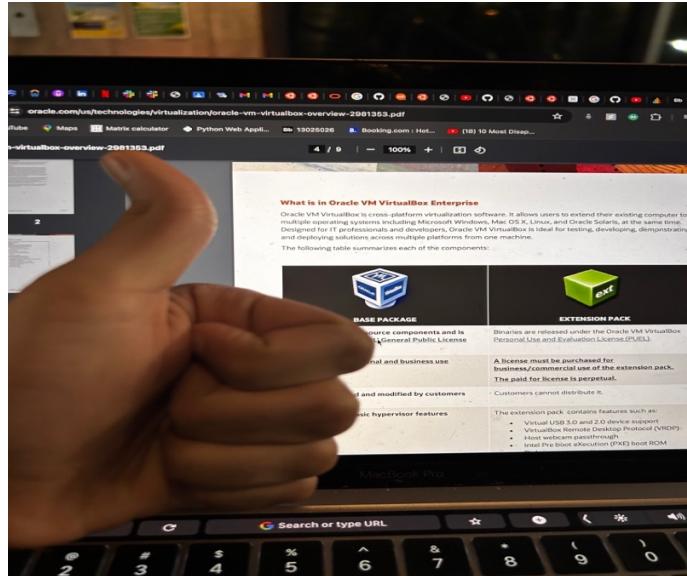


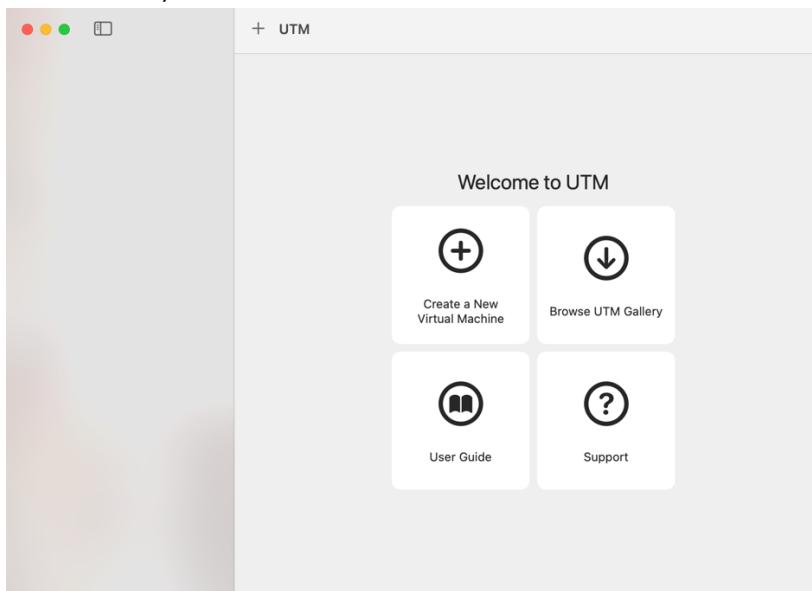
CS 553 – Cloud Computing

Assignment – 1

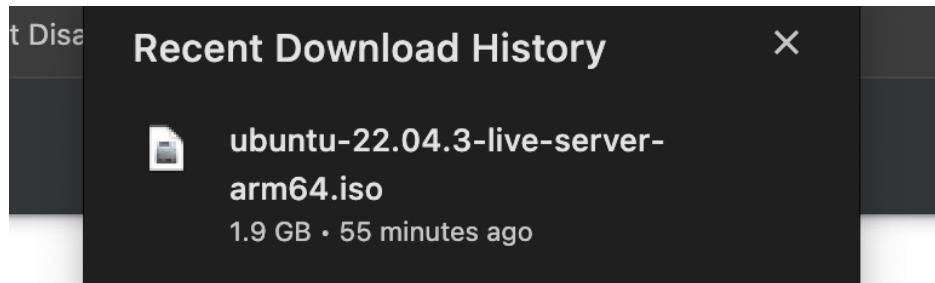
1. (30 points) Setup VM, Linux, and basic testing – must take screen shots at each step to receive points
 - a. Read Oracle VirtualBox White Paper



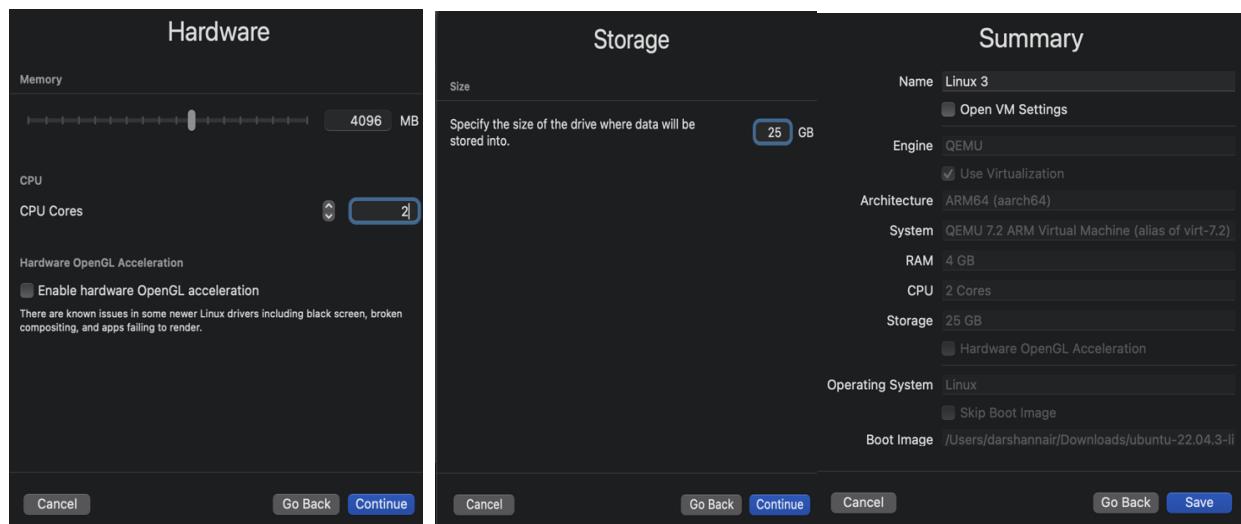
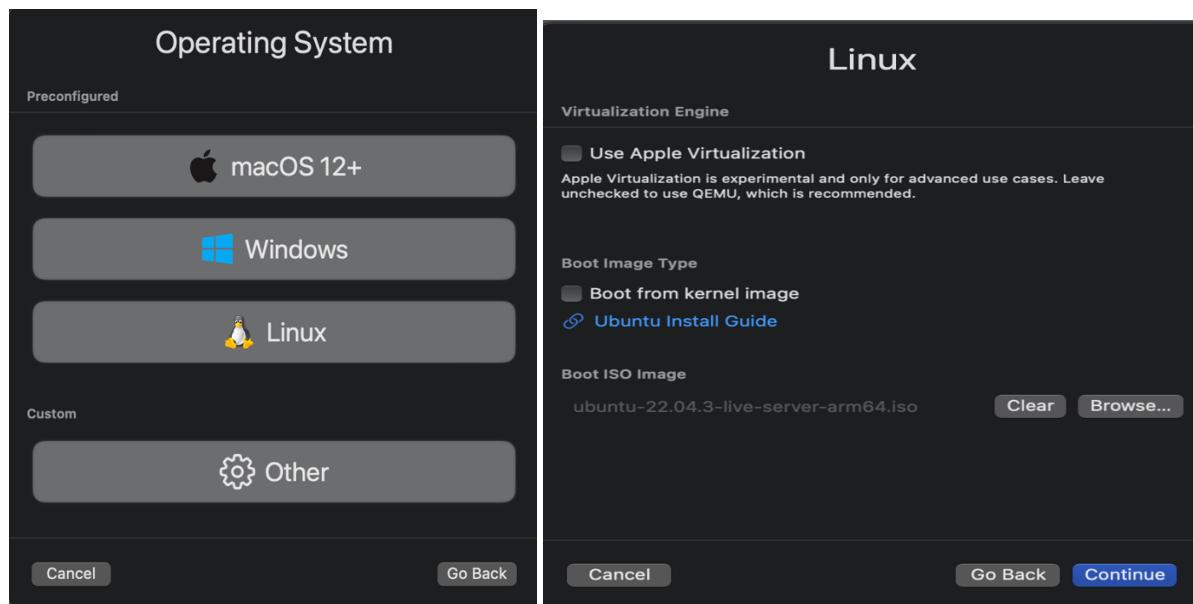
- a. Read Oracle VirtualBox White Paper
- b. Download Oracle VirtualBox 7.0 and c. Install VirtualBox 7.0 (for M1/M2 Apple, use UTM)

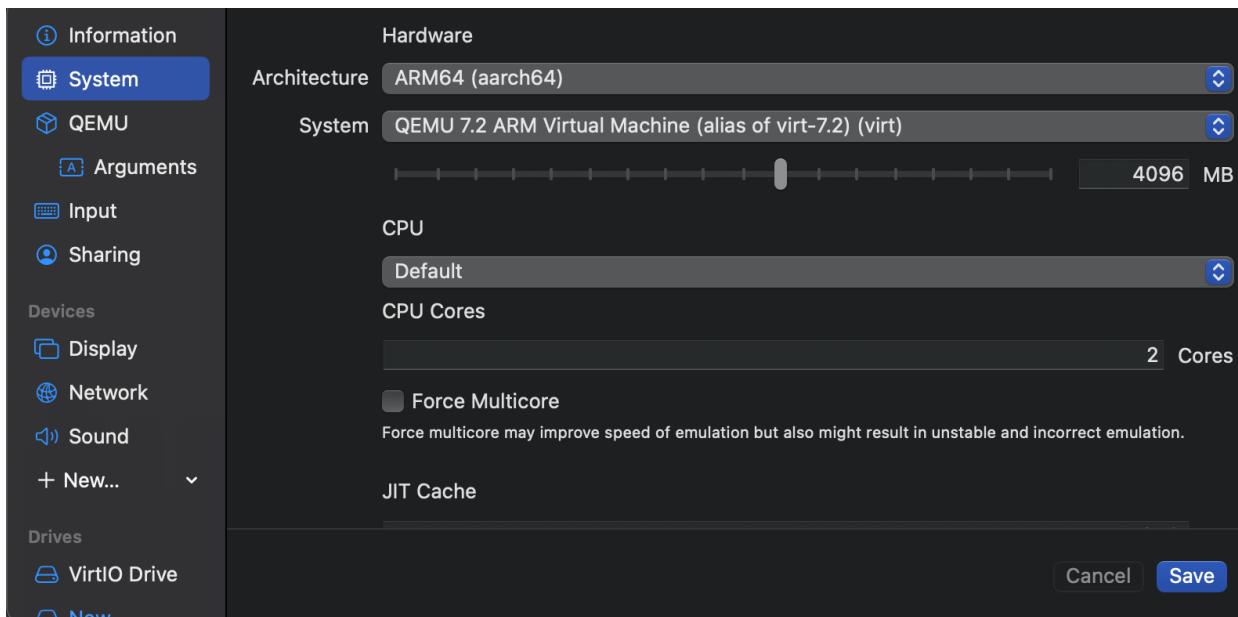
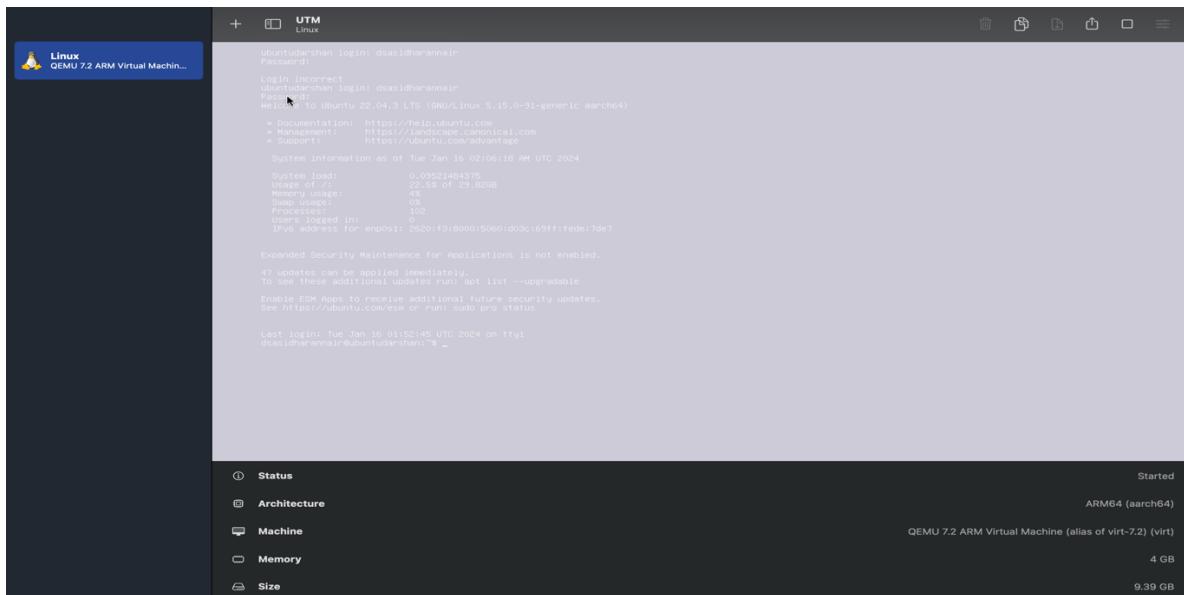


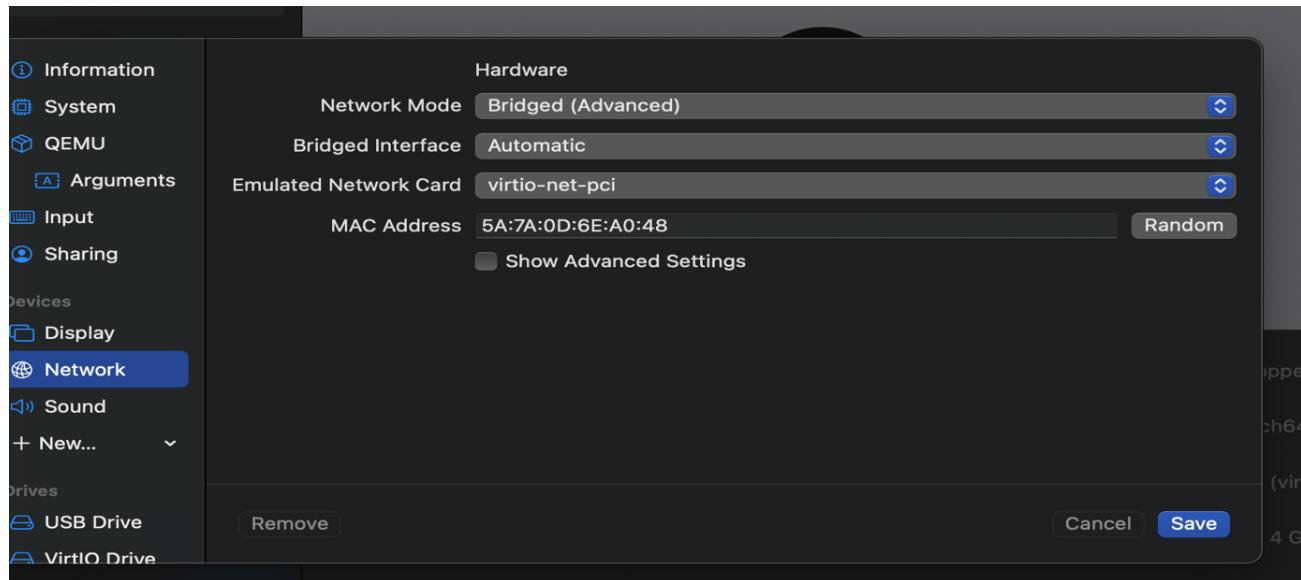
d. Download Ubuntu 22.04 Linux ISO image



