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LAB 1 : BASIC LINUX COMMANDS

1.ls

Interpretation: List information about the FILES (the current directory by default)

Output:

```
~/Dev/lab_assignment/src/OS (master) » ls surab@WoodenNebula
dirs holder OS-LabReport.docx outputs place
```

2.dir

Interpretation: List information about the FILES (the current directory by default)

Output:

```
~/Dev/lab_assignment/src/OS (master*) » dir surab@WoodenNebula
dirs holder OS-LabReport.docx outputs place
```

3. ls -a

Interpretation: Lists contents and do not ignore entries starting with .

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls -a surab@WoodenNebula
. dirs .lab-1-command-list OS-LabReport.docx place
.. holder .~lock.OS-LabReport.docx# outputs
```

4.ls -l

Interpretation: use a long listing format

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls -l surab@WoodenNebula
total 80
drwxr-xr-x 2 noxtar noxtar 4096 Aug  2 14:11 dirs
drwxr-xr-x 2 noxtar noxtar 4096 Aug  2 14:11 holder
-rw-r--r-- 1 noxtar noxtar 61576 Aug  2 19:21 OS-LabReport.docx
drwxr-xr-x 3 noxtar noxtar 4096 Aug  2 14:44 outputs
drwxr-xr-x 2 noxtar noxtar 4096 Aug  2 14:11 place
```

5.ls -lh

Interpretation:

Lists contents along with human readable size formats

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls -lh surab@WoodenNebula
total 80K
drwxr-xr-x 2 noxtar noxtar 4.0K Aug  2 14:11 dirs
drwxr-xr-x 2 noxtar noxtar 4.0K Aug  2 14:11 holder
-rw-r--r-- 1 noxtar noxtar 61K Aug  2 19:21 OS-LabReport.docx
drwxr-xr-x 3 noxtar noxtar 4.0K Aug  2 14:44 outputs
drwxr-xr-x 2 noxtar noxtar 4.0K Aug  2 14:11 place
```

6.ls -F

Interpretation: append indicator (one of */=>@|) to entries
WHEN

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls -F 2 ↵ surab@WoodenNebula
dirs/ holder/ OS-LabReport.docx outputs/ place/
```

7.ls -r

Interpretation: reverse order while sorting

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls -r           surab@WoodenNebula
place outputs OS-LabReport.docx holder dirs
```

8.ls -R

Interpretation: recursively list the directories

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls -R           surab@WoodenNebula
.:
dirs holder OS-LabReport.docx OS-LabReport.odt outputs place

./dirs:
./holder:
./outputs:
Screenshots

./outputs/Screenshots:
2025-08-02-141423_hyprshot.png 2025-08-02-142930_hyprshot.png
2025-08-02-141436_hyprshot.png 2025-08-02-142936_hyprshot.png
2025-08-02-141441_hyprshot.png 2025-08-02-142945_hyprshot.png
2025-08-02-141446_hyprshot.png 2025-08-02-142955_hyprshot.png
2025-08-02-141453_hyprshot.png 2025-08-02-143003_hyprshot.png
2025-08-02-141457_hyprshot.png 2025-08-02-143009_hyprshot.png
2025-08-02-141501_hyprshot.png 2025-08-02-143013_hyprshot.png
2025-08-02-141506_hyprshot.png 2025-08-02-143017_hyprshot.png
2025-08-02-141518_hyprshot.png 2025-08-02-143023_hyprshot.png
2025-08-02-141523_hyprshot.png 2025-08-02-143036_hyprshot.png
2025-08-02-141535_hyprshot.png 2025-08-02-143040_hyprshot.png
2025-08-02-141540_hyprshot.png 2025-08-02-143042_hyprshot.png
2025-08-02-141611_hyprshot.png 2025-08-02-143046_hyprshot.png
2025-08-02-141634_hyprshot.png 2025-08-02-143049_hyprshot.png
2025-08-02-141738_hyprshot.png 2025-08-02-143057_hyprshot.png
2025-08-02-141853_hyprshot.png 2025-08-02-143100_hyprshot.png
2025-08-02-141903_hyprshot.png 2025-08-02-143105_hyprshot.png
2025-08-02-142220_hyprshot.png 2025-08-02-143110_hyprshot.png
2025-08-02-142301_hyprshot.png 2025-08-02-143114_hyprshot.png
2025-08-02-142906_hyprshot.png 2025-08-02-143119_hyprshot.png
2025-08-02-142913_hyprshot.png 2025-08-02-143124_hyprshot.png
2025-08-02-142920_hyprshot.png 2025-08-02-143128_hyprshot.png
2025-08-02-142924_hyprshot.png

./place:
holder

./place/holder:
files
```

9.ls -ltr

Interpretation: Lists contents in long listing sorted by time in reverse(oldest first) order

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls -ltr surab@WoodenNebula
total 560
drwxr-xr-x 2 noxtar noxtar 4096 Aug  2 14:11 holder
drwxr-xr-x 2 noxtar noxtar 4096 Aug  2 14:11 dirs
drwxr-xr-x 3 noxtar noxtar 4096 Aug  2 14:44 outputs
-rw-r--r-- 1 noxtar noxtar 61576 Aug  2 19:21 OS-LabReport.docx
drwxr-xr-x 3 noxtar noxtar 4096 Aug  2 20:44 place
-rw-r--r-- 1 noxtar noxtar 490668 Aug  2 20:46 OS-LabReport.odt
```

10. ls -i

Interpretation: print the index number of each file

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls -i surab@WoodenNebula
3425725 dirs 3425800 OS-LabReport.docx 3424706 outputs
3425724 holder 3425936 OS-LabReport.odt 3425721 place
```

11. ls --version

Interpretation: output version information and exit

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls --version surab@WoodenNebula
ls (GNU coreutils) 9.7
Copyright (C) 2025 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <https://gnu.org/licenses/gpl.html>.
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.

Written by Richard M. Stallman and David MacKenzie.
```

12. ls --help

Interpretation: displays man/help page for the command ls

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls --help surab@WoodenNebula
Usage: ls [OPTION]... [FILE]...
List information about the FILEs (the current directory by default).
Sort entries alphabetically if none of -cftuvSUX nor --sort is specified.
```

13. ls -n

Interpretation: like -l, but list numeric user and group IDs

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls -n surab@WoodenNebula
total 560
drwxr-xr-x 2 1000 1000 4096 Aug 2 14:11 dirs
drwxr-xr-x 2 1000 1000 4096 Aug 2 14:11 holder
-rw-r--r-- 1 1000 1000 61576 Aug 2 19:21 OS-LabReport.docx
-rw-r--r-- 1 1000 1000 490668 Aug 2 20:46 OS-LabReport.odt
drwxr-xr-x 3 1000 1000 4096 Aug 2 14:44 outputs
drwxr-xr-x 3 1000 1000 4096 Aug 2 20:44 place
```

14. clear

Interpretation: clears the terminal screen to default prompt

Output:

```
~/Dev/lab_assignment/src/OS (master*) » | surab@WoodenNebula
```

15. mkdir

Interpretation: creates a directory with the provided name in current or supplied directory

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls surab@WoodenNebula
dirs holder OS-LabReport.docx OS-LabReport.odt outputs place

~/Dev/lab_assignment/src/OS (master*) » mkdir os surab@WoodenNebula

~/Dev/lab_assignment/src/OS (master*) » ls surab@WoodenNebula
dirs holder os OS-LabReport.docx OS-LabReport.odt outputs place
```

16. cd

Interpretation: changes current directory to the supplied directory

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls surab@WoodenNebula
dirs holder os OS-LabReport.docx OS-LabReport.odt outputs place

~/Dev/lab_assignment/src/OS (master*) » cd os surab@WoodenNebula

~/Dev/lab_assignment/src/OS/os (master*) » ls surab@WoodenNebula
```

17. touch

Interpretation: Updates the access and modification times of each FILE to the current. As a side effect, it creates the FILE if it doesn't exist yet

Output:

```
~/Dev/lab_assignment/src/OS/os (master*) » ls surab@WoodenNebula

~/Dev/lab_assignment/src/OS/os (master*) » touch linux.txt surab@WoodenNebula

~/Dev/lab_assignment/src/OS/os (master*) » ls surab@WoodenNebula
linux.txt
```

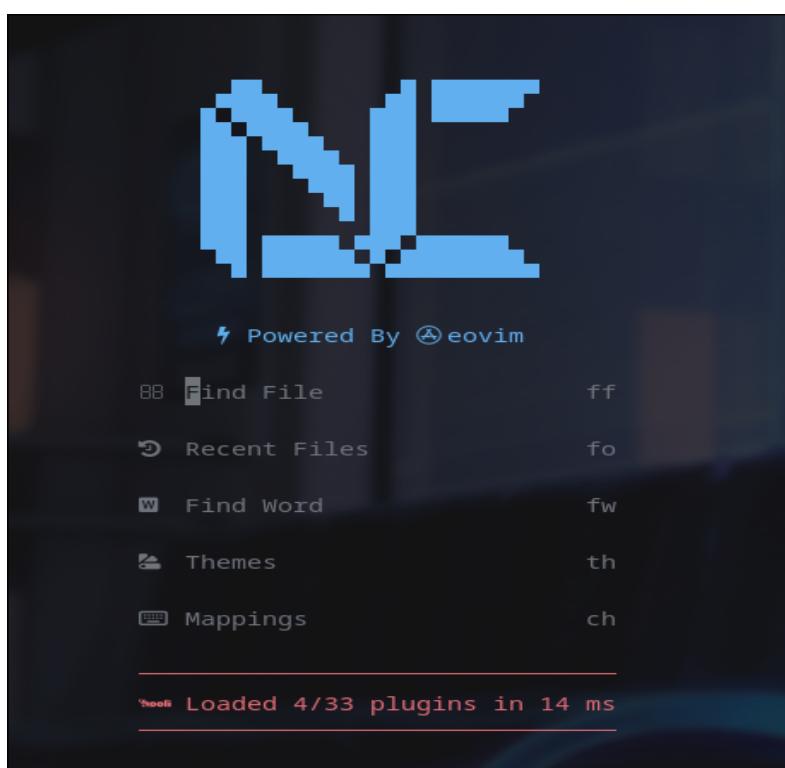
18. text editing

Command: nano/vi/vim/nvim text-file

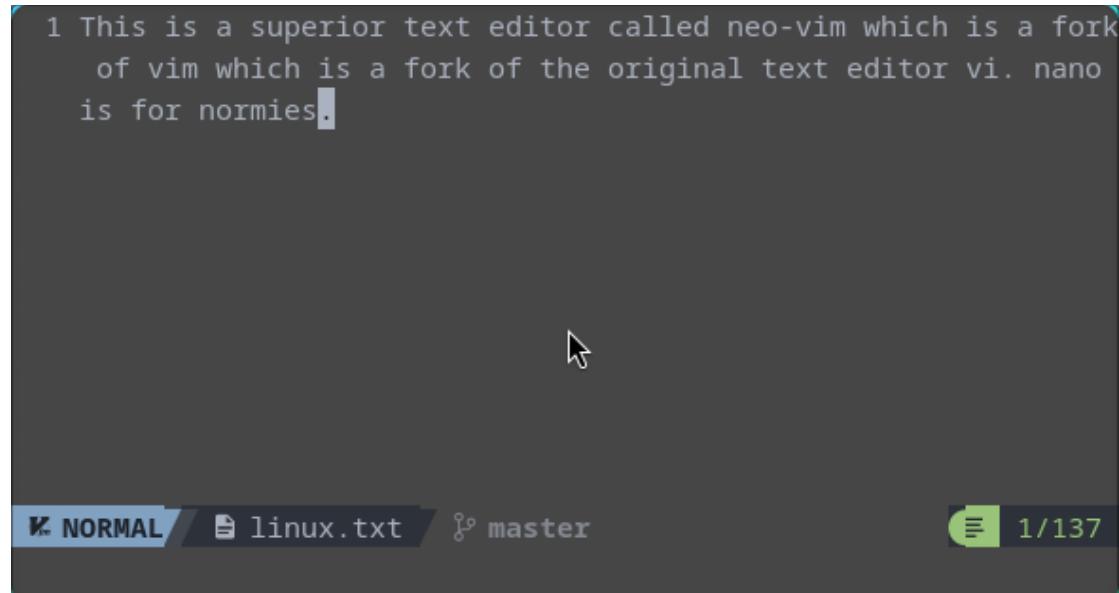
Interpretation: opens the text-file with the specific terminal based text editor

Output:

