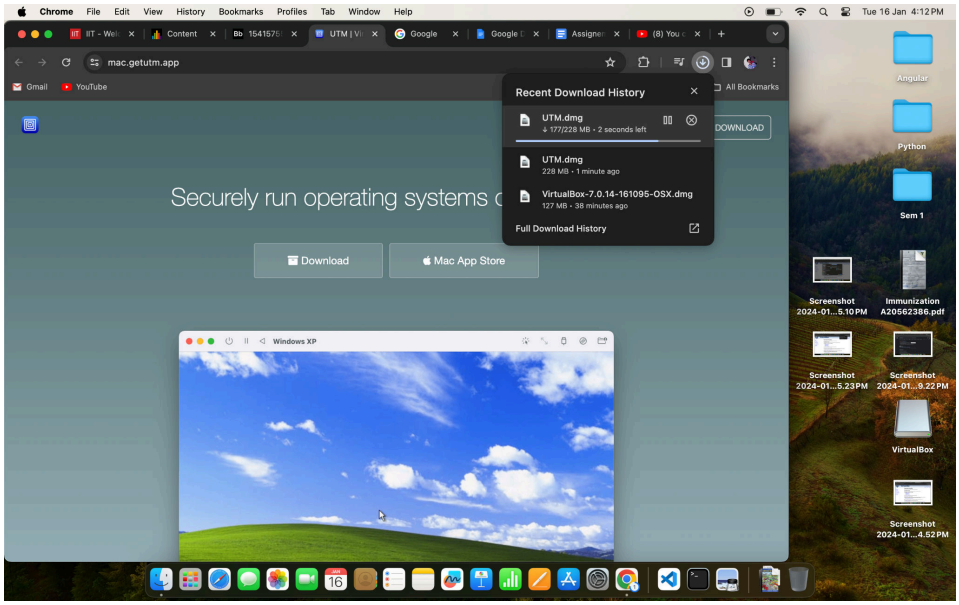
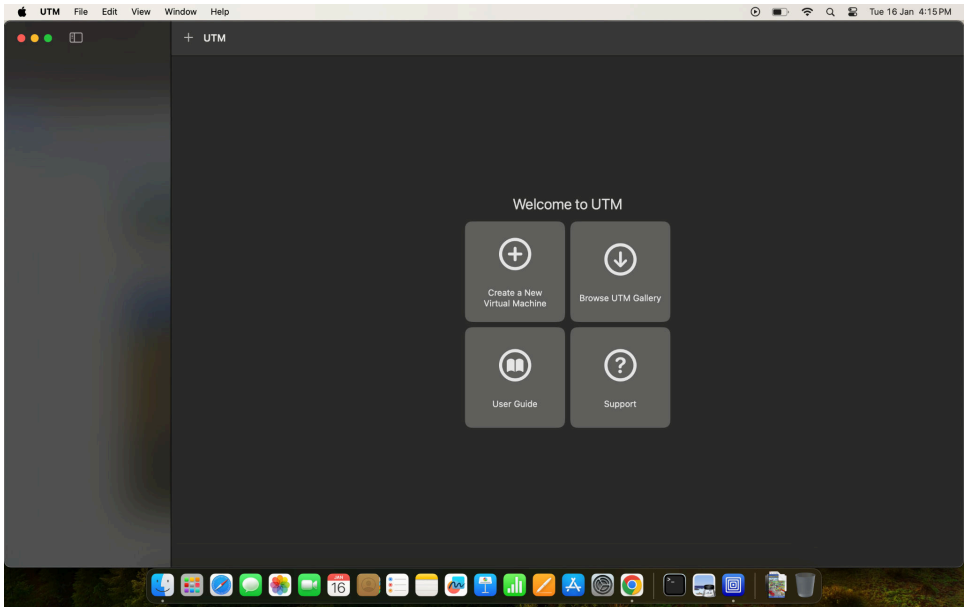
1)

a) Knowing the basics of virtual box.

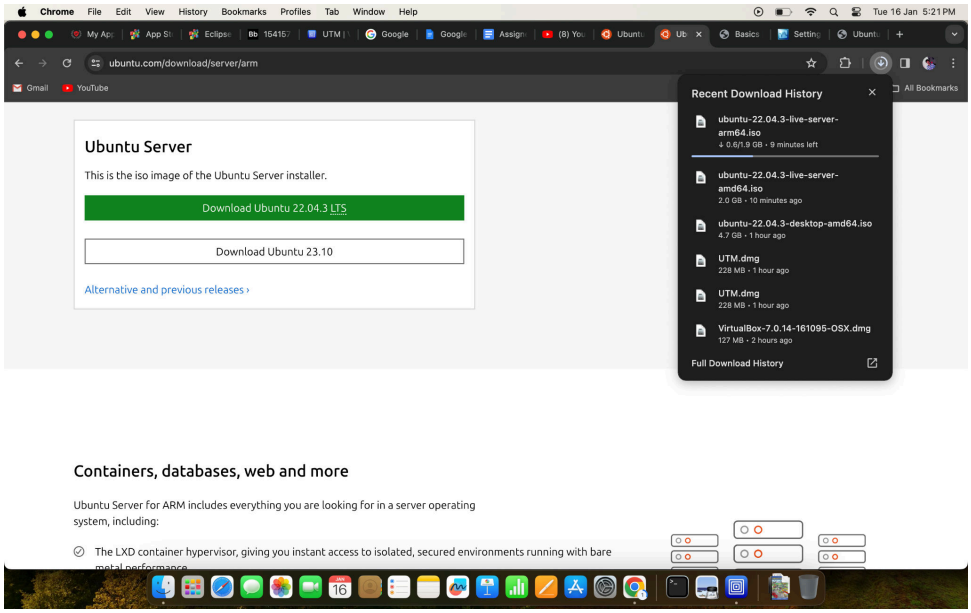
b)