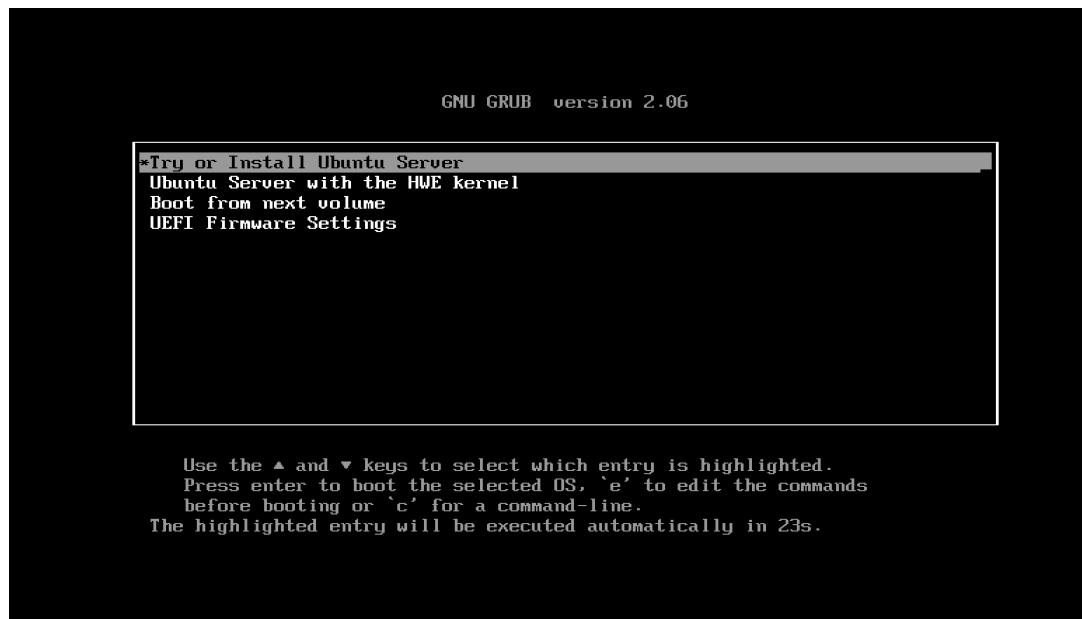
e. Create Virtual Machine (VM), to support Linux, Ubuntu, 64-bit, 4GB RAM, Virtual Disk 25GB, VDI image, dynamically allocated, 2-core, and a network interface (1GbE or WiFi) with Bridged Adapter

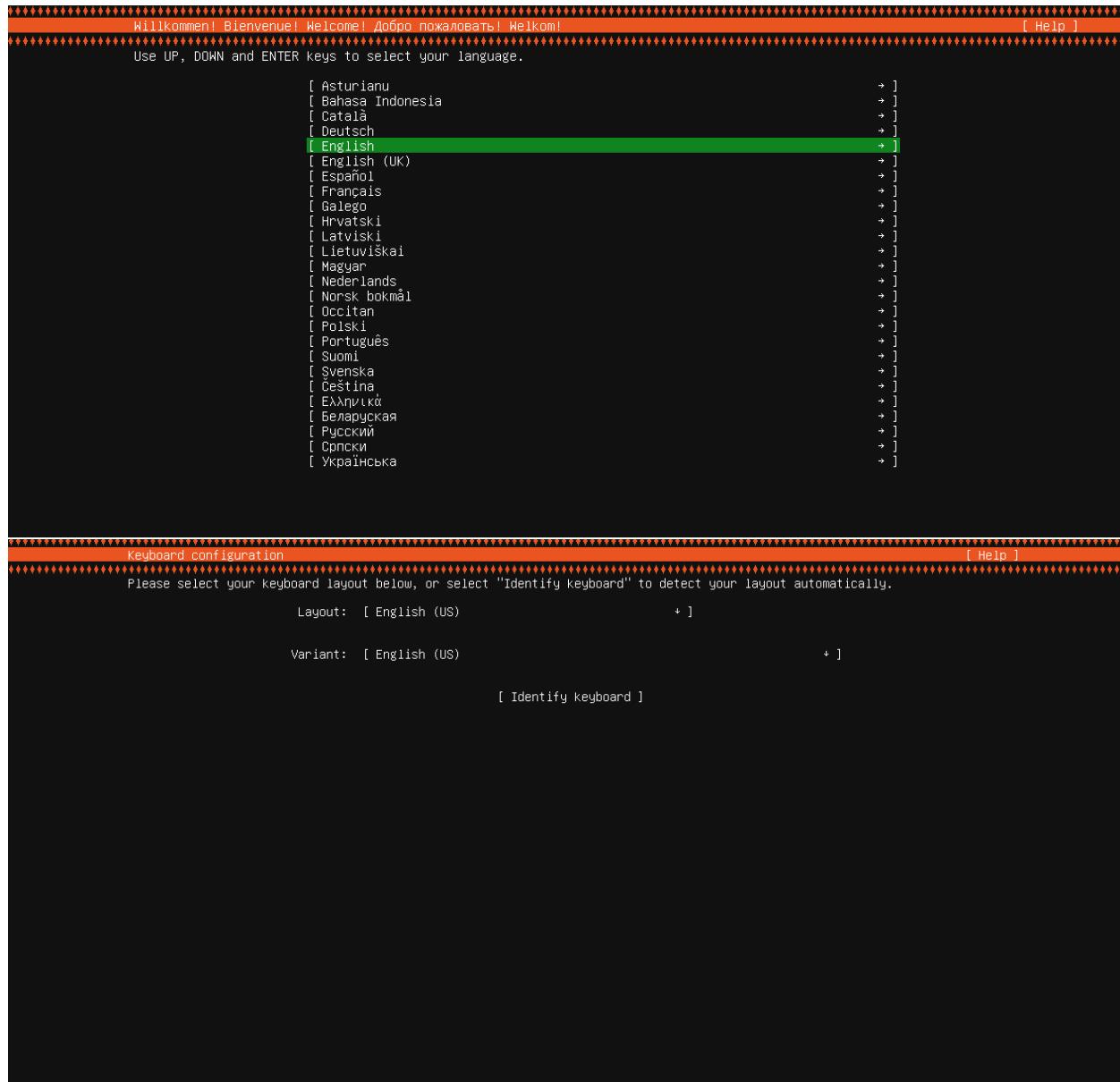


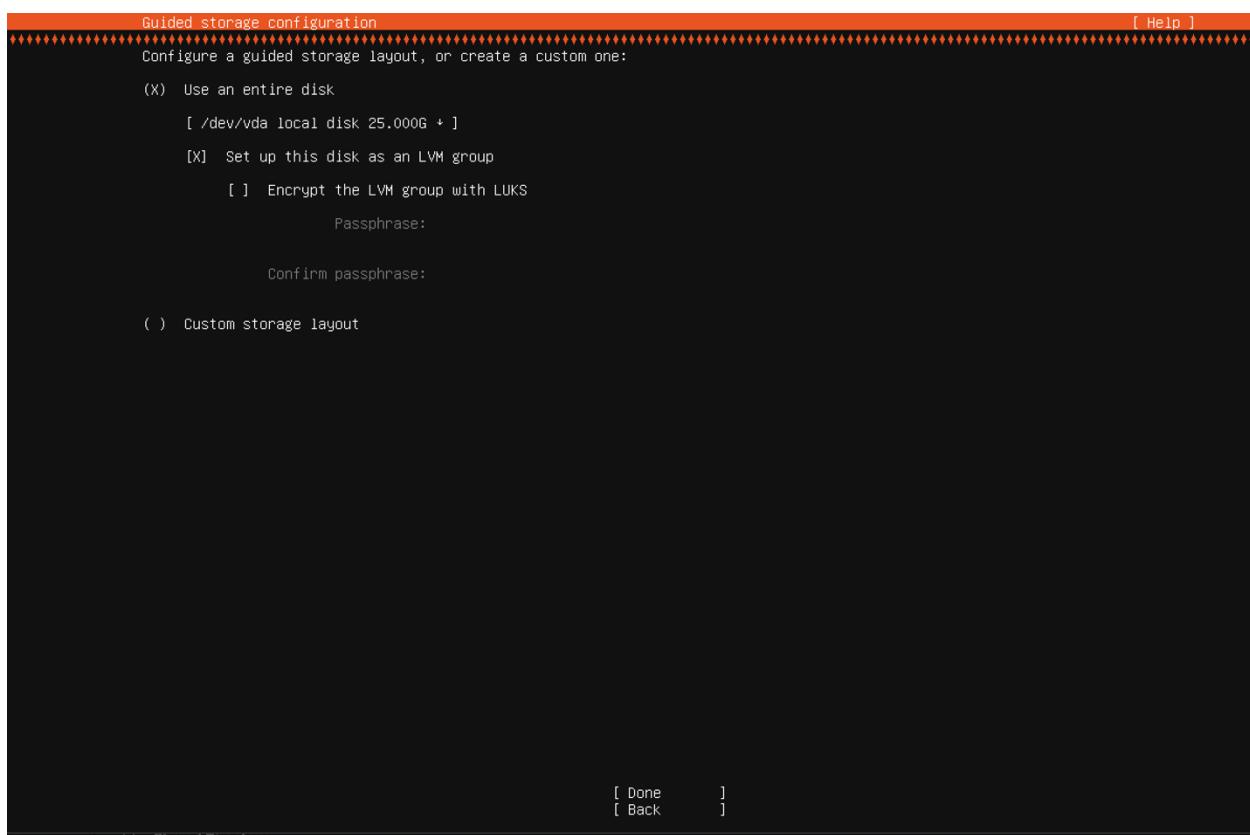
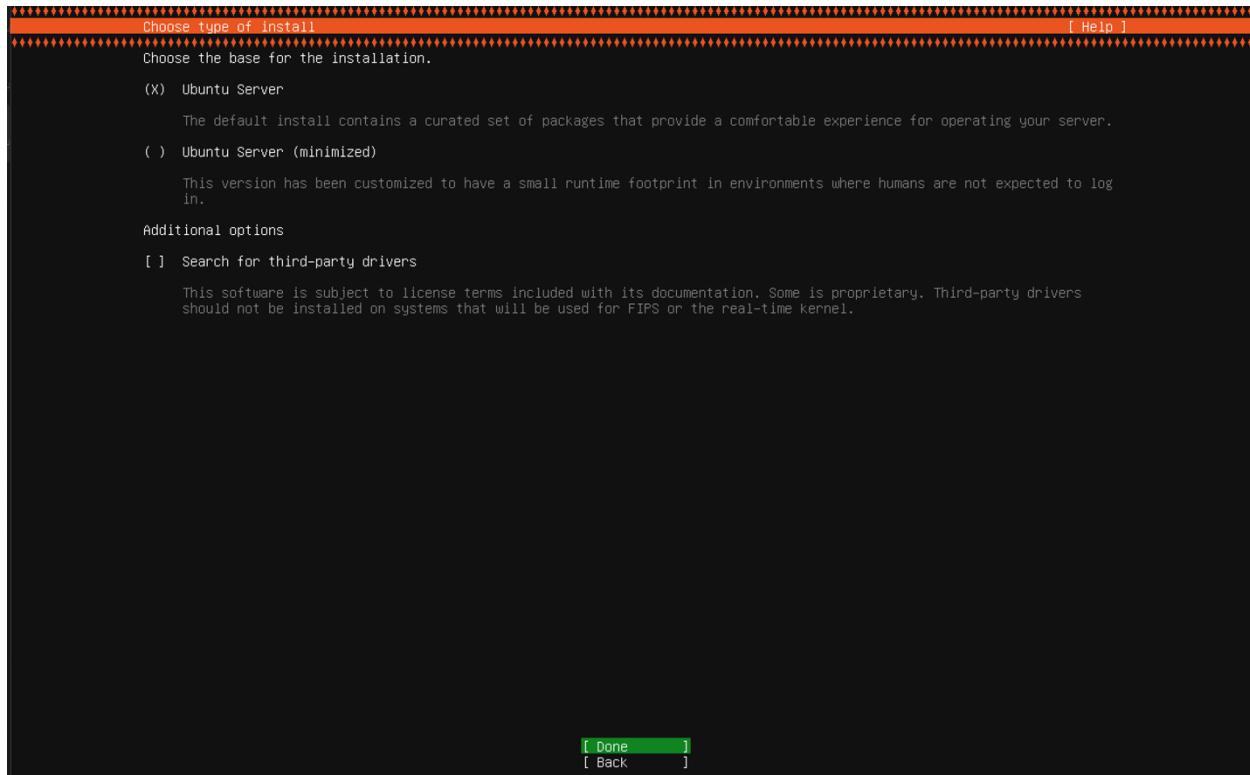




f. Install Linux from the ISO image







```
configuring format: format-1
configuring partition: partition-2
configuring lvm_vg: lvm_vdvgroup-0
configuring lvm_partition: lvm_partition-0
configuring format: format-2
configuring mount: mount-2
configuring mount: mount-1
configuring mount: mount-0
executing curtin install extract step
curtin command install
    writing install sources to disk
        running 'curtin extract'
        curtin command extract
    acquiring and extracting image from cp://tmp/tmpyomace6w/mount
executing curtin install curthooks step
curtin command install
    configuring installed system
        running 'curtin in-target -- setupcon --save-only'
        curtin command in-target
        running 'curtin curthooks'
        curtin command curthooks
    configuring apt
    configuring apt
installing missing packages
installing packages on target system: ['efibootmgr', 'grub-efi-arm64', 'grub-efi-arm64-signed', 'shim-signed']
configuring iscsi service
configuring raid (mdadm) service
installing kernel
setting up swap
apply networking config
writing etc/fstab
writing /etc/paths
updating packages on target system
configuring pollinate user-agent on target
updating initramfs configuration
configuring target system bootloader
installing grub to target devices
final system configuration
configuring cloud-init
calculating packages to install
installing openssh-server
    retrieving openssh-server /
    curtin command system-install -
```

