

System Commands
Professor Gandham Phanikumar
Metallurgical and Materials Engineering
Indian Institute of Technology Madras
Knowing your Hardware

(Refer Slide Time: 00:14)

Hardware items



- CPU
- Storage & Partitions
- Graphics Card
- Memory Modules
- Battery & status
- Network devices & configuration



So, the hardware items that we will be looking at are the following the CPU, the storage and various partitions that are there. And the graphics card, memory modules, battery and its current status, network devices and the configuration.

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Packages to install



```
clinfo, coreutils, dmidecode, fdisk,  
hardinfo, hdparm, hwdmidecode, lshw,  
memtester, net-tools, pciutils,  
procps, sysstat, upower, util-linux
```

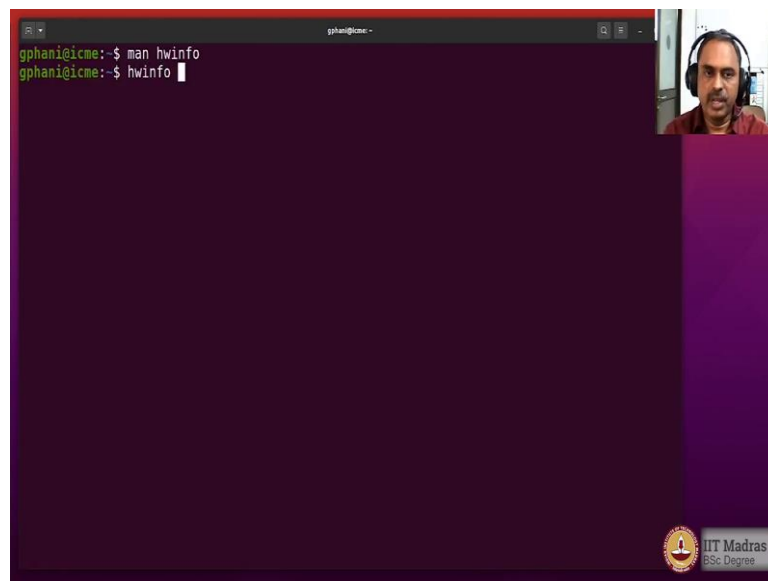


Now, there is a bunch of packages that we need to install in order to use these tools. So, here I am giving the names of those packages. So, please go ahead and install these using

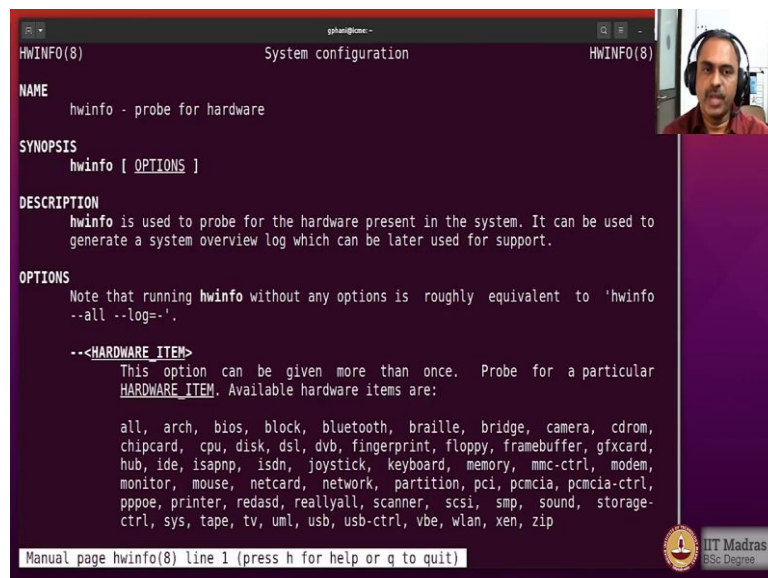
apt get install. And after that, we are ready to try out these commands on our machine. I am assuming that we are going to use the laptop that we have to try these utilities.

Often, we notice that the battery performance of a laptop keeps decreasing with time. And it is a good idea to know how much of its capacity is still retain, so that we can replace it before the prices for such a battery increase beyond our means or before such batteries are not available in the market.

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A terminal window titled 'gphani@icme: ~' shows the command 'man hwinfo' being executed. The prompt is 'gphani@icme:~\$' and the command is 'hwinfo'. The terminal output is empty, indicating the command has been entered but not yet executed. A small video feed of a man wearing headphones is visible in the top right corner. The IIT Madras BSc Degree logo is in the bottom right corner.



A terminal window titled 'gphani@icme: ~' shows the manual page for 'hwinfo'. The title is 'HwINFO(8) System configuration HwINFO(8)'. The content includes: NAME: hwinfo - probe for hardware; SYNOPSIS: hwinfo [OPTIONS]; DESCRIPTION: hwinfo is used to probe for the hardware present in the system. It can be used to generate a system overview log which can be later used for support. OPTIONS: Note that running hwinfo without any options is roughly equivalent to 'hwinfo --all --log=-'. --<HARDWARE_ITEM>: This option can be given more than once. Probe for a particular HARDWARE_ITEM. Available hardware items are: all, arch, bios, block, bluetooth, braille, bridge, camera, cdrom, chipcard, cpu, disk, dsl, dvb, fingerprint, floppy, framebuffer, gfxcard, hub, ide, isapnp, isdn, joystick, keyboard, memory, mmc-ctrl, modem, monitor, mouse, netcard, network, partition, pci, pcmcia, pcmcia-ctrl, pppoe, printer, redasd, reallyall, scanner, scsi, smp, sound, storage-ctrl, sys, tape, tv, uml, usb, usb-ctrl, vbe, wlan, xen, zip. The footer says 'Manual page hwinfo(8) line 1 (press h for help or q to quit)'. A small video feed of a man wearing headphones is visible in the top right corner. The IIT Madras BSc Degree logo is in the bottom right corner.

```
gphani@icme:~$ cat /sys/class/net/lo/ethtool -s
65: None 00:0: 10700 Loopback
[Created at net.126]
Unique ID: ZsBS.GQNx7L4uPNA
SysFS ID: /class/net/lo
Hardware Class: network interface
Model: "Loopback network interface"
Device File: lo
Link detected: yes
Config Status: cfg=new, avail=yes, need=no, active=unknown

66: None 00:0: 10701 Ethernet
[Created at net.126]
Unique ID: 23b5.ndpeucax6V1
Parent ID: AhzA.JiHiFuaKr87
SysFS ID: /class/net/enp0s31f6
SysFS Device Link: /devices/pci0000:00/0000:00:1f.6
Hardware Class: network interface
Model: "Ethernet network interface"
Driver: "e1000e"
Driver Modules: "e1000e"
Device File: enp0s31f6
HW Address: 14:b3:1f:0a:62:7b
Permanent HW Address: 14:b3:1f:0a:62:7b
Link detected: yes
Config Status: cfg=new, avail=yes, need=no, active=unknown
Attached to: #23 (Ethernet controller)
gphani@icme:~$
```

Let us get started with the hardware diagnostics. The first tool we will be using is hwdmfo. So, if you have already installed the package, it will be available. And hwdmfo used to probe for hardware. So, when you run this, it will probe the hardware and dump a lot of output on the screen.

(Refer Slide Time: 01:47)

```
gphani@icme:~$ hwdmfo > hwdmfo.txt
gphani@icme:~$ less hwdmfo.txt
```

```
===== start debug info =====
libhd version 21.68u (x86-64) [7688]
using /var/lib/hardware
kernel version is 5.13
----- /proc/cmdline -----
BOOT_IMAGE=/boot/vmlinuz-5.13.0-30-generic root=UUID=a9b7998d-8da2-42bd-a610-c93c92e085b9
ro quiet splash vt.handoff=7
----- /proc/cmdline end -----
debug = 0xff7ffff7
probe = 0x15938fcd aal7fcf9fffe (+memory +pci +isapnp +net +floppy +misc +misc.serial +misc.
par +misc.floppy +serial +cpu +bios +monitor +mouse +scsi +usb -usb.mods +modem +modem.usb
+parallel +parallel.lp +parallel.zip -isa -isa.isdn +isdn +kbd +prom +sbus +int +braille +b
raille.alva +braille.fhp +braille.ht -ignx11 +sys -bios.vbe -isapnp.old -isapnp.new -isapnp
.mod +braille.baum -manual +fb +pppoe -scan +pcmcia +fork -parallel.imm +s390 +cpumemu -sysf
s -s390disks +udev +block +block.cdrom +block.part +edd +edd.mod -bios.ddc -bios.fb -bios.m
ode +input +block.mods +bios.vesa -cpumemu.debug -scsi.noserial +wlan -bios.crc -hal +bios.v
ram +bios.acpi -bios.ddc.ports=0 +modules.pata -net.eeprom +x86emu=dump -max -lxc)
shm: attached segment 32774 at 0x7fd13101000
>> hal.1: read hal data
>> floppy.1: get nvram
>> floppy.2: klog info
>> bios.1: cmdline
>> bios.1.1: apm
>> bios.2: ram
>> bios.2: disks
>> bios.2: rom
>> bios.3: smp
hwinfo.txt
```

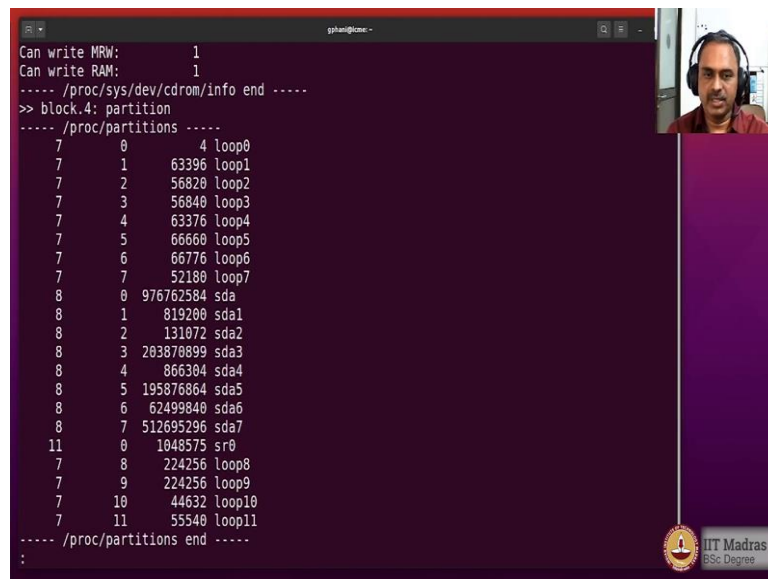
So, it is a good idea to write it to a file. So, I would write it to hwinfo dot txt. And then I will use the command less to look at the content. So, page by page, we could see the hardware information.

(Refer Slide Time: 02:06)

```
>> misc.3.4: RTC
>> cpu.1: cpuinfo
----- /proc/cpuinfo -----
processor       : 0
vendor_id     : GenuineIntel
cpu family    : 6
model         : 158
model name    : Intel(R) Core(TM) i3-7100 CPU @ 3.90GHz
stepping      : 9
microcode    : 0xea
cpu MHz       : 3900.000
cache size    : 3072 KB
physical id   : 0
siblings      : 4
core id       : 0
cpu cores     : 2
apicid        : 0
initial apicid : 0
fpu           : yes
fpu_exception : yes
cpuid level   : 22
wp            : yes
flags         : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant tsc ar
t arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid aperfperf pni pclmulqdq dtes64 monitor ds_cpl vmx est tm2 ssse3 sdbg fma cx16 xtpr pdcm pcid sse4_1 sse4_2 x2apic m
ovbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid
:
```

So, you could see that we have information about the processors. So, and then we have information about PCI devices that are plugged in.

(Refer Slide Time: 02:22)

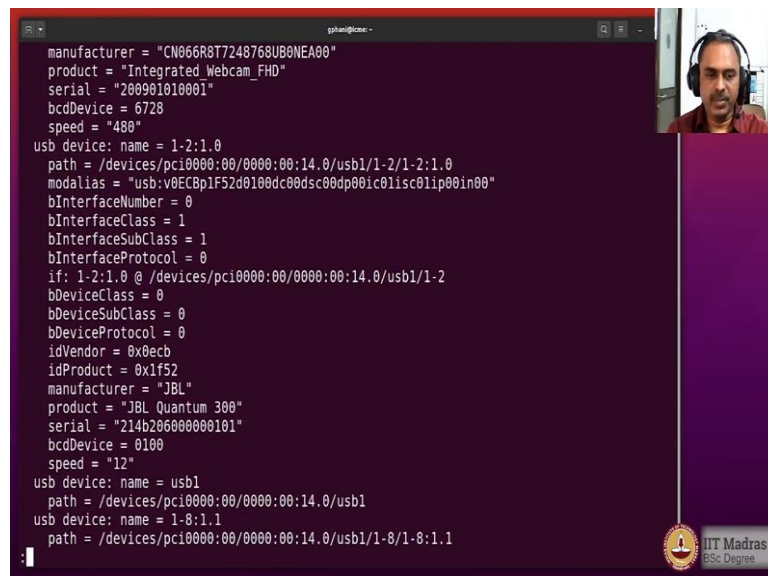


```
Can write MRW: 1
Can write RAM: 1
----- /proc/sys/dev/cdrom/info end -----
>> block.4: partition
----- /proc/partitions -----
 7      0      4 loop0
 7      1    63396 loop1
 7      2    56828 loop2
 7      3    56840 loop3
 7      4    63376 loop4
 7      5    66660 loop5
 7      6    66776 loop6
 7      7    52180 loop7
 8      0 976762584 sda
 8      1   819200 sda1
 8      2   131072 sda2
 8      3 203870809 sda3
 8      4   866304 sda4
 8      5 195876864 sda5
 8      6 62499840 sda6
 8      7 512695296 sda7
11      0   1048575 sr0
 7      8   224256 loop8
 7      9   224256 loop9
 7     10   44632 loop10
 7     11   55540 loop11
----- /proc/partitions end -----
```

The terminal window displays the output of the 'cat /proc/partitions' command, showing a list of partitions including loop devices and hard disk partitions (sda). A video feed of a man wearing headphones is visible in the top right corner of the terminal window.