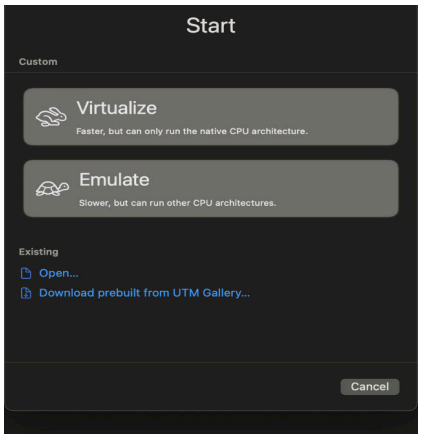
c)

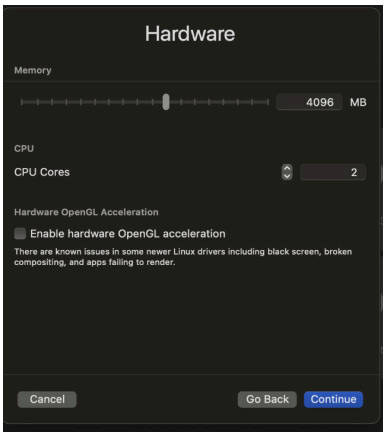


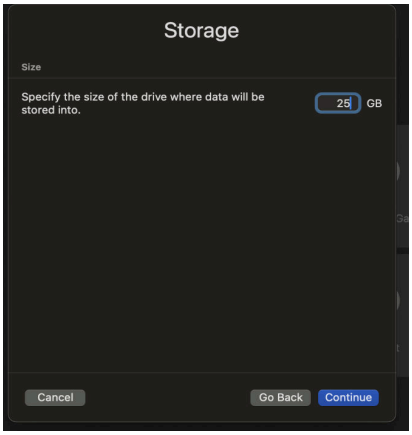
d)

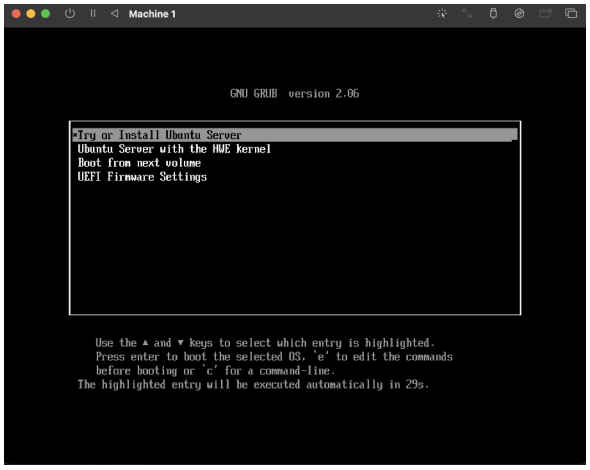

Chrome File Edit View History Bookmarks Profiles Tab Window Help
Tue 16 Jan 5:21 PM
ubuntu.com/download/server/arm
Ubuntu Server
This is the iso image of the Ubuntu Server installer.
Download Ubuntu 22.04.3 LTS
Download Ubuntu 23.10
Alternative and previous releases ›
Recent Download History
ubuntu-22.04.3-live-server-arm64.iso
0.6/1.9 GB · 9 minutes left
ubuntu-22.04.3-live-server-amd64.iso
2.0 GB · 10 minutes ago
ubuntu-22.04.3-desktop-amd64.iso
4.7 GB · 1 hour ago
UTM.dmg
228 MB · 1 hour ago
UTM.dmg
228 MB · 1 hour ago
VirtualBox-7.0.14-161095-OSX.dmg
127 MB · 2 hours ago
Full Download History
Containers, databases, web and more
Ubuntu Server for ARM includes everything you are looking for in a server operating system, including:
The LXD container hypervisor, giving you instant access to isolated, secured environments running with bare

e)

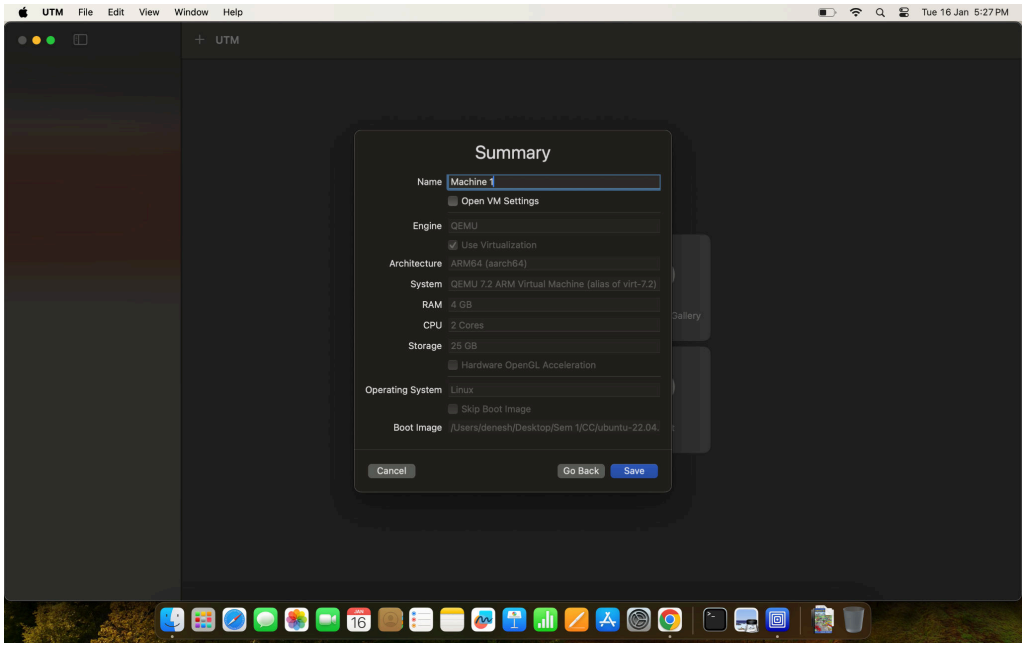

Start
Custom
Virtualize
Faster, but can only run the native CPU architecture.
Emulate
Slower, but can run other CPU architectures.
Existing
Open...
Download prebuilt from UTM Gallery...
Cancel