g. Create a user id and password

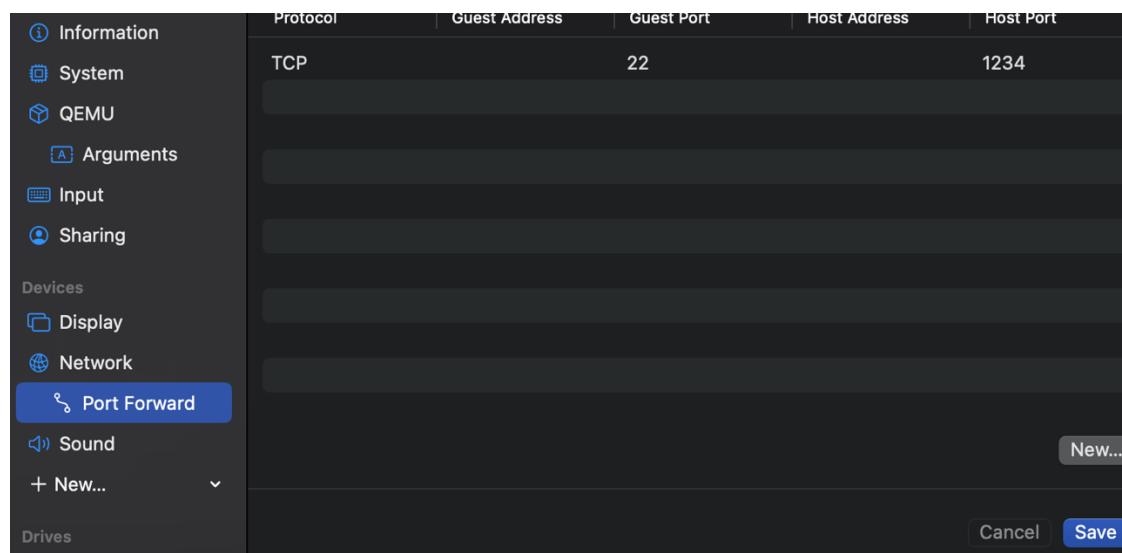


```
Ubuntu 22.04.3 LTS ubuntudarshan tty1
ubuntudarshan login: dsasidharannair
Password: _
```

h. Turn on Firewall and block all ports

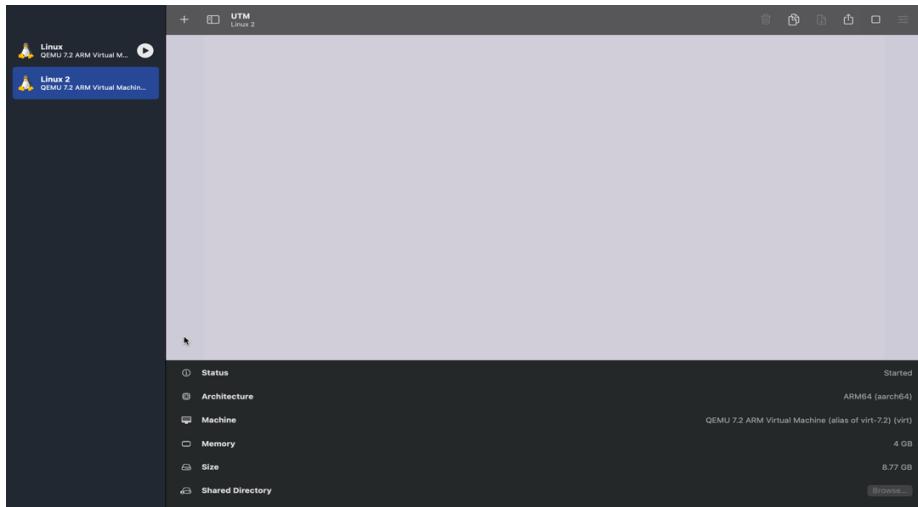
```
Last login: Tue Jan 16 02:06:18 UTC 2024 on tty1
dsasidharannair@ubuntudarshan:~$ sudo ufw enable
[sudo] password for dsasidharannair:
Firewall is active and enabled on system startup
dsasidharannair@ubuntudarshan:~$
```

i. Enable SSH access to your new Linux installation; open SSH port in firewall



```
dsasidharannair@ubuntudarshan:~$ ip route
default via 10.0.2.2 dev enp0s1 proto dhcp src 10.0.2.15 metric 100
10.0.2.0/24 dev enp0s1 proto kernel scope link src 10.0.2.15 metric 100
10.0.2.2 dev enp0s1 proto dhcp scope link src 10.0.2.15 metric 100
10.0.2.3 dev enp0s1 proto dhcp scope link src 10.0.2.15 metric 100
dsasidharannair@ubuntudarshan:~$ ssh ssh darshannair@10.0.2.2
ssh: Could not resolve hostname ssh: Temporary failure in name resolution
dsasidharannair@ubuntudarshan:~$ ufw
ERROR: not enough args
dsasidharannair@ubuntudarshan:~$ ufw status
ERROR: You need to be root to run this script
dsasidharannair@ubuntudarshan:~$ sudo !!
sudo ufw status
[sudo] password for dsasidharannair:
Status: active
dsasidharannair@ubuntudarshan:~$ sudo ufw allow 22/tcp
Rule added
Rule added (v6)
```

j. Repeat steps 5 through 9, and create another VM with the same specifications as the first one



k. Create private/public keys and install them properly in both of your new VMs

Key of VM2 in VM1

VM2 Keygen

```
[dsasidharannair@darshanubuntu2:~$ ssh-keygen
Generating public/private rsa key pair.
[Enter file in which to save the key (/home/dsasidharannair/.ssh/id_rsa):
[Enter passphrase (empty for no passphrase):
[Enter same passphrase again:
Your identification has been saved in /home/dsasidharannair/.ssh/id_rsa
Your public key has been saved in /home/dsasidharannair/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:1DPYQv4rU4EhmExgNraiHZZE+IochxFSH94rFGSJ6Bs dsasidharannair@darshanubuntu2
The key's randomart image is:
+---[RSA 3072]---+
|.*@***+. o
|+*.B=+ + *
|o.B + . * *
|.E.+ o o +
|+.* . . S o
|oo . . .
| o .
| o
+---[SHA256]---+
```

VM1 authorized_keys

```
dsasidharannair@ubuntudarshan:~$ nano .ssh/authorized_keys
```

```
GNU nano 6.2 .ssh/authorized_keys
ssh-rsa AAAQAB3NzaC1yc2EAAAQABAAAABgQDWh2PjM2oULQ3u1uqd6NybJ11PIWh6xLBXJLa1EQLdm01AK+o8N7E47n1EbpbaeHoU2U9tJNtf2u4iyUcuwEGuPS+GTdo0WhFDI02KCHOUrsaklnbxr9xDKpe
```

Key of VM1 in VM2

VM1 Keygen

VM2 authorized_keys

```
dsasidharannair@darshanubuntu2:~$ nano .ssh/authorized_keys
```

```
GNU nano 6.2 .ssh/authorized_keys
gsh-rsa AAAAB3NzaC1yc2EAAAQABAAAABgQDWhzPjM2oULQ3u1Uqd6NybJi1PIWn6xLxBXJLa1EQLdm8iAK+o8N7E47n1EbpbaeWoU2U9tJNtfZu4iyUcwsEGuPS+GTdoDWhFDI2kCH0UrsaWnbxx9x0KpeNonYVII67jh3r1Vur/iP94nhHu01lTRU1e4Q5SAfSz08
```

- I. Test that you can connect remotely to your VMs with your keys, from one VM to the other VM

Connecting from VM2 to VM1

```
dsasidharannair@darshanubuntu2:~$ ssh dsasidharannair@10.0.2.2 -p 1234
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-91-generic aarch64)

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

 System information as of Thu Jan 18 11:11:53 PM UTC 2024

 System load:          0.0
 Usage of /:           23.2% of 29.82GB
 Memory usage:         5%
 Swap usage:          0%
 Processes:            109
 Users logged in:     1
 IPv4 address for enp0s1: 10.0.2.15
 IPv6 address for enp0s1: fec0::d03c:69ff:fedc:7de7

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
 just raised the bar for easy, resilient and secure K8s cluster deployment.
 https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Expanded Security Maintenance for Applications is not enabled.           ↗
0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

Last login: Thu Jan 18 23:10:45 2024
dsasidharannair@ubuntudarshan:~$
```

Connecting from VM1 to VM2

```
dsasidharannair@ubuntudarshan:~$ ip route
default via 10.0.2.2 dev enp0s1 proto dhcp src 10.0.2.15 metric 100
10.0.2.0/24 dev enp0s1 proto kernel scope link src 10.0.2.15 metric 100
10.0.2.2 dev enp0s1 proto dhcp scope link src 10.0.2.15 metric 100
10.0.2.3 dev enp0s1 proto dhcp scope link src 10.0.2.15 metric 100
dsasidharannair@ubuntudarshan:~$ ssh dsasidharannair@10.0.2.2 -p 4321
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-91-generic aarch64)

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

 System information as of Thu Jan 18 11:33:39 PM UTC 2024

 System load:          0.0
 Usage of /:           22.9% of 29.82GB
 Memory usage:         5%
 Swap usage:          0%
 Processes:            100
 Users logged in:     1
 IPv4 address for enp0s1: 10.0.2.15
 IPv6 address for enp0s1: fec0::53:5aff:fe29:55c1

Expanded Security Maintenance for Applications is not enabled.
48 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

Last login: Thu Jan 18 23:30:05 2024 from 10.0.2.2
dsasidharannair@darshanubuntu2:~$
```

2. (25 points) Show an example of using the following commands (hint: you can use man to find more information about each one); take screen shots of your commands; make sure to clear the screen between each command; explain in your own words what these commands do:

a. SSH

```
dsasidharannair@ubuntudarshan:~$ ip route
default via 10.0.2.2 dev enp0s1 proto dhcp src 10.0.2.15 metric 100
10.0.2.0/24 dev enp0s1 proto kernel scope link src 10.0.2.15 metric 100
10.0.2.2 dev enp0s1 proto dhcp scope link src 10.0.2.15 metric 100
10.0.2.3 dev enp0s1 proto dhcp scope link src 10.0.2.15 metric 100
dsasidharannair@ubuntudarshan:~$ ssh dsasidharannair@10.0.2.2 -p 4321
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-91-generic aarch64)

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

System information as of Thu Jan 18 11:39:39 PM UTC 2024

System load:          0.0
Usage of /:           22.9% of 29.82GB
Memory usage:         5%
Swap usage:           0%
Processes:            100
Users logged in:     1
IPv4 address for enp0s1: 10.0.2.15
IPv6 address for enp0s1: fe00::53:5aff:fe29:55c1

Expanded Security Maintenance for Applications is not enabled.

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

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

Last login: Thu Jan 18 23:30:05 2024 from 10.0.2.2
dsasidharannair@darshanubuntu2:~$ _
```

SSH Command: Can be used for securely connecting to a remote machine over a network.

b. SSH-KEYGEN

```
[dsasidharannair@darshanubuntu2:~$ ssh-keygen
Generating public/private rsa key pair.
[Enter file in which to save the key (/home/dsasidharannair/.ssh/id_rsa):
[Enter passphrase (empty for no passphrase):
[Enter same passphrase again:
Your identification has been saved in /home/dsasidharannair/.ssh/id_rsa
Your public key has been saved in /home/dsasidharannair/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:1DPYQv4rU4EhmExgNraiHZZE+IochxFSH94rFGSJ6Bs dsasidharannair@darshanubuntu2
The key's randomart image is:
+---[RSA 3072]---+
|.*@***+. o
|+*.B+=+ + *
|o.B + . * *
|.E.+ o o +
|+.* . . S o
|oo . . .
| o .
| o
+---[SHA256]---+
```

Ssh-keygen command generates public and private keys to access the virtual system

c. SCP

```
Last login: Mon Jan 22 14:30:25 on ttys013
(base) darshannair@Darshans-MacBook-Pro ~ % scp -P 1234 dsasidharannair@127.0.0.1:/home/dsasidharannair/disk-benchmark-background-log.txt '/Users/darshannair/Desktop/CS 553 Assignments/'
[dsasidharannair@127.0.0.1's password:
disk-benchmark-background-log.txt
(base) darshannair@Darshans-MacBook-Pro ~ %
```

Scp command: Is used to securely copy files and directories to and from hosts over ssh.

d. HISTORY

```
dsasidharannair@ubuntudarshan:~$ history
 1  man man
 2  sudo apt install tasksel
 3  sudo tasksel install ubuntu-desktop
 4  sudo reboot
 5  sudo ufw enable
 6  ssh version
 7  ssh
 8  clear
 9  man ssh
10  man history
11  clear
12  history
dsasidharannair@ubuntudarshan:~$ _
```

History command: Displays the history of all the previous commands entered in the bash shell.

e. SUDO

```
dsasidharannair@ubuntudarshan:~$ sudo apt update
Ign:1 http://ports.ubuntu.com/ubuntu-ports Jammy InRelease
Ign:2 http://ports.ubuntu.com/ubuntu-ports Jammy-updates InRelease
Ign:3 http://ports.ubuntu.com/ubuntu-ports Jammy-backports InRelease
Ign:4 http://ports.ubuntu.com/ubuntu-ports Jammy-security InRelease
Ign:1 http://ports.ubuntu.com/ubuntu-ports Jammy InRelease
Ign:2 http://ports.ubuntu.com/ubuntu-ports Jammy-updates InRelease
Ign:3 http://ports.ubuntu.com/ubuntu-ports Jammy-backports InRelease
Ign:4 http://ports.ubuntu.com/ubuntu-ports Jammy-security InRelease
Ign:1 http://ports.ubuntu.com/ubuntu-ports Jammy InRelease
Ign:2 http://ports.ubuntu.com/ubuntu-ports Jammy-updates InRelease
Ign:3 http://ports.ubuntu.com/ubuntu-ports Jammy-backports InRelease
Ign:4 http://ports.ubuntu.com/ubuntu-ports Jammy-security InRelease
Err:1 http://ports.ubuntu.com/ubuntu-ports Jammy InRelease
  Temporary failure resolving 'ports.ubuntu.com'
Err:2 http://ports.ubuntu.com/ubuntu-ports Jammy-updates InRelease
  Temporary failure resolving 'ports.ubuntu.com'
Err:3 http://ports.ubuntu.com/ubuntu-ports Jammy-backports InRelease
  Temporary failure resolving 'ports.ubuntu.com'
Err:4 http://ports.ubuntu.com/ubuntu-ports Jammy-security InRelease
  Temporary failure resolving 'ports.ubuntu.com'
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
48 packages can be upgraded. Run 'apt list --upgradable' to see them.
W: Failed to fetch http://ports.ubuntu.com/ubuntu-ports/dists/jammy/InRelease  Temporary failure resolving 'ports.ubuntu.com'
W: Failed to fetch http://ports.ubuntu.com/ubuntu-ports/dists/jammy-updates/InRelease  Temporary failure resolving 'ports.ubuntu.com'
W: Failed to fetch http://ports.ubuntu.com/ubuntu-ports/dists/jammy-backports/InRelease  Temporary failure resolving 'ports.ubuntu.com'
W: Failed to fetch http://ports.ubuntu.com/ubuntu-ports/dists/jammy-security/InRelease  Temporary failure resolving 'ports.ubuntu.com'
W: Some index files failed to download. They have been ignored, or old ones used instead.
dsasidharannair@ubuntudarshan:~$ _
```

Sudo command: Runs commands with a higher privilege which can open up locked directories, files etc.

f. IP

```
dsasidharannair@ubuntudarshan:~$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
  link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
      valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
      valid_lft forever preferred_lft forever
2: enp0s1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
  link/ether d2:3c:69:de:7d:e7 brd ff:ff:ff:ff:ff:ff
    inet6 2620:f3:8000:5060:d03c:69ff:fede:7de7/64 scope global dynamic mngtmpaddr noprefixroute
      valid_lft 599780sec preferred_lft 599780sec
    inet6 fe80::d03c:69ff:fede:7de7/64 scope link
      valid_lft forever preferred_lft forever
dsasidharannair@ubuntudarshan:~$ _
```

Ip command: Can be used to view and edit network attributes relating to the system.

g. TOUCH and h. LS

```
dsasidharannair@ubuntudarshan:~$ touch samplefile.txt
dsasidharannair@ubuntudarshan:~$ ls
samplefile.txt
dsasidharannair@ubuntudarshan:~$ _
```

Touch command: Creates a new file in a specified directory by default in the current directory.