```
~/Dev/lab_assignment/src/OS/os (master*) » nvim linux.txt | surab@WoodenNebula
```



1 This is a superior text editor called neo-vim which is a fork of vim which is a fork of the original text editor vi. nano is for normies.



19. [bc]at

Command: bat/cat

Interpretation: concatenate files and print on the standard output

Output:

```
~/Dev/lab_assignment/src/OS/os (master*) » cat linux.txt surab@WoodenNebula
File: linux.txt
1 This is a superior text editor called neo-vim which is a fork of vim which is a fork of the original text editor vi. nano is for normies.
```

20. >

Command: command > file

Interpretation: redirects the input from the command or stdin to the supplied file

Output:

```
~/Dev/lab_assignment/src/OS/os (master*) » touch unix.txt
~/Dev/lab_assignment/src/OS/os (master*) » cat > unix.txt surab@WoodenNebula
This is an example of redirector operator >
^C
~/Dev/lab_assignment/src/OS/os (master*) » cat unix.txt
File: unix.txt
1 This is an example of redirector operator >
```

21. touch file1 file2 ...

Interpretation: touches multiple supplied files

Output:

```
~/Dev/lab_assignment/src/OS/os (master*) » touch {arch,red_hat}.txt fedora.txt
debian.txt

~/Dev/lab_assignment/src/OS/os (master*) » ls surab@WoodenNebula
arch.txt debian.txt fedora.txt linux.txt red_hat.txt unix.txt
```

22. cp

Command: cp <source> <dest>

Interpretation: copies content from source to destination

Output:

```
~/Dev/lab_assignment/src/OS/os (master*) » cp linux.txt fedora.txt

~/Dev/lab_assignment/src/OS/os (master*) » cat fedora.txt surab@WoodenNebula
File: fedora.txt
1 This is a superior text editor called neo-vim which is a fork of vim w
hich is a fork of the original text editor vi. nano is for normies.
```

23. cd ..

Interpretation: goes up a directory in current dir-tree

Output:

```
~/Dev/lab_assignment/src/OS/os (master*) » cd .. surab@WoodenNebula
~/Dev/lab_assignment/src/OS (master*) » | surab@WoodenNebula
```

24. pwd

Interpretation: prints current working directory

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls           1 ↵ surab@WoodenNebula
dirs holder os OS-LabReport.docx OS-LabReport.odt outputs place

~/Dev/lab_assignment/src/OS (master*) » mkdir arch-btw      surab@WoodenNebula

~/Dev/lab_assignment/src/OS (master*) » ls           surab@WoodenNebula
arch-btw holder os OS-LabReport.docx outputs
dirs       os     OS-LabReport.odt place

~/Dev/lab_assignment/src/OS (master*) » pwd          surab@WoodenNebula
/home/noxtar/Dev/lab_assignment/src/OS
```

25. cp <file_src> <file_dest>

Interpretation: Copies file from provided source to destination

Output:

```
~/Dev/lab_assignment/src/OS (master*) » ls arch-btw      surab@WoodenNebula

~/Dev/lab_assignment/src/OS (master*) » cp os/fedora.txt arch-btw

~/Dev/lab_assignment/src/OS (master*) » ls arch-btw      surab@WoodenNebula
fedora.txt

~/Dev/lab_assignment/src/OS (master*) » cat arch-btw/fedora.txt
File: arch-btw/fedora.txt
1 This is a superior text editor called neo-vim which is a fork of vim w
hich is a fork of the original text editor vi. nano is for normies.

~/Dev/lab_assignment/src/OS (master*) » | surab@WoodenNebula
```

26. mv

Interpretation: moves file from source to destination

Output:

```
~/Dev/lab_assignment/src/OS (master*) » mv os/debian.txt arch-btw
surab@WoodenNebula

~/Dev/lab_assignment/src/OS (master*) » ls os
arch.txt fedora.txt linux.txt red_hat.txt unix.txt

~/Dev/lab_assignment/src/OS (master*) » ls arch-btw
surab@WoodenNebula
debian.txt fedora.txt
```

27. rm

Command: rm <file1> <file2> ...

Interpretation: removes file at provided paths, wildcards can be used to pattern match as well for removing multiple files

Output:

```
~/Dev/lab_assignment/src/OS (master*) » cd os
surab@WoodenNebula

~/Dev/lab_assignment/src/OS/os (master*) » ls
surab@WoodenNebula
arch.txt fedora.txt linux.txt red_hat.txt unix.txt

~/Dev/lab_assignment/src/OS/os (master*) » rm fedora.txt
surab@WoodenNebula

~/Dev/lab_assignment/src/OS/os (master*) » ls
surab@WoodenNebula
arch.txt linux.txt red_hat.txt unix.txt

~/Dev/lab_assignment/src/OS/os (master*) » rm {arch,linux}.txt
surab@WoodenNebula

~/Dev/lab_assignment/src/OS/os (master*) » ls
surab@WoodenNebula
red_hat.txt unix.txt

~/Dev/lab_assignment/src/OS/os (master*) » rm *.txt
surab@WoodenNebula

~/Dev/lab_assignment/src/OS/os (master*) » ls
surab@WoodenNebula
```

28. rmdir

Command: rmdir <dir>

Interpretation: removes empty directory at supplied directory

Output:

```
~/Dev/lab_assignment/src/OS/os (master*) » cd .. surab@WoodenNebula
~/Dev/lab_assignment/src/OS (master*) » ls surab@WoodenNebula
arch-btw holder OS-LabReport.docx outputs
dirs os OS-LabReport.odt place

~/Dev/lab_assignment/src/OS (master*) » rmdir os surab@WoodenNebula
~/Dev/lab_assignment/src/OS (master*) » ls surab@WoodenNebula
arch-btw dirs holder OS-LabReport.docx OS-LabReport.odt outputs place
```

29. rm -rf

Interpretation: remove supplied directory recursively and forcefully

Output:

```
~/Dev/lab_assignment/src/OS (master*) » rmdir arch-btw surab@WoodenNebula
rmdir: failed to remove 'arch-btw': Directory not empty

~/Dev/lab_assignment/src/OS (master*) » rm -rf arch-btw 1 ↵ surab@WoodenNebula
~/Dev/lab_assignment/src/OS (master*) » ls surab@WoodenNebula
dirs holder OS-LabReport.docx OS-LabReport.odt outputs place

~/Dev/lab_assignment/src/OS (master*) » rm -fr / # remove french language for faster linux experience ↵
```

LAB 2 :

INTERMEDIATE

LINUX COMMANDS

1. lscpu

Interpretation: lscpu gathers CPU architecture information from sysfs, /proc/cpuinfo and any applicable architecture-specific libraries. The information includes, the no. of CPUs, threads, cores, sockets, and NUMA nodes. There is also information about the CPU caches and cache sharing, family, model, bogomIPS, byte order, and stepping.

Output:

```

surab in ~/Dev/lab_assignment/src/OS %
lscpu
Architecture:          x86_64
CPU op-mode(s):        32-bit, 64-bit
Address sizes:         39 bits physical, 48 bits virtual
Byte Order:            Little Endian
CPU(s):                16
On-line CPU(s) list:  0-15
Vendor ID:             GenuineIntel
Model name:            13th Gen Intel(R) Core(TM) i7-13620H
CPU family:            6
Model:                 186
Thread(s) per core:   2
Core(s) per socket:   10
Socket(s):             1
Stepping:              2
CPU(s) scaling MHz:  17%
CPU max MHz:          4900.0000
CPU min MHz:          400.0000
BogoMIPS:              5836.80
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 art arch_perfmon pebs bts rep_good nopl xtopology nonstop_
tsc cpuid aperf mperf tsc_known_freq pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3 sdbe fma cx16 xt
pr pdcm pcid sse4_1 sse4_2 x2apic movebe popcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowp
refetch cpuid_fault epb ssbd ibrs ibpb stibp ibrs_enhanced tpr_shadow flexpriority ept vpid ept_ad fsgsbase ts
c_adjust bmi1 avx2 smep bmi2 erms invpcid rdseed adx smap clflushopt clwb intel_pt sha_ni xsaveopt xsavec xget
bv1 xsaves split_lock_detect user_shstx avx_vnni dtherm ida arat pln pts hwp hwp_notify hwp_act_window hwp_epp
hwp_pkg_req hfi vnni umip pkru ospkc waitpkg gfn1 vaes vpclmulqdq rdpid movdir64b fsrm md_clear serial
ize arch_lbr ibt flush_lll arch_capabilities
Virtualization features:
  Virtualization:      VT-x
Caches (sum of all):
  L1d:                 416 Kib (10 instances)
  L1i:                 448 Kib (10 instances)
  L2:                  9.5 Mib (7 instances)
  L3:                  24 MiB (1 instance)
NUMA:
  NUMA node(s):        1
  NUMA node0 CPU(s):   0-15

```

2. [sudo] lshw

Interpretation: lshw is a small tool to extract detailed information on the hardware configuration 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).

