 521 14 1057 0 PCI-MSI 1572867-edge enp3s0-tx-2
144: 0 1951 0 0 0 0 18 13 PCI-MSI 1572868-edge enp3s0-tx-3
NMI: 2 2 2 2 3 2 2 2 Non-maskable interrupts
LOC: 88451 67712 67257 58527 68013 69390 62555 68479 Local timer interrupts
SPU: 0 0 0 0 0 0 0 0 Spurious interrupts
PMI: 2 2 2 2 3 2 2 2 Performance monitoring interrupts
IWI: 30078 1412 1909 1131 1005 971 795 672 IRQ work interrupts
RTR: 5 0 0 0 0 0 0 0 APIC ICR read retries
RES: 1438 1284 1304 1216 1212 1442 1201 1380 Rescheduling interrupts
CAL: 24821 27645 23311 25384 23816 23130 24284 23361 Function call interrupts
TLB: 16933 21494 18911 20994 18375 18592 20410 18397 TLB shootdowns
TRM: 0 0 0 0 0 0 0 0 Thermal event interrupts
THR: 0 0 0 0 0 0 0 0 Threshold APIC interrupts
DFR: 0 0 0 0 0 0 0 0 Deferred Error APIC interrupts
MCE: 0 0 0 0 0 0 0 0 Machine check exceptions
MCP: 3 4 4 4 4 4 4 4 Machine check polls
ERR: 0
MIS: 0
PIN: 0 0 0 0 0 0 0 0 Posted-interrupt notification event
NPI: 0 0 0 0 0 0 0 0 Nested posted-interrupt event
PIW: 0 0 0 0 0 0 0 0 Posted-interrupt wakeup event
parth@GL62M-7RDX:/proc$ cat /proc/dma
4: cascade
parth@GL62M-7RDX:/proc$ cat /proc/ioports
0000-0000 : PCI Bus 0000:00


parth@GL62M-7RDX: /proc/1
parth@GL62M-7RDX:~/Desktop$ cd /proc
parth@GL62M-7RDX:/proc$ ls
1 12 1685 2539 2885 3215 415 53 977 loadavg
10 120 17 2554 2886 3219 4152 54 979 locks
1004 121 1744 2559 2887 34 4154 540 980 mdstat
1005 122 18 256 2890 347 416 544 981 meminfo
1007 123 187 2566 2893 35 4163 55 982 misc
1009 124 19 2572 2894 357 417 56 983 modules
1011 125 2 2576 2899 358 418 578 acpi mounts
1012 126 20 2580 29 36 419 58 asound mtrr
1013 127 22 2588 2901 37 42 586 bootconfig net
1014 129 222 2595 2903 372 420 587 buddyinfo pagetypeinfo
1015 13 223 26 2904 374 421 588 bus partitions
1016 130 224 2602 2905 38 422 59 cgroups pressure
1020 132 225 2606 2909 383 423 6 cmdline sched_debug
1022 133 227 2612 291 39 424 60 consoles schedstat
1084 134 228 2631 2912 396 425 61 cpuinfo scsi
1090 135 229 2634 2915 397 426 62 crypto self
1099 136 23 2636 2916 4 427 63 devices slabinfo
11 138 230 2659 2917 40 428 64 diskstats softirqs
1101 139 231 2735 293 4002 4285 640 dma stat
1103 14 232 2756 2934 401 43 649 driver swaps
1104 140 233 2761 294 4066 44 65 dynamic_debug sys
1117 141 234 2771 2941 407 4545 650 execdomains sysrq-trigger
1122 144 235 2778 2942 4073 4555 66 fb sysvipc
1146 148 236 2792 2958 4074 46 67 filesystems thread-self
1154 1481 238 28 3 4075 4600 68 fs timer_list
116 1496 24 2819 30 4078 4642 7 interrupts tty
1166 1498 240 2823 3018 4080 4667 74 iomem uptime
1167 1499 242 2824 303 4086 47 760 ioports version
1168 15 243 2828 3044 4087 4745 762 irq version_signature
1169 1500 244 2831 3060 4088 4753 77 kallsyms vmallocinfo
117 152 245 2841 3080 41 48 9 kcore vmstat
1170 1556 25 2844 31 4107 49 914 keys zoneinfo
1171 156 2516 2846 3122 411 4905 938 key-users
1172 1568 2524 2854 3194 413 4925 969 kmsg
1173 16 2525 2863 3199 4137 498 970 kpagecgroup
118 164 2533 2870 32 4138 50 971 kpagecount
119 165 2535 2884 3210 414 52 976 kpageflags
parth@GL62M-7RDX:/proc$ cat /proc/cpuinfo
processor : 0
vendor_id : GenuineIntel
cpu family : 6
model : 158
model name : Intel(R) Core(TM) i7-7700HQ CPU @ 2.80GHz
stepping : 9
microcode : 0xea
cpu MHz : 2800.000
cache size : 6144 KB
physical id : 0
siblings : 8
core id : 0
cpu cores : 4
apicid : 0
initial apicid : 0
fpu : yes