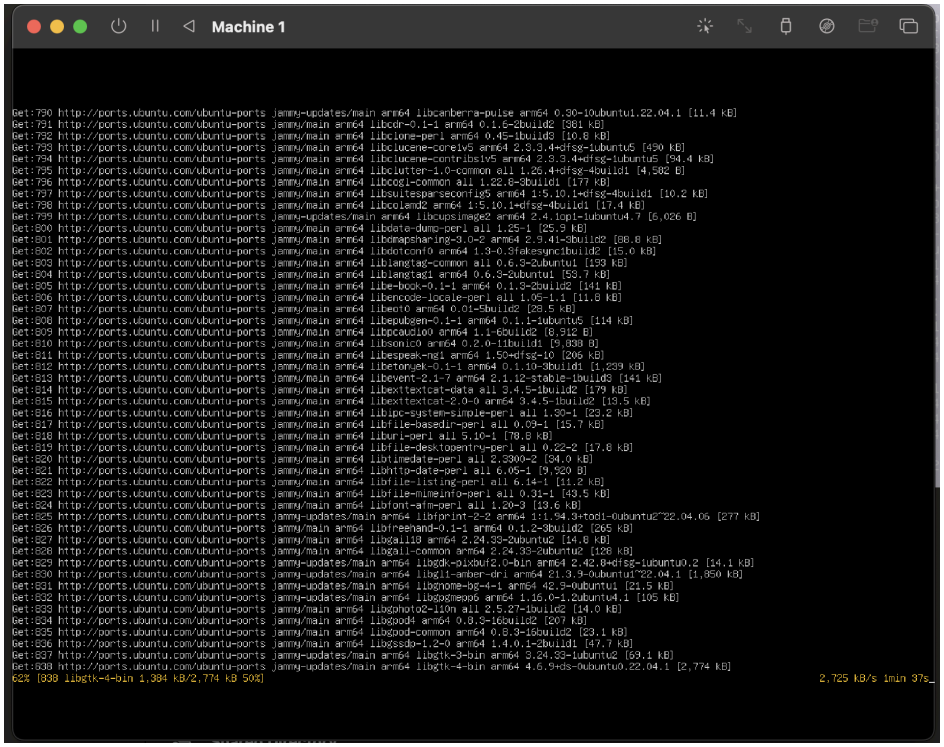

Hardware
Memory
4096 MB
CPU
CPU Cores
2
Hardware OpenGL Acceleration
Enable hardware OpenGL acceleration
There are known issues in some newer Linux drivers including black screen, broken compositing, and apps failing to render.
Cancel
Go Back
Continue


Storage
Size
Specify the size of the drive where data will be stored into.
25 GB
Cancel
Go Back
Continue

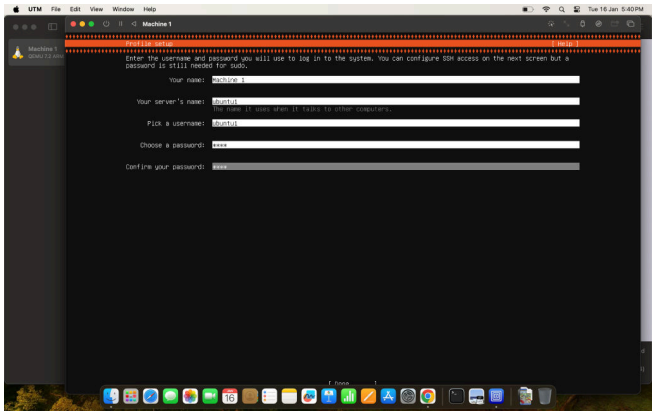

Machine 1
GNU GRUB version 2.06
*Try or Install Ubuntu Server
Ubuntu Server with the HWE kernel
Boot from next volume
UEFI Firmware Settings
Use the ▲ and ▼ keys to select which entry is highlighted.
Press enter to boot the selected OS, `e' to edit the commands
before booting or `c' for a command-line.
The highlighted entry will be executed automatically in 29s.

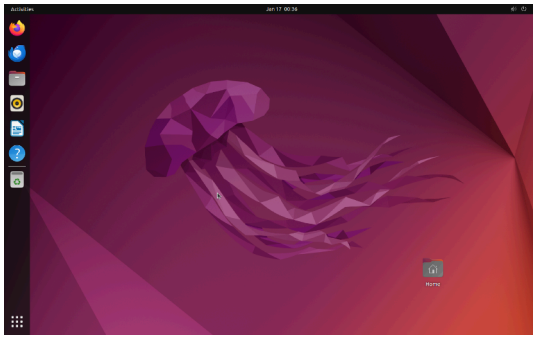
f)


UTM File Edit View Window Help
Tue 16 Jan 5:27 PM
UTM
Summary
Name Machine 1
Open VM Settings
Engine QEMU
Use Virtualization
Architecture ARM64 (aarch64)
System QEMU 7.2 ARM Virtual Machine (alias of virt-7.2)
RAM 4 GB
CPU 2 Cores
Storage 25 GB
Hardware OpenGL Acceleration
Operating System Linux
Skip Boot Image
Boot Image /Users/denesh/Desktop/Sem 1/CC/ubuntu-22.04.
Cancel
Go Back
Save