And we also have information about the partitions that are there in the system.

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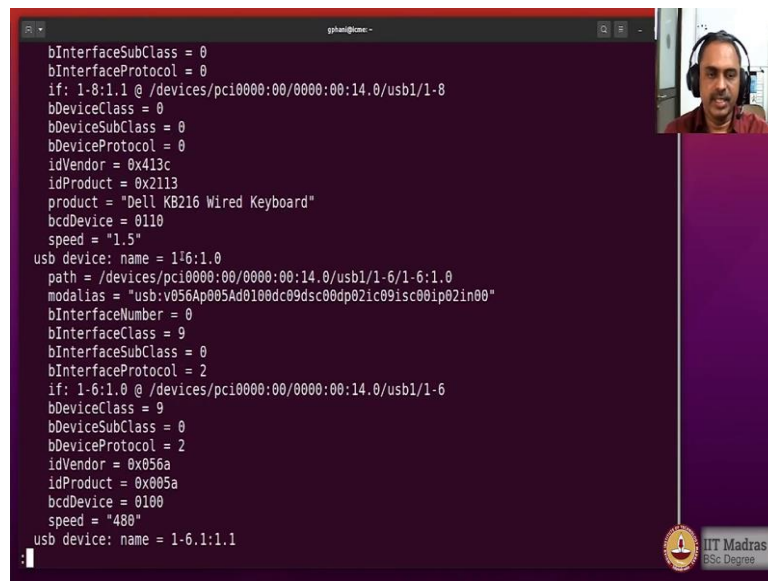


```
manufacturer = "CN066R8T7248768UB0NEA00"
product = "Integrated Webcam_FHD"
serial = "200901010001"
bcdDevice = 6728
speed = "480"
usb device: name = 1-2:1.0
path = /devices/pci0000:00/0000:00:14.0/usb1/1-2/1-2:1.0
modalias = "usb:v08ECbplF52d0100dc00dsc00dp00ic01isc01ip00in00"
bInterfaceNumber = 0
bInterfaceClass = 1
bInterfaceSubClass = 1
bInterfaceProtocol = 0
if: 1-2:1.0 @ /devices/pci0000:00/0000:00:14.0/usb1/1-2
bDeviceClass = 0
bDeviceSubClass = 0
bDeviceProtocol = 0
idVendor = 0x0ecb
idProduct = 0x1f52
manufacturer = "JBL"
product = "JBL Quantum 300"
serial = "214b206000000101"
bcdDevice = 0100
speed = "12"
usb device: name = usb1
path = /devices/pci0000:00/0000:00:14.0/usb1
usb device: name = 1-8:1.1
path = /devices/pci0000:00/0000:00:14.0/usb1/1-8/1-8:1.1
```

The terminal window displays the output of the 'lsusb -v' command for a JBL Quantum 300 headset. It shows detailed USB descriptor information such as manufacturer, product, serial, and interface details. A video feed of the same man is visible in the top right corner.

And here you see the headphones that I am using JBL Quantum 300, it is also detected here as one of the devices, USB device.

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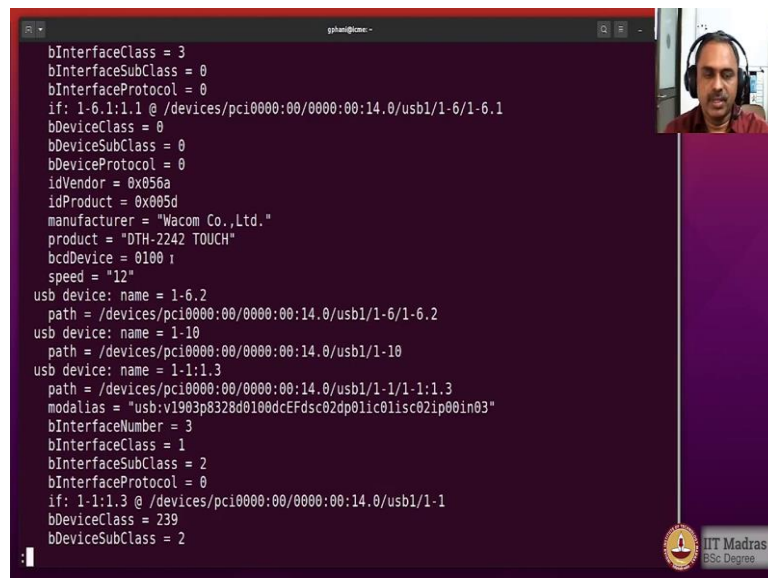


A terminal window with a dark purple background and white text. It displays the output of a command to list USB devices. The output shows details for a Dell KB216 Wired Keyboard, including its interface class, protocol, vendor ID, product ID, and speed. A small video inset in the top right corner shows a man wearing headphones. In the bottom right corner, there is a logo for IIT Madras BSc Degree.

```
bInterfaceSubClass = 0
bInterfaceProtocol = 0
if: 1-8:1.1 @ /devices/pci0000:00/0000:00:14.0/usb1/1-8
bDeviceClass = 0
bDeviceSubClass = 0
bDeviceProtocol = 0
idVendor = 0x413c
idProduct = 0x2113
product = "Dell KB216 Wired Keyboard"
bcdDevice = 0110
speed = "1.5"
usb device: name = 1-6:1.0
path = /devices/pci0000:00/0000:00:14.0/usb1/1-6/1-6:1.0
modalias = "usb:v056Ap005Ad0100dc09dsc00dp02ic09isc00ip02in00"
bInterfaceNumber = 0
bInterfaceClass = 9
bInterfaceSubClass = 0
bInterfaceProtocol = 2
if: 1-6:1.0 @ /devices/pci0000:00/0000:00:14.0/usb1/1-6
bDeviceClass = 9
bDeviceSubClass = 0
bDeviceProtocol = 2
idVendor = 0x056a
idProduct = 0x005a
bcdDevice = 0100
speed = "480"
usb device: name = 1-6:1.1
```

And then the Dell keyboard is detected here.

(Refer Slide Time: 02:49)

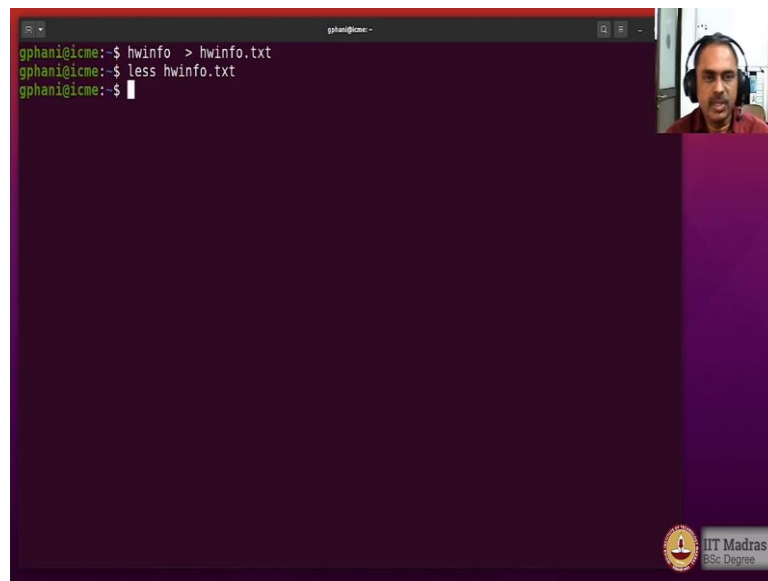


A terminal window with a dark purple background and white text. It displays the output of a command to list USB devices. The output shows details for a Wacom tablet, including its interface class, protocol, vendor ID, product ID, manufacturer, and speed. A small video inset in the top right corner shows a man wearing headphones. In the bottom right corner, there is a logo for IIT Madras BSc Degree.

```
bInterfaceClass = 3
bInterfaceSubClass = 0
bInterfaceProtocol = 0
if: 1-6:1.1 @ /devices/pci0000:00/0000:00:14.0/usb1/1-6/1-6.1
bDeviceClass = 0
bDeviceSubClass = 0
bDeviceProtocol = 0
idVendor = 0x056a
idProduct = 0x005d
manufacturer = "Wacom Co.,Ltd."
product = "DTH-2242 TOUCH"
bcdDevice = 0100
speed = "12"
usb device: name = 1-6.2
path = /devices/pci0000:00/0000:00:14.0/usb1/1-6/1-6.2
usb device: name = 1-10
path = /devices/pci0000:00/0000:00:14.0/usb1/1-10
usb device: name = 1-1:1.3
path = /devices/pci0000:00/0000:00:14.0/usb1/1-1/1-1:1.3
modalias = "usb:v1903p8328d0100dcEFdsc02dp01ic01isc02ip00in03"
bInterfaceNumber = 3
bInterfaceClass = 1
bInterfaceSubClass = 2
bInterfaceProtocol = 0
if: 1-1:1.3 @ /devices/pci0000:00/0000:00:14.0/usb1/1-1
bDeviceClass = 239
bDeviceSubClass = 2
```

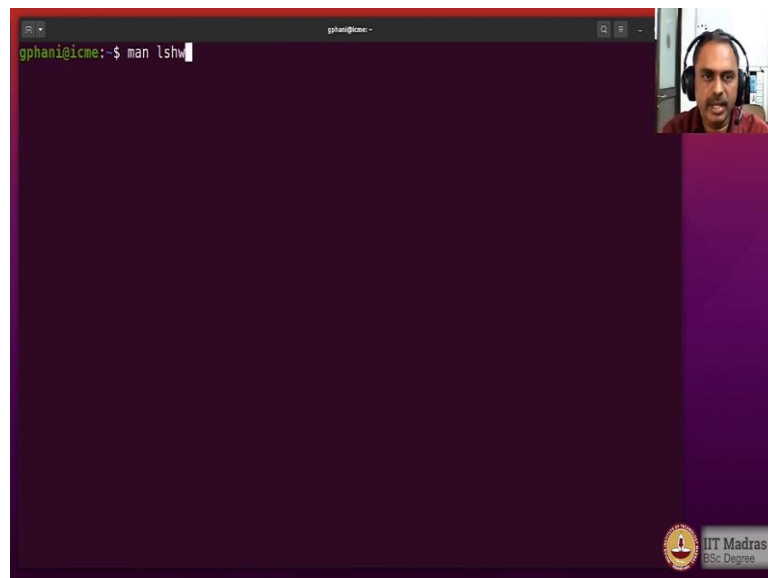
And the tablet on which I am doing this recording, that is a Wacom tablet that is also record recognized and so on.

(Refer Slide Time: 02:57)



A terminal window with a dark purple background. The prompt is 'gphani@icme:~'. The user has entered the following commands: 'hwinfo > hwinfo.txt', 'less hwinfo.txt', and the cursor is on a new line. In the top right corner, there is a small video feed of a man wearing headphones. In the bottom right corner, there is a logo for 'IIT Madras BSc Degree'.

```
gphani@icme:~$ hwinfo > hwinfo.txt
gphani@icme:~$ less hwinfo.txt
gphani@icme:~$
```

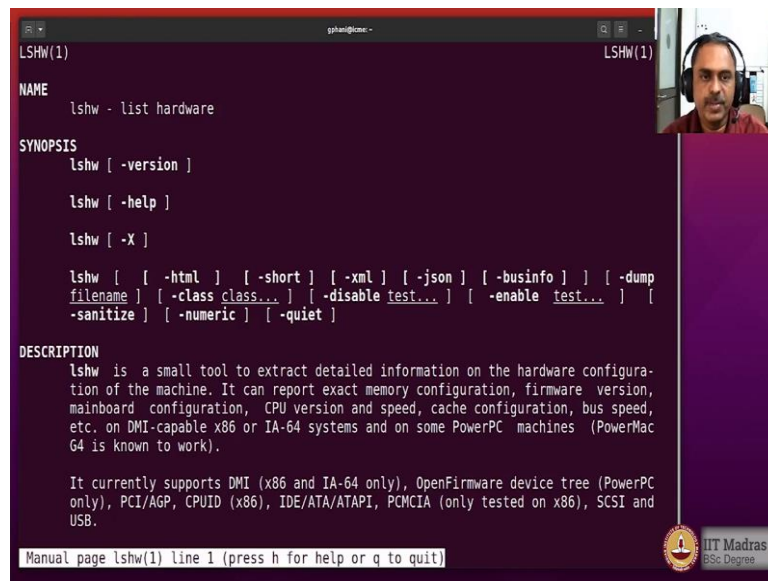


A terminal window with a dark purple background. The prompt is 'gphani@icme:~'. The user has entered the command 'man lshw' and the cursor is at the end of the line. In the top right corner, there is a small video feed of a man wearing headphones. In the bottom right corner, there is a logo for 'IIT Madras BSc Degree'.

```
gphani@icme:~$ man lshw
```

So, you could actually look at this file to know more details about the hardware. Now, there are some more commands that we have. So, let us look at them.