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
lshw
WARNING: you should run this program as super-user.
woodennebula
      description: Computer
      width: 64 bits
      capabilities: smp vsyscall32
*-core
      description: Motherboard
      physical id: 0
      *-memory
          description: System memory
          physical id: 0
          size: 15GiB
      *-cpu
          product: 13th Gen Intel(R) Core(TM) i7-13620H
          vendor: Intel Corp.
          physical id: 1
          bus info: cpu@0
          version: 6.186.2
          size: 400MHz
          capacity: 4700MHz
          width: 64 bits
          capabilities: fpu fpu_exception wp vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush dts acpi mmx fxsr
ssse2 ss ht tm pbe syscall nx pdpe1gb rdtscp x86_64 constant_tsc art arch_perfmon pebs bts rep_good nopl xttopology nonstop_tsc cpuid ape
rfmprefr tsc_known_freq pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3 sdbg fma cx16 xtrp pdcm pcid sse4_1 sse4_2 x2apic movbe po
pcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epp ssbd ibrs ibpb stibp ibrs_enhanced tpr_shadow f
lxpriority ept vpid ept_ad fsgsbase tsc_adjust bmm1 avx2 smep bmm2 erms invpcid rdseed adx snap clflushopt clwb intel_pt sha_ni xsaveoxt x
savesc xgetbv1 xsaves split_lock_detect user_shstck avx_vnni dtherm ida arat pln pts hwp hwp_notify hwp_act_window hwp_epp hwp_pkg_req hfi vn
mi umip pkru opkru waitpkg gfn1 vaes vpcimulqdf rdpid movdir64b fsm md_clear serialize arch_lbr ibt flush_lid arch_capabilities cu
freq
          configuration: microcode=20739
```

```
surab in ~/Dev/lab_assignment/src/OS λ
sudo lshw
[sudo] password for noxtar:
woodennebula
      description: Notebook
      product: Nitro ANV15-51 (0000000000000000)
      vendor: Acer
      version: V1.26
      serial: NHQN8SA0023390ABAD7600
      width: 64 bits
      capabilities: smbios-3.4 @ dmci-3.4-0 smp vsyscall32
      configuration: chassis=notebook family=Acer Nitro V 15 sku=0000000000000000 uuid=06c93f7c-55c4-a64f-95a1-74d4dd2e1c6c
*-core
      description: Motherboard
      product: Nitro ANV15-51 (0000000000000000)
      vendor: Acer
      version: V1.26
      serial: NHQN8SA0023390ABAD7600
      slot: Type2 Board Chassis Location
      *-firmware
          description: BIOS
          vendor: INSYDE Corp.
          physical id: 0
          version: V1.26
          date: 03/2022
          size: 128KiB
          capacity: 32MiB
          capabilities: pci upgrade shadowing cdboot bootselect edd int13floppyiec int13floppytoshiba int13floppy360 int13floppy1200 int13
loppy20 int13floppy2800 int9keyboard int10video acpi usb biosbootspecification uefi
      *-cpu
          description: CPU
          product: 13th Gen Intel(R) Core(TM) i7-13620H
          vendor: Intel Corp.
          physical id: 4
          bus info: cpu@0
          version: 6.186.2
          serial: To Be Filled By O.E.M.
          slot: U8E1
          size: 400MHz
          capacity: 4700MHz
          width: 64 bits
          clock: 1000MHz
          capabilities: lm fpu fpu_exception wp vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush dts acpi mmx fx
ssse2 ss ht tm pbe syscall nx pdpe1gb rdtscp x86_64 constant_tsc art arch_perfmon pebs bts rep_good nopl xttopology nonstop_tsc cpuid ape
rfmprefr tsc_known_freq pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3 sdbg fma cx16 xtrp pdcm pcid sse4_1 sse4_2 x2apic movbe po
pcnt tsc_deadline_timer aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epp ssbd ibrs ibpb stibp ibrs_enhanced tpr_shadow f
lxpriority ept vpid ept_ad fsgsbase tsc_adjust bmm1 avx2 smep bmm2 erms invpcid rdseed adx snap clflushopt clwb intel_pt sha_ni xsaveoxt x
savesc xgetbv1 xsaves split_lock_detect user_shstck avx_vnni dtherm ida arat pln pts hwp hwp_notify hwp_act_window hwp_epp hwp_pkg_req hfi vn
mi umip pkru opkru waitpkg gfn1 vaes vpcimulqdf rdpid movdir64b fsm md_clear serialize arch_lbr ibt flush_lid arch_capabilities cu
freq
          configuration: cores=10 enabledcores=10 microcode=20739 threads=16
```

3. hwinfo [--short]

Interpretation: 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.

Output:

```
surab in ~ λ hwinfo | head
=====
libhd version 25.0u (x86-64) [7688]
using /var/lib/hardware
kernel version is 6.15
-----
/proc/cmdline -----
BOOT_IMAGE=/vmlinuz-linux root=UUID=7b52ede5-ee85-4070-83bb-0c5afa350e89 rw quiet loglevel=3 rd.syste
md.show_status=no rd.udev.log_level=3
-----
/proc/cmdline end -----
debug = 0xff7ffff7
probe = 0x15938fcdaa17fcf9ffe (+memory +pci +isapnp +net +floppy +misc +misc.serial +misc.par +misc.fl
oppy +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 +braille.alva +braille.fhp +braille.ht
-ignx11 +sys -bios.vbe -no.remove -loose.match -isapnp.mod +braille.baum -manual +fb +pppoe -scan +pcm
cia +fork -parallel.imm +s390 +cpuemu -sysfs -s390disks +udev +block +block.cdrom +block.part +edd +edd
.mod -bios.ddc -bios.fb -bios.mode +input +block.mods +bios.vesa -cpuemu.debug -scsi.noserial +wlan -bi
os.crc -hal +bios.vram +bios.acpi -bios.ddc.ports=0 +modules.pata -net.eeprom +x86emu=dump -max -lxrc)
shm: attached segment 58 at 0x7f0e6d9a5000
```

Command: hwinfo --short

Interpretation: Show only a summary.

Output:

```
surab in ~ λ hwinfo --short
cpu:
    13th Gen Intel(R) Core(TM) i7-13620H, 400 MHz
    13th Gen Intel(R) Core(TM) i7-13620H, 2200 MHz
    13th Gen Intel(R) Core(TM) i7-13620H, 400 MHz
    13th Gen Intel(R) Core(TM) i7-13620H, 1119 MHz
    13th Gen Intel(R) Core(TM) i7-13620H, 400 MHz
    13th Gen Intel(R) Core(TM) i7-13620H, 1700 MHz
    13th Gen Intel(R) Core(TM) i7-13620H, 1694 MHz
    13th Gen Intel(R) Core(TM) i7-13620H, 1700 MHz
    13th Gen Intel(R) Core(TM) i7-13620H, 1700 MHz

keyboard:
    /dev/input/event4      Apple Aluminium Keyboard (ANSI)
    /dev/input/event3      AT Translated Set 2 keyboard

mouse:
    /dev/input/mice        Wings Tech FANTECH BLAKE
    /dev/input/mice        Apple Aluminium Keyboard (ANSI)
    /dev/input/mice        PIXA3848:00 093A:3848 Mouse
    /dev/input/mice        PIXA3848:00 093A:3848 Touchpad

printer:
    Brother Industries DCP-1510

monitor:
    XV272U V3
    CMN LCD Monitor

graphics card:
    nVidia AD107M [GeForce RTX 4050 Max-Q / Mobile]
    Intel Raptor Lake-P [UHD Graphics]
```

4. lspci

Interpretation: lspci is a utility for displaying information about PCI buses in the system and devices connected to them.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
lspci
0000:00:00.0 Host bridge: Intel Corporation Device a715
0000:00:02.0 VGA compatible controller: Intel Corporation Raptor Lake-P [UHD Graphics] (rev 04)
0000:00:04.0 Signal processing controller: Intel Corporation Raptor Lake Dynamic Platform and Thermal Framework Processor Participant
0000:00:06.0 PCI bridge: Intel Corporation Raptor Lake PCIe 4.0 Graphics Port
0000:00:07.0 PCI bridge: Intel Corporation Raptor Lake-P Thunderbolt 4 PCIe Root Port #0
0000:00:08.0 System peripheral: Intel Corporation GNA Scoring Accelerator module
0000:00:0a.0 Signal processing controller: Intel Corporation Raptor Lake Crashlog and Telemetry (rev 01)
0000:00:0d.0 USB controller: Intel Corporation Raptor Lake-P Thunderbolt 4 USB Controller
0000:00:0d.2 USB controller: Intel Corporation Raptor Lake-P Thunderbolt 4 NHI #0
0000:00:0e.0 RAID bus controller: Intel Corporation Volume Management Device NVMe RAID Controller Intel Corporation
0000:00:14.0 USB controller: Intel Corporation Alder Lake PCH USB 3.2 eXtensible Host Controller (rev 01)
0000:00:14.2 RAM memory: Intel Corporation Alder Lake PCH Shared SRAM (rev 01)
0000:00:15.0 Serial bus controller: Intel Corporation Alder Lake PCH Serial IO I2C Controller #0 (rev 01)
0000:00:16.0 Communication controller: Intel Corporation Alder Lake PCH HECI Controller (rev 01)
0000:00:1c.0 PCI bridge: Intel Corporation Alder Lake-P PCH PCIe Root Port #4 (rev 01)
0000:00:1c.6 PCI bridge: Intel Corporation Device 51be (rev 01)
0000:00:1d.0 System peripheral: Intel Corporation RST VMD Managed Controller
0000:00:1f.0 ISA bridge: Intel Corporation Raptor Lake LPC/eSPI Controller (rev 01)
0000:00:1f.3 Multimedia audio controller: Intel Corporation Raptor Lake-P/U/H CAVS (rev 01)
0000:00:1f.4 SMBus: Intel Corporation Alder Lake PCH-P SMBus Host Controller (rev 01)
0000:00:1f.5 Serial bus controller: Intel Corporation Alder Lake-P PCH SPI Controller (rev 01)
0000:01:00.0 VGA compatible controller: NVIDIA Corporation AD107M [GeForce RTX 4050 Max-Q / Mobile] (rev a1)
0000:01:00.1 Audio device: NVIDIA Corporation AD107 High Definition Audio Controller (rev a1)
0000:3e:00.0 Network controller: MEDIATEK Corp. MT7921 802.11ax PCIe Wireless Network Adapter
0000:3f:00.0 Ethernet controller: Realtek Semiconductor Co., Ltd. RTL8111/8168/8211/8411 PCIe Express Gigabit Ethernet Controller (rev 15)
10000:e0:06.0 System peripheral: Intel Corporation RST VMD Managed Controller
10000:e0:06.2 PCI bridge: Intel Corporation Device a73d
10000:e0:1d.0 PCI bridge: Intel Corporation Alder Lake PCI Express Root Port #9 (rev 01)
10000:e1:00.0 Non-Volatile memory controller: SK hynix BC901 NVMe Solid State Drive (DRAM-less) (rev 03)
10000:e2:00.0 Non-Volatile memory controller: Transcend Information, Inc. NVMe PCIe SSD 110Q (DRAM-less) (rev 01)
```