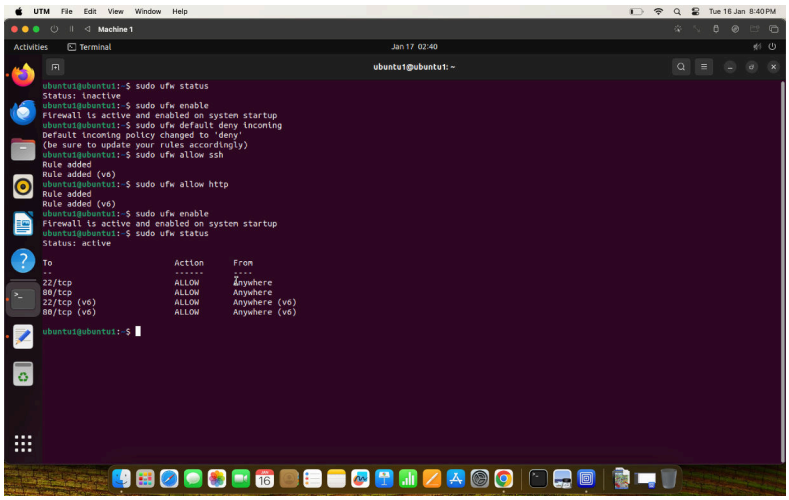

Machine 1
Get:790 http://ports.ubuntu.com/ubuntu-ports jammy-updates/main arm64 libcanberra-pulse arm64 0.30-10ubuntu1.22.04.1 [11.4 kB]
Get:791 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libcdr-0.1-1 arm64 0.1.6-2build2 [381 kB]
Get:792 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libclone-perl arm64 0.45-1build3 [10.8 kB]
Get:793 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libcluecene-core1v5 arm64 2.3.3.4+dfsg-1ubuntu5 [450 kB]
Get:794 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libcluecene-contribs1v5 arm64 2.3.3.4+dfsg-1ubuntu5 [94.4 kB]
Get:795 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libclutter-1.0-common all 1.26.4+dfsg-4build1 [4,502 B]
Get:796 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libcogl-common all 1.22.8-3build1 [177 kB]
Get:797 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libsuitesparseconfig5 arm64 1:5.10.1+dfsg-4build1 [10.2 kB]
Get:798 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libccolamd2 arm64 1:5.10.1+dfsg-4build1 [17.4 kB]
Get:799 http://ports.ubuntu.com/ubuntu-ports jammy-updates/main arm64 libcupsimage2 arm64 2.4.1op1-1ubuntu4.7 [6,026 B]
Get:800 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libdata-dump-perl all 1.25-1 [25.5 kB]
Get:801 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libdnsapsharing-3.0-2 arm64 2.9.41-3build2 [80.8 kB]
Get:802 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libdotconf0 arm64 1.3-0.5fakesyncbuild2 [15.6 kB]
Get:803 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libiangtag-common all 0.6.3-2ubuntu1 [193 kB]
Get:804 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libiangtag1 arm64 0.6.3-2ubuntu1 [59.7 kB]
Get:805 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libe-book-0.1-1 arm64 0.1.3-2build2 [141 kB]
Get:806 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libencode-locale-perl all 1.05-1.1 [11.8 kB]
Get:807 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libeot0 arm64 0.01-5build2 [28.5 kB]
Get:808 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libepubgen-0.1-1 arm64 0.1.1-1ubuntu5 [114 kB]
Get:809 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libpcaudio0 arm64 1.1-6build2 [8,912 B]
Get:810 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libsonic0 arm64 0.2.0-11build1 [9,038 B]
Get:811 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libespeak-ng1 arm64 1.50+dfsg-10 [206 kB]
Get:812 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libetonyek-0.1-1 arm64 0.1.10-3build1 [1,239 kB]
Get:813 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libevent-2.1-7 arm64 2.1.12-stable-1build3 [141 kB]
Get:814 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libexttextcat-data all 3.4.5-1build2 [179 kB]
Get:815 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libexttextcat-2.0-0 arm64 3.4.5-1build2 [13.5 kB]
Get:816 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libipc-system-simple-perl all 1.30-1 [23.2 kB]
Get:817 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libfile-basedir-perl all 0.09-1 [15.7 kB]
Get:818 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 liburi-perl all 5.10-1 [70.8 kB]
Get:819 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libfile-desktopentry-perl all 0.22-2 [17.8 kB]
Get:820 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libtimedate-perl all 2.3300-2 [34.0 kB]
Get:821 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libhttp-date-perl all 6.05-1 [9,920 B]
Get:822 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libfile-listing-perl all 6.14-1 [11.2 kB]
Get:823 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libfile-mimeinfo-perl all 0.31-1 [43.5 kB]
Get:824 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libfont-afm-perl all 1.20-3 [13.6 kB]
Get:825 http://ports.ubuntu.com/ubuntu-ports jammy-updates/main arm64 libfprint-2-2 arm64 1:1.94.3+tod1-0ubuntu2~22.04.05 [277 kB]
Get:826 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libfreehand-0.1-1 arm64 0.1.2-3build2 [265 kB]
Get:827 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libgail18 arm64 2.24.33-2ubuntu2 [14.8 kB]
Get:828 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libgail-common arm64 2.24.33-2ubuntu2 [128 kB]
Get:829 http://ports.ubuntu.com/ubuntu-ports jammy-updates/main arm64 libgdk-pixbuf2.0-bin arm64 2.42.8+dfsg-1ubuntu0.2 [14.1 kB]
Get:830 http://ports.ubuntu.com/ubuntu-ports jammy-updates/main arm64 libgl1-amber-dri arm64 21.3.9-0ubuntu1~22.04.1 [1,850 kB]
Get:831 http://ports.ubuntu.com/ubuntu-ports jammy-updates/main arm64 libgnome-bg-4-1 arm64 42.9-0ubuntu1 [21.5 kB]
Get:832 http://ports.ubuntu.com/ubuntu-ports jammy-updates/main arm64 libgoa-backend-1.0-1 arm64 3.44.1-1ubuntu1 [105 kB]
Get:833 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libgphoto2-l10n all 2.5.27-1build2 [14.0 kB]
Get:834 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libgpod4 arm64 0.8.3-16build2 [207 kB]
Get:835 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libgpod-common arm64 0.8.3-16build2 [23.1 kB]
Get:836 http://ports.ubuntu.com/ubuntu-ports jammy/main arm64 libgssdp-1.2-0 arm64 1.4.0.1-2build1 [47.7 kB]
Get:837 http://ports.ubuntu.com/ubuntu-ports jammy-updates/main arm64 libgtk-3-bin arm64 3.24.33-1ubuntu2 [69.1 kB]
Get:838 http://ports.ubuntu.com/ubuntu-ports jammy-updates/main arm64 libgtk-4-bin arm64 4.6.9+ds-0ubuntu0.22.04.1 [2,774 kB]
62% [838 libgtk-4-bin 1,384 kB/2,774 kB 50%]
2,725 kB/s 1min 37s