Ls command: Lists all the files/directories within the current directory.

i. MKDIR

```
dsasidharannair@ubuntudarshan:~$ mkdir SampleDirectory
dsasidharannair@ubuntudarshan:~$ ls
SampleDirectory  samplefile.txt
dsasidharannair@ubuntudarshan:~$
```

Mkdir command: Creates a new directory within the current directory.

j. CD

```
dsasidharannair@ubuntudarshan:~$ ls
SampleDirectory  samplefile.txt
dsasidharannair@ubuntudarshan:~$ cd SampleDirectory
dsasidharannair@ubuntudarshan:~/SampleDirectory$ ls
dsasidharannair@ubuntudarshan:~/SampleDirectory$
```

Cd command: Changes the current working directory

k. DD

```
dd: failed to open 'sample.txt': No such file or directory
dsasidharannair@ubuntudarshan:~$ ls
NewDirectory  SampleDirectory  samplefile.txt
dsasidharannair@ubuntudarshan:~$ dd if=samplefile.txt of=newsample.txt
0+0 records in
0+0 records out
0 bytes copied, 0.000463333 s, 0.0 kB/s
dsasidharannair@ubuntudarshan:~$ ls
NewDirectory  newsample.txt  SampleDirectory  samplefile.txt
dsasidharannair@ubuntudarshan:~$ _
```

Dd command: It is used for copying contents within one file to another file.

l. FDISK

```
dsasidharannair@ubuntudarshan:~$ sudo fdisk -l
[sudo] password for dsasidharannair:
Disk /dev/loop0: 59.25 MiB, 62124032 bytes, 121936 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes

Disk /dev/loop1: 46.41 MiB, 48668672 bytes, 95056 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes

Disk /dev/loop2: 109.61 MiB, 114929664 bytes, 224472 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes

Disk /dev/vda: 64 GiB, 68719476736 bytes, 134217728 sectors
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: 3C57F304-CCEB-4A79-A7B2-5782FCD59DC7

Device      Start      End  Sectors  Size Type
/dev/vda1    2048    2203647    2201600    1G EFI System
/dev/vda2  2203648  6397951   4194304    2G Linux filesystem
/dev/vda3  6397952 134215679 127817728 60.9G Linux filesystem

Disk /dev/mapper/ubuntu--vg-ubuntu--lv: 30.47 GiB, 32719765504 bytes, 63905792 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
dsasidharannair@ubuntudarshan:~$ _
```

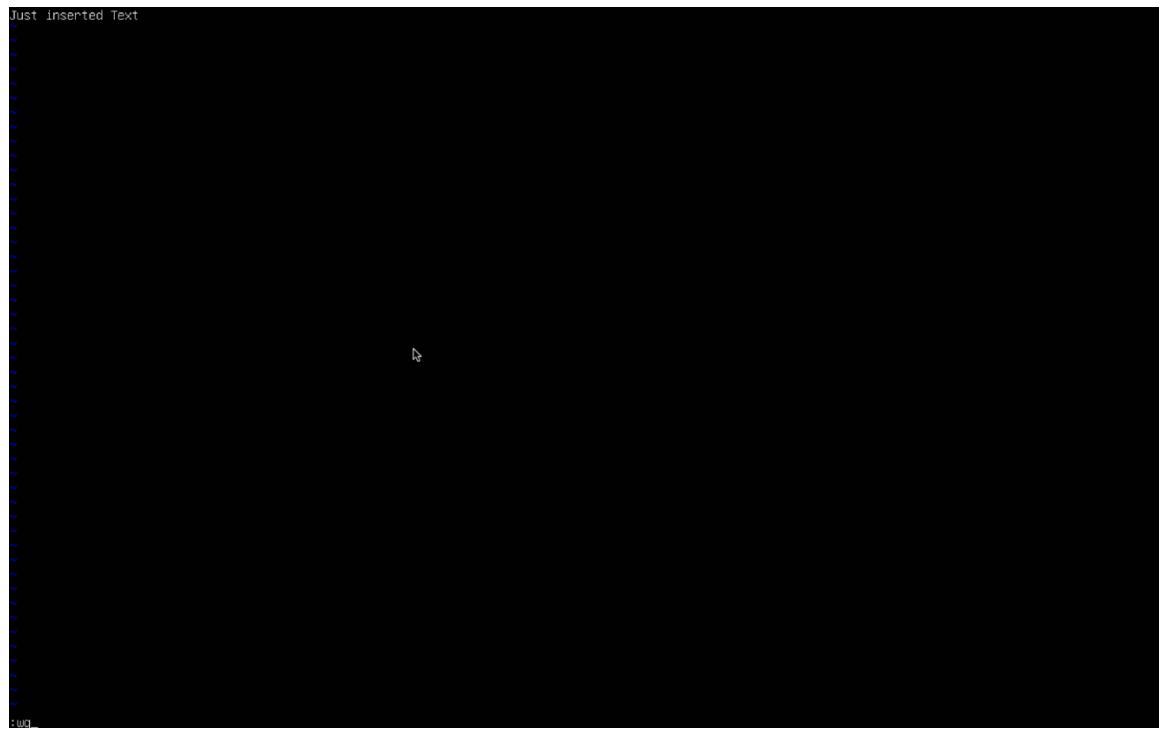
fdisk command: Used for viewing and manipulating the disk partition table.

m. APT

```
dsasidharannair@ubuntudarshan:~$ sudo apt update
Ign:1 http://ports.ubuntu.com/ubuntu-ports Jammy InRelease
Ign:2 http://ports.ubuntu.com/ubuntu-ports Jammy-updates InRelease
Ign:3 http://ports.ubuntu.com/ubuntu-ports Jammy-backports InRelease
Ign:4 http://ports.ubuntu.com/ubuntu-ports Jammy-security InRelease
Ign:1 http://ports.ubuntu.com/ubuntu-ports Jammy InRelease
Ign:2 http://ports.ubuntu.com/ubuntu-ports Jammy-updates InRelease
Ign:3 http://ports.ubuntu.com/ubuntu-ports Jammy-backports InRelease
Ign:4 http://ports.ubuntu.com/ubuntu-ports Jammy-security InRelease
Ign:1 http://ports.ubuntu.com/ubuntu-ports Jammy InRelease
Ign:2 http://ports.ubuntu.com/ubuntu-ports Jammy-updates InRelease
Ign:3 http://ports.ubuntu.com/ubuntu-ports Jammy-backports InRelease
Ign:4 http://ports.ubuntu.com/ubuntu-ports Jammy-security InRelease
Err:1 http://ports.ubuntu.com/ubuntu-ports Jammy InRelease
  Temporary failure resolving 'ports.ubuntu.com'
Err:2 http://ports.ubuntu.com/ubuntu-ports Jammy-updates InRelease
  Temporary failure resolving 'ports.ubuntu.com'
Err:3 http://ports.ubuntu.com/ubuntu-ports Jammy-backports InRelease
  Temporary failure resolving 'ports.ubuntu.com'
Err:4 http://ports.ubuntu.com/ubuntu-ports Jammy-security InRelease
  Temporary failure resolving 'ports.ubuntu.com'
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
48 packages can be upgraded. Run 'apt list --upgradable' to see them.
W: Failed to fetch http://ports.ubuntu.com/ubuntu-ports/dists/jammy/InRelease  Temporary failure resolving 'ports.ubuntu.com'
W: Failed to fetch http://ports.ubuntu.com/ubuntu-ports/dists/jammy-updates/InRelease  Temporary failure resolving 'ports.ubuntu.com'
W: Failed to fetch http://ports.ubuntu.com/ubuntu-ports/dists/jammy-backports/InRelease  Temporary failure resolving 'ports.ubuntu.com'
W: Failed to fetch http://ports.ubuntu.com/ubuntu-ports/dists/jammy-security/InRelease  Temporary failure resolving 'ports.ubuntu.com'
W: Some index files failed to download. They have been ignored, or old ones used instead.
dsasidharannair@ubuntudarshan:~$ _
```

apt command: apt is a high-level command line interface to interact with the inbuilt package management system.

n. VI



Vi command: Opens the VIM text editor on a specified file to read/modify the file

O. TIME

```
dsasidharannair@ubuntudarshan:~$ time ls
NewDirectory  newsample.txt  SampleDirectory  samplefile.txt

real    0m0.005s
user    0m0.004s
sys     0m0.001s
dsasidharannair@ubuntudarshan:~$ _
```

Time command: Measures the time taken to execute a command

P. TAR

```
dsasidharannair@ubuntudarshan:~$ ls
NewDirectory newsample.txt SampleDirectory samplefile.txt
dsasidharannair@ubuntudarshan:~$ tar -cv samplefile.txt
tar: Refusing to write archive contents to terminal (missing -f option?)
tar: Error is not recoverable: exiting now
dsasidharannair@ubuntudarshan:~$ tar -cvf archivedfile.tar samplefile.txt
samplefile.txt
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar NewDirectory newsample.txt SampleDirectory samplefile.txt
dsasidharannair@ubuntudarshan:~$
```

Tar command: Can be used to archive a file/directory or unzip a archived file

Q. RM

```
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar NewDirectory newsample.txt SampleDirectory samplefile.txt
dsasidharannair@ubuntudarshan:~$ rm newsample.txt
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar NewDirectory SampleDirectory samplefile.txt
dsasidharannair@ubuntudarshan:~$
```

Rm command: Can be used to remove files and directories.

R. CAT

```
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar NewDirectory SampleDirectory samplefile.txt
dsasidharannair@ubuntudarshan:~$ cat samplefile.txt
Just inserted Text
dsasidharannair@ubuntudarshan:~$
```

Cat command: Used to concatenate and print contents of a file.

S. BASH

```
dsasidharannair@ubuntudarshan:~$ bash
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar NewDirectory SampleDirectory samplefile.txt
dsasidharannair@ubuntudarshan:~$ exit
exit
dsasidharannair@ubuntudarshan:~$
```

Bash command: Opens a new bash shell session. Can use exit to exit this session

T. MORE

```
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar  NewDirectory  SampleDirectory  samplefile.txt
dsasidharannair@ubuntudarshan:~$ more samplefile.txt
Just inserted Text
dsasidharannair@ubuntudarshan:~$
```

More command: Similar to the cat command, displays the contents of the file. If text content exceeds screen length allows for screening the text page by page.

U. WATCH

```
dsasidharannair@ubuntudarshan:~$ watch ls
```

```
Every 2.0s: ls
archivedfile.tar
NewDirectory
SampleDirectory
samplefile.txt
                                         ubuntudarshan: Tue Jan 16 11:07:22 2024
```

Watch command executes a command periodically with full screen output

V. PS

```
dsasidharannair@ubuntudarshan:~$ ps
  PID TTY          TIME CMD
 980 tty1        00:00:00 bash
 2024 tty1        00:00:00 ps
dsasidharannair@ubuntudarshan:~$ _
```

Ps command: Displays the active processes running on the system.

W. TOP

```
top - 11:18:39 up 8:51, 1 user, load average: 0.01, 0.01, 0.00
Tasks: 96 total, 1 running, 95 sleeping, 0 stopped, 0 zombie
%Cpu(s): 0.0 us, 0.2 sy, 0.0 ni, 99.8 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
Mib Mem: 3911.5 total, 3191.5 free, 162.2 used, 557.9 buff/cache
Mib Swap: 3911.0 total, 3911.0 free, 0.0 used. 3601.3 avail Mem

PID USER PR NI VIRT RES SHR S %CPU %MEM TIME+ COMMAND
2081 dsasidh+ 20 0 9948 3432 2624 R 0.3 0.1 0:00:05 top
 1 root 20 0 101084 10780 7500 S 0.0 0.3 0:02.69 systemd
 2 root 20 0 0 0 0 S 0.0 0.0 0:00:02 kthreadd
 3 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 rcu_gp
 4 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 rcu_par_gp
 5 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 slab_flushwq
 6 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 netns
 8 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 kworker/0:0H-events_highpri
10 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 mm_percpu_wq
11 root 20 0 0 0 0 S 0.0 0.0 0:00:00 rcu_tasks_rude_
12 root 20 0 0 0 0 S 0.0 0.0 0:00:00 rcu_tasks_trace
13 root 20 0 0 0 0 S 0.0 0.0 0:00:27 ksoftirqd/0
14 root 20 0 0 0 0 I 0.0 0.0 0:00:45 rcu_sched
15 root rt 0 0 0 0 S 0.0 0.0 0:00:35 migration/0
16 root -51 0 0 0 0 S 0.0 0.0 0:00:00 idle_inject/0
18 root 20 0 0 0 0 S 0.0 0.0 0:00:00 cpuhp/0
19 root 20 0 0 0 0 S 0.0 0.0 0:00:00 cpuhp/1
20 root -51 0 0 0 0 S 0.0 0.0 0:00:00 idle_inject/1
21 root rt 0 0 0 0 S 0.0 0.0 0:00:38 migration/1
22 root 20 0 0 0 0 S 0.0 0.0 0:00:03 ksoftirqd/1
24 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 kworker/1:0H-events_highpri
25 root 20 0 0 0 0 S 0.0 0.0 0:00:00 kdevtmpfs
26 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 inet_frag_wq
28 root 20 0 0 0 0 S 0.0 0.0 0:00:00 kaudited
29 root 20 0 0 0 0 S 0.0 0.0 0:00:05 khungtaskd
30 root 20 0 0 0 0 S 0.0 0.0 0:00:00 oom_reaper
31 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 writeback
32 root 20 0 0 0 0 S 0.0 0.0 0:02:34 kcompactd0
33 root 25 5 0 0 0 S 0.0 0.0 0:00:00 ksmd
34 root 39 19 0 0 0 S 0.0 0.0 0:00:00 khugepaged
80 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 kintegrityd
81 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 kblockd
82 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 blkcg_punt_bio
83 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 tpm_dev_wq
84 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 ata_sff
85 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 md
86 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 edac-poller
87 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 devfreq_wq
88 root -51 0 0 0 0 S 0.0 0.0 0:00:00 watchdogd
90 root 0 -20 0 0 0 I 0.0 0.0 0:00:02 kworker/1:1H-kblockd
91 root 20 0 0 0 0 S 0.0 0.0 0:00:00 kswapd0
92 root 20 0 0 0 0 S 0.0 0.0 0:00:00 cryptifs-kthrea
94 root 0 -20 0 0 0 I 0.0 0.0 0:00:00 kthrotld
```