5. lsscsi

Interpretation: Uses information in sysfs to list SCSI devices (or hosts) currently attached to the system. Many non-SCSI storage devices (but not all) used the SCSI subsystem in Linux.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
lsscsi
[N:0:1:1]      disk      HFS512GEJ9X110N_1                               /dev/nvme0n1
[N:1:1:1]      disk      TS512GMTE110S_1                               /dev/nvme1n1
```

6. lsusb

Interpretation: lsusb is a utility for displaying information about USB buses in the system and the devices connected to them. It uses udev's hardware database to associate a full human-readable name to the vendor ID and the product ID.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
lsusb
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 003 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 003 Device 002: ID 05ac:024f Apple, Inc. Aluminium Keyboard (ANSI)
Bus 003 Device 003: ID 1a40:0101 Terminus Technology Inc. Hub
Bus 003 Device 004: ID 0408:403a Quanta Computer, Inc. ACER HD User Facing
Bus 003 Device 005: ID 04f9:02d0 Brother Industries, Ltd DCP-1510
Bus 003 Device 006: ID 04ca:3802 Lite-On Technology Corp. Wireless_Device
Bus 003 Device 007: ID 2ea8:2203 Wings Tech FANTECH BLAKE
Bus 004 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
```

Command: lsusb | tee lsusb.txt

Interpretation: print each line and write to a file named lsusb.txt

```
surab in ~/Dev/lab_assignment/src/OS on master • • λ ls
lshw.html  lsusb.txt  OS-LabReport.docx  OS-LabReport.odt  outputs
```

7. inxi [-f][-F][-x]

Interpretation: Command line system information tool for console and IRC

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
inxi
CPU: 10-core (6-mt/4-st) 13th Gen Intel Core i7-13620H (-MST AMCP-)
speed/min/max: 568/400/4700:4900:3600 MHz Kernel: 6.15.8-arch1-2 x86_64 Up: 4h 32m
Mem: 4.81/15.32 GiB (31.4%) Storage: 953.88 GiB (3.5% used) Procs: 367 Shell: Zsh inxi: 3.3.38
```

Command: inxi -fx

Interpretation: Lists all cpu flags used

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
inxi -fx
CPU:
Info: 10-core (6-mt/4-st) model: 13th Gen Intel Core i7-13620H bits: 64 type: MST AMCP
      arch: Raptor Lake rev: 2 cache: L1: 864 KiB L2: 9.5 MiB L3: 24 MiB
Speed (MHz): avg: 1300 min/max: 400/4700:4900:3600 cores: 1: 1300 2: 1300 3: 1300 4: 1300
      5: 1300 6: 1300 7: 1300 8: 1300 9: 1300 10: 1300 11: 1300 12: 1300 13: 1300 14: 1300 15: 1300
      16: 1300 bogomips: 93388
Flags: 3dnowprefetch abm acpi adx aes aperfmpf perf apic arat arch_capabilities arch_lbr
      arch_perfmon art avx avx2 avx_vnni bmi1 bmi2 bts clflush clflushopt clwb cmov constant_tsc
      cpuid cpuid_fault cx16 cx8 de ds_cpl dtes64 dtherm dts epb ept ept_ad erms est f16c
      flexpriority flush_l1d fma fpu fsgsbase fsrfsim fxsr gfni hfi ht hwp hwp_act_window hwp_epp
      hwp_notify hwp_pkg_req ibpb ibrs ibrs_enhanced ibt ida intel_pt invpcid lahf_lm lm mca mce
      md_clear mmx monitor movbe movdir64b movdiri msr mtrr nonstop_tsc nopl nx ospe pae pat pbe
      pcid pclmulqdq pdcm pdpe1gb pebs pge pku pln popcnt pse pse36 pts rdpid rdrand rdseed
      rdtscp rep_good sdbg sep serialize sha_ni smap smep smx split_lock_detect ss ssbd sse sse2
      sse4_1 sse4_2 ssse3 stibp syscall tm tm2 tpr_shadow tsc tsc_adjust tsc_deadline_timer
      tsc_known_freq umip user_shstk vaes vme vmx vnmi vpclmulqdq vpid waitpkg x2apic xgetbv1 xsave
      xsaverc xsaveopt xsaves xtopology xtrp
```

Command: inxi -Fx

Interpretation: Lists expanded basic CPU data line

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
inxi -Fx
System:
  Host: WoodenNebula Kernel: 6.15.8-arch1-2 arch: x86_64 bits: 64 compiler: gcc v: 15.1.1
  Desktop: Hyprland v: 0.50.1 Distro: Arch Linux
Machine:
  Type: Laptop System: Acer product: Nitro ANV15-51 v: V1.26 serial: <superuser required>
  Mobo: RPL model: Sportage_RTH v: V1.26 serial: <superuser required> UEFI: INSYDE v: 1.26
  date: 03/21/2025
Battery:
  ID-1: BAT1 charge: 44.3 Wh (79.5%) condition: 55.7/57.5 Wh (96.9%) volts: 16.1 min: 15.4
    model: LGC AP21D8M status: charging
CPU:
  Info: 10-core (6-mt/4-st) model: 13th Gen Intel Core i7-13620H bits: 64 type: MST AMCP
    arch: Raptor Lake rev: 2 cache: L1: 864 KiB L2: 9.5 MiB L3: 24 MiB
    Speed (MHz): avg: 400 min/max: 400/4700:4900:3600 cores: 1: 400 2: 400 3: 400 4: 400 5: 400
    6: 400 7: 400 8: 400 9: 400 10: 400 11: 400 12: 400 13: 400 14: 400 15: 400 16: 400
    bogomips: 93388
    Flags: avx avx2 ht lm nx pae sse sse2 sse3 sse4_1 sse4_2 ssse3 vmx
Graphics:
  Device-1: Intel Raptor Lake-P [UHD Graphics] vendor: Acer Incorporated ALI driver: i915 v: kernel
    arch: Xe bus-ID: 0000:00:02.0
  Device-2: NVIDIA AD107M [GeForce RTX 4050 Max-Q / Mobile] vendor: Acer Incorporated ALI
    driver: nvidia v: 575.64.05 arch: Lovelace bus-ID: 0000:01:00.0
  Device-3: Quanta ACER HD User Facing driver: uvcvideo type: USB bus-ID: 3-6:4
  Display: wayland server: Xwayland v: 24.1.8 compositor: Hyprland v: 0.50.1 driver: X:
    loaded: modesetting,nvidia dri: iris gpu: i915,nvidia,nvidia-nvswitch
    resolution: no compositor data resolution: 1: 2560x1440 2: 1920x1080
  API: EGL Message: EGL data requires eglinfo. Check --recommends.
  Info: Tools: gpu: nvidia-settings,nvidia-smi x11: xprop
```

8. lsblk

Interpretation: lists information about all available or the specified block devices. The lsblk command reads the sysfs filesystem and udev db to gather information.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
lsblk


| NAME        | MAJ:MIN | RM | SIZE   | RO | TYPE | MOUNTPOINTS |
|-------------|---------|----|--------|----|------|-------------|
| nvme0n1     | 259:0   | 0  | 476.9G | 0  | disk |             |
| └─nvme0n1p1 | 259:1   | 0  | 1G     | 0  | part | /boot       |
| └─nvme0n1p2 | 259:2   | 0  | 16M    | 0  | part |             |
| └─nvme0n1p3 | 259:3   | 0  | 359.3G | 0  | part |             |
| └─nvme0n1p4 | 259:4   | 0  | 658M   | 0  | part |             |
| └─nvme0n1p5 | 259:5   | 0  | 100G   | 0  | part | /           |
| └─nvme0n1p6 | 259:6   | 0  | 16G    | 0  | part | [SWAP]      |
| nvme1n1     | 259:7   | 0  | 476.9G | 0  | disk |             |
| └─nvme1n1p1 | 259:8   | 0  | 16M    | 0  | part |             |
| └─nvme1n1p2 | 259:9   | 0  | 476.9G | 0  | part |             |


```

9. df

Interpretation: report file system space usage

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
df


| Fs             | 1K-blocks | Used     | Available | Use% | Mounted on                                |
|----------------|-----------|----------|-----------|------|-------------------------------------------|
| /dev/nvme0n1p5 | 102626232 | 34640268 | 62726700  | 36%  | /                                         |
| devtmpfs       | 7974976   | 0        | 7974976   | 0%   | /dev                                      |
| tmpfs          | 8033460   | 800      | 8032660   | 1%   | /dev/shm                                  |
| efivarfs       | 268       | 136      | 128       | 52%  | /sys/firmware/efi/efivars                 |
| tmpfs          | 3213388   | 2064     | 3211324   | 1%   | /run                                      |
| tmpfs          | 1024      | 0        | 1024      | 0%   | /run/credentials/systemd-journald.service |
| tmpfs          | 8033464   | 8928     | 8024536   | 1%   | /tmp                                      |
| /dev/nvme0n1p1 | 1044480   | 338716   | 705764    | 33%  | /boot                                     |
| tmpfs          | 1024      | 0        | 1024      | 0%   | /run/credentials/getty@tty1.service       |
| tmpfs          | 1606692   | 56       | 1606636   | 1%   | /run/user/1000                            |


```

10. pydf

Interpretation: ydf is a python script that displays the amount of disk space available on the mounted filesystems, using different colours for different types of filesystems. Output format is completely customizable.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
pydf
Filesystem      Size Used Avail Use%          Mounted on
/dev/nvme0n1p5   98G  33G   60G 33.8 [#####.....] /
/dev/nvme0n1p1 1020M 331M  689M 32.4 [#####.....] /boot
efivarsfs       268k 136k   127k 50.7 [#####.....] /sys/firmware/efi/efivars
```

11. fdisk [-l]

Interpretation: fdisk is a dialog-driven program for creation and manipulation of partition tables. It understands GPT, MBR, Sun, SGI and BSD partition tables.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
sudo fdisk -l
Disk /dev/nvme0n1: 476.94 GiB, 512110190592 bytes, 1000215216 sectors
Disk model: HFS512GEJ9X110N
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: gpt
Disk identifier: 6285EC40-D54D-43F2-8151-60DC8A42A962

Device        Start      End    Sectors  Size Type
/dev/nvme0n1p1     2048  2099199   2097152    1G EFI System
/dev/nvme0n1p2  2099200   2131967    32768   16M Microsoft reserved
/dev/nvme0n1p3  2131968 755548159 753416192 359.3G Microsoft basic data
/dev/nvme0n1p4 755548160  756895743   1347584   658M Windows recovery environment
/dev/nvme0n1p5 756895744 966610943 209715200 100G Linux filesystem
/dev/nvme0n1p6 966610944 1000214527 33603584   16G Linux swap

Disk /dev/nvme1n1: 476.94 GiB, 512110190592 bytes, 1000215216 sectors
Disk model: TS512GMTE110S
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: gpt
Disk identifier: 8632941F-5C2C-419D-AEF2-572D9C3CCD89

Device        Start      End    Sectors  Size Type
/dev/nvme1n1p1      34    32767    32734   16M Microsoft reserved
/dev/nvme1n1p2 32768 1000212479 1000179712 476.9G Microsoft basic data
```

12. free

Interpretation: free displays the total amount of free and used physical and swap memory in the system, as well as the buffers and caches used by the kernel. The information is gathered by parsing /proc/meminfo

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
free
total        used        free      shared   buff/cache   available
Mem:       16066924     4997096    9073260      223884     2559708    11069828
Swap:      16801788          0    16801788
```

13. dmidecode [-t <type>]

Interpretation: dmidecode is a tool for dumping a computer's DMI (SMBIOS) table contents in a human-readable format. This table contains a description of the system's hardware components from which we can retrieve this information without having to probe for the actual hardware.