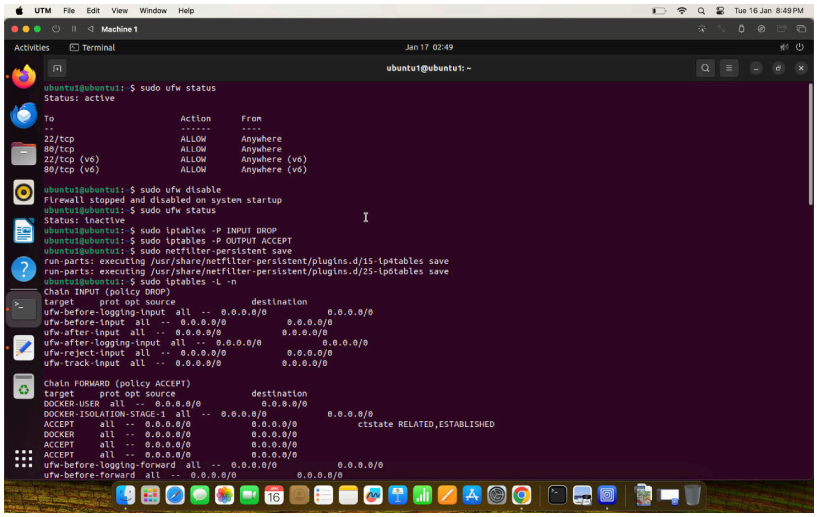
g)

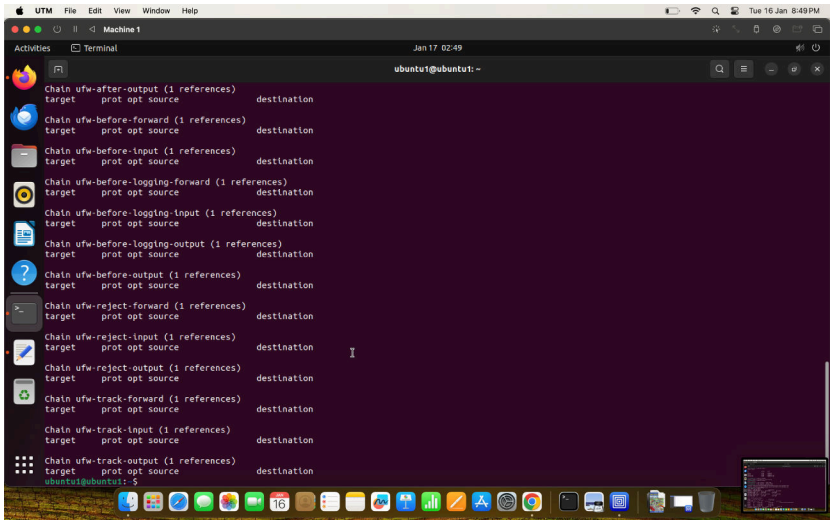

Machine 1
Enter the username and password you will use to log in to the system. You can configure SSH access on the next screen but a password is still needed for sudo.
Your name:
Your server's name:
Pick a username:
Choose a password:
Confirm your password:



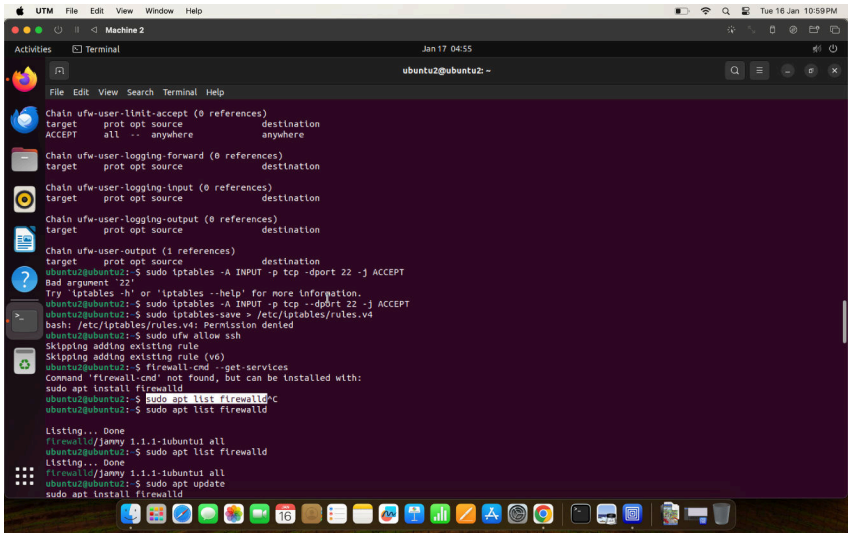
h)


Machine 1
Activities
Terminal
Jan 17 02:40
ubuntu1@ubuntu1: ~
ubuntu1@ubuntu1:~$ sudo ufw status
Status: inactive
ubuntu1@ubuntu1:~$ sudo ufw enable
Firewall is active and enabled on system startup
ubuntu1@ubuntu1:~$ sudo ufw default deny incoming
Default incoming policy changed to 'deny'
(be sure to update your rules accordingly)
ubuntu1@ubuntu1:~$ sudo ufw allow ssh
Rule added
Rule added (v6)
ubuntu1@ubuntu1:~$ sudo ufw allow http
Rule added
Rule added (v6)
ubuntu1@ubuntu1:~$ sudo ufw enable
Firewall is active and enabled on system startup
ubuntu1@ubuntu1:~$ sudo ufw status
Status: active
To Action From
-- ------ ----
22/tcp ALLOW Anywhere
80/tcp ALLOW Anywhere
22/tcp (v6) ALLOW Anywhere (v6)
80/tcp (v6) ALLOW Anywhere (v6)
ubuntu1@ubuntu1:~$