(Refer Slide Time: 03:09)



```
LSHW(1)
NAME
    lshw - list hardware

SYNOPSIS
    lshw [ -version ]

    lshw [ -help ]

    lshw [ -X ]

    lshw [ [ -html ] [ -short ] [ -xml ] [ -json ] [ -businfo ] ] [ -dump
    filename ] [ -class class... ] [ -disable test... ] [ -enable test... ] [
    -sanitize ] [ -numeric ] [ -quiet ]

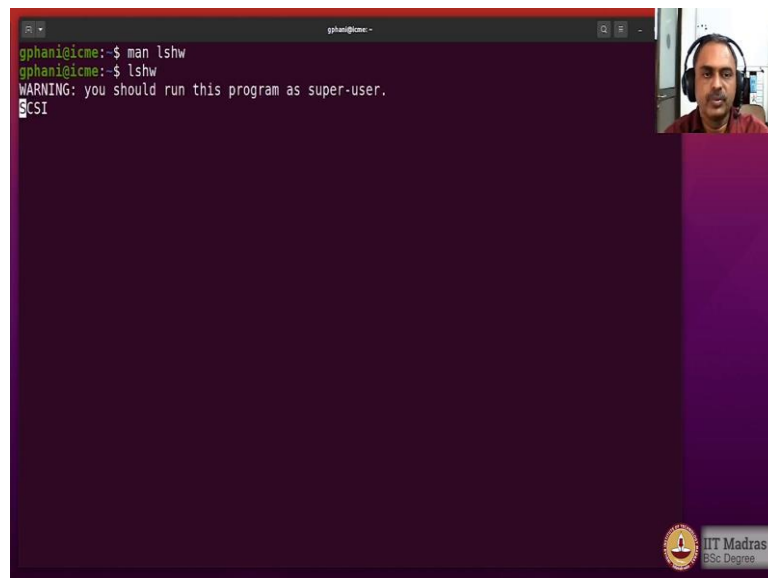
DESCRIPTION
    lshw is a small tool to extract detailed information on the hardware configura-
    tion of the machine. It can report exact memory configuration, firmware version,
    mainboard configuration, CPU version and speed, cache configuration, bus speed,
    etc. on DMI-capable x86 or IA-64 systems and on some PowerPC machines (PowerMac
    G4 is known to work).

    It currently supports DMI (x86 and IA-64 only), OpenFirmware device tree (PowerPC
    only), PCI/AGP, CPUID (x86), IDE/ATA/ATAPI, PCMCIA (only tested on x86), SCSI and
    USB.

Manual page lshw(1) line 1 (press h for help or q to quit)
```

So, lshw is also one more such utility list hardware.

(Refer Slide Time: 03:14)



```
gphani@icme:~$ man lshw
gphani@icme:~$ lshw
WARNING: you should run this program as super-user.
$
```



```
gphani@icme: ~  
*-pnp00:0a  
  product: PnP device PNP0c02  
  physical id: c  
  capabilities: pnp  
  configuration: driver=system  
*-scsi  
  physical id: d  
  logical name: scsi1  
  capabilities: emulated  
*-cdrom  
  description: DVD-RAM writer  
  product: DVD+-RW GU90N  
  vendor: HL-DT-ST  
  physical id: 0.0.0  
  bus info: scsi1:0.0.0  
  logical name: /dev/cdrom  
  logical name: /dev/cdrw  
  logical name: /dev/dvd  
  logical name: /dev/dvdrw  
  logical name: /dev/sr0  
  version: AIC3  
  capabilities: removable audio cd-r cd-rw dvd dvd-r dvd-ram  
  configuration: ansiversion=5 status=nodisc  
WARNING: output may be incomplete or inaccurate, you should run this program as super-user.  
gphani@icme:~$ lshw > lshw.txt  
WARNING: you should run this program as super-user.  
WARNING: output may be incomplete or inaccurate, you should run this program as super-user.  
gphani@icme:~$ vi
```

And let us look at that. So, it is again dumping the output on the screen, which is quite large. So, I write the output to the text file.

(Refer Slide Time: 03:30)

```
gphani@icme: ~  
gphani@icme:~$ less lshw.txt
```

```
gphani@icme:~$ cat lshw.txt
description: Computer
width: 64 bits
capabilities: smp vsyscall32
*-core
  description: Motherboard
  physical id: 0
*-memory
  description: System memory
  physical id: 0
  size: 32GiB
*-cpu
  product: Intel(R) Core(TM) i3-7100 CPU @ 3.90GHz
  vendor: Intel Corp.
  physical id: 1
  bus info: cpu@0
  size: 3481MHz
  capacity: 3900MHz
  width: 64 bits
  capabilities: fpu fpu_exception wp vme de pse tsc msr pae mce cx8 apic sep mtrr p
ge mca cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rd
tscp x86-64 constant_tsc art arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpui
d aperfmperf pni pclmulqdq dtes64 monitor ds_cpl vmx est 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 3dnowprefetch cpuid_fault epb invpcid_single pti ssbd ibrs ibpb stibp tpr_shadow vnmi
flexpriority ept vpid ept_ad fsgsbase tsc_adjust bmi1 avx2 smep bmi2 erms invpcid mpx rdsee
d adx smap clflushopt intel_pt xsaveopt xsavec xgetbv1 xsaves dtherm arat pln pts hwp hwp
lshw.txt
```

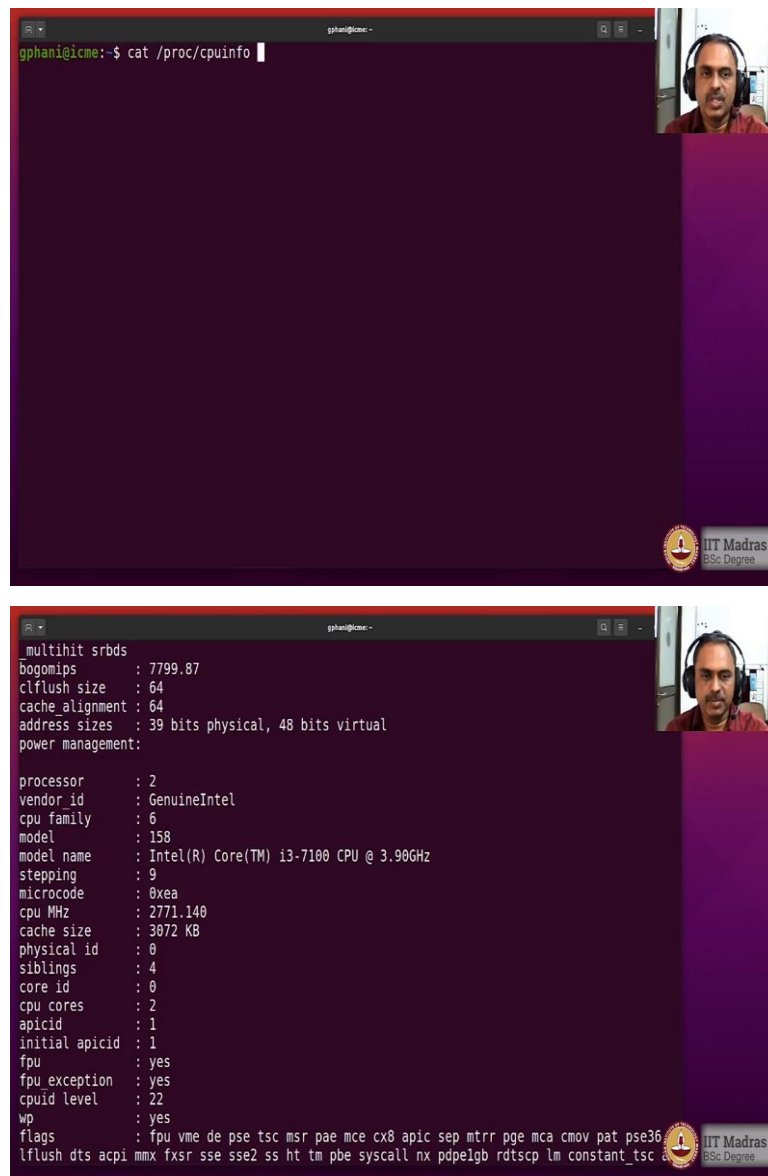
And using the command less I would go screen by screen. So, you can now see that the way the information is displayed is slightly different compared to the other tool, but it is a little bit easier because it has limited information. So, you could now see that this information is coming in various sections.

(Refer Slide Time: 03:50)

```
gphani@icme:~$ less lshw.txt
gphani@icme:~$ lshw -c display
WARNING: you should run this program as super-user.
*-display
  description: VGA compatible controller
  product: HD Graphics 630
  vendor: Intel Corporation
  physical id: 2
  bus info: pci@0000:00:02.0
  version: 04
  width: 64 bits
  clock: 33MHz
  capabilities: vga_controller bus_master cap_list
  configuration: driver=i915 latency=0
  resources: irq:128 memory:f0000000-f0ffffff memory:e0000000-efffffff ioport:f000(siz
e=64) memory:c0000-dffff
WARNING: output may be incomplete or inaccurate, you should run this program as super-user.
gphani@icme:~$
```

So, we could also ask the information to come, to be displayed in a particular section. Also, say for example, you could ask for display and only for display it will tell what is information that is available.

(Refer Slide Time: 04:11)



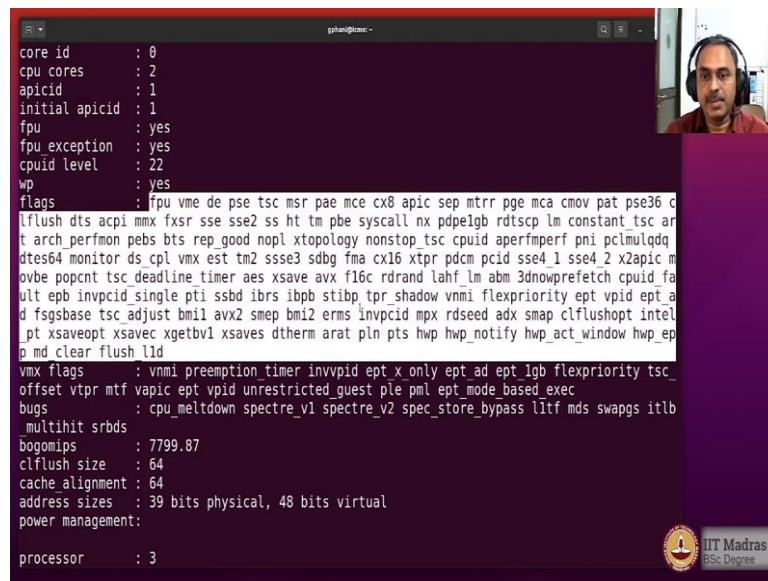
```
gphan@icme:~$ cat /proc/cpuinfo

multihit srbd
bogomips      : 7799.87
clflush size  : 64
cache_alignm  : 64
address sizes : 39 bits physical, 48 bits virtual
power managem

processor      : 2
vendor_id     : GenuineIntel
cpu family    : 6
model         : 158
model name    : Intel(R) Core(TM) i3-7100 CPU @ 3.90GHz
stepping      : 9
microcode     : 0xea
cpu MHz       : 2771.140
cache size    : 3072 KB
physical id   : 0
siblings      : 4
core id       : 0
cpu cores     : 2
apicid        : 1
initial apicid : 1
fpu           : yes
fpu exception : yes
cpuid level   : 22
wp            : yes
flags         : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36
lflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant_tsc a
```

Now, if you are interested to know more about only the CPUs that is also available in the proc file system, CPU info. So, you simply cat that file and you have got the information about the processors that are available.

(Refer Slide Time: 04:27)

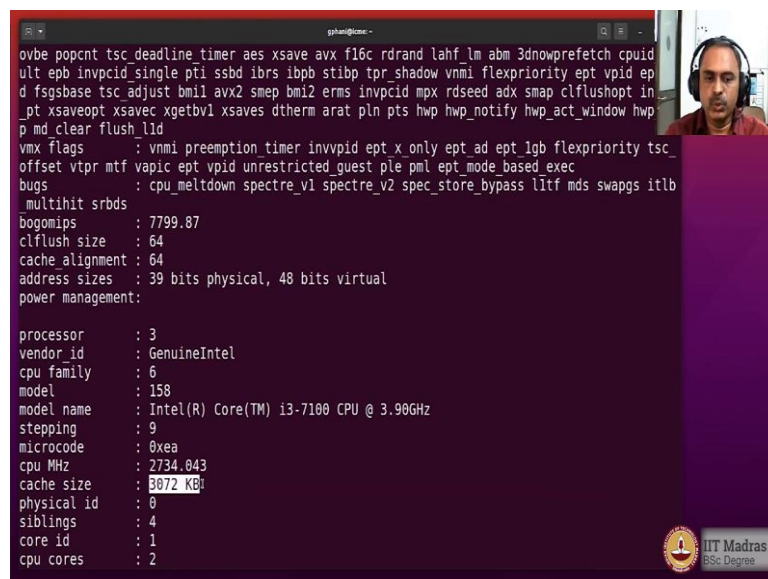


```
core id      : 0
cpu cores    : 2
apicid       : 1
initial apicid : 1
fpu          : yes
fpu_exception : yes
cpuid level  : 22
wp           : yes
flags        : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant tsc ar
t arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid aperfmperf pni pclmulqdq dtes64 monitor ds cpl vmx est tm2 ssse3 sdbg fma cx16 xtpr pdcm pcid sse4_1 sse4_2 x2apic m
ovbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epb invpcid_single pti ssbd ibrs ibpb stibp tpr_shadow vnmi flexpriority ept vpid ept_a
d fsgsbase tsc_adjust bmi1 avx2 smep bmi2 erms invpcid mpx rdseed adx smap clflushopt intel_pt xsaveopt xsavec xgetbv1 xsaves dtherm arat pln pts hwp hwp_notify hwp_act_window hwp_e
nd_clear flush_lld
vmx flags    : vnmi preemption_timer invvpid ept_x_only ept_ad ept_lgb flexpriority tsc_offset vtpr mtf vapic ept vpid unrestricted_guest ple pml ept_mode_based_exec
bugs        : cpu_meltdown spectre_v1 spectre_v2 spec_store_bypass l1tf mds swapgs itlb_multihit srbsds
bogomips     : 7799.87
clflush size : 64
cache alignment : 64
address sizes : 39 bits physical, 48 bits virtual
power management:

processor     : 3
```

And the information here contains many, many flags which actually tell the capability of the CPU. And the cache memory.