Top command: Opens a full screen output with system summary information as well as the top processes running on the system

X. HTOP

```

0[          0.0%]  Tasks: 26, 34 thr: 1 running
1[          0.7%]  Load average: 0.00 0.00 0.00
Mem[||||| 168M/3.82G]  Uptime: 08:55:19
Sup[          0K/3.82G]

PID USER PRI NI VIRT RES SHR S CPU%+MEM% TIME+ Command
 1 root  20  0 98M 10780 7500 S 0.0  0.3 0:02.70 /sbin/init
399 root  19 -1 46296 17740 16688 S 0.0  0.4 0:00.49 /lib/systemd/systemd-journald
442 root  20  0 25976 6580 4184 S 0.0  0.2 0:00.35 /lib/systemd/systemd-udevd
445 root  RT  0 282M 25664 7388 S 0.0  0.6 0:07.06 /sbin/multipathd -d -s
447 root  20  0 282M 25664 7388 S 0.0  0.6 0:00.00 /sbin/multipathd -d -s
448 root  RT  0 282M 25664 7388 S 0.0  0.6 0:00.00 /sbin/multipathd -d -s
449 root  RT  0 282M 25664 7388 S 0.0  0.6 0:00.00 /sbin/multipathd -d -s
450 root  RT  0 282M 25664 7388 S 0.0  0.6 0:00.12 /sbin/multipathd -d -s
451 root  RT  0 282M 25664 7388 S 0.0  0.6 0:05.54 /sbin/multipathd -d -s
452 root  RT  0 282M 25664 7388 S 0.0  0.6 0:00.00 /sbin/multipathd -d -s
555 systemd-t 20  0 86676 3780 3036 S 0.0  0.1 0:07.78 /lib/systemd/systemd-timesyncd
588 systemd-t 20  0 86676 3780 3036 S 0.0  0.1 0:05.38 /lib/systemd/systemd-timesyncd
614 systemd-t 20  0 16296 6852 5956 S 0.0  0.2 0:00.53 /lib/systemd/systemd-networkd
616 systemd-r 20  0 25240 11504 7348 S 0.0  0.3 0:07.51 /lib/systemd/systemd-resolved
627 root  20  0 6516 2580 2348 S 0.0  0.1 0:00.26 /usr/sbin/cron -f -P
628 messagebu 20  0 9116 4524 3668 S 0.0  0.1 0:00.06 @ibus-daemon --system --address=systemd: --nofork --nopidfile --systemd-activation --syslog-on
634 root  20  0 82096 3376 2980 S 0.0  0.1 0:02.88 /usr/sbin/irqbalance --foreground
635 root  20  0 32596 17932 9324 S 0.0  0.4 0:00.03 /usr/bin/python3 /usr/bin/networkd-dispatcher --run-startup-triggers
636 root  20  0 228M 6672 5932 S 0.0  0.2 0:00.00 /usr/libexec/polkitd --no-debug
637 syslog  20  0 216M 4480 3672 S 0.0  0.1 0:00.07 /usr/bin/rsyslogd -n -iNONE
640 root  20  0 653M 38560 19196 S 0.0  1.0 0:04.16 /usr/lib/snapd/snapd
643 root  20  0 15572 6876 5952 S 0.0  0.2 0:00.22 /lib/systemd/systemd-logind
645 root  20  0 384M 11500 9504 S 0.0  0.3 0:00.25 /usr/libexec/udisks2/udisksd
648 root  20  0 228M 6672 5932 S 0.0  0.2 0:00.00 /usr/libexec/polkitd --no-debug
650 syslog  20  0 216M 4480 3672 S 0.0  0.1 0:00.01 /usr/sbin/rsyslogd -n -iNONE
651 syslog  20  0 216M 4480 3672 S 0.0  0.1 0:00.00 /usr/sbin/rsyslogd -n -iNONE
652 syslog  20  0 384M 11500 9504 S 0.0  0.1 0:00.02 /usr/libexec/rsyslogd -n -iNONE
654 root  20  0 384M 11500 9504 S 0.0  0.3 0:00.00 /usr/libexec/udisks2/udisksd
663 root  20  0 82096 3376 2980 S 0.0  0.1 0:00.00 /usr/sbin/irqbalance --foreground
664 root  20  0 5212 800 724 S 0.0  0.0 0:00.00 /sbin/agetty -p -- %u --keep-baud 115200,57600,38400,9600 ttymA0 vt220
666 root  20  0 9692 4008 3324 S 0.0  0.1 0:00.02 /bin/login -p --
688 root  20  0 384M 11500 9504 S 0.0  0.3 0:00.00 /usr/libexec/udisks2/udisksd
684 root  20  0 228M 6672 5932 S 0.0  0.2 0:00.00 /usr/libexec/polkitd --no-debug
686 root  20  0 313M 11164 9244 S 0.0  0.3 0:00.04 /usr/sbin/ModemManager
690 root  20  0 15164 7972 6436 S 0.0  0.2 0:00.00 sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups
692 root  20  0 313M 11164 9244 S 0.0  0.3 0:00.00 /usr/sbin/ModemManager
693 root  20  0 384M 11500 9504 S 0.0  0.3 0:00.00 /usr/libexec/udisks2/udisksd
696 root  20  0 106M 20172 12036 S 0.0  0.5 0:00.02 /usr/bin/python3 /usr/share/unattended-upgrades/unattended-upgrade-shutdown --wait-for-signal
699 root  20  0 313M 11164 9244 S 0.0  0.3 0:00.00 /usr/sbin/ModemManager
705 root  20  0 106M 20172 12036 S 0.0  0.5 0:00.00 /usr/bin/python3 /usr/share/unattended-upgrades/unattended-upgrade-shutdown --wait-for-signal
706 root  20  0 384M 11500 9504 S 0.0  0.3 0:00.00 /usr/libexec/udisks2/udisksd
712 root  20  0 853M 38560 19196 S 0.0  1.0 0:00.44 /usr/lib/snapd/snapd

E1Help E2Setup E3Search E4Filter E5Tree E6SortBuf E7Nice -E8Nice E9Kill E10Quit

```

Htop command: Opens up an interactive processes screen with system summary and active processes where the user can use function keys to perform desired tasks.

Y. GCC

```
dsasidharannair@ubuntudarshan:~/Desktop$ gcc sample.c -o sample
dsasidharannair@ubuntudarshan:~/Desktop$ ls
disk-benchmark-background-log.txt  network-test-latency.txt      network-test.sh  sample  SampleDirectory
disk-benchmark-background.sh       network-test-machineList.txt  OutputFileDelete  sample.c
dsasidharannair@ubuntudarshan:~/Desktop$
```

```
dsasidharanna@ubuntudarshan:~$ ./sample
Hello World
dsasidharanna@ubuntudarshan:~$ _
```

Gcc command: Gcc is used to convert a .c file into a executable.

Z. TAIL

```
dsasidharannair@ubuntudarshan:~$ tail samplefile.txt
Line 4
Line 5
Line 6
Line 7
Line 8
Line 9
Line 10
Line11
Line 12

dsasidharannair@ubuntudarshan:~$
```

Tail command: Displays the last 10 lines of the file to standard output

AA. GREP

```
dsasidharannair@ubuntudarshan:~$ grep "Line " samplefile.txt
Line 1
Line 2
Line 3
Line 4
Line 5
Line 6
Line 7
Line 8
Line 9
Line 10
Line 12
dsasidharannair@ubuntudarshan:~$
```

Grep command: Can be used to search for patterns in a text file.

BB. KILL

```
killprogram.sh [new] 32, too many
dsasidharannair@ubuntudarshan:~$ chmod +x killprogram.sh
dsasidharannair@ubuntudarshan:~$ ps
  PID TTY      TIME CMD
 1039 tty1    00:00:01 bash
 5637 tty1    00:00:00 ps
dsasidharannair@ubuntudarshan:~$ ./killprogram.sh
Start Sleep Background process
Started
dsasidharannair@ubuntudarshan:~$ ps
  PID TTY      TIME CMD
 1039 tty1    00:00:01 bash
 5639 tty1    00:00:00 sleep
 5640 tty1    00:00:00 ps
dsasidharannair@ubuntudarshan:~$ kill 5639
dsasidharannair@ubuntudarshan:~$ ps
  PID TTY      TIME CMD
 1039 tty1    00:00:01 bash
 5641 tty1    00:00:00 ps
dsasidharannair@ubuntudarshan:~$
```

Kill command: Sends a signal to a specific process by process ID. Default signal is terminate. In the above example I ran a simple background process and then terminated it using kill.

CC. KILLALL

```
dsasidharannair@ubuntudarshan:~$ ./killprogram.sh
Start Sleep Background process
Started
dsasidharannair@ubuntudarshan:~$ ps
  PID TTY      TIME CMD
 1039 tty1    00:00:01 bash
 5664 tty1    00:00:00 sleep
 5665 tty1    00:00:00 ps
dsasidharannair@ubuntudarshan:~$ killall sleep
dsasidharannair@ubuntudarshan:~$ ps
  PID TTY      TIME CMD
 1039 tty1    00:00:01 bash
 5668 tty1    00:00:00 ps
dsasidharannair@ubuntudarshan:~$
```

Killall command: Sends a signal to all processes. Default signal is terminate. In the above example I ran a simple background process and then terminated it using kill.

DD. DU

```
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar  NewDirectory  SampleDirectory  samplefile.txt
dsasidharannair@ubuntudarshan:~$ du samplefile.txt
4      samplefile.txt
dsasidharannair@ubuntudarshan:~$ _
```

Du command: Used to estimate the usage space for a file/directory.

EE. DF

```
dsasidharannair@ubuntudarshan:~$ df
Filesystem      1K-blocks    Used Available Use% Mounted on
tmpfs            400536    1296   399240  1% /run
/dev/mapper/ubuntu--vg-ubuntu--lv 31270768 7021360 22635380 24% /
tmpfs            2002676      0  2002676  0% /dev/shm
tmpfs              5120      0    5120  0% /run/lock
/dev/vda2        1992552 131580  1739732  8% /boot
/dev/vda1        1098628   6452  1092176  1% /boot/efi
tmpfs            400532       4   400528  1% /run/user/1000
dsasidharannair@ubuntudarshan:~$ _
```

Df command: Displays information about disk usage in the system.

FF. SCREEN

```
dsasidharannair@ubuntudarshan:~$ screen

GNU Screen version 4.09.00 (GNU) 30-Jan-22
Copyright (c) 2018-2020 Alexander Naumov, Amadeusz Sławiński
Copyright (c) 2015-2017 Juergen Weigert, Alexander Naumov, Amadeusz Sławiński
Copyright (c) 2010-2014 Juergen Weigert, Sadrul Habib Chowdhury
Copyright (c) 2008-2009 Juergen Weigert, Michael Schroeder, Micah Cowan, Sadrul Habib Chowdhury
Copyright (c) 1993-2007 Juergen Weigert, Michael Schroeder
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You should have received a copy of the GNU General Public License along with this program (see the file COPYING); if not, see https://www.gnu.org/licenses/, or contact Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02111-1301 USA.

Send bugreports, fixes, enhancements, t-shirts, money, beer & pizza to screen-devel@gnu.org

Capabilities:
+copy +remote-detach +power-detach +multi-attach +multi-user +font +color-256 +utf8 +rxvt +builtin-telnet

[Press Space or Return to end.]
dsasidharannair@ubuntudarshan:~$ screen -ls
There are screens on:
  2567.tty1.ubuntudarshan (01/16/2024 02:06:27 PM)          (Attached)
  2492.tty1.ubuntudarshan (01/16/2024 01:58:07 PM)          (Detached)
2 Sockets in /run/screen/S-dsasidharannair.
dsasidharannair@ubuntudarshan:~$ _
```

Screen command: Screen is a full screen window manager that used to create and manage terminal sessions.

GG. VIM

```
dsasidharannair@ubuntudarshan:~$ vim samplefile.txt_
```

Line 1
Line 2
Line 3
Line 4
Line 5
Line 6
Line 7
Line 8
Line 9
Line 10
Line11
Line 12
Line 13

200

Vim command: Opens a text editor compatible to Vi and is especially useful for editing programs.

HH. CHMOD

```
dsasidharannair@ubuntudarshan:~$ ls -l samplefile.txt
-rw-rw-r-- 1 dsasidharannair dsasidharannair 94 Jan 16 14:30 samplefile.txt
dsasidharannair@ubuntudarshan:~$ chmod u=r,go=r samplefile.txt
dsasidharannair@ubuntudarshan:~$ ls -l samplefile.txt
-r--r--r-- 1 dsasidharannair dsasidharannair 94 Jan 16 14:30 samplefile.txt
dsasidharannair@ubuntudarshan:~$ _
```

Chmod command: Can be used to change the permissions for a certain file or directory. In the above example, I changed the user permission and group permission to read only.

II. CHOWN

```
dsasidharannair@ubuntudarshan:~$ ls -l samplefile.txt
-r--r--r-- 1 dsasidharannair dsasidharannair 94 Jan 16 14:30 samplefile.txt
dsasidharannair@ubuntudarshan:~$ chown guest samplefile.txt
chown: changing ownership of 'samplefile.txt': Operation not permitted
dsasidharannair@ubuntudarshan:~$ sudo chown guest samplefile.txt
dsasidharannair@ubuntudarshan:~$ ls -l samplefile.txt
-r--r--r-- 1 guest dsasidharannair 94 Jan 16 14:30 samplefile.txt
dsasidharannair@ubuntudarshan:~$ _
```

Chown command: Changes the ownership of a certain file or directory to the specified user.