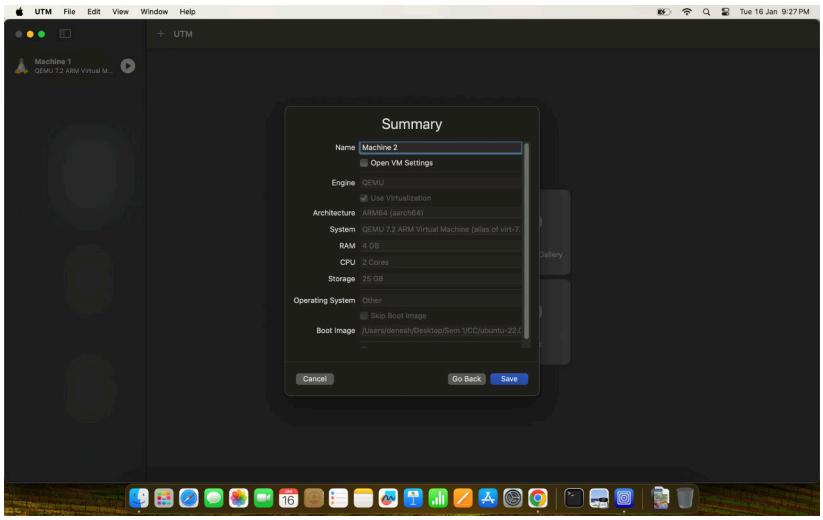

Machine 1
Activities
Terminal
Jan 17 02:49
ubuntu1@ubuntu1: ~
ubuntu1@ubuntu1:~$ sudo ufw status
Status: active
To Action From
22/tcp ALLOW Anywhere
80/tcp ALLOW Anywhere
22/tcp (v6) ALLOW Anywhere (v6)
80/tcp (v6) ALLOW Anywhere (v6)
ubuntu1@ubuntu1:~$ sudo ufw disable
Firewall stopped and disabled on system startup
ubuntu1@ubuntu1:~$ sudo ufw status
Status: inactive
ubuntu1@ubuntu1:~$ sudo iptables -P INPUT DROP
ubuntu1@ubuntu1:~$ sudo iptables -P OUTPUT ACCEPT
ubuntu1@ubuntu1:~$ sudo netfilter-persistent save
run-parts: executing /usr/share/netfilter-persistent/plugins.d/15-ip4tables save
run-parts: executing /usr/share/netfilter-persistent/plugins.d/25-ip6tables save
ubuntu1@ubuntu1:~$ sudo iptables -L -n
Chain INPUT (policy DROP)
target prot opt source destination
ufw-before-logging-input all -- 0.0.0.0/0 0.0.0.0/0
ufw-before-input all -- 0.0.0.0/0 0.0.0.0/0
ufw-after-input all -- 0.0.0.0/0 0.0.0.0/0
ufw-after-logging-input all -- 0.0.0.0/0 0.0.0.0/0
ufw-reject-input all -- 0.0.0.0/0 0.0.0.0/0
ufw-track-input all -- 0.0.0.0/0 0.0.0.0/0
Chain FORWARD (policy ACCEPT)
target prot opt source destination
DOCKER-USER all -- 0.0.0.0/0 0.0.0.0/0
DOCKER-ISOLATION-STAGE-1 all -- 0.0.0.0/0 0.0.0.0/0
ACCEPT all -- 0.0.0.0/0 0.0.0.0/0 ctstate RELATED,ESTABLISHED
DOCKER all -- 0.0.0.0/0 0.0.0.0/0
ACCEPT all -- 0.0.0.0/0 0.0.0.0/0
ACCEPT all -- 0.0.0.0/0 0.0.0.0/0
ufw-before-logging-forward all -- 0.0.0.0/0 0.0.0.0/0
ufw-before-forward all -- 0.0.0.0/0 0.0.0.0/0

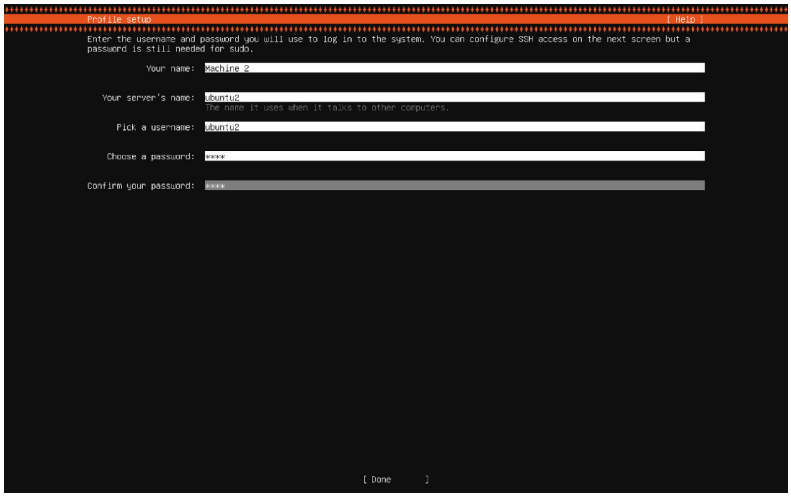

UTM File Edit View Window Help
Tue 16 Jan 8:49 PM
Machine 1
Activities
Terminal
Jan 17 02:49
ubuntu1@ubuntu1: ~
Chain ufw-after-output (1 references)
target prot opt source destination
Chain ufw-before-forward (1 references)
target prot opt source destination
Chain ufw-before-input (1 references)
target prot opt source destination
Chain ufw-before-logging-forward (1 references)
target prot opt source destination
Chain ufw-before-logging-input (1 references)
target prot opt source destination
Chain ufw-before-logging-output (1 references)
target prot opt source destination
Chain ufw-before-output (1 references)
target prot opt source destination
Chain ufw-reject-forward (1 references)
target prot opt source destination
Chain ufw-reject-input (1 references)
target prot opt source destination
Chain ufw-reject-output (1 references)
target prot opt source destination
Chain ufw-track-forward (1 references)
target prot opt source destination
Chain ufw-track-input (1 references)
target prot opt source destination
Chain ufw-track-output (1 references)
target prot opt source destination
ubuntu1@ubuntu1: $