-t <type> option makes it to only display information for the supplied device type.

Command: sudo dmidecode -t processor

Output:

```
surab in ~ λ sudo dmidecode -t processor
[sudo] password for noxtar:
# dmidecode 3.6
Getting SMBIOS data from sysfs.
SMBIOS 3.4 present.

Handle 0x0004, DMI type 4, 50 bytes
Processor Information
    Socket Designation: U3E1
    Type: Central Processor
    Family: Core i7
    Manufacturer: Intel(R) Corporation
    ID: A2 06 0B 00 FF FB EB BF
    Signature: Type 0, Family 6, Model 186, Stepping 2
    Flags:
```

Command: sudo dmidecode -t memory

Output:

```
surab in ~ λ sudo dmidecode -t memory

[sudo] password for noxtar:
# dmidecode 3.6
Getting SMBIOS data from sysfs.
SMBIOS 3.4 present.

Handle 0x0011, DMI type 16, 23 bytes
Physical Memory Array
    Location: System Board Or Motherboard
    Use: System Memory
    Error Correction Type: None
    Maximum Capacity: 64 GB
    Error Information Handle: Not Provided
    Number Of Devices: 2

Handle 0x0012, DMI type 17, 92 bytes
Memory Device
    Array Handle: 0x0011
    Error Information Handle: Not Provided
    Total Width: Unknown
    Data Width: Unknown
    Size: No Module Installed
    Form Factor: Unknown
    Set: None
    Locator: Controller0-ChannelA-DIMM0
    Bank Locator: BANK 0
    Type: Unknown
    Type Detail: None
```

Command: sudo dmidecode -t bios

Output:

```
surab in ~ λ sudo dmidecode -t bios

# dmidecode 3.6
Getting SMBIOS data from sysfs.
SMBIOS 3.4 present.

Handle 0x0000, DMI type 0, 26 bytes
BIOS Information
    Vendor: INSYDE Corp.
    Version: V1.26
    Release Date: 03/21/2025
    Address: 0xE0000
    Runtime Size: 128 kB
    ROM Size: 32 MB
    Characteristics:
        PCI is supported
        BIOS is upgradeable
        BIOS shadowing is allowed
        Boot from CD is supported
        Selectable boot is supported
        EDD is supported
        Japanese floppy for NEC 9800 1.2 MB is supported (int 13h)
        Japanese floppy for Toshiba 1.2 MB is supported (int 13h)
        5.25"/360 kB floppy services are supported (int 13h)
        5.25"/1.2 MB floppy services are supported (int 13h)
        3.5"/720 kB floppy services are supported (int 13h)
        3.5"/2.88 MB floppy services are supported (int 13h)
        8042 keyboard services are supported (int 9h)
        CGA/mono video services are supported (int 10h)
        ACPI is supported
        USB legacy is supported
        BIOS boot specification is supported
        Targeted content distribution is supported
        UEFI is supported
    BIOS Revision: 1.26
    Firmware Revision: 1.6
```

14. cat /proc/meminfo

Interpretation: reads file /proc/meminfo and output the various information of memory segments of the computer system.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
cat /proc/meminfo
MemTotal:       16066924 kB
MemFree:        8497116 kB
MemAvailable:   10533032 kB
Buffers:         145972 kB
Cached:          2340840 kB
SwapCached:      0 kB
Active:          4998204 kB
Inactive:        1516356 kB
Active(anon):    4297296 kB
Inactive(anon):  0 kB
Active(file):    700908 kB
Inactive(file):  1516356 kB
Unevictable:     81384 kB
Mlocked:         252 kB
SwapTotal:       16801788 kB
SwapFree:        16801788 kB
```

15. cat /proc/version

Interpretation: displays the system information in quick summary

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
cat /proc/version
Linux version 6.15.8-arch1-2 (linux@archlinux) (gcc (GCC) 15.1.1 20250729, GNU ld (GNU Binutils) 2.45.0) #1 SMP PREEMPT_DYNAMIC Tue, 29 Jul
2025 15:05:00 +0000
```

16. hparm [-i </dev/sata_device>]

Interpretation: Displays the identification info which the kernel drivers (IDE, libata) have stored from boot/configuration time for the SATA/IDE device

```
surab in ~ λ sudo hparm -i /dev/nvme1
/dev/nvme1:
HDIO_GET_IDENTITY failed: Inappropriate ioctl for device
```

Note: My laptop only has NVMe drives, so the command failed

17. uname [-n] [-r]

Interpretation: print system information

```
surab in ~/Dev/lab_assignment/src/OS on master • • λ uname
Linux
```

-n: print the network node hostname

```
surab in ~/Dev/lab_assignment/src/OS λ
uname -n
WoodenNebula
```

-v: print the kernel version

```
surab in ~/Dev/lab_assignment/src/OS λ
uname -v
#1 SMP PREEMPT_DYNAMIC Tue, 29 Jul 2025 15:05:00 +0000
```

-r: print the kernel release

```
surab in ~/Dev/lab_assignment/src/OS λ
uname -r
6.15.8-arch1-2
```

-m: print the machine hardware name

```
surab in ~/Dev/lab_assignment/src/OS λ
uname -m
x86_64
```

-a: print all the information

```
surab in ~/Dev/lab_assignment/src/OS λ
uname -a
Linux WoodenNebula 6.15.8-arch1-2 #1 SMP PREEMPT_DYNAMIC Tue, 29 Jul 2025 15:05:00 +0000 x86_64 GNU/Linux
```

18. factor

Interpretation: Print the prime factors of each specified integer NUMBER. If none are specified on the command line, read them from standard input.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
factor 69420
69420: 2 2 3 5 13 89
```

19. bc

Command: echo '3*9' | bc

Interpretation: bc is an arbitrary precision calculator language. The expression 3*9 is piped into bc as input to calculate for output.

Output:

```
surab in ~ λ echo '3*9' | bc
27
```

20. id

Interpretation: print real and effective user and group IDs

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
id
uid=1000(noxtar) gid=1000(noxtar) groups=1000(noxtar),98(power),985(video),987(storage),994(input),996(audio),998(wheel),
```

21. shutdown

Interpretation: Halt, power off or reboot the machine, with no params, it shutsdown after 1 minute

Command: shutdown now

Interpretation: Immediately shutdown the machine

Command: shutdown 13:20

Interpretation: Shutdown the machine at 13:20 O' clock

Command: shutdown 10

Interpretation: Shutdown the machine after 10 mins have elapsed after the command triggers

Command: shutdown -r +10

Interpretation: Restart the machine after 10 mins have elapsed after the command triggers

Command: shutdown -c

Interpretation: Cancel any pending shutdown

```
surab in ~ λ shutdown 13:20
Shutdown scheduled for Sun 2025-08-03 13:20:00 +0545, use 'shutdown -c' to cancel.
surab in ~ λ shutdown 10
Shutdown scheduled for Sun 2025-08-03 00:45:54 +0545, use 'shutdown -c' to cancel.
surab in ~ λ shutdown -r +10
Reboot scheduled for Sun 2025-08-03 00:45:58 +0545, use 'shutdown -c' to cancel.
surab in ~ λ shutdown -c
```

22. ping

Command: ping -w3 google.com

Interpretation: send ICMP ECHO_REQUEST to google.com for 3 seconds.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
ping -w 3 google.com
PING google.com (142.250.194.46) 56(84) bytes of data.
64 bytes from del12s02-in-f14.1e100.net (142.250.194.46): icmp_seq=1 ttl=114 time=21.4 ms
64 bytes from del12s02-in-f14.1e100.net (142.250.194.46): icmp_seq=2 ttl=114 time=17.1 ms
64 bytes from del12s02-in-f14.1e100.net (142.250.194.46): icmp_seq=3 ttl=114 time=20.8 ms

--- google.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 17.065/19.775/21.440/1.933 ms
```

23. netstat [-r]

Interpretation: Print network connections, routing tables, interface statistics, masquerade connections, and multicast memberships.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
netstat
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address          Foreign Address        State
tcp      0      0 WoodenNebula:32968      tzdela-ay-in-f14.:https ESTABLISHED
tcp      0      0 WoodenNebula:53010      del12s20-in-f9.1e:https ESTABLISHED
tcp      0      0 WoodenNebula:36484      edge-star-shv-02.:https ESTABLISHED
tcp      0      0 WoodenNebula:36490      edge-star-shv-02.:https ESTABLISHED
tcp      0      0 WoodenNebula:38954      edge-z-p3-shv-02.:https ESTABLISHED
tcp      0      0 WoodenNebula:51028      edge-star-shv-02.:https ESTABLISHED
tcp      0      0 WoodenNebula:59564      162.159.61.4:https    ESTABLISHED
tcp      0      0 WoodenNebula:55672      edge-star-shv-02.:https TIME_WAIT
tcp      0      0 WoodenNebula:56692      edge-star-shv-02.:https ESTABLISHED
tcp      0      0 WoodenNebula:41108      edge-dgw-shv-02-d:https ESTABLISHED
tcp      0      0 WoodenNebula:33862      45.224.186.35.bc.:https ESTABLISHED
tcp      0      0 WoodenNebula:59484      edge-dgw-shv-02-d:https ESTABLISHED
tcp      0      0 WoodenNebula:47124      162.159.135.234:https ESTABLISHED
tcp      1      0 WoodenNebula:40740      192.168.1.:microsoft-ds CLOSE_WAIT
tcp      0      0 WoodenNebula:45490      93.243.107.34.bc.:https ESTABLISHED
tcp      0      0 WoodenNebula:53166      instagram-p3-shv-:https ESTABLISHED
tcp      0      0 WoodenNebula:53168      instagram-p3-shv-:https ESTABLISHED
udp      0      0 WoodenNebula:bootpc     _gateway:bootps       ESTABLISHED
```