JJ. USERADD

```
dsasidharannair@ubuntudarshan:~$ sudo useradd guest
[sudo] password for dsasidharannair:
```

```
dsasidharannair@ubuntudarshan:~$ sudo passwd guest
New password:
Retype new password:
passwd: password updated successfully
dsasidharannair@ubuntudarshan:~$ su guest
Password:
$ who
dsasidharannair  tty1          2024-01-18 17:40
$ whoami
guest
$
```

Useradd command: Is a low-level utility used for adding users to the system.

KK. MV

```
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar  NewDirectory  SampleDirectory  samplefile.txt
dsasidharannair@ubuntudarshan:~$ mv samplefile.txt SampleDirectory/newname.txt
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar  NewDirectory  SampleDirectory
dsasidharannair@ubuntudarshan:~$ ls SampleDirectory
Directory1file.txt  newname.txt
dsasidharannair@ubuntudarshan:~$
```

Mv command: Can be used to mv files between directories and/or rename the file.

LL. MAN

```
dsasidharannair@ubuntudarshan:~$ man man
```

```

MAN(1)                                Manual pager utils                                MAN(1)

NAME
    man - an interface to the system reference manuals

SYNOPSIS
    man [man options] [[section] page ...] ...
    man -k [apropos options] regexp ...
    man -K [man options] [section] term ...
    man -f [whatis options] page ...
    man -l [man options] file ...
    man -w|-W [man options] page ...

DESCRIPTION
    man is the system's manual pager. Each page argument given to man is normally the name of a program, utility or function. The manual page associated with each of these arguments is then found and displayed. A section, if provided, will direct man to look only in that section of the manual. The default action is to search in all of the available sections following a pre-defined order (see DEFAULTS), and to show only the first page found, even if page exists in several sections.

    The table below shows the section numbers of the manual followed by the types of pages they contain.

1 Executable programs or shell commands
2 System calls (functions provided by the kernel)
3 Library calls (functions within program libraries)
4 Special files (usually found in /dev)
5 File formats and conventions, e.g. /etc/passwd
6 Games
7 Miscellaneous (including macro packages and conventions), e.g. man(7), groff(7), man-pages(7)
8 System administration commands (usually only for root)
9 Kernel routines [Non standard]

    A manual page consists of several sections.

    Conventional section names include NAME, SYNOPSIS, CONFIGURATION, DESCRIPTION, OPTIONS, EXIT STATUS, RETURN VALUE, ERRORS, ENVIRONMENT, FILES, VERSIONS, CONFORMING TO, NOTES, BUGS, EXAMPLE, AUTHORS, and SEE ALSO.

    The following conventions apply to the SYNOPSIS section and can be used as a guide in other sections.

bold text      type exactly as shown.
italic text    replace with appropriate argument.
[abc]          any or all arguments within [ ] are optional.
-a|-b         options delimited by | cannot be used together.
argument ...  argument is repeatable.
[expression] ... entire expression within [ ] is repeatable.

    Exact rendering may vary depending on the output device. For instance, man will usually not be able to render italics when running in a terminal, and will typically use underlined or coloured text instead.

    The command or function illustration is a pattern that should match all possible invocations. In some cases it is advisable to illustrate several
Manual page man(1) line 1 (press h for help or q to quit)

```

Man command: Is used as an interface to access the systems command manuals.

MM. LOCATE

```

dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar  NewDirectory  SampleDirectory
dsasidharannair@ubuntudarshan:~$ ls SampleDirectory
Directory1file.txt  newname.txt
dsasidharannair@ubuntudarshan:~$ locate newname.txt
dsasidharannair@ubuntudarshan:~$ sudo updatedb
dsasidharannair@ubuntudarshan:~$ locate newname.txt
/home/dsasidharannair/SampleDirectory/newname.txt
dsasidharannair@ubuntudarshan:~$ _

```

Locate command: Finds the location of the files or directories within the system by name or pattern

NN. FIND

```
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar  disk-benchmark-background-log.txt  disk-benchmark-background.sh  OutputFileDelete  SampleDirectory  yes  yes.pub
dsasidharannair@ubuntudarshan:~$ ls SampleDirectory
Directoryfile.txt  newname.txt
dsasidharannair@ubuntudarshan:~$ find SampleDirectory
SampleDirectory
SampleDirectory/Directoryfile.txt
SampleDirectory/newname.txt
dsasidharannair@ubuntudarshan:~$ find SampleDirectory -name newname.txt
SampleDirectory/newname.txt
dsasidharannair@ubuntudarshan:~$
```

Find command: Is a utility used for finding files or directories within a specified directory. If directory is not specified defaults to current directory.

OO. SED

```
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar  disk-benchmark-background-log.txt  disk-benchmark-background.sh  OutputFileDelete  SampleDirectory  Toedit.txt  yes  yes.pub
dsasidharannair@ubuntudarshan:~$ cat Toedit.txt
Hello, How are you doing today?
dsasidharannair@ubuntudarshan:~$ sed "s/today/tomorrow/" Toedit.txt
sed: -e expression #1, char 16: unterminated 's' command
dsasidharannair@ubuntudarshan:~$ sed "s/today/tomorrow/" Toedit.txt
Hello, How are you doing tomorrow?
dsasidharannair@ubuntudarshan:~$
```

Sed command: It is a text processing tool used to perform basic text transformations on an input stream. The above example replaces a string in a file with another string.

PP. AWK

```
dsasidharannair@ubuntudarshan:~$ cat Toedit.txt
Hello, How are you doing today?
Hello, Are you going to college?
Bye See you later!
dsasidharannair@ubuntudarshan:~$ awk '/Hello/ {print}' Toedit.txt
Hello, How are you doing today?
Hello, Are you going to college?
dsasidharannair@ubuntudarshan:~$ awk '{print $2}' Toedit.txt
How
Are
See
dsasidharannair@ubuntudarshan:~$
```

Awk command: Awk is an utility that allows the user to pattern scan and process data within a file. The first command in the above example prints all the strings that contain Hello and the second prints the second word in each of the three sentences.

QQ. DIFF

```
dsasidharannair@ubuntudarshan:~$ cat Toedit.txt
Hello, How are you doing today?
Hello, Are you going to college?
Bye See you later!
dsasidharannair@ubuntudarshan:~$ cat Tocompare.txt
Hello, how are you doing tommorow?
Hello, are you going to school?
Bye See you later!
dsasidharannair@ubuntudarshan:~$ diff Toedit.txt Tocompare.txt
1,2c1,2
< Hello, How are you doing today?
< Hello, Are you going to college?
---
> Hello, how are you doing tommorow?
> Hello, are you going to school?
dsasidharannair@ubuntudarshan:~$
```

Diff command: It is an utility used to compare two files line by line and outputs the lines that do not match.

RR. SORT

```
dsasidharannair@ubuntudarshan:~$ cat Tosort.txt
e
d
c
b
a
dsasidharannair@ubuntudarshan:~$ sort Tosort.txt
a
b
c
d
e
dsasidharannair@ubuntudarshan:~$ _
```

Sort command: It is a tool used to sort lines alphabetically from a file. It can also arrange lines numerically. The above example sorts lines alphabetically.

SS. EXPORT

```
dsasidharannair@ubuntudarshan:~$ export EXAMPLE="sample"
dsasidharannair@ubuntudarshan:~$ export
declare -x DBUS_SESSION_BUS_ADDRESS="unix:path=/run/user/1000/bus"
declare -x EXAMPLE="sample"
declare -x HOME="/home/dsasidharannair"
declare -x HUSHLOGIN="FALSE"
declare -x INVOCATION_ID="995c2c8d25f46c29ee3eba0e7ab07a7"
declare -x JOURNAL_STREAM="8:20238"
declare -x LANG="en_US.UTF-8"
declare -x LESSCLOSE="/usr/bin/lesspipe %s %s"
declare -x LESSOPEN="| /usr/bin/lesspipe %s"
declare -x LOGNAME="dsasidharannair"
declare -x LS_COLORS="rs=0:di=0:ln=0:pi=0:so=0:st=0:bd=0:33:cd=0:33:or=0:31:mi=0:0:su=37:41:sg=30:43:ca=30:41:tw=30:42:ow=3
4:42:st=37:44:ex=01:32:*,tar=01:31:*,tgz=01:31:*,arc=01:31:*,arj=01:31:*,lha=01:31:*,l2z=01:31:*,lzh=01:31:*,lzma=01:31:*,lzo=01:31:*,lz=01:31:*,xz=01:31:*,zst=01:31:*,tzst=01:31:*,bz2=01:31:*,bz=01:31:*,tbz=01:31:*,tb2=01:31:*,tz=01:31:*,deb=01:31:*,rpm=01:31:*,jar=01:31:*,war=01:31:*,ear=01:31:*,sar=01:31:*,rar=01:31:*,alz=01:31:*,ace=01:31:*,zoo=01:31:*,cpio=01:31:*,cab=01:31:*,rz=01:31:*,win=01:31:*,sum=01:31:*,dum=01:31:*,esd=01:31:*,jpeg=01:35:*,mpg=01:35:*,mpeg=01:35:*,gif=01:35:*,bmp=01:35:*,pbm=01:35:*,pgm=01:35:*,ppm=01:35:*,tga=01:35:*,xbm=01:35:*,xpm=01:35:*,tif=01:35:*,tiff=01:35:*,png=01:35:*,svg=01:35:*,svz=01:35:*,mng=01:35:*,pcx=01:35:*,mov=01:35:*,mpg=01:35:*,mpeg=01:35:*,m2v=01:35:*,mkv=01:35:*,webm=01:35:*,webp=01:35:*,ogm=01:35:*,mp4=01:35:*,mp4v=01:35:*,mp4v=01:35:*,vob=01:35:*,qt=01:35:*,ogg=00:36:*,ra=00:36:*,wav=00:36:*,ogg=00:36:*,opus=00:36:*,spx=00:36:*,xspf=00:36:*
declare -x MAIL="/var/mail/dsasidharannair"
declare -x MOTD_SHOWN="pam"
declare -x OLDPWD
declare -x PATH="/usr/local/sbin:/usr/local/bin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin"
declare -x PWD="/home/dsasidharannair"
declare -x SHELL="/bin/bash"
declare -x SHLVL="1"
declare -x SYSTEM_EXEC_PID="716"
declare -x TERM="linux"
declare -x USER="dsasidharannair"
declare -x XDG_DATA_DIRS="/usr/local/share:/var/lib/snapd/desktop"
declare -x XDG_RUNTIME_DIR="/run/user/1000"
declare -x XDG_SEAT="seat0"
declare -x XDG_SESSION_CLASS="user"
declare -x XDG_SESSION_ID="1"
declare -x XDG_SESSION_TYPE="tty"
declare -x XDG_VTNR="1"
dsasidharannair@ubuntudarshan:~$ EXAMPLE
EXAMPLE: command not found
dsasidharannair@ubuntudarshan:~$ echo $EXAMPLE
sample
dsasidharannair@ubuntudarshan:~$ _
```

Export command: Can be used to set the environment variable for the current shell session. The above example sets an environment variable EXAMPLE and then echo's it.

TT. PWD

```
dsasidharannair@ubuntudarshan:~$ pwd
/home/dsasidharannair
dsasidharannair@ubuntudarshan:~$ cd SampleDirectory
dsasidharannair@ubuntudarshan:~/SampleDirectory$ pwd
/home/dsasidharannair/SampleDirectory
dsasidharannair@ubuntudarshan:~/SampleDirectory$ _
```

Pwd command: Outputs the current/working directory

III. CRONTAB

```
dsasidharannair@ubuntudarshan:~$ crontab -l
# Edit this file to introduce tasks to be run by cron.
#
# Each task to run has to be defined through a single line
# indicating with different fields when the task will be run
# and what command to run for the task
#
# To define the time you can provide concrete values for
# minute (m), hour (h), day of month (dom), month (mon),
# and day of week (dow) or use '*' in these fields (for 'any').
#
# Notice that tasks will be started based on the cron's system
# daemon's notion of time and timezones.
#
# Output of the crontab jobs (including errors) is sent through
# email to the user the crontab file belongs to (unless redirected).
#
# For example, you can run a backup of all your user accounts
# at 5 a.m every week with:
# 0 5 * * 1 tar -zcf /var/backups/home.tgz /home/
#
# For more information see the manual pages of crontab(5) and cron(8)
#
# m h  dom mon dow   command
*/1 * * * * /tmp/killprogram.sh
dsasidharannair@ubuntudarshan:~$
```

Crontab command: Is a utility in bash used to add and manage cron jobs. These are jobs/tasks that are executed automatically at specified intervals of time.

VV. MOUNT

```
dsasidharannair@ubuntudarshan:~/SampleDirectory$ mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
udev on /dev type devtmpfs (rw,nosuid,relatime,size=1930496k,nr_inodes=482624,mode=755,inode64)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,nodev,noexec,relatime,size=400536k,mode=755,inode64)
efivarfs on /sys/firmware/efi/efivars type efivarfs (rw,nosuid,nodev,noexec,relatime)
/dev/mapper/ubuntu--vg-ubuntu--lv on / type ext4 (rw,relatime)
securityfs on /sys/kernel/security type securityfs (rw,nosuid,nodev,noexec,relatime)
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev,inode64)
tmpfs on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k,inode64)
cgroup2 on /sys/fs/cgroup type cgroup2 (rw,nosuid,nodev,noexec,relatime,nsdelegate,memory_recursiveprot)
pstore on /sys/fs/pstore type pstore (rw,nosuid,nodev,noexec,relatime)
bpf on /sys/fs/bpf type bpf (rw,nosuid,nodev,noexec,relatime,mode=700)
systemd-1 on /proc/sys/fs/binfmt_misc type autofs (rw,relatime,fd=29,pgrp=1,timeout=0,minproto=5,maxproto=5,direct,pipe_ino=18578)
debugfs on /sys/kernel/debug type debugfs (rw,nosuid,nodev,noexec,relatime)
tracefs on /sys/kernel/tracing type tracefs (rw,nosuid,nodev,noexec,relatime)
mqueue on /dev/mqueue type mqueue (rw,nosuid,nodev,noexec,relatime)
hugetlbfs on /dev/hugepages type hugetlbfs (rw,relatime,pagesize=2M)
configfs on /sys/kernel/config type configfs (rw,nosuid,nodev,noexec,relatime)
none on /run/credentials/systemd-sysusers.service type ramfs (ro,nosuid,nodev,noexec,relatime,mode=700)
fusectl on /sys/fs/fuse/connections type fusectl (rw,nosuid,nodev,noexec,relatime)
/var/lib/snapd/snaps/core20_1977.snap on /snap/core20/1977 type squashfs (ro,nodev,relatime,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/snapd_19459.snap on /snap/snapd/19459 type squashfs (ro,nodev,relatime,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/snapd_20674.snap on /snap/snapd/20674 type squashfs (ro,nodev,relatime,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/core20_2107.snap on /snap/core20/2107 type squashfs (ro,nodev,relatime,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/1xd_24326.snap on /snap/1xd/24326 type squashfs (ro,nodev,relatime,errors=continue,x-gdu.hide)
/dev/vda2 on /boot type ext4 (rw,relatime)
/dev/vda1 on /boot/efi type vfat (rw,relatime,fmask=0022,dmask=0022,codepage=437,iocharset=iso8859-1,shortname=mixed,errors=remount-ro)
binfmt_misc on /proc/sys/fs/binfmt_misc type binfmt_misc (rw,nosuid,nodev,noexec,relatime)
tmpfs on /run/snapd/ns type tmpfs (rw,nosuid,nodev,noexec,relatime,size=400536k,mode=755,inode64)
nsfs on /run/snapd/ns/1xd.mnt type nsfs (rw)
tmpfs on /run/user/1000 type tmpfs (rw,nosuid,nodev,relatime,size=400536k,nr_inodes=100134,mode=700,uid=1000,gid=1000,inode64)
dsasidharannair@ubuntudarshan:~/SampleDirectory$
```

Mount command: It is a utility used to mount file systems found on some device into some directory in the Linux file tree. The above example just displays the already mounted filesystems.