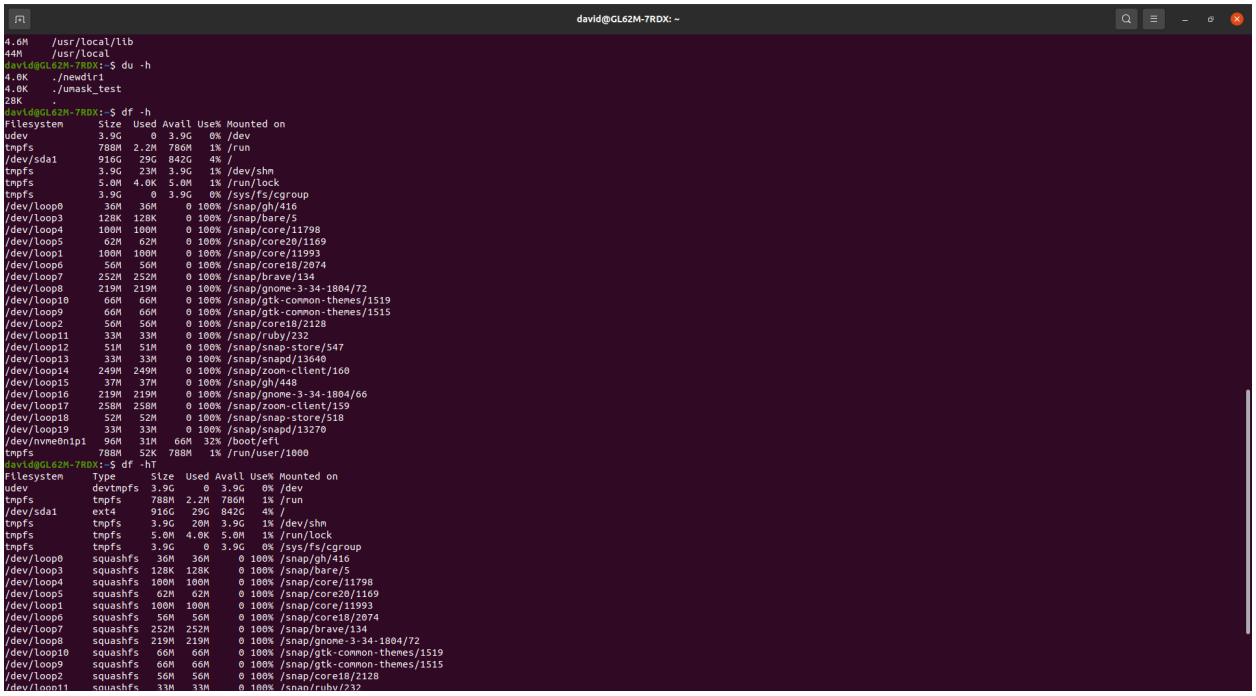
2. Setting Permissions

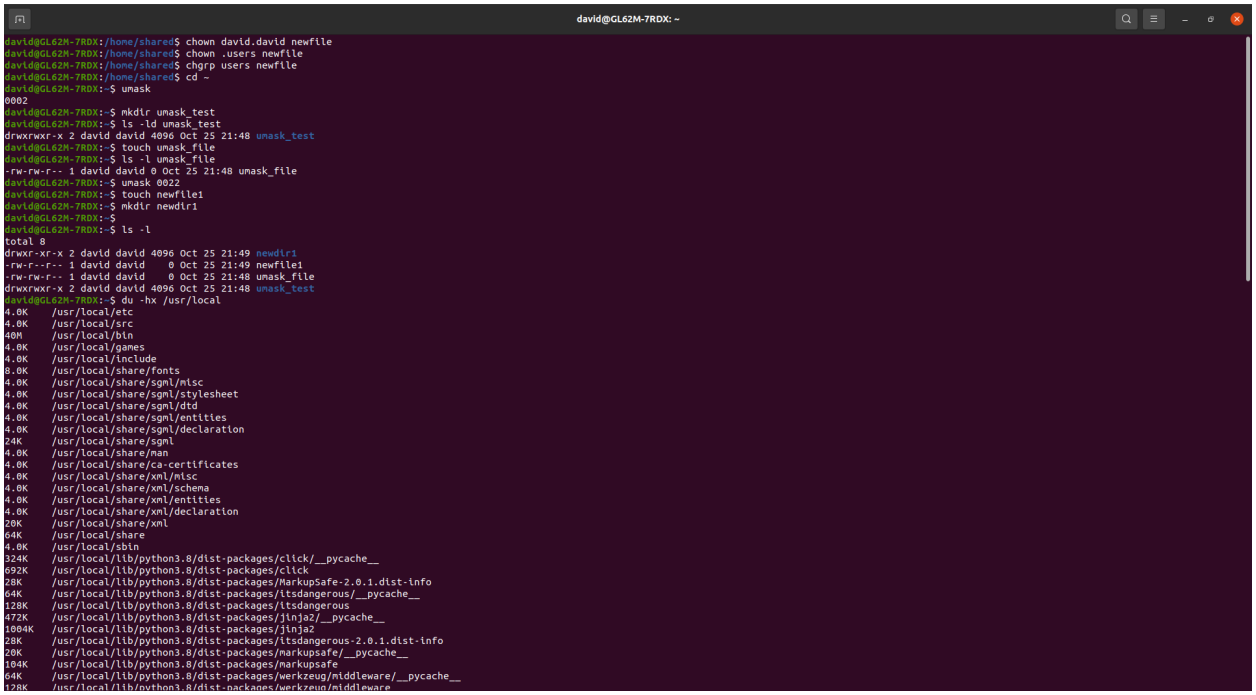


3. Setting SGID on a directory

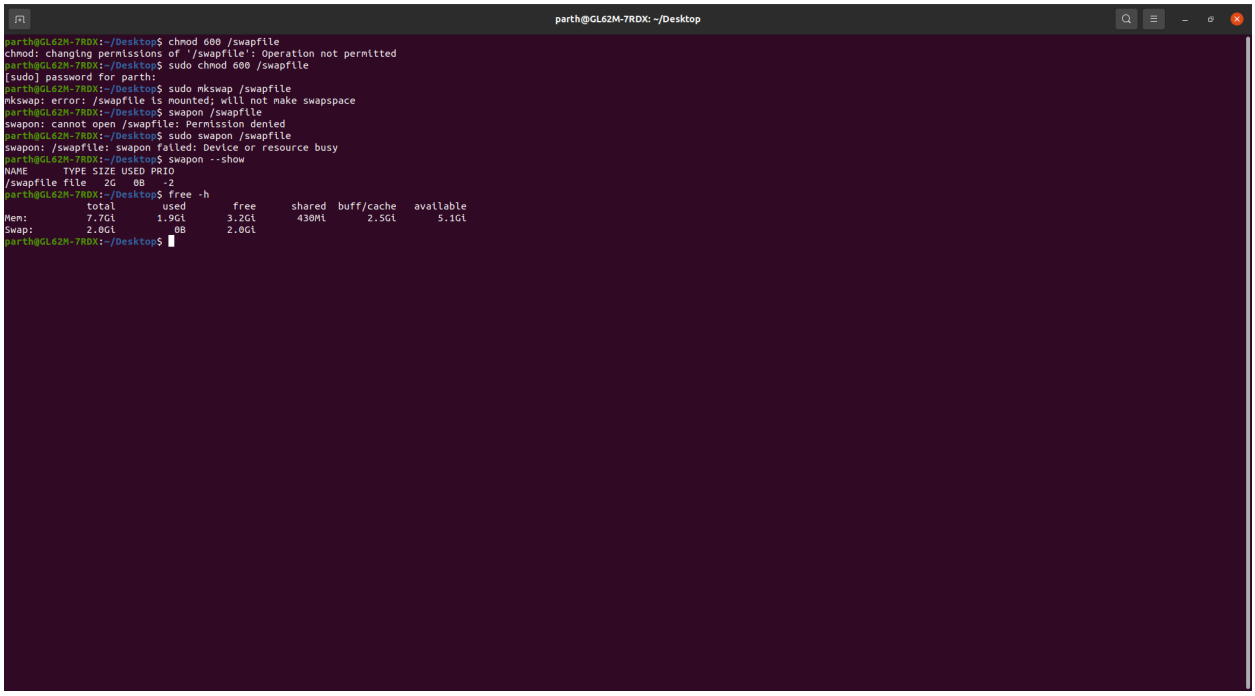


4. chown and chgrp - umask - Using the du command - Using the df command





5. SWAP


parth@GL62M-7RDX: ~/Desktop
parth@GL62M-7RDX:~/Desktop$ chmod 600 /swapfile
chmod: changing permissions of '/swapfile': Operation not permitted
parth@GL62M-7RDX:~/Desktop$ sudo chmod 600 /swapfile
[sudo] password for parth:
parth@GL62M-7RDX:~/Desktop$ sudo mkswap /swapfile
mkswap: error: /swapfile is mounted; will not make swapspace
parth@GL62M-7RDX:~/Desktop$ swapon /swapfile
swapon: cannot open /swapfile: Permission denied
parth@GL62M-7RDX:~/Desktop$ sudo swapon /swapfile
swapon: /swapfile: swapon failed: Device or resource busy
parth@GL62M-7RDX:~/Desktop$ swapon --show
NAME   TYPE SIZE USED PRIO
/swapfile file   2G   0B   -2
parth@GL62M-7RDX:~/Desktop$ free -h
               total   used   free   shared buff/cache   available
Mem: 7.7Gi   1.9Gi   3.2Gi   430Mi   2.5Gi   5.1Gi
Swap: 2.0Gi   0B   2.0Gi
parth@GL62M-7RDX:~/Desktop$