(Refer Slide Time: 04:41)

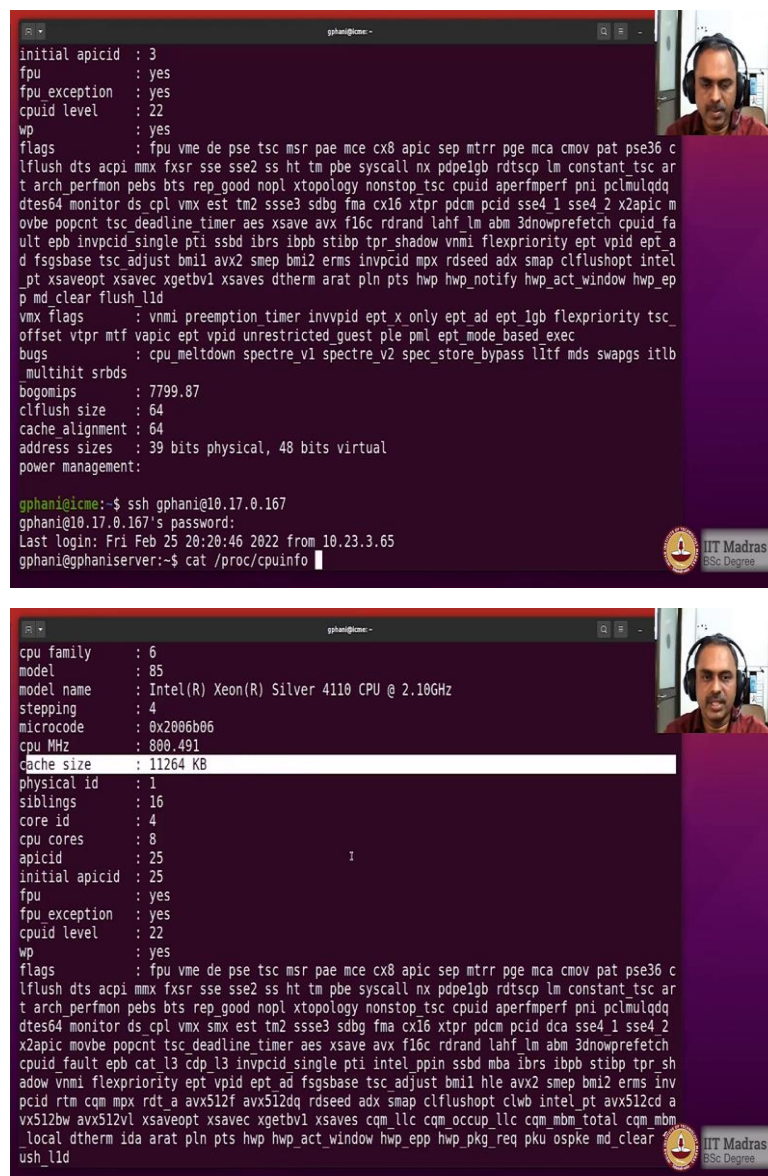


```
ovbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epb invpcid_single pti ssbd ibrs ibpb stibp tpr_shadow vnmi flexpriority ept vpid ept_a
d fsgsbase tsc_adjust bmi1 avx2 smep bmi2 erms invpcid mpx rdseed adx smap clflushopt intel_pt xsaveopt xsavec xgetbv1 xsaves dtherm arat pln pts hwp hwp_notify hwp_act_window hwp_e
nd_clear flush_lld
vmx flags    : vnmi preemption_timer invvpid ept_x_only ept_ad ept_lgb flexpriority tsc_offset vtpr mtf vapic ept vpid unrestricted_guest ple pml ept_mode_based_exec
bugs        : cpu_meltdown spectre_v1 spectre_v2 spec_store_bypass l1tf mds swapgs itlb_multihit srbsds
bogomips     : 7799.87
clflush size : 64
cache alignment : 64
address sizes : 39 bits physical, 48 bits virtual
power management:

processor     : 3
vendor_id    : GenuineIntel
cpu family   : 6
model        : 158
model name   : Intel(R) Core(TM) i3-7100 CPU @ 3.90GHz
stepping     : 9
microcode    : 0xea
cpu MHz      : 2734.043
cache size   : 3072 KB
physical id   : 0
siblings     : 4
core id      : 1
cpu cores    : 2
```

Here, tells you how good the machine is going to work for heavy computation. So, some of the processors like Xenon would have a cache memory that is significantly larger. So, let us look at that by logging into a machine which has a Xeon processor. So, this one, for example is a core i3.

(Refer Slide Time: 05:03)



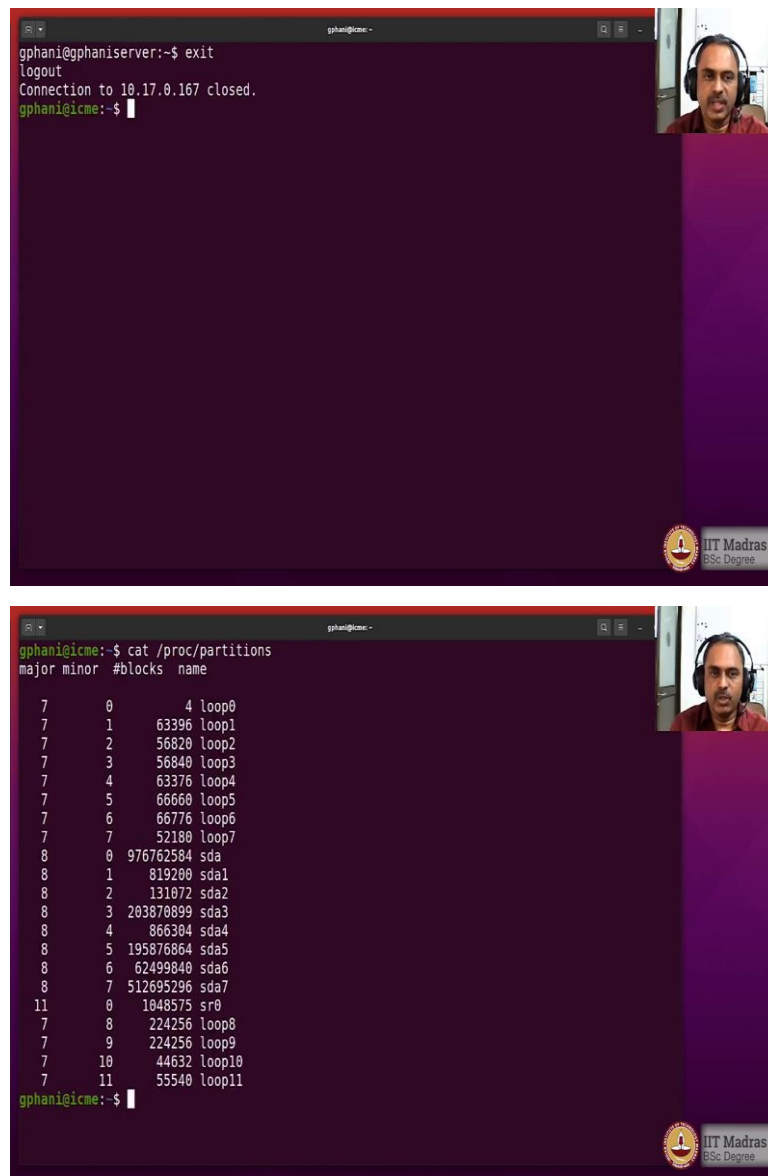
```
gphani@icme:~$ cat /proc/cpuinfo
initial apicid : 3
fpu : yes
fpu_exception : yes
cpuid level : 22
wp : yes
flags : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant tsc ar
t arch_perfmon pebs bts rep good nopl xtopology nonstop_tsc cpuid aperfmperf pni pclmulqdq
dtes64 monitor ds cpl vmx est tm2 ssse3 sdbg fma cx16 xtpr pdcm pcid sse4_1 sse4_2 x2apic m
ovbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid fa
ult epb invpcid_single pti ssbd ibrs ibpb stibp tpr_shadow vnmi flexpriority ept vpid ept_a
d fsgsbase tsc_adjust bmi1 avx2 smep bmi2 erms invpcid mpx rdseed adx smap clflushopt intel
_pt xsaveopt xsavec xgetbv1 xsaves dtherm arat pln pts hwp hwp_notify hwp_act_window hwp_ep
p md_clear flush_lld
vmx flags : vnmi preemption_timer invvpid ept x_only ept_ad ept_lgb flexpriority tsc_
offset vtptr mtf vapic ept vpid unrestricted guest ple pml ept_mode_based_exec
bugs : cpu_meltdown spectre_v1 spectre_v2 spec_store_bypass l1tf mds swapgs itlb
_multihit srbsds
bogomips : 7799.87
clflush size : 64
cache alignment : 64
address sizes : 39 bits physical, 48 bits virtual
power management:

gphani@icme:~$ ssh gphani@10.17.0.167
gphani@10.17.0.167's password:
Last login: Fri Feb 25 20:20:46 2022 from 10.23.3.65
gphani@gphaniserver:~$ cat /proc/cpuinfo

cpu family : 6
model : 85
model name : Intel(R) Xeon(R) Silver 4110 CPU @ 2.10GHz
stepping : 4
microcode : 0x2006b06
cpu MHz : 800.491
cache size : 11264 KB
physical id : 1
siblings : 16
core id : 4
cpu cores : 8
apicid : 25
initial apicid : 25
fpu : yes
fpu_exception : yes
cpuid level : 22
wp : yes
flags : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 c
lflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp lm constant tsc ar
t arch_perfmon pebs bts rep good nopl xtopology nonstop_tsc cpuid aperfmperf pni pclmulqdq
dtes64 monitor ds cpl vmx smx est tm2 ssse3 sdbg fma cx16 xtpr pdcm pcid dca sse4_1 sse4_2
x2apic movbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch
cpuid_fault epb cat_l3 cdp_l3 invpcid_single pti intel_ppin ssbd mba ibrs ibpb stibp tpr_sh
adow vnmi flexpriority ept vpid ept_ad fsgsbase tsc_adjust bmi1 hle avx2 smep bmi2 erms inv
pcid rtm cqm mpx rdt_a avx512f avx512dq rdseed adx smap clflushopt clwb intel_pt avx512cd a
vx512bw avx512vl xsaveopt xsavec xgetbv1 xsaves cqm_llc cqm_occup_llc cqm_mbm_total cqm_mbm
_local dtherm ida arat pln pts hwp hwp_act_window hwp_epp hwp_pkg_req pku ospke md_clear
ush_lld
```

So, I log in now to a machine which is just beside this particular desktop. And there I look at this option and you can see that the cache size here is roughly about 12 megabytes and that is because this is a Xeon processor.

(Refer Slide Time: 05:27)



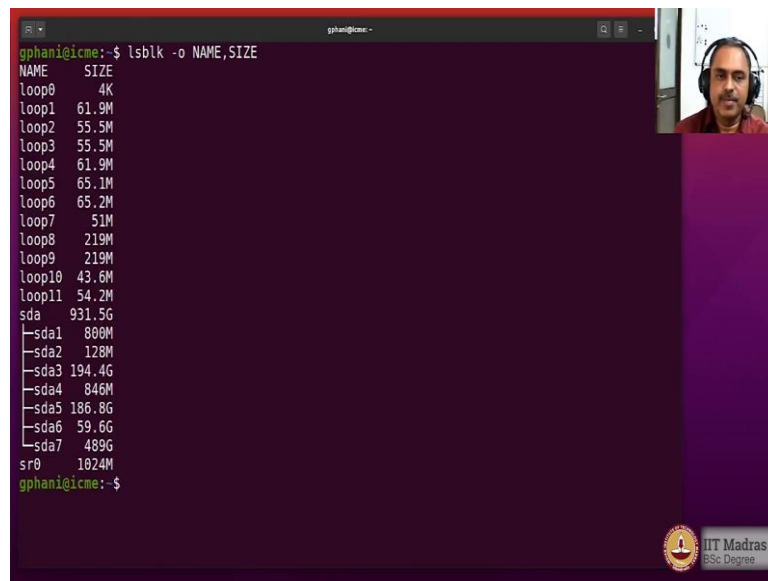
```
gphani@gphaniserver:~$ exit
logout
Connection to 10.17.0.167 closed.
gphani@icme:~$
```



```
gphani@icme:~$ cat /proc/partitions
major minor #blocks name
7 0 4 loop0
7 1 63396 loop1
7 2 56820 loop2
7 3 56840 loop3
7 4 63376 loop4
7 5 66660 loop5
7 6 66776 loop6
7 7 52180 loop7
8 0 976762584 sda
8 1 819200 sda1
8 2 131072 sda2
8 3 203870899 sda3
8 4 866304 sda4
8 5 195876864 sda5
8 6 62499840 sda6
8 7 512695296 sda7
11 0 1048575 sr0
7 8 224256 loop8
7 9 224256 loop9
7 10 44632 loop10
7 11 55540 loop11
gphani@icme:~$
```

So, you can see that one can actually get more details about the CPU, and its finer hardware details using these commands, which are also available in multiple forms. What are the various partitions that are created in the storage device attached with this computer can also be listed. So, you could test slash proc file system has a partition information also, and it lists you what are the various partitions including the loop devices, which are meant for usually snap packages, and you also have the block sizes that are listed here. Now, how many block type devices are available, how many storage devices are available.