WW. PASSWD

```
dsasidharannair@ubuntudarshan:~$ sudo passwd guest
New password:
Retype new password:
passwd: password updated successfully
dsasidharannair@ubuntudarshan:~$ su guest
Password:
$ who
dsasidharannair  tty1          2024-01-18 17:40
$ whoami
guest
$
```

Passwd command: Helps change passwords for user accounts.

XX. UNAME

```
dsasidharannair@ubuntudarshan:~/SampleDirectory$ uname
Linux
dsasidharannair@ubuntudarshan:~/SampleDirectory$ uname -a
Linux ubuntudarshan 5.15.0-91-generic #101-Ubuntu SMP Tue Nov 14 13:29:11 UTC 2023 aarch64 aarch64 aarch64 GNU/Linux
dsasidharannair@ubuntudarshan:~/SampleDirectory$
```

Uname command: Displays all of the system information.

YY. WHEREIS

```
dsasidharannair@ubuntudarshan:~/SampleDirectory$ whereis bash
bash: /usr/bin/bash /usr/share/man/man1/bash.1.gz
dsasidharannair@ubuntudarshan:~/SampleDirectory$ whereis ls
ls: /usr/bin/ls /usr/share/man/man1/ls.1.gz
dsasidharannair@ubuntudarshan:~/SampleDirectory$
```

Whereis command: Is a utility used to locate the source, binary and manual page for a command. The above example finds the location for both ls and bash commands.

ZZ. WHATIS

```
dsasidharannair@ubuntudarshan:~/SampleDirectory$ whatis whatis
whatis (1)           - display one-line manual page descriptions
dsasidharannair@ubuntudarshan:~/SampleDirectory$ whatis ls
ls (1)               - list directory contents
dsasidharannair@ubuntudarshan:~/SampleDirectory$ _
```

Whatis command: Outputs a one line description of the command's manual page.

AAA. LESS

```
dsasidharannair@ubuntudarshan:~$ less Tosort.txt
e
d
c
b
a
Tosort.txt (END)
```

Less command: Less is a utility that helps read contents of a file while providing navigation features to the user.

BBB. SU

```
dsasidharannair@ubuntudarshan:~$ sudo passwd guest
New password:
Retype new password:
passwd: password updated successfully
dsasidharannair@ubuntudarshan:~$ su guest
Password:
$ who
dsasidharannair  tty1          2024-01-18 17:40
$ whoami
guest
$
```

Su command: It is a utility used to switch to another user within the system. Can also be used to run commands as a different user.

CCC. PING

```
dsasidharannair@ubuntudarshan:~$ ping google.com
PING google.com (142.250.190.46) 56(84) bytes of data.
ping: Warning: time of day goes back (-466710721856713834us), taking countermeasures
ping: Warning: time of day goes back (-466710721856708063us), taking countermeasures
64 bytes from ord37s33-in-f14.1e100.net (142.250.190.46): icmp_seq=0 ttl=255 time=0.000 ms
wrong data byte #16 should be 0x10 but was 0x0
#16      0 1 0 1 13 c9 aa 65 0 0 0 0 af 90 5 0 0 0 0 0 10 11 12 13 14 15 16 17 18 19 1a 1b
#48      1c 1d 1e 1f 20 21 22 23
64 bytes from ord37s33-in-f14.1e100.net (142.250.190.46): icmp_seq=0 ttl=255 time=882961791471894 ms (DUP!)
wrong data byte #16 should be 0x10 but was 0x0
#16      0 1 0 2 14 c9 aa 65 0 0 0 0 69 a2 5 0 0 0 0 0 10 11 12 13 14 15 16 17 18 19 1a 1b
#48      1c 1d 1e 1f 20 21 22 23
64 bytes from ord37s33-in-f14.1e100.net (142.250.190.46): icmp_seq=0 ttl=255 time=2342691020694355 ms (DUP!)
wrong data byte #16 should be 0x10 but was 0x0
#16      0 1 0 3 15 c9 aa 65 0 0 0 0 aa b5 5 0 0 0 0 0 10 11 12 13 14 15 16 17 18 19 1a 1b
#48      1c 1d 1e 1f 20 21 22 23
64 bytes from ord37s33-in-f14.1e100.net (142.250.190.46): icmp_seq=0 ttl=255 time=3782998476523795 ms (DUP!)
wrong data byte #16 should be 0x10 but was 0x0
#16      0 1 0 4 16 c9 aa 65 0 0 0 0 a6 c8 5 0 0 0 0 0 10 11 12 13 14 15 16 17 18 19 1a 1b
#48      1c 1d 1e 1f 20 21 22 23
64 bytes from ord37s33-in-f14.1e100.net (142.250.190.46): icmp_seq=0 ttl=255 time=5456648688046352 ms (DUP!)
wrong data byte #16 should be 0x10 but was 0x0
#16      0 1 0 5 17 c9 aa 65 0 0 0 0 df de 5 0 0 0 0 0 10 11 12 13 14 15 16 17 18 19 1a 1b
#48      1c 1d 1e 1f 20 21 22 23
64 bytes from ord37s33-in-f14.1e100.net (142.250.190.46): icmp_seq=0 ttl=255 time=7374900654330480 ms (DUP!)
wrong data byte #16 should be 0x10 but was 0x0
#16      0 1 0 6 18 c9 aa 65 0 0 0 0 7c f8 5 0 0 0 0 0 10 11 12 13 14 15 16 17 18 19 1a 1b
#48      1c 1d 1e 1f 20 21 22 23
64 bytes from ord37s33-in-f14.1e100.net (142.250.190.46): icmp_seq=0 ttl=255 time=9026314342692904 ms (DUP!)
wrong data byte #16 should be 0x10 but was 0x0
#16      0 1 0 7 19 c9 aa 65 0 0 0 0 66 e 6 0 0 0 0 0 10 11 12 13 14 15 16 17 18 19 1a 1b
#48      1c 1d 1e 1f 20 21 22 23
^C
--- google.com ping statistics ---
7 packets transmitted, 1 received, +6 duplicates, 85.7143% packet loss, time 6032ms
rtt min/avg/max/mdev = 0.000/4123787853394254.336/9026314342692904.473/-9223372036854775.-808 ms, pipe 8
dsasidharannair@ubuntudarshan:~$
```

Ping command: Sends a ICMP echo request to a specified network host to test its reachability.

DDD. TRACEROUTE

```
dsasidharannair@ubuntudarshan:~$ traceroute google.com
traceroute to google.com (142.250.190.46), 30 hops max, 60 byte packets
 1  _gateway (10.0.2.2)  1.007 ms  0.940 ms  0.921 ms
 2  * * *
 3  * * *
 4  * * *
 5  * * *
 6  * * *
 7  * * *
 8  * * *
 9  * * *
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
```

Traceroute command: It is a utility that outputs the route that packets take from an IP network(source) to a network host(destination).

EEE. DATE

```
dsasidharannair@ubuntudarshan:~$ date
Fri Jan 19 07:16:51 PM UTC 2024
dsasidharannair@ubuntudarshan:~$ _
```

Date command: Is a utility used to view or modify the date and time of the system.

FFF. WGET

Wget command: Is a utility used for downloading files directly from a web link. The above examples downloads a sample text file from a GitHub account.

GGG. WC

```
dsasidharannair@ubuntudarshan:~$ ls
archivedfile.tar          disk-benchmark-background.sh  SampleDirectory  Tosort.txt  yes.pub
disk-benchmark-background-log.txt  OutputFileDelete      sample_log_file.txt  yes
dsasidharannair@ubuntudarshan:~$ wc sample_log_file.txt
 30 300 2599 sample_log_file.txt
dsasidharannair@ubuntudarshan:~$ _
```

Wc command: It is a utility that outputs the number of lines, words and bytes for specified file/files.

HHH. CLEAR

Before clear

```

clear(1)                                General Commands Manual                               clear(1)
NAME      clear - clear the terminal screen
SYNOPSIS  clear [-Ttype] [-V] [-X]
DESCRIPTION
    clear clears your screen if this is possible, including its scrollback buffer (if the extended "E3" capability is defined). clear looks in the environment for the terminal type given by the environment variable TERM, and then in the terminfo database to determine how to clear the screen.

    clear writes to the standard output. You can redirect the standard output to a file (which prevents clear from actually clearing the screen), and later cat the file to the screen, clearing it at that point.

OPTIONS
-T type
    indicates the type of terminal. Normally this option is unnecessary, because the default is taken from the environment variable TERM. If -T is specified, then the shell variables LINES and COLUMNS will also be ignored.

-V
    reports the version of ncurses which was used in this program, and exits. The options are as follows:

-X
    do not attempt to clear the terminal's scrollback buffer using the extended "E3" capability.

HISTORY
A clear command appeared in 2.79BSD dated February 24, 1979. Later that was provided in Unix 8th edition (1985).

AT&T adapted a different BSD program (tset) to make a new command (tput), and used this to replace the clear command with a shell script which calls tput clear, e.g.:

/usr/bin/tput ${1:+-T$1} clear 2> /dev/null
exit

In 1989, when Keith Bostic revised the BSD tput command to make it similar to the AT&T tput, he added a shell script for the clear command:
exec tput clear

The remainder of the script in each case is a copyright notice.

The ncurses clear command began in 1995 by adapting the original BSD clear command (with terminfo, of course).

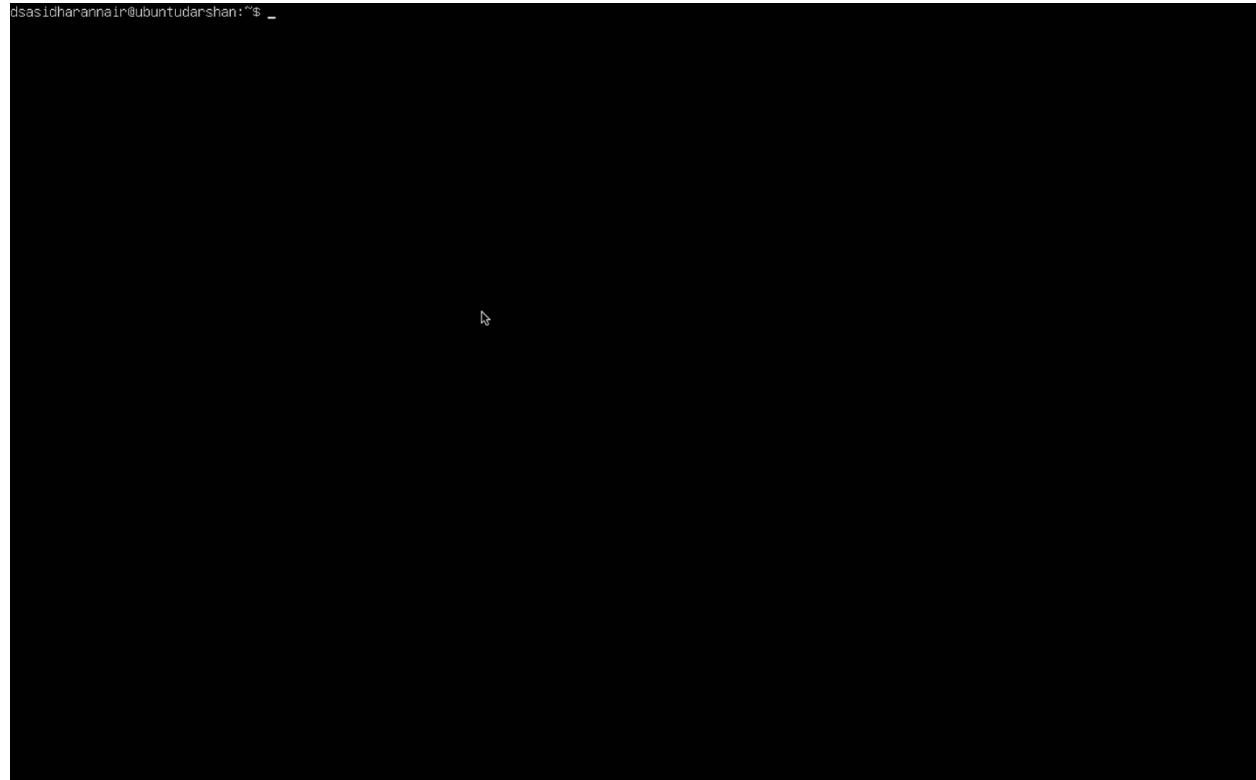
The E3 extension came later:
• In June 1999, xterm provided an extension to the standard control sequence for clearing the screen. Rather than clearing just the visible part of the screen using

    printf '\033[2J'

one could clear the scrollback using
dsasidharannair@ubuntudarshan:~$ clear