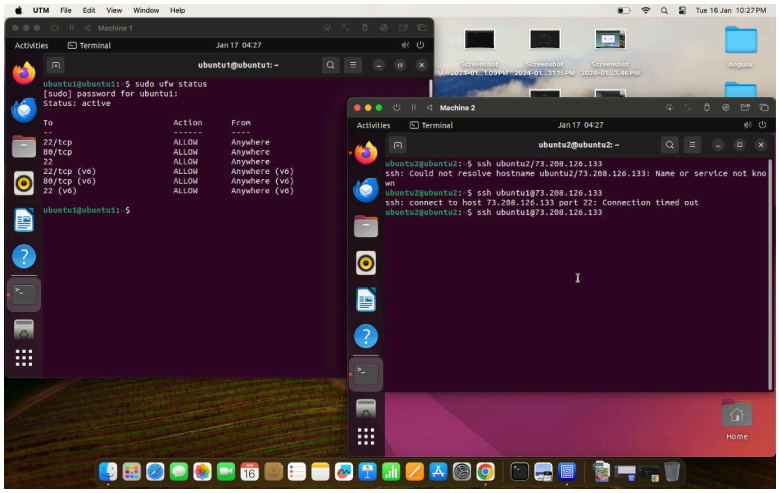
i)


UTM File Edit View Window Help
Tue 16 Jan 10:59 PM
Machine 2
Activities
Terminal
Jan 17 04:55
ubuntu2@ubuntu2: ~
File Edit View Search Terminal Help
Chain ufw-user-limit-accept (0 references)
target prot opt source destination
ACCEPT all -- anywhere anywhere
Chain ufw-user-logging-forward (0 references)
target prot opt source destination
Chain ufw-user-logging-input (0 references)
target prot opt source destination
Chain ufw-user-logging-output (0 references)
target prot opt source destination
Chain ufw-user-output (1 references)
target prot opt source destination
ubuntu2@ubuntu2:~$ sudo iptables -A INPUT -p tcp -dport 22 -j ACCEPT
Bad argument '22'
Try 'iptables -h' or 'iptables --help' for more information.
ubuntu2@ubuntu2:~$ sudo iptables -A INPUT -p tcp --dport 22 -j ACCEPT
ubuntu2@ubuntu2:~$ sudo iptables-save > /etc/iptables/rules.v4
bash: /etc/iptables/rules.v4: Permission denied
ubuntu2@ubuntu2:~$ sudo ufw allow ssh
Skipping adding existing rule
Skipping adding existing rule (v6)
ubuntu2@ubuntu2:~$ firewall-cmd --get-services
Command 'firewall-cmd' not found, but can be installed with:
sudo apt install firewalld
ubuntu2@ubuntu2:~$ sudo apt list firewalld^C
ubuntu2@ubuntu2:~$ sudo apt list firewalld
Listing... Done
firewalld/jammy 1.1.1-1ubuntu1 all
ubuntu2@ubuntu2:~$ sudo apt list firewalld
Listing... Done
firewalld/jammy 1.1.1-1ubuntu1 all
ubuntu2@ubuntu2:~$ sudo apt update
sudo apt install firewalld

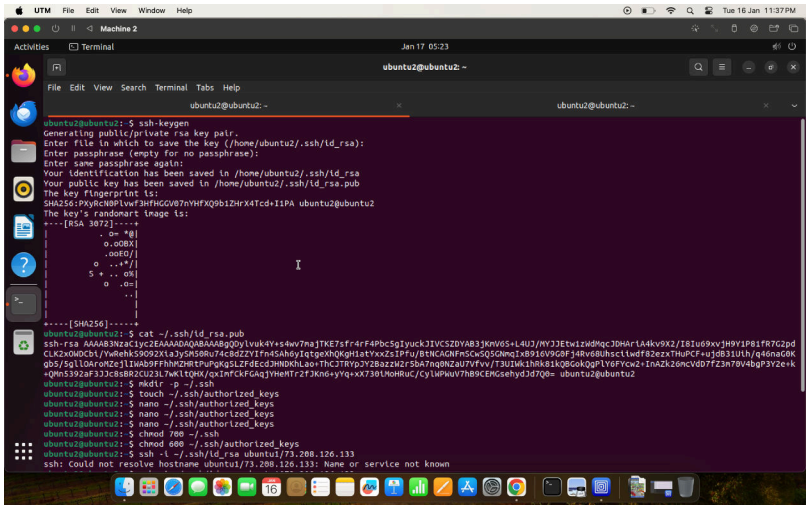
j)


UTM File Edit View Window Help
Tue 16 Jan 9:27 PM
UTM
Machine 1
QEMU 7.2 ARM Virtual M...
Summary
Name Machine 2
Open VM Settings
Engine QEMU
Use Virtualization
Architecture ARM64 (aarch64)
System QEMU 7.2 ARM Virtual Machine (alias of virt-7.
RAM 4 GB
CPU 2 Cores
Storage 25 GB
Operating System Other
Skip Boot Image
Boot Image /Users/denesh/Desktop/Sem 1/CC/ubuntu-22.
Cancel
Go Back
Save