Command: netstat -r

Interpretation: display kernel routing tables

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
netstat -r
Kernel IP routing table
Destination     Gateway         Genmask        Flags   MSS Window irtt Iface
default         _gateway       0.0.0.0        UG        0 0          0 enp63s0
192.168.1.0    0.0.0.0        255.255.255.0  U         0 0          0 enp63s0
```

Command: netstat -p

Interpretation: Show the PID and name of the program to which each socket belongs. A hyphen is shown if the socket belongs to the kernel

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
netstat -p
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address          Foreign Address        State      PID/Program name
tcp      0      0 WoodenNebula:32968      tzdela-ay-in-f14.:https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:53010      del12s20-in-f9.1e:https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:36484      edge-star-shv-02-.https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:36490      edge-star-shv-02-.https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:38954      edge-z-p3-shv-02-.https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:39386      124.41.209.17:https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:49014      edge-star-mini-sh:https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:51028      edge-star-shv-02-.https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:59564      162.159.61.4:https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:56692      edge-star-shv-02-.https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:41108      edge-dgw-shv-02-d:https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:33862      45.224.186.35.bc.:https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:59484      edge-dgw-shv-02-d:https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:58532      instagram-p42-shv:https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:47124      162.159.135.234:https ESTABLISHED 1453/zen-bin
tcp      1      0 WoodenNebula:40740      192.168.1.:microsoft-ds CLOSE_WAIT 49296/kioworker
tcp      0      0 WoodenNebula:45490      93.243.107.34.bc.:https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:53166      instagram-p3-shv:https ESTABLISHED 1453/zen-bin
tcp      0      0 WoodenNebula:53168      instagram-p3-shv:https ESTABLISHED 1453/zen-bin
udp      0      0 WoodenNebula:bootpc  _gateway:bootps ESTABLISHED -
Active UNIX domain sockets (w/o servers)
Proto RefCnt Flags       Type      State      I-Node  PID/Program name    Path
unix  3      [ ]        STREAM    CONNECTED  10431   795/dbus-broker    /run/user/1000/at-spi/bus_0
unix  2      [ ]        DGRAM     CONNECTED  5281784  -
unix  3      [ ]        STREAM    CONNECTED  4818192  72401/alacritty
unix  2      [ ]        DGRAM     CONNECTED  16798   -
unix  3      [ ]        STREAM    CONNECTED  3312849  1861/zen-bin
unix  3      [ ]        STREAM    CONNECTED  24586   1453/zen-bin
unix  3      [ ]        STREAM    CONNECTED  23692   1606/zen-bin
unix  3      [ ]        STREAM    CONNECTED  5193165  98246/alacritty
unix  3      [ ]        SEQPACKET CONNECTED  3571398  1453/zen-bin
unix  3      [ ]        SEQPACKET CONNECTED  20806   1453/zen-bin
unix  2      [ ]        DGRAM     CONNECTED  422422  10564/kwalletd6
```

24. tcpdump

Interpretation: dump traffic on a network.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
sudo tcpdump
[sudo] password for noxtar:
tcpdump: verbose output suppressed, use -v[v]... for full protocol decode
listening on enp63s0, link-type EN10MB (Ethernet), snapshot length 262144 bytes
00:41:50:49:63:19 IP 2400-1a00-b080.ip6.wlink.com.np > WoodenNebula: ICMP6, neighbor solicitation, who has WoodenNebula, length 32
00:41:50:49:63:84 IP6 WoodenNebula > 2400-1a00-b080.ip6.wlink.com.np: ICMP6, neighbor advertisement, tgt is WoodenNebula, length 24
00:41:50:50:54:09 ARP, Request who-has WoodenNebula tell _gateway, length 46
00:41:50:50:54:40 ARP, Reply WoodenNebula is-at 74:d4:dd:2e:1c:6c (oui Unknown), length 28
00:41:50:54:08:35 IP WoodenNebula.59484 > edge-dgw-shv-02-deli.facebook.com.https: Flags [P.], seq 2428767875:2428767904, ack 2914452928, win 554, options [nop,nop,TS val 1931526496 ecr 3165030626], length 29
00:41:50:54:33:04 IP WoodenNebula.43255 > 100.127.255.165.domain: 13503+ PTR? 1.0.0.0.0.0.0.0.0.0.0.0.0.a.2.d.d.0.8.0.b.0.0.a.1.0.0.4.2.ip6.arpa. (90)
00:41:50:56:21:40 IP edge-dgw-shv-02-deli.facebook.com.https > WoodenNebula.59484: Flags [.], ack 29, win 1035, options [nop,nop,TS val 3165041703 ecr 1931526496], length 0
00:41:50:78:26:30 IP edge-dgw-shv-02-deli.facebook.com.https > WoodenNebula.59484: Flags [P.], seq 1:26, ack 29, win 1035, options [nop,nop,TS val 3165041703 ecr 1931526496], length 25
00:41:50:78:26:85 IP WoodenNebula.59484 > edge-dgw-shv-02-deli.facebook.com.https: Flags [.], ack 26, win 554, options [nop,nop,TS val 1931526738 ecr 3165041703], length 0
00:41:51:17:04:47 IP 100.127.255.165.domain > WoodenNebula.43255: 13503 1/0/0 PTR 2400-1a00-b080.ip6.wlink.com.np. (135)
00:41:51:17:14:49 IP WoodenNebula.56748 > 100.127.255.165.domain: 37804+ PTR? 11.239.240.157.in-addr.arpa. (45)
00:41:51:17:71:70 IP 100.127.255.165.domain > WoodenNebula.56748: 37804 1/0/0 PTR edge-dgw-shv-02-deli.facebook.com. (92)
00:41:51:17:74:72 IP WoodenNebula.45267 > 100.127.255.165.domain: 13619+ PTR? 165.255.127.100.in-addr.arpa. (46)
00:41:51:18:33:96 IP 100.127.255.165.domain > WoodenNebula.45267: 13619 NXDomain* 0/1/0 (105)
```

25. host google.com

Interpretation: host is a simple utility for performing DNS lookups. It is normally used to convert names to IP addresses and vice versa.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
host google.com
google.com has address 142.250.194.46
google.com has IPv6 address 2404:6800:4002:81f::200e
google.com mail is handled by 10 smtp.google.com.
google.com has HTTP service bindings 1 . alpn="h2,h3" ↵
```

26. tracepath achsnepal.edu.np

Interpretation: It traces the network path to destination discovering MTU along this path. It uses UDP port or some random port. It is similar to traceroute.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
tracepath achsnepal.edu.np
1?: [LOCALHOST]                                pmtu 1500
1: _gateway                                     0.741ms
1: _gateway                                     0.854ms
2: 27.34.20.1                                   5.911ms
3: be-73-150.42.gwc-dhub-core-01.wlink.com.np   7.940ms
4: 198-32-231-29.setg.net                      6.296ms
5: d3-228.accessworld.net                     7.187ms asymm 62
6: makuri.accessworld.net                      7.469ms !H
Resume: pmtu 1500
```

27. ifconfig

Interpretation: Ifconfig is used to configure the kernel-resident network interfaces. It is used at boot time to set up interfaces as necessary. After that, it is usually only needed when debugging or when system tuning is needed.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
ifconfig
enp63s0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
          inet 192.168.1.81  netmask 255.255.255.0  broadcast 192.168.1.255
          inet6 fe80::5cc4:3e4a:1b8b:dd7c  prefixlen 64  scopeid 0x20<link>
          ether 74:d4:dd:2e:1c:6c  txqueuelen 1000  (Ethernet)
          RX packets 2006935  bytes 2653748504 (2.4 GiB)
          RX errors 0  dropped 3965  overruns 0  frame 0
          TX packets 1089536  bytes 108219015 (103.2 MiB)
          TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

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 32  bytes 1920 (1.8 KiB)
      RX errors 0  dropped 0  overruns 0  frame 0
      TX packets 32  bytes 1920 (1.8 KiB)
      TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

wlan0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
      ether 56:98:3f:74:1f:f9  txqueuelen 1000  (Ethernet)
      RX packets 0  bytes 0 (0.0 B)
      RX errors 0  dropped 0  overruns 0  frame 0
      TX packets 0  bytes 0 (0.0 B)
      TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0
```

28. route

Interpretation: Route shows/manipulates the kernel's IP routing tables.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
default         _gateway       0.0.0.0        UG    100    0        0 enp63s0
192.168.1.0    0.0.0.0        255.255.255.0  U     100    0        0 enp63s0
```

29. nslookup

Interpretation: nslookup is a program to query Internet domain name servers. nslookup has two modes: interactive and non-interactive. Interactive mode allows the user to query name servers for information about various hosts and domains or to print a list of hosts in a domain. Non-interactive mode prints just the name and requested information for a host or domain.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
nslookup achsnepal.edu.np
Server:          100.127.255.165
Address:         100.127.255.165#53

Non-authoritative answer:
Name:   achsnepal.edu.np
Address: 103.233.59.42
```

30. whois

Interpretation: whois searches for an object in a RFC 3912 database.

Output:

```
surab in ~/Dev/lab_assignment/src/OS λ
whois brainyquote.com
Domain Name: BRAINYQUOTE.COM
Registry Domain ID: 72115611_DOMAIN_COM-VRSN
Registrar WHOIS Server: whois.godaddy.com
Registrar URL: http://www.godaddy.com
Updated Date: 2023-01-29T01:56:17Z
Creation Date: 2001-06-07T22:43:38Z
Registry Expiry Date: 2026-06-07T22:43:38Z
Registrar: GoDaddy.com, LLC
Registrar IANA ID: 146
Registrar Abuse Contact Email: abuse@godaddy.com
Registrar Abuse Contact Phone: 480-624-2505
Domain Status: clientDeleteProhibited https://icann.org/epp#clientDeleteProhibited
Domain Status: clientRenewProhibited https://icann.org/epp#clientRenewProhibited
Domain Status: clientTransferProhibited https://icann.org/epp#clientTransferProhibited
Domain Status: clientUpdateProhibited https://icann.org/epp#clientUpdateProhibited
Name Server: ROB.NS.CLOUDFLARE.COM
Name Server: ZOE.NS.CLOUDFLARE.COM
DNSSEC: unsigned
URL of the ICANN Whois Inaccuracy Complaint Form: https://www.icann.org/wicf/
>>> Last update of whois database: 2025-08-02T19:04:07Z <<<
```

31. pacman [-S[yy][u]] [package_name]

pacman is a package manager for arch based distros. It does similar work to apt-get for debian based.