```

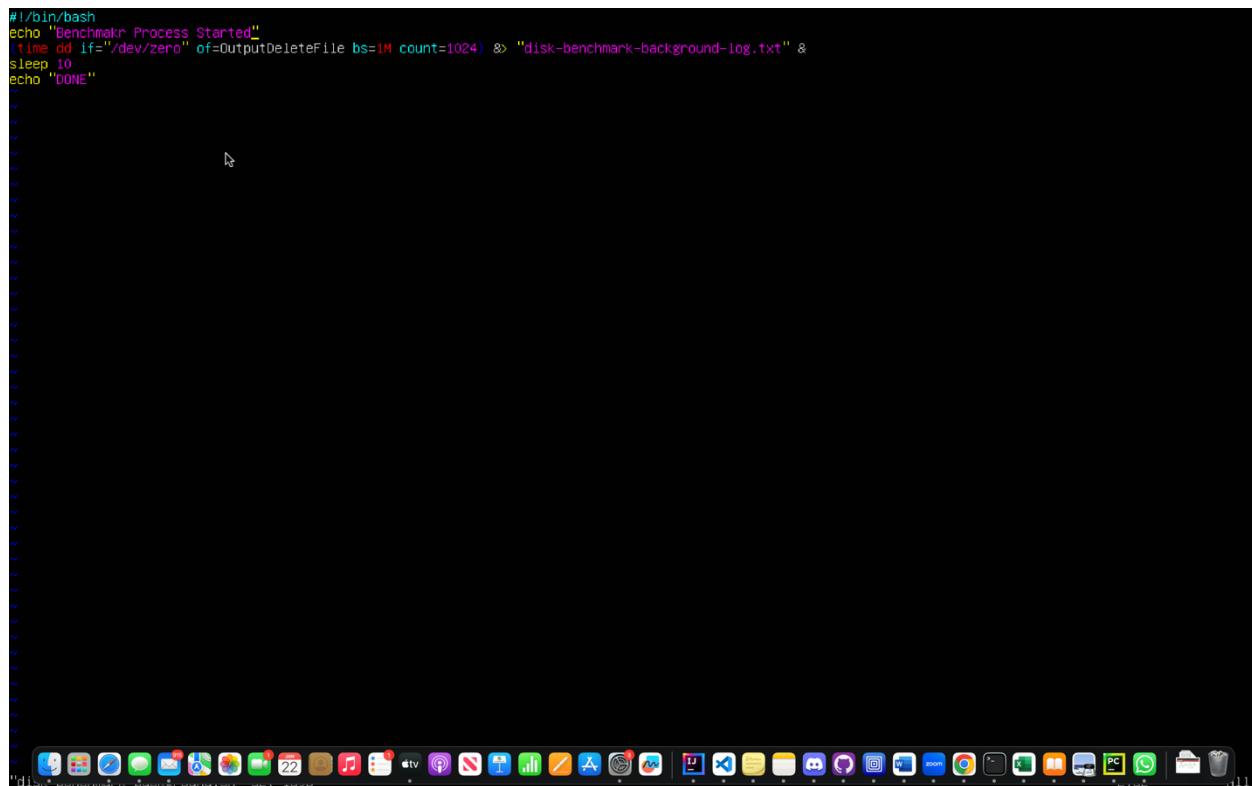
After clear



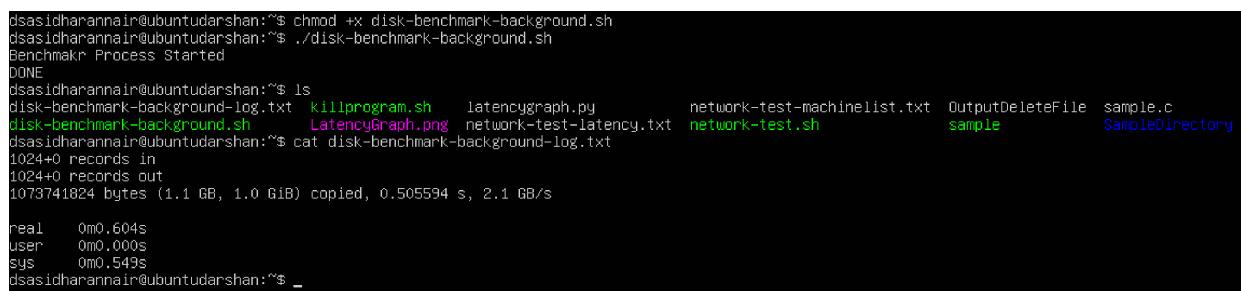
Clear command : Clears the terminal screen of all the input and output

3. (25 points) Write bash scripts to do the following:

a. Write a script called “disk-benchmark-background.sh” that uses the dd command to run a benchmark against the local disk in the background, that captures all the output (both standard out and error output) to a file “disk-benchmark-background-log.txt”. Use the “time” command to show how long the benchmark took to complete. The benchmark should run for at least 10 seconds, and it should complete even if the ssh (or bash) session is terminated.



```
#!/bin/bash
echo "Benchmark Process Started"
(time dd if="/dev/zero" of=OutputDeleteFile bs=1M count=1024) >> "disk-benchmark-background-log.txt" &
sleep 10
echo "DONE"
```



```
dsasidharannair@ubuntudarshan:~$ chmod +x disk-benchmark-background.sh
dsasidharannair@ubuntudarshan:~$ ./disk-benchmark-background.sh
Benchmark Process Started
DONE
dsasidharannair@ubuntudarshan:~$ ls
disk-benchmark-background-log.txt  killprogram.sh  latencygraph.py  network-test-machinelist.txt  OutputDeleteFile  sample.c
disk-benchmark-background.sh  LatencyGraph.png  network-test-latency.txt  network-test.sh  sample  SampleDirectory
dsasidharannair@ubuntudarshan:~$ cat disk-benchmark-background-log.txt
1024+0 records in
1024+0 records out
1073741824 bytes (1.1 GB, 1.0 GiB) copied, 0.505594 s, 2.1 GB/s
real    0m0.604s
user    0m0.000s
sys     0m0.549s
dsasidharannair@ubuntudarshan:~$ _
```

For this part I did the following tasks

1. Create a file called `disk-benchmark-background.sh` using vim or any file editor of your choice and write `#!/bin/bash` at the top of the file
 2. Fill the file with the above bash script and then save and exit
 3. Use `chmod +x filename` to make the file executable
 4. Do `./filename` to run the bash script

Script Theory: In the above script I have used dd which is command that facilities copying files to copy sample bytes of continuous zeroes into a output file in the disk. I timed the time taken to execute this task and well and stored the results of both the benchmark and time taken into the required file.

b. Write a script called “network-test.sh” that takes input a file “network-test-machinelist.txt” with a list of DNS names (e.g. google.com, iit.edu, anl.gov), each name on a separate line, and runs the ping utility collecting 3 samples from each DNS name, and writing the RTT (round trip time) average latency into a file “network-test-latency.txt” where each line will have the DNS name and average RTT separated by a space. Make sure it works with at least 10 DNS names, but it should work for an unspecified number of DNS names.

```
dsasidharannair@ubuntudarshan:~$ ./network-test.sh
Pinging for google.com ...
17.857
Pinging for iit.edu ...
40.378
Pinging for meta.com ...
8.024
Pinging for instagram.com ...
9.881
Pinging for twitter.com ...
43.632
Pinging for bing.com ...
17.081
Pinging for youtube.com ...
7.895
Pinging for gmail.com ...
15.362
Pinging for figma.com ...
10.171
Pinging for booking.com ...
9.983
dsasidharannair@ubuntudarshan:~$ _
```

```
dsasidharannair@ubuntudarshan:~$ ls
disk-benchmark-background-log.txt  killprogram.sh  latencygraph.py  network-test-machinelist.txt  OutputDeleteFile  sample.c
disk-benchmark-background.sh  LatencyGraph.png  network-test-latency.txt  network-test.sh  sample  SampleDirectory
dsasidharannair@ubuntudarshan:~$ cat network-test-latency.txt
google.com 17.857
iit.edu 40.378
meta.com 8.024
instagram.com 9.881
twitter.com 43.632
bing.com 17.081
youtube.com 7.895
gmail.com 15.362
figma.com 10.171
booking.com 9.983
dsasidharannair@ubuntudarshan:~$
```

For this part I did the following tasks

1. Create a file called `network-test.sh` using vim or any file editor of your choice and write `#!/bin/bash` at the top of the file
2. Fill the file with the above bash script and then save and exit
3. Use `chmod +x filename` to make the file executable
4. Do `./filename` to run the bash script

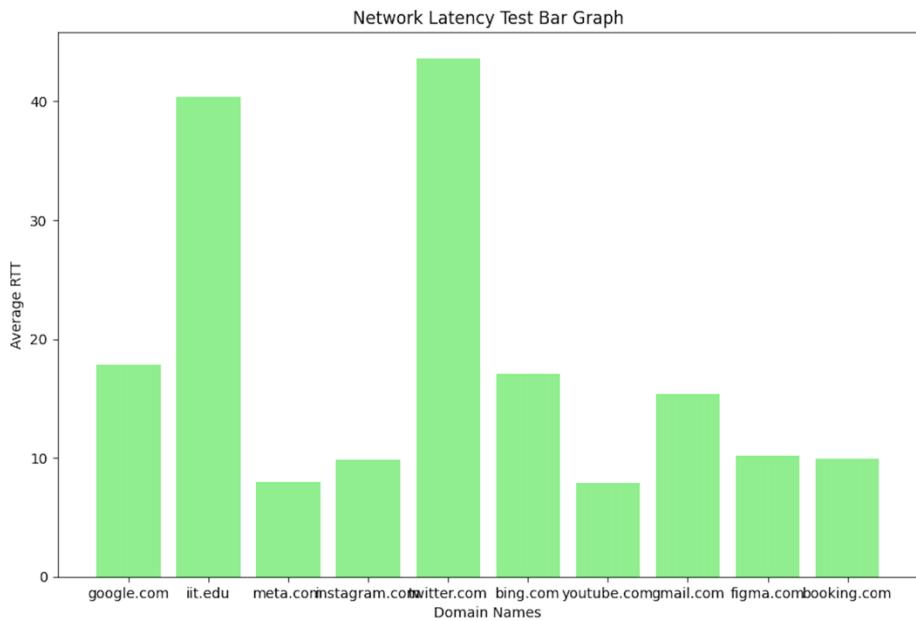
Script Theory: In the above script I used the ping command to send 3 echo_request packets the server address which I then tied to grep to the pick out the final line that contains the RTT overview. From the previous result I performed grep to select the average RTT from the last line. I copied the domain name and the average rtt into a output file with a space between the two.

c. Write a Python matplotlib script to generate a graph of the “network-test-latency.txt” data. The graph should automatically adjust to the number of entries, and the scale of the data.

For this part I did the following tasks

1. Downloaded pip3 and used it to download matplotlib.
 2. Create a file called latencygraph.py using vim or any file editor of your choice
 3. Fill the file with the above python script and then save and exit.
 4. Do python3 filename to run the file

Script Theory: I opened up the file in the python program and traversed it to add the dns name to the names array and the average RTT to the avg_rtt array. I then used plt instance from matplotlib to create a bar graph from the data I had collected above.



4. (20 points) Answer the following questions about VMs:

a. In the system configuration of the VM, explain how changing the number of processors changes the behavior of your VM. Explain a scenario where you want to set this to the minimum, and a scenario where you want to set it to the maximum. Why is setting it to the maximum potentially a bad idea?

A) The number of cores in the VM is directly related to its processing power. Increasing the number of cores can significantly improve the number of processes that can be handled simultaneously but can also lead to a lot of issues such as overhead.

A system that only runs simple tasks that does not require intensive parallel processing would benefit a lot from the setting the number of processors to a minimum.

A system that runs highly resource intensive operations that are parallelizable would benefit a lot from the setting the number of processors to the maximum value.

While setting the number of processors to the maximum can have its benefits it does have its drawbacks as well. Assigning a lot more processors than required by the system can cause a lot of overhead which could potentially bring down the performance. Furthermore, over assigning processors to a VM can lead to a competition for the actual physical CPU's resources that could bring down the performance of both the Host machine and the VM.

b. In the system configuration of the VM, under the Acceleration Tab, explain the difference between the paravirtualization options: None, Legacy, Minimal, Hyper-V, and KVM. Explain which one would be best to use with Ubuntu Linux, and why.

A) The *None* option disables paravirtualization, and instead uses full hardware emulation. The *legacy* option provides basic paravirtualization support. The *minimal* option exposes the presence of a virtualized environment to the guest OS. It reports to the guest OS about the time stamp counter and APIC frequency. The *Hyper-V* option tells the guest OS about the presence of Microsoft Hypervisor. The *KVM* option informs the guest OS about the presence of the Linux KVM hypervisor which is recognized for the Linux kernel.

Since Ubuntu Linux as the name implies is a Linux based OS, KVM would be the best to use as it incorporates the Linux KVM hypervisor and is easily recognized by the Linux kernel.

c. In storage devices when configuring the VM, there are multiple types of storage controllers: explain the difference between the IDE, SATA, and NVMe controller. Give an 2 example for each type of storage controller of a scenario where you may want to use this type of controller.

A) IDE which is short for Integrated Drive Electronics is an older standard controller that uses parallel data transfer protocol. SATA stands for Serial Advanced Technology Attachment and is widely used in modern systems. SATA uses a serial data transfer protocol. NVMe is short for non-volatile memory express designed specifically for SSDs and delivers transfer rates of up to 32 GB/s. Out of the above 3 storage controllers NVMe offers the highest performance followed by SATA and then IDE. Furthermore, SATA is also more compatible than IDE due to its standard connector and power supply as opposed to IDEs more diverse set of connectors. But there are some areas where IDE is more beneficial than SATA such as durability and cost. In contrast to NVMe, SATA was designed as a storage interface for transfer of data to and from HDDs while the former was designed specifically for SSDs that use flash technologies. NVMe is also far more compatible than SATA for newer age technologies. Although the difference in cost between the SATA and NVMe is not a lot, SATA is still more affordable than NVMe.

IDE scenario: When older systems require compatible software or virtualization, IDE can be used.

SATA scenario: SATA can be used for Video editing and Audio production.

NVMe scenario: NVMe's comes in really handy when handling large databases that have frequent reads and writes.

d. In the network configuration of the VM, there are multiple types of network adapters: explain the difference between NAT, Bridged Adapter, Internal Network, and Host-only Network. Give an example for each type of network of a scenario where you may want to use this type of network.

The NAT adapter is used to mask the IP address of the VM by the host IP address when connecting to the internet from the VM. This makes it look as if network activity came from the host OS and not the individual VM. In this setting you cannot connect to other VMs from the VM. Safely test out web applications in a controlled environment before deploying it for production,

In a bridged network setting the VM is granted its own IP address which can then be used to connect with other machines on the network on vice versa. This sort of network setting would be useful when you want to host a web server publicly from inside the VM.

In an internal network setting only VMs within the same host can communicate with each other. Any other sorts of connection to an external network or communicating to the host is not possible from within a VM. This setting would be useful in cases where there is need of transfer of sensitive data between the VMs but should not be accessible to an external network.

In a Host only network setting only permits interaction between the VM and the host OS. Connection to other VMS or an external network is not possible. This setting can be used to create a isolated development environment.

e. For the USB configuration of the VM, explain the difference between USB 1.1, 2.0, and 3.0 controllers.

In terms of speed the USB 1.1 is the slowest offering a maximum data transfer rate of 12MBPS, followed by USB 2.0 that is significantly faster than 1.1 offering transfer speeds up to 480MBPS. But the fastest of the three is USB 3.0 with a transfer speed of 5GBPS which is ideal for high bandwidth devices.

USB 1.1 was developed as means of a simple data transfer tool from a host computer to external devices. USB 2.0 on the other hand was specifically designed to enable much faster performance from its predecessor especially during large file transfers. USB 3.0 is a net gen step up from 2.0 and is specially used for demanding tasks such as video editing and high-resolution file transfer.

USB 1.1 and 2.0 are backwards compatible and is compatible with most operating systems and devices. USB 3.0 on the other hand require more specific compatible devices and drivers and may not be compatible with older operating systems.