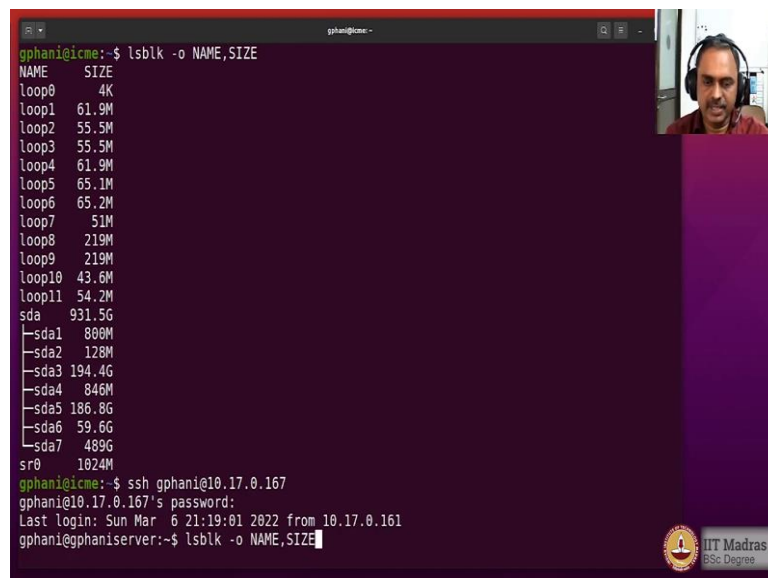
(Refer Slide Time: 06:17)



```
gphani@icme:~$ lsblk -o NAME,SIZE
NAME        SIZE
loop0        4K
loop1       61.9M
loop2       55.5M
loop3       55.5M
loop4       61.9M
loop5       65.1M
loop6       65.2M
loop7        51M
loop8       219M
loop9       219M
loop10      43.6M
loop11      54.2M
sda         931.5G
├─sda1       800M
├─sda2       128M
├─sda3      194.4G
├─sda4       846M
├─sda5      186.8G
├─sda6       59.6G
├─sda7       489G
sr0         1024M
gphani@icme:~$
```

So, that is available using lsblk command and I would like to ask it to give me the name and the size. So, all the block devices are listed and here is a nice display it is available here it says that the storage is about 1 TB and there are seven partitions and each of those partitions what is the size is now listed here, slightly more easy to read. Now, let us look at this also in the other machine that I was referring to.

(Refer Slide Time: 06:50)



```
gphani@icme:~$ lsblk -o NAME,SIZE
NAME        SIZE
loop0        4K
loop1       61.9M
loop2       55.5M
loop3       55.5M
loop4       61.9M
loop5       65.1M
loop6       65.2M
loop7        51M
loop8       219M
loop9       219M
loop10      43.6M
loop11      54.2M
sda         931.5G
├─sda1       800M
├─sda2       128M
├─sda3      194.4G
├─sda4       846M
├─sda5      186.8G
├─sda6       59.6G
├─sda7       489G
sr0         1024M
gphani@icme:~$ ssh gphani@10.17.0.167
gphani@10.17.0.167's password:
Last login: Sun Mar  6 21:19:01 2022 from 10.17.0.161
gphani@gphaniserver:~$ lsblk -o NAME,SIZE
```



```
gphani@icme:~$ lsblk
loop7 75.4M
loop8 219M
loop9 219M
loop10 424.2M
loop11 2.5M
loop12 65.2M
loop13 168.8M
loop14 55.5M
loop15 17.9M
loop16 134.8M
loop17 247.9M
loop18 162.9M
loop19 61.9M
loop20 248.8M
loop21 65.1M
loop22 110.5M
loop23 2.5M
loop24 61.9M
loop25 55.5M
loop26 178.6M
loop27 110.8M
sda 21.9T
sdb 446.6G
├─sdb1 512M
├─sdb2 300G
└─sdb3 146.1G
sr0 1024M
gphani@gphani-server:~$
```

So lsblk minus o NAME comma SIZE. So, here you can see that the storage devices are actually two, one of them actually has a 21.9 terabytes and the other one has half a terabyte. So, there are two devices and the one which is 21.9 terabytes is actually a raid device, which we will learn about in one of the following modules.

(Refer Slide Time: 07:25)

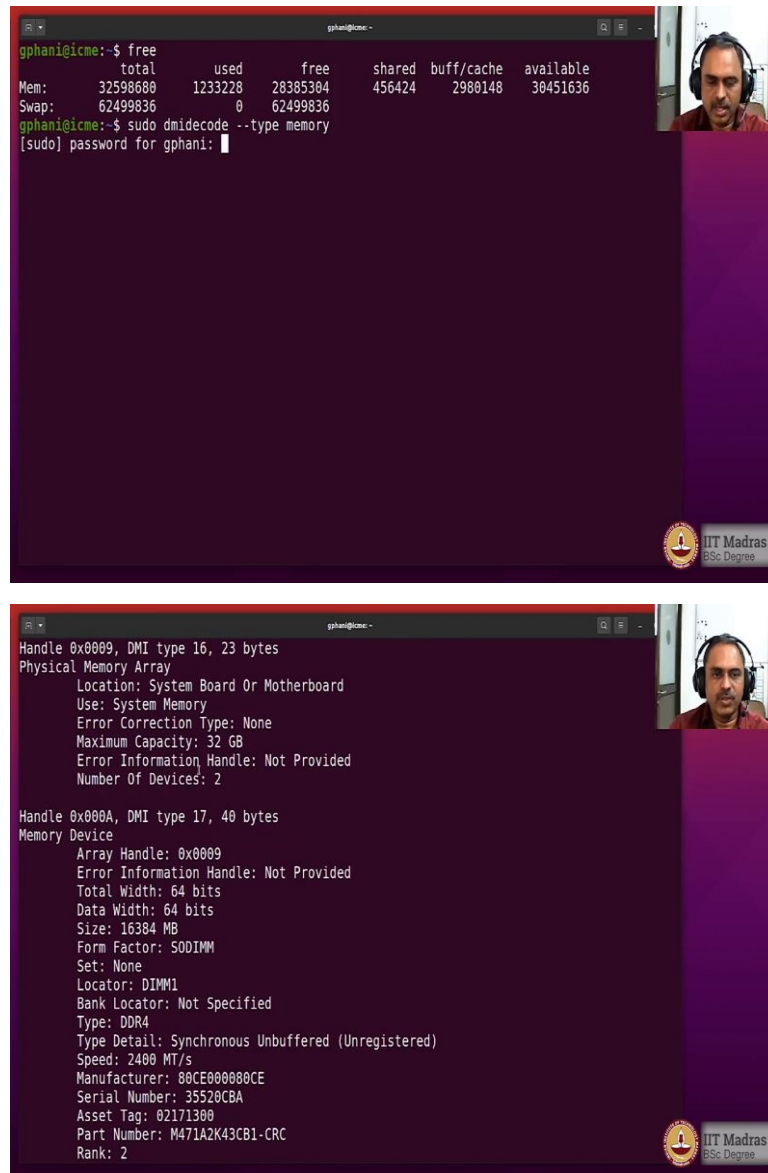
```
gphani@icme:~$ lspci
00:00.0 Host bridge: Intel Corporation Xeon E3-1200 v6/7th Gen Core Processor Host Bridge/DRAM Registers (rev 06)
00:02.0 VGA compatible controller: Intel Corporation HD Graphics 630 (rev 04)
00:14.0 USB controller: Intel Corporation 200 Series/Z370 Chipset Family USB 3.0 xHCI Controller
00:14.2 Signal processing controller: Intel Corporation 200 Series PCH Thermal Subsystem
00:16.0 Communication controller: Intel Corporation 200 Series PCH CSME HECI #1
00:17.0 SATA controller: Intel Corporation 200 Series PCH SATA controller [AHCI mode]
00:1c.0 PCI bridge: Intel Corporation 200 Series PCH PCI Express Root Port #6 (rev f0)
00:1c.6 PCI bridge: Intel Corporation 200 Series PCH PCI Express Root Port #7 (rev f0)
00:1f.0 ISA bridge: Intel Corporation 200 Series PCH LPC Controller (Q270)
00:1f.2 Memory controller: Intel Corporation 200 Series/Z370 Chipset Family Power Management Controller
00:1f.3 Audio device: Intel Corporation 200 Series PCH HD Audio
00:1f.4 SMBus: Intel Corporation 200 Series/Z370 Chipset Family SMBus Controller
00:1f.6 Ethernet controller: Intel Corporation Ethernet Connection (5) I219-V
01:00.0 Unassigned class [ff00]: Realtek Semiconductor Co., Ltd. RTS525A PCI Express Card Reader (rev 01)
02:00.0 Network controller: Intel Corporation Wireless 3165 (rev 79)
gphani@icme:~$
```

Now, what are the various PCI devices that are connected to this computer, so that is known from the command lspci. So, you can see the list of various hardware items. And there are some bridge adapters. So, there is a graphics card that is installed. And then you have some things that are recognized, here for example, the Ethernet card.

So, the ethernet controller, which is for the network connectivity with the LAN that is installed, and you also have a sound device, Realtek, and then there is a wireless device also

serial number 3165 that is coming from Intel. So, most of the hardware items that are plugged into the motherboard, using the PCI buzz can also be listed here.

(Refer Slide Time: 08:18)



The image shows two screenshots of a terminal window. The top screenshot displays the output of the 'free' command, showing memory usage statistics. The bottom screenshot displays the output of the 'sudo dmidecode --type memory' command, providing detailed information about the system's memory modules.

```
gphani@icme:~$ free
              total        used        free      shared  buff/cache   available
Mem:      32598688      1233228      28385384      456424      2988148      30451636
Swap:      62499836           0      62499836

gphani@icme:~$ sudo dmidecode --type memory
[sudo] password for gphani:
Handle 0x0009, DMI type 16, 23 bytes
Physical Memory Array
  Location: System Board Or Motherboard
  Use: System Memory
  Error Correction Type: None
  Maximum Capacity: 32 GB
  Error Information Handle: Not Provided
  Number Of Devices: 2

Handle 0x000A, DMI type 17, 40 bytes
Memory Device
  Array Handle: 0x0009
  Error Information Handle: Not Provided
  Total Width: 64 bits
  Data Width: 64 bits
  Size: 16384 MB
  Form Factor: SODIMM
  Set: None
  Locator: DIMM1
  Bank Locator: Not Specified
  Type: DDR4
  Type Detail: Synchronous Unbuffered (Unregistered)
  Speed: 2400 MT/s
  Manufacturer: 80CE000000CE
  Serial Number: 35520CBA
  Asset Tag: 02171300
  Part Number: M471A2K43C01-CRC
  Rank: 2
```

Now, there is a command called free which would tell you some details, it will tell you about how much of memory is free and how much swap memory is unutilized and this means that there is certain amount of memory that we have of which something is used and something is free. So, you can make out here that this computer has about 32 GB of RAM.

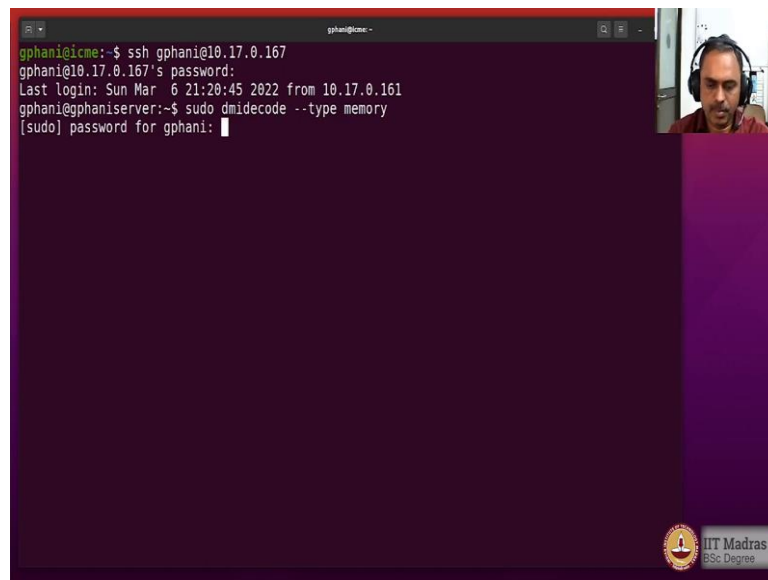
And I have usually it is a practice to have double the memory as swap storage and that is why it is about roughly double the size of the memory that I have created here. If you want to know how is this memory installed, how many DIMM modules are actually used to have this RAM available in the computer you also have it utility to know that.

This is a information coming from quite deep within the operating system. So, superuser permissions may be required. So, dmidecode is utility and I want to have that for the memory. So, you now see that the memory information is coming out and you have got the maximum capacity 32 GB and this 32 GB is given in two DIMM modules. So, the DIMM1 and the DIMM2.

So, there are two modules that is 216 GB memory modules that are installed and each of these have a lot of information coming up, for example, what is the voltage and what is the speed of that particular memory device and using this number you and also find out who is the manufacturer, and so on. So, 16 GB DIMM slot first one type of DDR4 with a speed of 2400 MT per second and operating at 1.2 volts.