Command: pacman -Syyu

Interpretation: force sync local package cache database and update them

Output:

```
surab in ~/Dev/lab_assignment/src/OS on master • • λ sudo pacman -Syyu
[sudo] password for noxtar:
:: Synchronizing package databases...
core                                119.5 KiB  421 KiB/s 00:00 [----] 100%
extra                               7.8 MiB  6.67 MiB/s 00:01 [-----] 100%
multilib                            133.3 KiB  326 KiB/s 00:00 [----] 100%
:: Starting full system upgrade...
resolving dependencies...
looking for conflicting packages...

Package (2)          Old Version  New Version  Net Change  Download Size
core/bash            5.3.3-1      5.3.3-2      0.01 MiB     1.89 MiB
extra/python-matplotlib 3.10.3-1    3.10.5-1      0.18 MiB     6.13 MiB

Total Download Size:  8.02 MiB
Total Installed Size: 38.22 MiB
Net Upgrade Size:    0.18 MiB

:: Proceed with installation? [Y/n] Y
:: Retrieving packages...
bash-5.3.3-2-x86_64                1934.5 KiB  3.45 MiB/s 00:01 [----] 100%
python-matplotlib-3.10.5-1-x86_64   6.1 MiB  6.21 MiB/s 00:01 [-----] 100%
Total (2/2)                         8.0 MiB  7.76 MiB/s 00:01 [----] 100%
(2/2) checking keys in keyring      [-----] 100%
(2/2) checking package integrity    [-----] 100%
(2/2) loading package files        [-----] 100%
(2/2) checking for file conflicts   [-----] 100%
(2/2) checking available disk space [-----] 100%
:: Processing package changes...
```

Command: pacman -S sl

Interpretation: Searches for a package named sl and installs it if not already installed

Output:

```
surab in ~/Dev/lab_assignment/src/OS on master • • λ sudo pacman -S sl
resolving dependencies...
looking for conflicting packages...

Package (1)  New Version  Net Change  Download Size
extra/sl     5.05-5      0.02 MiB     0.01 MiB

Total Download Size:  0.01 MiB
Total Installed Size: 0.02 MiB

:: Proceed with installation? [Y/n] Y
:: Retrieving packages...
sl-5.05-5-x86_64                  10.1 KiB  66.0 KiB/s 00:00 [----] 100%
(1/1) checking keys in keyring      [-----] 100%
(1/1) checking package integrity    [-----] 100%
(1/1) loading package files        [-----] 100%
(1/1) checking for file conflicts   [-----] 100%
(1/1) checking available disk space [-----] 100%
:: Processing package changes...
(1/1) installing sl                [-----] 100%
:: Running post-transaction hooks...
(1/1) Arming ConditionNeedsUpdate...
```

32. sl

It is one of many easter egg commands in linux. This one is for typo of ls command.

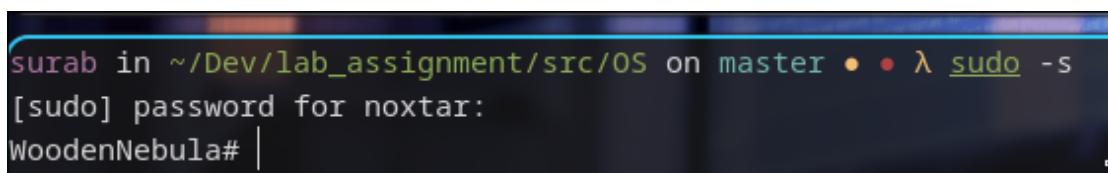
Output:



33. sudo -s

Interpretation: Change to sudo SHELL for the user

Output:



34. exit

Interpretation: exits out of current shell environment

Output:



LAB 3 : BASH

SCRIPTING

1. basic scripting

Script:

```
#!/bin/bash
echo "Hello Bash Scripting!"
```

Interpretation:

#!/bin/bash specifies the bash interpreter

echo just prints out the string to stdout

It is necessary to chmod a+x basic.sh to execute it properly

Output:

```
surab in ~/Dev/lab_assignment/src/OS on master λ ls
OS-LabReport.docx OS-LabReport.odt OS-LabReport.pdf outputs
surab in ~/Dev/lab_assignment/src/OS on master λ mkdir bash
surab in ~/Dev/lab_assignment/src/OS on master λ cd bash
surab in ~/Dev/lab_assignment/src/OS/bash on master λ ls
surab in ~/Dev/lab_assignment/src/OS/bash on master λ nvim basic.sh
surab in ~/Dev/lab_assignment/src/OS/bash on master λ chmod a+x basic.sh
surab in ~/Dev/lab_assignment/src/OS/bash on master λ ./basic.sh
Hello Bash Scripting!
```

2. Input

```
#!/bin/bash

read -p "Enter your name: " name

echo "Your name is $name"
```

Interpretation:

read is for inputting from stdin. read -p means to print while waiting for input and name is the variable to store the input into.

Output:



```
surab in ~/Dev/lab_assignment/src/OS/bash on master • λ ./3.2-input.sh
Enter your name: Surab Parajuli
Your name is Surab Parajuli
```

3. Square

```
#!/bin/bash

read -p "Enter a number: " number

square=$((number*number))

echo "Square is $square"
```

Interpretation:

square is variable for storing result of number*number. Here, the \$(()) tells the interpreter to interpret the result as a mathematical operation.

Output:



```
surab in ~/Dev/lab_assignment/src/OS/bash on master • λ ./3.3-square.sh
Enter a number: 69
Square is 4761
```

4. Branching

```
#!/bin/bash

read -p "Enter a number: " number
remainder=$((number%2))

if [[ ($number == 0) ]]; then
    echo "The number is Zero."
elif [[ ($remainder == 0) ]]; then
    echo "The number is Even."
else
    echo "The number is Odd."
fi
```

Interpretation:

if is branching statement followed by [[condition]]; then. elif is else-if and the ending is fi. The above script reads a number and checks if its even or odd or zero

Output:

```
surab in ~/Dev/lab_assignment/src/OS/bash on master • λ ./3.4-branch.sh
Enter a number: 0
The number is Zero.
surab in ~/Dev/lab_assignment/src/OS/bash on master • λ ./3.4-branch.sh
Enter a number: 69
The number is Odd.
surab in ~/Dev/lab_assignment/src/OS/bash on master • λ ./3.4-branch.sh
Enter a number: 420
The number is Even.
```

5. for-loop

```
#!/bin/bash
echo "Printing 0-9"
for ((i = 0; i < 10; i++)); do
    echo -n "$i "
done
echo
```

Interpretation:

for is looping statement followed by ((init; condition; statement)); do. The for loop is closed by done. The above script prints number from 0 to 9 in a single line, as denoted by echo -n

Output:

```
surab in ~/Dev/lab_assignment/src/OS/bash on master • λ ./3.5-for.sh
Printing 0-9
0 1 2 3 4 5 6 7 8 9
```

6. while-loop

```
#!/bin/bash  
echo "Printing 0-9"  
i=0  
while (( i < 10 )); do  
    echo -n "$i "  
    i=$((i+1))  
done  
echo
```

Interpretation:

while is looping statement followed by ((condition)); do. Initialization has to be done separately. The while loop is also closed by done.

Output:

```
surab in ~/Dev/lab_assignment/src/OS/bash on master • λ ./3.6-while.sh  
Printing 0-9  
0 1 2 3 4 5 6 7 8 9
```

7. directory manipulation

```
#!/bin/bash

mkdir arch

cd arch

touch arch.txt

echo "I use Arch btw." > arch.txt

cat arch.txt

cd ..
```

Interpretation:

The above script shows basic directory manipulation through bash script. It creates a dir named arch, cd's into it and writes “I use Arch btw.” to a file named arch.txt and cats it.

Output:

```
surab in ~/Dev/lab_assignment/src/OS/bash on master • λ ls
3.1-basic.sh 3.3-square.sh 3.5-for.sh 3.7-dir.sh
3.2-input.sh 3.4-branch.sh 3.6-while.sh
surab in ~/Dev/lab_assignment/src/OS/bash on master • λ ./3.7-dir.sh
I use Arch btw.
surab in ~/Dev/lab_assignment/src/OS/bash on master • λ ls
3.1-basic.sh 3.3-square.sh 3.5-for.sh 3.7-dir.sh
3.2-input.sh 3.4-branch.sh 3.6-while.sh arch
surab in ~/Dev/lab_assignment/src/OS/bash on master • λ ls arch
arch.txt
```

8. while-dir

```
#!/bin/bash

count=10

i=1

should_make_dir=true

while $should_make_dir; do

    new_dir="arch""$i"

    mkdir $new_dir

    cd $new_dir

    echo "$i. I use Arch btw." > arch.txt

    cat arch.txt

    if (( i ≥ count )); then

        should_make_dir=false;

    fi

    ((i++))

done
```

Interpretation:

The script makes a new directory named archi where i is the current loop iteration. cd's into it and writes a file arch.txt. This is repeated for 10 times.

Output:

```
surab in ~/Dev/lab_assignment/src/OS/bash on master • • λ ./3.8-while-dir.sh
1. I use Arch btw.
2. I use Arch btw.
3. I use Arch btw.
4. I use Arch btw.
5. I use Arch btw.
6. I use Arch btw.
7. I use Arch btw.
8. I use Arch btw.
9. I use Arch btw.
10. I use Arch btw.
```

```
surab in ~/Dev/lab_assignment/src/OS/bash on master • • λ tree arch1
arch1
└── arch2
    ├── arch3
    │   ├── arch4
    │   │   ├── arch5
    │   │   │   ├── arch6
    │   │   │   │   ├── arch7
    │   │   │   │   │   ├── arch8
    │   │   │   │   │   │   ├── arch9
    │   │   │   │   │   │   │   ├── arch10
    │   │   │   │   │   │   │   └── arch.txt
    │   │   │   │   │   └── arch.txt
    │   │   │   └── arch.txt
    │   └── arch.txt
    └── arch.txt
        └── arch.txt
```

9. commands

```
#!/bin/bash
lsusb > lsusb.txt
lshw -html > lshw.html
```

Interpretation:

Runs the command and redirects the output to files

Output:

```
surab in ~/Dev/lab_assignment/src/OS/bash on master • • λ ./3.9-commands.sh
WARNING: you should run this program as super-user.
WARNING: output may be incomplete or inaccurate, you should run this program as
super-user.
surab in ~/Dev/lab_assignment/src/OS/bash on master • • λ ls
3.1-basic.sh 3.4-branch.sh 3.7-dir.sh      arch      lshw.html
3.2-input.sh  3.5-for.sh    3.8-while-dir.sh arch1    lsusb.txt
3.3-square.sh 3.6-while.sh 3.9-commands.sh arch.txt ,
```

10. system update

```
#!/bin/bash

sudo pacman -Syy

sudo pacman -Syyu
```

Interpretation:

Updates the package list and updates installed packages

Output:

```
surab in ~/Dev/lab_assignment/src/OS/bash on master • • λ ./3.10-update.sh
:: Synchronizing package databases...
core           119.5 KiB  372 KiB/s 00:00 [-----] 100%
extra          7.8 MiB   7.06 MiB/s 00:01 [-----] 100%
multilib        133.3 KiB  383 KiB/s 00:00 [-----] 100%
:: Synchronizing package databases...
core           119.5 KiB  422 KiB/s 00:00 [-----] 100%
extra          7.8 MiB   7.36 MiB/s 00:01 [-----] 100%
multilib        133.3 KiB  425 KiB/s 00:00 [-----] 100%
:: Starting full system upgrade...
resolving dependencies...
looking for conflicting packages...

Package (5)      Old Version    New Version    Net Change  Download Size
extra/libnmm     1.52.1-1      1.54.0-1      0.03 MiB    0.87 MiB
core/linux       6.15.8.arch1-2  6.15.9.arch1-1  0.00 MiB    141.23 MiB
extra/networkmanager 1.52.1-1  1.54.0-1      0.12 MiB    3.62 MiB
extra/nvidia-open 575.64.05-3  575.64.05-4  0.00 MiB    7.06 MiB
extra/wayland    1.23.1-2      1.24.0-1      0.02 MiB    0.14 MiB

Total Download Size: 152.93 MiB
Total Installed Size: 170.93 MiB
Net Upgrade Size: 0.17 MiB

:: Proceed with installation? [Y/n] Y
:: Retrieving packages...
wayland-1.24.0-1... 142.6 KiB  490 KiB/s 00:00 [-----] 100%
libnmm-1.54.0-1-x... 894.5 KiB  1606 KiB/s 00:01 [-----] 100%
networkmanager-1... 3.6 MiB   3.06 MiB/s 00:01 [-----] 100%
nvidia-open-575.... 7.1 MiB   4.21 MiB/s 00:02 [-----] 100%
linux-6.15.9.arch1... 141.2 MiB  8.91 MiB/s 00:16 [-----] 100%
Total (5/5)         152.9 MiB  9.61 MiB/s 00:16 [-----] 100%
(5/5) checking keys in keyring                         [-----] 100%
(5/5) checking package integrity                      [-----] 100%
(5/5) loading package files                          [-----] 100%
(5/5) checking for file conflicts                   [-----] 100%
(5/5) checking available disk space                [-----] 100%
```

LAB 4 : PROCESSES

1. print

Code:

```
#include <stdio.h>
int main(int argc, char *argv[]) {
    printf("Hello World! This is printed through print syscall.");
}
```

Interpretation:

print syscall used in printf

Output:

```
surab in ~/Dev/lab_assignment on master • λ cat run
#!/bin/bash
fname="$1"
fdir="./src/OS/syscalls/"
bin="./src/OS/outputs/"

if [ $# = 0 ]; then
    echo "File name required!!!"
else
    fbin="$bin$1"
    file="$fdir$1.c"
    # echo "file=$file, fbin=$fbin"
    gcc $file -o $fbin
    chmod u+x $fbin
    $fbin
    echo
fi
surab in ~/Dev/lab_assignment on master • λ ./run 1-print
Hello World! This is printed through print syscall.
```

2. fork

Code:

```
#include <stdio.h>
#include <unistd.h>

int main(int argc, char *argv[]) {
    if (fork() == 0) {    printf("Child Process!\n");  }
    else { ("Parent Process!\n");  }
    printf("Hello Arch Linux!\n");
}
```

Interpretation:

A program for creating child process from a parent process using function `fork()`.

Output:

```
surab in ~/Dev/lab_assignment on master • λ ./run 2-fork
Parent Process!
Hello Arch Linux!
Child Process!
Hello Arch Linux!
```

3. pid

Code:

```
#include <stdio.h>
#include <unistd.h>

int main(int argc, char *argv[]) {
    int child_pid = fork();
    if (child_pid == 0) { printf("[%d] Child Process! PPID = %d\n", getpid(), getppid()); }
    int child_pid_2 = fork();
    if (child_pid_2 == 0) { printf("[%d] Child Process! PPID = %d\n", getpid(), getppid()); }
    return 0;
}
```

Interpretation:

A simple program for demonstration of fork() function which is used to create a child process from parent process.

Output:

```
surab in ~/Dev/lab_assignment on master • λ ./run 3-pid
[83791] Child Process! PPID = 83790
[83792] Child Process! PPID = 83790
[83793] Child Process! PPID = 83791
```

4. execute

Code:

```
#include <stdio.h>
#include <unistd.h>

int main(int argc, char *argv[]) {
    const char path[] = "/home/noxtar/Dev/lab_assignment/src/OS/outputs/1-print";
    char *args[] = {"src/OS/outputs/1-print", "", "", NULL};
    args[0] = "src/OS/outputs/1-print";
    if (fork() == 0) {
        printf("Child Process:\n");
        printf("PID: %d\n", getpid());
        printf("PPID: %d\n", getppid());
        printf("Executing another c program\n");
        execve(path, args, NULL);
    } else {
        printf("Parent Process : id = %d\n", getpid());
    }
}
```

Interpretation:

A program for demonstrating execve() function which causes the program that is currently being run by the calling process to be replaced with a new program, with newly initialized stack, heap, and (initialized and uninitialized) data segments.

Output:

```
surab in ~/Dev/lab_assignment on master • λ ./run 4-execute
Parent Process : id = 85534
Child Process:
PID: 85535
PPID: 85534
Executing another c program

Hello World! This is printed through print syscall.%
```

LAB 5 : THREADS

1. basic

Code:

```
#include <pthread.h>
#include <stdio.h>
#include <time.h>

void *show(void *u) { printf("New thread\n"); }

int main() {
    pthread_t tid;
    time_t t;
    time(&t);
    printf("\nThis program has been written at (date and time): %s", ctime(&t));
    pthread_create(&tid, NULL, &show, NULL);
    printf("Main thread\n");
    pthread_join(tid, NULL);
    return 0;
}
```

Interpretation:

Creating new thread using pthread_create() function and executing a user-defined function show().

Output:

```
surab in ~/Dev/lab_assignment on master • λ ./run 1-basic ArchBtw
This program has been written at (date and time): Sun Aug 3 22:33:59 2025
Main thread
New thread
```

2. multi-thread

Code:

```
#include <pthread.h>
#include <stdio.h>
#include <time.h>
#include <unistd.h>

int g_time = 1;

void *sleep_a(void *u) {
    printf("\nNew Thread");
    g_time += 5;
    printf("\nSleeping for %d seconds", g_time);
    sleep(g_time);
    printf("\nSlept for %d seconds", g_time);
}

void *sleep_b(void *u) {
    printf("\nOld Thread");
    g_time += 2;
    printf("\nSleeping for %d seconds", g_time);
    sleep(g_time);
    printf("\nSlept for %d seconds", g_time);
}

int main() {
    pthread_t tid, tid2;
    time_t t;
    time(&t);
    printf("\nThis program has been written at (date and time): %s", ctime(&t));
    pthread_create(&tid, NULL, &sleep_a, NULL);
    pthread_create(&tid2, NULL, &sleep_b, NULL);
    printf("\nMain thread\n");
    pthread_join(tid, NULL);
    pthread_join(tid2, NULL);
}
```

Interpretation:

The pthread_join() function waits for the thread specified by thread to terminate. If that thread has already terminated, then pthread_join() returns immediately.

Output:

```
surab in ~/Dev/lab_assignment on master • • λ ./run 2-multi-thread ArchBtw
This program has been written at (date and time): Sun Aug 3 23:28:50 2025
Main thread
Old Thread
Sleeping for 3 seconds
New Thread
Sleeping for 8 seconds
Slept for 8 seconds
Slept for 8 seconds
```

3. thread-process

Code:

```
#include <pthread.h>
#include <stdio.h>
#include <stdlib.h>
#include <time.h>
#include <unistd.h>

void *show(void *u) {
    int pid;
    printf("\n[%d]→[%d] : Old Thread ", getppid(), getpid());
}

int main() {
    int pid;
    pthread_t tid;
    pthread_t tid_child;
    time_t t;
    time(&t);
    printf("\nThis program has been written at (date and time): %s", ctime(&t));
    pthread_create(&tid, NULL, &show, NULL);
    printf("\n[%d]→[%d] : Main thread", getppid(), getpid());
    pid = fork();
    if (pid == 0) {
        printf("\n[%d]→[%d] : Child Process", getppid(), getpid());
        exit(0);
    }
    pthread_join(tid, NULL);
    return 0;
}
```

Interpretation:

Creating thread and creating its child process

Output:

```
surab in ~/Dev/lab_assignment on master • • λ ./run 3-thread-process ArchBtw
This program has been written at (date and time): Sun Aug 3 23:30:14 2025
[5457]->[5466] : Main thread
[5457]->[5466] : Old Thread [5457]->[5466] : Old Thread
[5466]->[5468] : Child Process
```

4. thread-argument

Code:

```
#include <pthread.h>
#include <stdio.h>
#include <stdlib.h>
#include <time.h>
#include <unistd.h>
int global;
void square() { global = global * global; }
void cube() { global = global * global * global; }
void *calculate(void *choice) {
    int *id_ptr, taskid;
    sleep(1);
    id_ptr = (int *)choice;
    taskid = *id_ptr;
    printf("\nEnter a number: ");
    scanf("%d", &global);
    if (taskid == 0) {
        square();
        printf("\nthe square is %d: \n", global);
    } else if (taskid == 1) {
        cube();
```

```

    printf("\nthe cube is %d: \n", global);
}

pthread_exit(NULL);
}

int main() {
    pthread_t threads;
    int *choice = malloc(sizeof(int *));
    int rc;
    time_t t;
    time(&t);
    printf("\nThis program has been written at (date and time): %s", ctime(&t));
    printf("\nEnter 0 for square and 1 for cube number: ");
    scanf("%d", choice);
    printf("Creating thread \n");
    rc = pthread_create(&threads, NULL, calculate, (void *)choice);
    if (rc) {
        printf("ERROR; return code from pthread_create() is %d\n", rc);
        exit(-1);
    }
    pthread_exit(NULL);
}

```

Interpretation:

Demonstration of creating thread by passing function and its argument as parameter to the `pthread_create()` function.

Output:

```

surab in ~/Dev/lab_assignment on master • • λ ./run 4-thread-argument ArchBtw
This program has been written at (date and time): Sun Aug 3 23:34:31 2025
Enter 0 for square and 1 for cube number: 0
Creating thread

Enter a number: 69
the square is 4761:

```