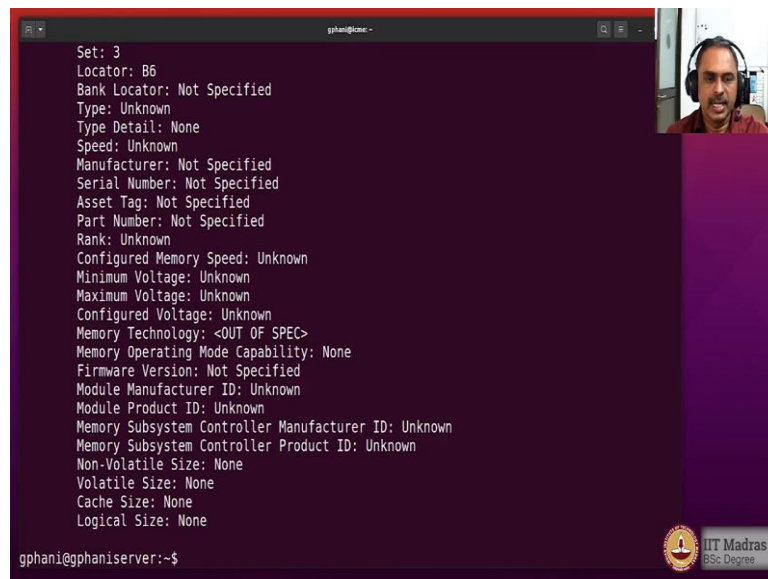
This is the information that we need, when we want to add one more DIMM module by procuring it in let us say Amazon. Now, but the form factors is important because the memory can come in small and large formats for desktop and laptop computers. So, this form factor is also something that you may want to look at. So, let us look at this form factor in the other computer that I have.

(Refer Slide Time: 10:38)



```
gphani@icme:~$ ssh gphani@10.17.0.167
gphani@10.17.0.167's password:
Last login: Sun Mar  6 21:20:45 2022 from 10.17.0.161
gphani@gphaniserver:~$ sudo dmidecode --type memory
[sudo] password for gphani: 
```

The image shows a terminal window with a dark purple background. The text is white and green. The prompt is 'gphani@icme:~\$'. The user runs 'ssh gphani@10.17.0.167'. The prompt changes to 'gphani@10.17.0.167's password:'. The user enters the password. The prompt changes to 'Last login: Sun Mar 6 21:20:45 2022 from 10.17.0.161'. The user runs 'gphani@gphaniserver:~\$ sudo dmidecode --type memory'. The prompt changes to '[sudo] password for gphani:'. The user enters the password. In the top right corner, there is a small video feed of a man wearing a headset. In the bottom right corner, there is a logo for 'IIT Madras BSc Degree'.

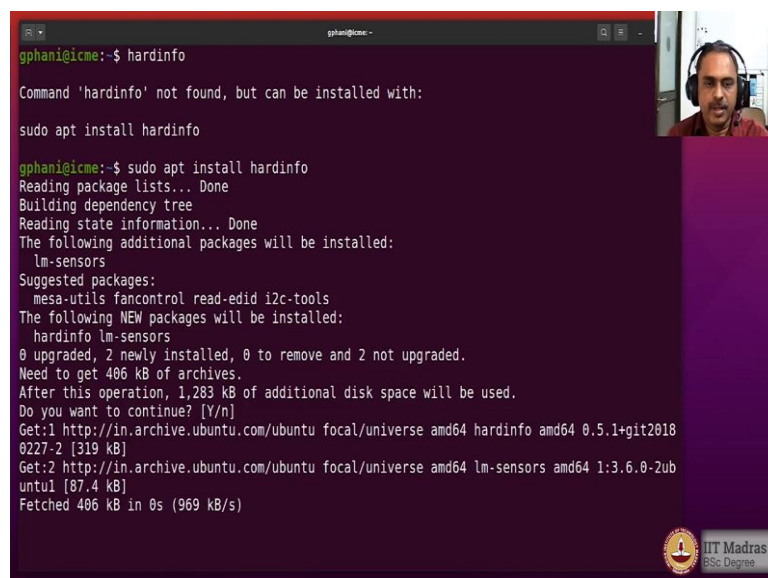
A terminal window with a dark purple background. It displays a list of memory-related system information. In the top right corner, there is a small video call inset showing a man with a beard and headphones. In the bottom right corner, there is a logo for IIT Madras BSc Degree.

```
gphani@icme: ~  
Set: 3  
Locator: B6  
Bank Locator: Not Specified  
Type: Unknown  
Type Detail: None  
Speed: Unknown  
Manufacturer: Not Specified  
Serial Number: Not Specified  
Asset Tag: Not Specified  
Part Number: Not Specified  
Rank: Unknown  
Configured Memory Speed: Unknown  
Minimum Voltage: Unknown  
Maximum Voltage: Unknown  
Configured Voltage: Unknown  
Memory Technology: <OUT OF SPEC>  
Memory Operating Mode Capability: None  
Firmware Version: Not Specified  
Module Manufacturer ID: Unknown  
Module Product ID: Unknown  
Memory Subsystem Controller Manufacturer ID: Unknown  
Memory Subsystem Controller Product ID: Unknown  
Non-Volatile Size: None  
Volatile Size: None  
Cache Size: None  
Logical Size: None  
gphani@gphaniserver:~$
```

So, you can see that here, there are multiple items. So, naturally this is a bigger computer, so it has more DIMM modules occupied. And this has 64 GB memory actually, and the DDR4 memory has a form factor which says DIMM and not SODIMM. So, that is a difference. So, the computer on which I am actually recording is a Dell all in one.


So, it has a memory model, which is smaller in size, which is same as laptop one, but the computer where I am showing you information is actually workstation where the memory module is large one, so one needs to basically keep an eye on those details also. And you also make out that it is a bit faster, because the speed is listed here as slightly more.

(Refer Slide Time: 11:43)


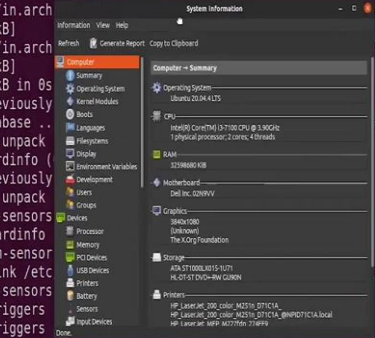
A terminal window with a dark purple background. It shows the process of installing the 'hardinfo' package. In the top right corner, there is a small video call inset showing the same man with a beard and headphones. In the bottom right corner, there is a logo for IIT Madras BSc Degree.

```
gphani@icme: ~  
gphani@icme:~$ hardinfo  
Command 'hardinfo' not found, but can be installed with:  
  
sudo apt install hardinfo  
  
gphani@icme:~$ sudo apt install hardinfo  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following additional packages will be installed:  
  lm-sensors  
Suggested packages:  
  mesa-utils fancontrol read-edid i2c-tools  
The following NEW packages will be installed:  
  hardinfo lm-sensors  
0 upgraded, 2 newly installed, 0 to remove and 2 not upgraded.  
Need to get 406 kB of archives.  
After this operation, 1,283 kB of additional disk space will be used.  
Do you want to continue? [Y/n]  
Get:1 http://in.archive.ubuntu.com/ubuntu focal/universe amd64 hardinfo amd64 0.5.1+git20180227-2 [319 kB]  
Get:2 http://in.archive.ubuntu.com/ubuntu focal/universe amd64 lm-sensors amd64 1:3.6.0-2ubuntu1 [87.4 kB]  
Fetched 406 kB in 0s (969 kB/s)
```


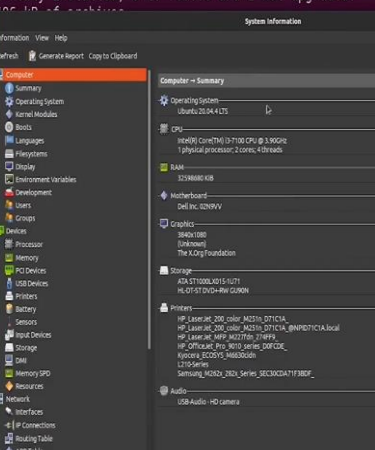
```
gphani@icme:~$ sudo apt-get install hardinfo lm-sensors
0 upgraded, 2 newly installed, 0 to remove and 2 not upgraded.
Need to get 406 kB of archives.
After this operation, 1,283 kB of additional disk space will be used.
Do you want to continue? [Y/n]
Get:1 http://in.archive.ubuntu.com/ubuntu focal/universe amd64 hardinfo amd64 0.5.1+git2022-2 [319 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu focal/universe amd64 lm-sensors amd64 1:3.6.0-2ubuntu1 [87.4 kB]
Fetched 406 kB in 0s (969 kB/s)
Selecting previously unselected package hardinfo.
(Reading database ... 336116 files and directories currently installed.)
Preparing to unpack .../hardinfo_0.5.1+git20180227-2_amd64.deb ...
Unpacking hardinfo (0.5.1+git20180227-2) ...
Selecting previously unselected package lm-sensors.
Preparing to unpack .../lm-sensors_1:3.6.0-2ubuntu1_amd64.deb ...
Unpacking lm-sensors (1:3.6.0-2ubuntu1) ...
Setting up hardinfo (0.5.1+git20180227-2) ...
Setting up lm-sensors (1:3.6.0-2ubuntu1) ...
Created symlink /etc/systemd/system/multi-user.target.wants/lm-sensors.service → /lib/systemd/system/lm-sensors.service.
Processing triggers for mime-support (3.6.4ubuntu1) ...
Processing triggers for gnome-menus (3.36.0-1ubuntu1) ...
Processing triggers for systemd (245.4-4ubuntu3.15) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for desktop-file-utils (0.24-1ubuntu3) ...
gphani@icme:~$
```



```
gphani@icme:~$ sudo apt-get install hardinfo lm-sensors
0 upgraded, 2 newly installed, 0 to remove and 2 not upgraded.
Need to get 406 kB of archives.
After this operation, 1,283 kB of additional disk space will be used.
Do you want to continue? [Y/n]
Get:1 http://in.archive.ubuntu.com/ubuntu focal/universe amd64 hardinfo amd64 0.5.1+git2022-2 [319 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu focal/universe amd64 lm-sensors amd64 1:3.6.0-2ubuntu1 [87.4 kB]
Fetched 406 kB in 0s (969 kB/s)
Selecting previously unselected package hardinfo.
(Reading database ... 336116 files and directories currently installed.)
Preparing to unpack .../hardinfo_0.5.1+git20180227-2_amd64.deb ...
Unpacking hardinfo (0.5.1+git20180227-2) ...
Selecting previously unselected package lm-sensors.
Preparing to unpack .../lm-sensors_1:3.6.0-2ubuntu1_amd64.deb ...
Unpacking lm-sensors (1:3.6.0-2ubuntu1) ...
Setting up hardinfo (0.5.1+git20180227-2) ...
Setting up lm-sensors (1:3.6.0-2ubuntu1) ...
Created symlink /etc/systemd/system/multi-user.target.wants/lm-sensors.service → /lib/systemd/system/lm-sensors.service.
Processing triggers for mime-support (3.6.4ubuntu1) ...
Processing triggers for gnome-menus (3.36.0-1ubuntu1) ...
Processing triggers for systemd (245.4-4ubuntu3.15) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for desktop-file-utils (0.24-1ubuntu3) ...
gphani@icme:~$ hardinfo
Gtk-Message: 21:26:26.878: Failed to load module "canberra-gtk-module"
```



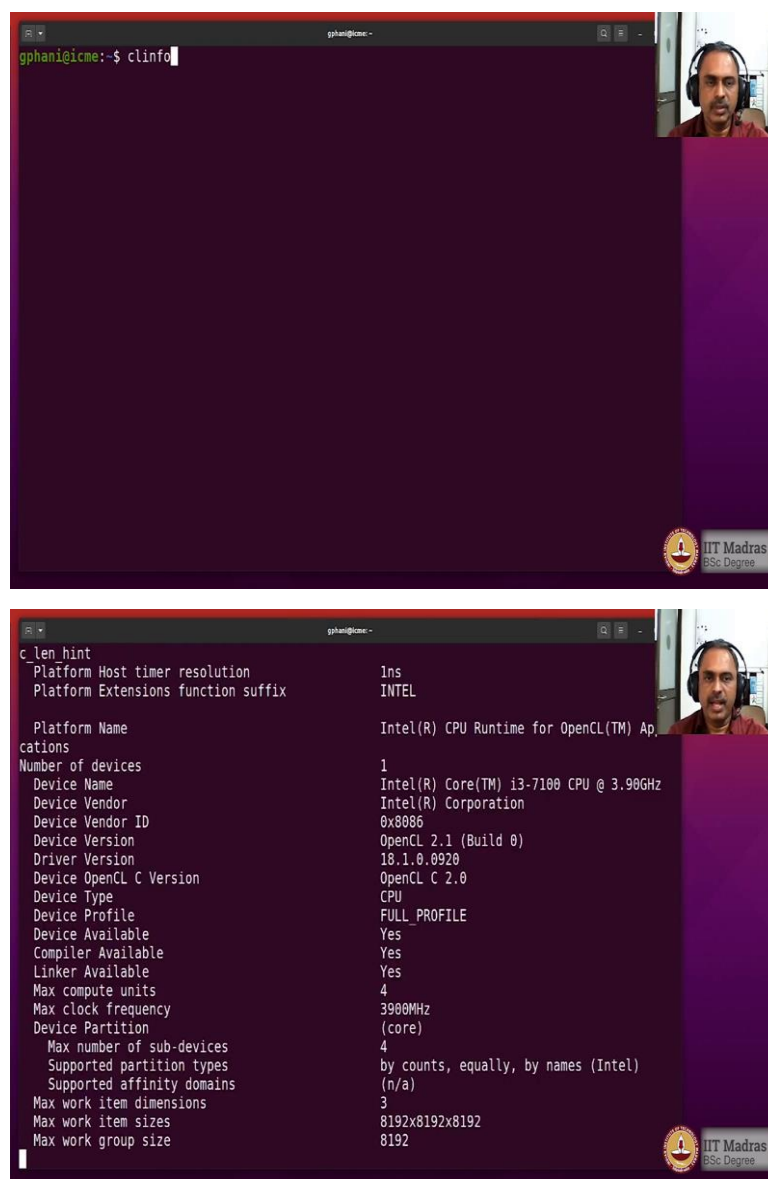
```
gphani@icme:~$ sudo apt-get install hardinfo lm-sensors
0 upgraded, 2 newly installed, 0 to remove and 2 not upgraded.
Need to get 406 kB of archives.
After this operation, 1,283 kB of additional disk space will be used.
Do you want to continue? [Y/n]
Get:1 http://in.archive.ubuntu.com/ubuntu focal/universe amd64 hardinfo amd64 0.5.1+git2022-2 [319 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu focal/universe amd64 lm-sensors amd64 1:3.6.0-2ubuntu1 [87.4 kB]
Fetched 406 kB in 0s (969 kB/s)
Selecting previously unselected package hardinfo.
(Reading database ... 336116 files and directories currently installed.)
Preparing to unpack .../hardinfo_0.5.1+git20180227-2_amd64.deb ...
Unpacking hardinfo (0.5.1+git20180227-2) ...
Selecting previously unselected package lm-sensors.
Preparing to unpack .../lm-sensors_1:3.6.0-2ubuntu1_amd64.deb ...
Unpacking lm-sensors (1:3.6.0-2ubuntu1) ...
Setting up hardinfo (0.5.1+git20180227-2) ...
Setting up lm-sensors (1:3.6.0-2ubuntu1) ...
Created symlink /etc/systemd/system/multi-user.target.wants/lm-sensors.service → /lib/systemd/system/lm-sensors.service.
Processing triggers for mime-support (3.6.4ubuntu1) ...
Processing triggers for gnome-menus (3.36.0-1ubuntu1) ...
Processing triggers for systemd (245.4-4ubuntu3.15) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for desktop-file-utils (0.24-1ubuntu3) ...
gphani@icme:~$ hardinfo
Gtk-Message: 21:26:26.878: Failed to load module "canberra-gtk-module"
```



There is also a utility called hardinfo, which is basically a GUI utility. So, I do not have it yet. So, let me get it. This is a graphical way of looking at the same information that we have been seen till now. So, nothing more is anyway available, but it may be slightly easier for you to look at it for them, the computer is right in front of you.

So, here is the information. And you can see that all the hardware items on the left, and you can click each of the items and look at whatever is the information that is available from the diagnostics. So, this is a very nice utility. However, the command line utility is also pretty good, it has all the information in a textual form for you to note down.

(Refer Slide Time: 12:32)



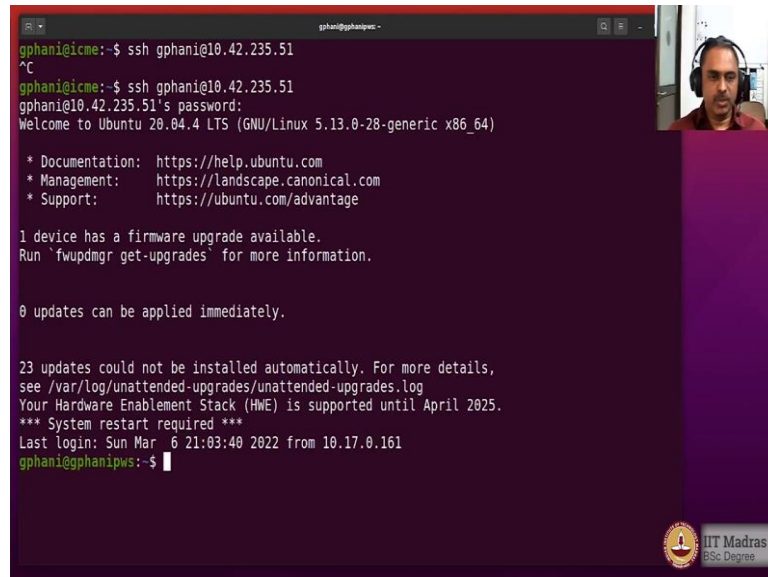
```
gphan@icme:~$ clinfo

c len hint
Platform Host timer resolution      1ns
Platform Extensions function suffix INTEL

Platform Name                      Intel(R) CPU Runtime for OpenCL(TM) Ap
cations
Number of devices                  1
Device Name                       Intel(R) Core(TM) i3-7100 CPU @ 3.90GHz
Device Vendor                     Intel(R) Corporation
Device Vendor ID                   0x8086
Device Version                     OpenCL 2.1 (Build 0)
Driver Version                     18.1.0.0920
Device OpenCL C Version            OpenCL C 2.0
Device Type                        CPU
Device Profile                     FULL_PROFILE
Device Available                   Yes
Compiler Available                 Yes
Linker Available                   Yes
Max compute units                  4
Max clock frequency                 3900MHz
Device Partition                   (core)
  Max number of sub-devices         4
  Supported partition types         by counts, equally, by names (Intel)
  Supported affinity domains        (n/a)
Max work item dimensions            3
Max work item sizes                8192x8192x8192
Max work group size                8192
```

Now what kind of a graphics card we have. So, for that, we need a utility called clinfo. And it tells you about the kind of libraries that are supported by the graphics card. So, we have only a Intel hardware here built in graphics card, so it does not have too many features.

(Refer Slide Time: 13:07)



```
gphani@icme:~$ ssh gphani@10.42.235.51
^C
gphani@icme:~$ ssh gphani@10.42.235.51
gphani@10.42.235.51's password:
Welcome to Ubuntu 20.04.4 LTS (GNU/Linux 5.13.0-28-generic x86_64)

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

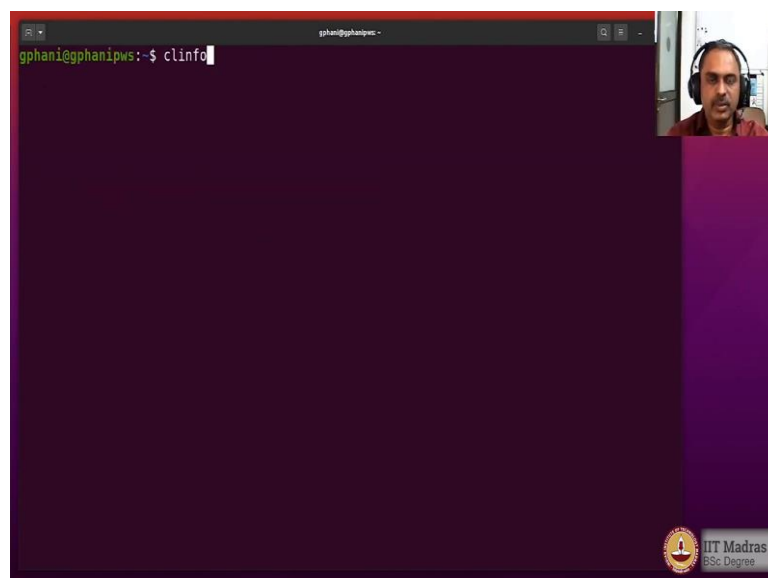
1 device has a firmware upgrade available.
Run 'fwupdmgtr get-upgrades' for more information.

0 updates can be applied immediately.

23 updates could not be installed automatically. For more details,
see /var/log/unattended-upgrades/unattended-upgrades.log
Your Hardware Enablement Stack (HWE) is supported until April 2025.
*** System restart required ***
Last login: Sun Mar  6 21:03:40 2022 from 10.17.0.161
gphani@gphanipws:~$
```

However, I can log into my laptop where I have this information which is going to be slightly different because there the graphics card is different. So, log in to the laptop there, okay, it was sleeping, so I just, yeah, so, laptop was actually going to sleep, so, yeah.

(Refer Slide Time: 13:35)



```
gphani@gphanipws:~$ clinfo
```



```
gphani@gphaniipws:~$ cat /dev/dri/renderD128
Platform Vendor: Intel(R) Corporation
Platform Version: OpenCL 2.1 LINUX
Platform Profile: FULL_PROFILE
Platform Extensions: cl_khr_icd cl_khr_global_int32_base_atomics cl_khr_global_int32_extended_atomics cl_khr_local_int32_base_atomics cl_khr_local_int32_extended_atomics cl_khr_byte_addressable_store cl_khr_depth_images cl_khr_3d_image_writes cl_khr_intel_exec_by_local_thread cl_khr_spir cl_khr_fp64 cl_khr_image2d_from_buffer cl_khr_intel_vec4_lan_hint
Platform Host timer resolution: 1ns
Platform Extensions function suffix: INTEL

Platform Name: Intel(R) CPU Runtime for OpenCL(TM) Applications
Number of devices: 1
Device Name: Intel(R) Core(TM) i5-10400H CPU @ 2.60GHz
Device Vendor: Intel(R) Corporation
Device Vendor ID: 0x8086
Device Version: OpenCL 2.1 (Build 0)
Driver Version: 18.1.0.0920
Device OpenCL C Version: OpenCL C 2.0
Device Type: CPU
Device Profile: FULL_PROFILE
Device Available: Yes
Compiler Available: Yes
Linker Available: Yes
Max compute units: 8
Max clock frequency: 2600MHz
```

So, here we can look at it. So, here you can see that the laptop when I run it has slightly more information coming up. So, it has slightly different information that is displayed the version number supported and what is the processor that is used to for computing the GPU languages such as OpenCL or CUDA in the case of Nvidia hardware. So, those can be displayed. So, it is a good idea to run these to know.

(Refer Slide Time: 14:10)

```
gphani@gphaniipws:~$ upower -e
/org/freedesktop/UPower/devices/line_power_AC
/org/freedesktop/UPower/devices/battery_BAT0
/org/freedesktop/UPower/devices/line_power_ucs1_source_psy_USBC00000001
/org/freedesktop/UPower/devices/line_power_ucs1_source_psy_USBC00000002
/org/freedesktop/UPower/devices/DisplayDevice
gphani@gphaniipws:~$ upower /org/freedesktop/UPower/devices/battery_BAT0
gphani@gphaniipws:~$ upower -i /org/freedesktop/UPower/devices/battery_BAT0
```

```
gphani@gphanipws:~$ upower /org/freedesktop/UPower/devices/battery_BAT0
gphani@gphanipws:~$ upower -i /org/freedesktop/UPower/devices/battery_BAT0
native-path: BAT0
vendor: BYD
model: DELL CR72X11
serial: 527
power supply: yes
updated: Sunday 06 March 2022 09:27:53 PM (120 seconds ago)
has history: yes
has statistics: yes
battery
present: yes
rechargeable: yes
state: discharging
warning-level: none
energy: 76.2888 Wh
energy-empty: 0 Wh
energy-full: 81.2934 Wh
energy-full-design: 95.0076 Wh
energy-rate: 35.7618 W
voltage: 11.999 V
time to empty: 2.1 hours
percentage: 93%
capacity: 85.5652%
technology: lithium-polymer
icon-name: 'battery-full-symbolic'

gphani@gphanipws:~$
```

```
power supply: yes
updated: Sunday 06 March 2022 09:31:38 PM (1 seconds ago)
has history: yes
has statistics: yes
battery
present: yes
rechargeable: yes
state: charging
warning-level: none
energy: 75.981 Wh
energy-empty: 0 Wh
energy-full: 81.2934 Wh
energy-full-design: 95.0076 Wh
energy-rate: 2.0634 W
voltage: 12.417 V
time to full: 2.6 hours
percentage: 93%
capacity: 85.5652%
technology: lithium-polymer
icon-name: 'battery-full-charging-symbolic'
History (rate):
1646582498 2.063 charging
1646582494 0.011 fully-charged
1646582492 2.212 fully-charged
1646582492 2.900 discharging
1646582394 2.212 discharging

gphani@gphanipws:~$
```

Now, there is a utility called upower which is used to know about the battery status. So, I have now logged on to the laptop so I look at that. So, upower and minus e option tells us what all the various battery devices. So, you see that there are a bunch of them and of these this particular device looks like a battery device. So, now I run with that particular device name a minus i option is required.

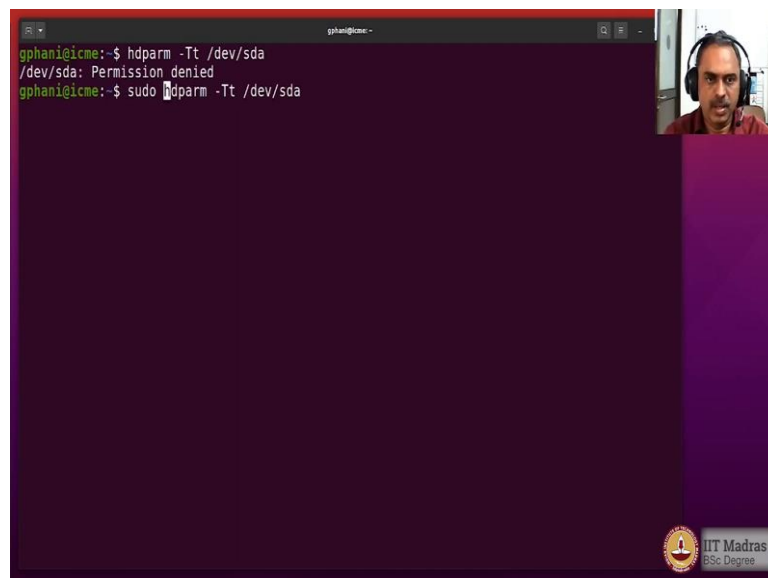
So, now what we can see is that this is a laptop with a battery. That is with a type model called Dell CR72X11. And right now, the state of the battery is it is discharging, that means it is not powered on to the mains and it is battery is actually running the computer. And the full capacity design capacities 95 watt hours and when it is fully charged it is 81 which means that we have lost about 7 or 8 percent of the capacity already and with time this number will keep coming down and it also tells in terms of percentage how much of battery power is still retained and how much time it is to empty that particular battery.

Right now, actually the computer was running something, so it was showing such a time but it would actually increase the time, you can see the time to empty is now 34 hours simply because when I first started the command it just started to run some utilities. So, it was CPU is going full blast. So, it should as if only to under 2.1 hours is available, but after some time when we ask again it says that there are 34 hours available.

So, this battery capacity I know is about 8 hours capacity at a normal usage. Now, what I do is that watch this state it says discharging. So, I will just switch on the power and then we will look at that again. So, I just switched on the adapter. And now, let us look at it and you will now see that the state has changed it says it is charging now.

So, this is how in fact by just command line utilities you can know what is happening to the battery system and how much of capacity is still remaining. So, this 93 becomes let us say 40 or 30 that means that it is about time to replace the battery. So, diagnostics on the battery at this level of details are not possible using a graphics utility on Windows also if you right click also nothing much will be shown but this is great you can see a lot of details.

(Refer Slide Time: 17:13)



```
gphani@icme:~$ hdparm -Tt /dev/sda
/dev/sda: Permission denied
gphani@icme:~$ sudo hdparm -Tt /dev/sda
```

```
gphani@icme:~$ sudo hdparm -Tt /dev/sda

/dev/sda:
Timing cached reads: 13022 MB in 1.99 seconds = 6520.55 MB/sec
Timing buffered disk reads: 384 MB in 3.01 seconds = 127.72 MB/sec
gphani@icme:~$
```

Some of the hardware devices that are installed like storage can be of different types. So, you can have a SATA hard disk or you can have a SSD hard disk, the difference between these is in terms of this speed. So, let us see how we can detect that. So, I want to now run the hard disk parameter check on the device called SDA so which is the only hard disk we have here.

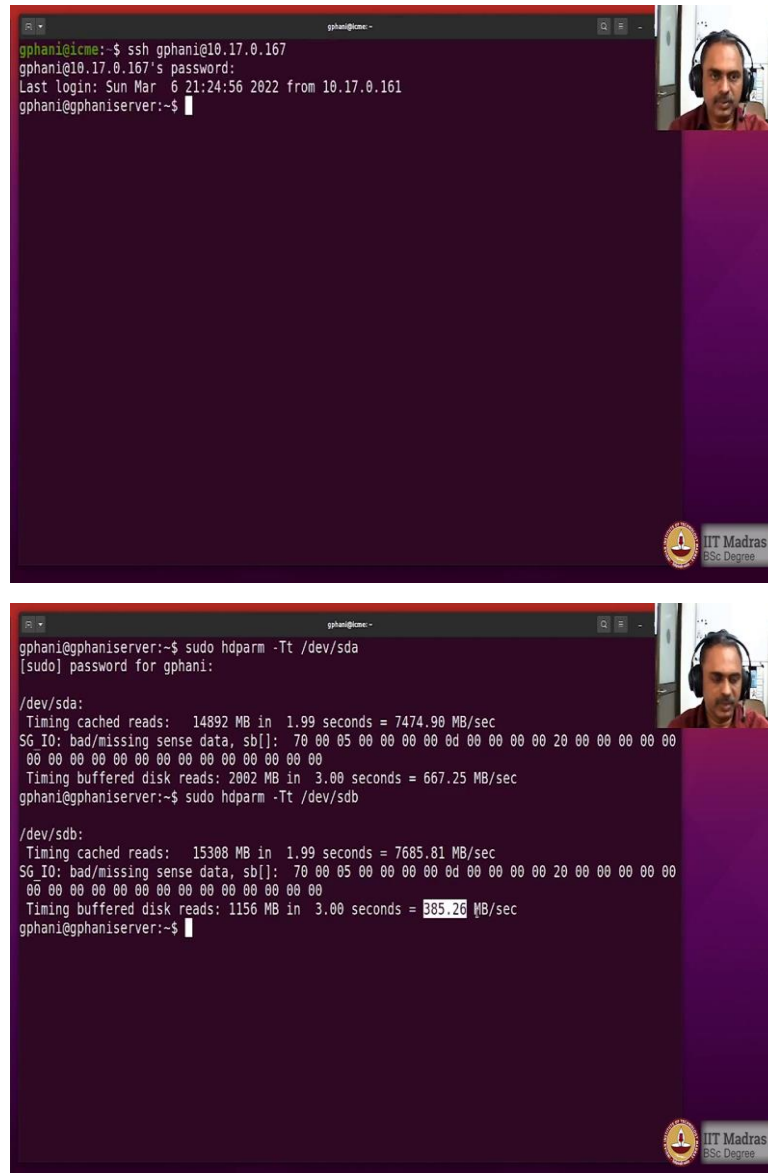
So, it will run those diagnostics and show you by sending the data and receiving the data it will tell you what is the kind of speed at which that particular device is operating. So, you can see that the reading from the disk is about 127 megabytes per second but from the cache is about 6 GB per second. So, that is a peak speed is 6 GB per second.

(Refer Slide Time: 18:18)

```
gphani@icme:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            16G   0B    16G   0% /dev
tmpfs            3.2G  2.1M  3.2G   1% /run
/dev/sda5       183G  29G   145G  17% /
tmpfs            16G   0B    16G   0% /dev/shm
tmpfs            5.0M  4.0K  5.0M   1% /run/lock
tmpfs            16G   0B    16G   0% /sys/fs/cgroup
/dev/loop0       128K  128K   0B 100% /snap/bare/5
/dev/loop2        56M   56M   0B 100% /snap/core18/2253
/dev/loop1        62M   62M   0B 100% /snap/core20/1328
/dev/loop3        56M   56M   0B 100% /snap/core18/2284
/dev/loop5        66M   66M   0B 100% /snap/gtk-common-themes/1515
/dev/loop4        62M   62M   0B 100% /snap/core20/1361
/dev/loop7        51M   51M   0B 100% /snap/snap-store/547
/dev/loop6        66M   66M   0B 100% /snap/gtk-common-themes/1519
/dev/loop8       219M  219M   0B 100% /snap/gnome-3-34-1804/72
/dev/loop9       219M  219M   0B 100% /snap/gnome-3-34-1804/77
/dev/loop10       44M   44M   0B 100% /snap/snapd/14978
/dev/loop11       55M   55M   0B 100% /snap/snap-store/558
/dev/sda1       796M   54M  743M   7% /boot/efi
/dev/sda7       481G  38G  419G   9% /home
tmpfs            3.2G  36K  3.2G   1% /run/user/1000
gphani@icme:~$
```

So, I have only one disk SDA which is actually a SATA disk. Now, I will log on to my workstation where I have two types of disks and there, we will see what this kind of information would look like.

(Refer Slide Time: 18:30)



```
gphani@icme:~$ ssh gphani@10.17.0.167
gphani@10.17.0.167's password:
Last login: Sun Mar 6 21:24:56 2022 from 10.17.0.161
gphani@gphaniserver:~$

gphani@gphaniserver:~$ sudo hdparm -Tt /dev/sda
[sudo] password for gphani:

/dev/sda:
Timing cached reads: 14892 MB in 1.99 seconds = 7474.90 MB/sec
SG_IO: bad/missing sense data, sb[]: 70 00 05 00 00 00 0d 00 00 00 20 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Timing buffered disk reads: 2002 MB in 3.00 seconds = 667.25 MB/sec
gphani@gphaniserver:~$ sudo hdparm -Tt /dev/sdb

/dev/sdb:
Timing cached reads: 15308 MB in 1.99 seconds = 7685.81 MB/sec
SG_IO: bad/missing sense data, sb[]: 70 00 05 00 00 00 0d 00 00 00 20 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Timing buffered disk reads: 1156 MB in 3.00 seconds = 385.26 MB/sec
gphani@gphaniserver:~$
```

Now, the SDA in this workstation is actually a raid device. So, I expect slightly better speed. So, let us look at that. So, you could see that the disk read is actually almost four times faster than on the first device that I tried. And the peak speed is also slightly better, it is about seven and a half Gbps. So, the reason why it is so fast is also because this is a raid array and we will learn about that in a moment.

But I also have another device which is sdb which is a SSD disk and you will see that these numbers will be quite different in that situation. So, now you see that the buffer disk read is

twice that of the faster disk that I did earlier and it is raid disk, it is a single disk and the reason why it is faster is because it is actually SSD device.

(Refer Slide Time: 20:10)

```
gphani@gphaniserver:~$ iostat -dx /dev/sdb

Command 'iostat' not found, but can be installed with:

sudo apt install sysstat

gphani@gphaniserver:~$ sudo apt install sysstat
Reading package lists... Done
Building dependency tree
Reading state information... Done
Suggested packages:
  isag
The following NEW packages will be installed:
  sysstat
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 448 kB of archives.
After this operation, 1,511 kB of additional disk space will be used.
Get:1 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 sysstat amd64 12.2.0-2ubuntu0.1 [448 kB]
Fetched 448 kB in 0s (1,143 kB/s)
Preconfiguring packages ...
Selecting previously unselected package sysstat.
(Reading database ... 863489 files and directories currently installed.)
Preparing to unpack .../sysstat_12.2.0-2ubuntu0.1_amd64.deb ...
Unpacking sysstat (12.2.0-2ubuntu0.1) ...
Setting up sysstat (12.2.0-2ubuntu0.1) ...

Progress: [ 60%] [#####.....]
```

```
isag
The following NEW packages will be installed:
  sysstat
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 448 kB of archives.
After this operation, 1,511 kB of additional disk space will be used.
Get:1 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 sysstat amd64 12.2.0-2ubuntu0.1 [448 kB]
Fetched 448 kB in 0s (1,143 kB/s)
Preconfiguring packages ...
Selecting previously unselected package sysstat.
(Reading database ... 863489 files and directories currently installed.)
Preparing to unpack .../sysstat_12.2.0-2ubuntu0.1_amd64.deb ...
Unpacking sysstat (12.2.0-2ubuntu0.1) ...
Setting up sysstat (12.2.0-2ubuntu0.1) ...

Creating config file /etc/default/sysstat with new version
update-alternatives: using /usr/bin/sar.sysstat to provide /usr/bin/sar (sar) in auto mode
Created symlink /etc/systemd/system/multi-user.target.wants/sysstat.service -> /lib/systemd/system/sysstat.service.
Processing triggers for systemd (245.4-4ubuntu3.15) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for ureadahead (0.100.0-21) ...
Processing triggers for doc-base (0.10.0) ...
Processing 1 added doc-base file...
gphani@gphaniserver:~$ iostat -dx /dev/sdb
```



```
gphani@gphaniserver:~$ iostat -dx /dev/sdb
Linux 5.6.0-1042-oem (gphaniserver) 06/03/22 _x86_64_ (32 CPU)

Device            r/s    kB/s    rrqm/s    %rrqm    r_await    rareq-sz    w/s    kB/s    wrqm/s
%wrqm    w_await    wareq-sz    d/s    dB/s    drqm/s    %drqm    d_await    dareq-sz    aqu-sz    %util
sdb         57.03    0.94    21.06    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.13

gphani@gphaniserver:~$ iostat -dx /dev/sda
Linux 5.6.0-1042-oem (gphaniserver) 06/03/22 _x86_64_ (32 CPU)

Device            r/s    kB/s    rrqm/s    %rrqm    r_await    rareq-sz    w/s    kB/s    wrqm/s
%wrqm    w_await    wareq-sz    d/s    dB/s    drqm/s    %drqm    d_await    dareq-sz    aqu-sz    %util
sda         58.70   277.19   183.45    0.00    0.00    0.00    0.00    0.00    0.00    0.03    0.04

gphani@gphaniserver:~$
```

So, one can actually also perform metrics on the hardware devices in this manner, which helps us understand the capacity of our hardware. Now, one last thing that I would like to show you also about the IO statistics. So, iostat happens to be coming from a package which I have not installed in the server. So, I just have that come in. And here are the speeds that we can look at.

So, when your computer is busy, and you are suspecting that perhaps there is a lot of work that is happening between the CPU and the storage devices, then you can look at these numbers to compare them with an idle time numbers to see if it was really a lot of IO operations that are happening, the input output operations that are happening.

(Refer Slide Time: 21:29)

```
gphani@icme:~$ ifconfig
enp0s31f6: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.17.0.161 netmask 255.255.252.0 broadcast 10.17.3.255
    inet6 fe80::16b3:1fff:fe0a:627b prefixlen 64 scopeid 0x20<link>
    ether 14:b3:1f:0a:62:7b txqueuelen 1000 (Ethernet)
    RX packets 251835 bytes 281337530 (281.3 MB)
    RX errors 0 dropped 14 overruns 0 frame 0
    TX packets 86353 bytes 6785026 (6.7 MB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
    device interrupt 20 memory 0xf7200000-f7220000

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 749 bytes 64881 (64.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 749 bytes 64801 (64.8 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

gphani@icme:~$
```


Now, regarding the network, `ifconfig` is a utility, which will tell you what kind of a network configuration we have. So, on this machine, I have got an Ethernet connection, a wired connection, which is having an IP address which is falling in the 10 point series. And then a loopback device, which is like 127.0.0.1. So, we will learn about these addresses in a moment.

But I just want to show you that this information as a part of hardware is also available. So, I hope you can make out that a lot of information about your hardware is available at the fingertips. And by having these packages installed. And keeping these names of utilities handy. You can diagnosis the details about your hardware. And in case you need to replace any of those. You can also look up the specs so that you can get compatible items for replacement when you need to.