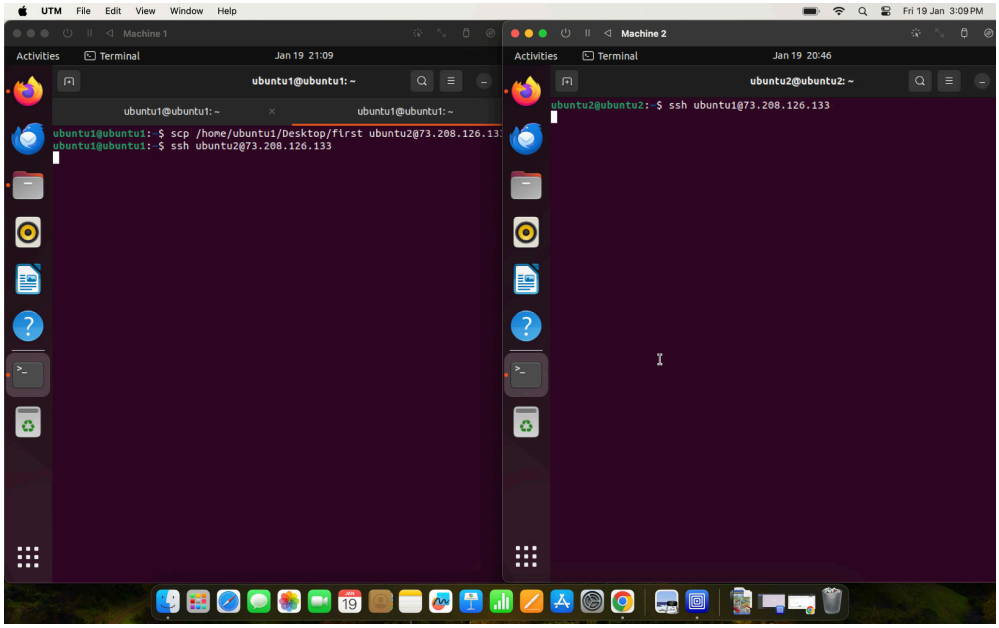

Profile setup
Help
Enter the username and password you will use to log in to the system. You can configure SSH access on the next screen but a password is still needed for sudo.
Your name: Machine 2
Your server's name: Ubuntu2
The name it uses when it talks to other computers.
Pick a username: Ubuntu2
Choose a password: ****
Confirm your password: ****
[Done]


UTM File Edit View Window Help
Tue 16 Jan 10:27 PM
Machine 1
Activities Terminal Jan 17 04:27
ubuntu1@ubuntu1: ~
ubuntu1@ubuntu1:~$ sudo ufw status
[sudo] password for ubuntu1:
Status: active
To Action From
-- ------ ----
22/tcp ALLOW Anywhere
80/tcp ALLOW Anywhere
22 ALLOW Anywhere
22/tcp (v6) ALLOW Anywhere (v6)
80/tcp (v6) ALLOW Anywhere (v6)
22 (v6) ALLOW Anywhere (v6)
ubuntu1@ubuntu1:~$
Machine 2
Activities Terminal Jan 17 04:27
ubuntu2@ubuntu2: ~
ubuntu2@ubuntu2:~$ ssh ubuntu2/73.208.126.133
ssh: Could not resolve hostname ubuntu2/73.208.126.133: Name or service not known
ubuntu2@ubuntu2:~$ ssh ubuntu1@73.208.126.133
ssh: connect to host 73.208.126.133 port 22: Connection timed out
ubuntu2@ubuntu2:~$ ssh ubuntu1@73.208.126.133
Home

k)


UTM File Edit View Window Help
Tue 16 Jan 11:37 PM
Machine 2
Activities Terminal Jan 17 05:23
ubuntu2@ubuntu2: ~
File Edit View Search Terminal Tabs Help
ubuntu2@ubuntu2: ~
ubuntu2@ubuntu2: ~
ubuntu2@ubuntu2:~$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/ubuntu2/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/ubuntu2/.ssh/id_rsa
Your public key has been saved in /home/ubuntu2/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:PXyRCN0Plvwf3HfHGGV07eYHfXQ9b1ZHrX4Tcd+I1PA ubuntu2@ubuntu2
The key's randomart image is:
+---[RSA 3072]----+
+----[SHA256]-----+
ubuntu2@ubuntu2:~$ cat ~/.ssh/id_rsa.pub
ubuntu2@ubuntu2:~$ mkdir -p ~/.ssh
ubuntu2@ubuntu2:~$ touch ~/.ssh/authorized_keys
ubuntu2@ubuntu2:~$ nano ~/.ssh/authorized_keys
ubuntu2@ubuntu2:~$ nano ~/.ssh/authorized_keys
ubuntu2@ubuntu2:~$ nano ~/.ssh/authorized_keys
ubuntu2@ubuntu2:~$ chmod 700 ~/.ssh
ubuntu2@ubuntu2:~$ chmod 600 ~/.ssh/authorized_keys
ubuntu2@ubuntu2:~$ ssh -i ~/.ssh/id_rsa ubuntu1/73.208.126.133
ssh: Could not resolve hostname ubuntu1/73.208.126.133: Name or service not known

I)



1. Download a virtual-box 7.0 in your machine if you are using windows other download UTM for mac uses. In my case, I'm using mac M1 chip which it is integrated with ARM, So i picked UTM.
2. Now download ubuntu 22.04 version from browser that fits your machine, I download a ARM related ubuntu image file. This iso file is used to install ubuntu on virtual box.
3. Now, click or start a new virtual machine, provide a readable name (let it be ubuntu1) , choose the location of iso file and click next.
4. Now allocate 4GB of RAM, 2 cores of processors, version as ubuntu 32 bit or 64 bit and change the network tab in advanced setting to bridged adaptor. Now click on proceed to build the virtual machine.
5. Till now you have configured everything for installation. Now you find ubuntu1 in the left navigation frame and double click on it to start. As soon as you double click, a popup is displayed and automatically starts the installation process by asking few questions.
6. Follow the on-screen instructions to complete the installation. During the installation process, it is mandatory to provide a username, strong password and re-type passwords fields .
7. Once ubuntu is properly installed, reboot your ubuntu. Now, block all ports by default and switch-on the firewall. Open only necessary port to access ssh, here the port is 22.
8. Now install openssh package and and enable ssh firewall.
9. Repeat steps 4 to 8 to create another virtual machine and name the VM as ubuntu2.
10. generate ssh keys by using ssh-keygen and create public/private keys.
11. Now copy the public key of ubuntu1 to ubuntu2. Connect to the other VM using SSH and the private key from one of them. If successful, you will have created secure remote access between the VMs.

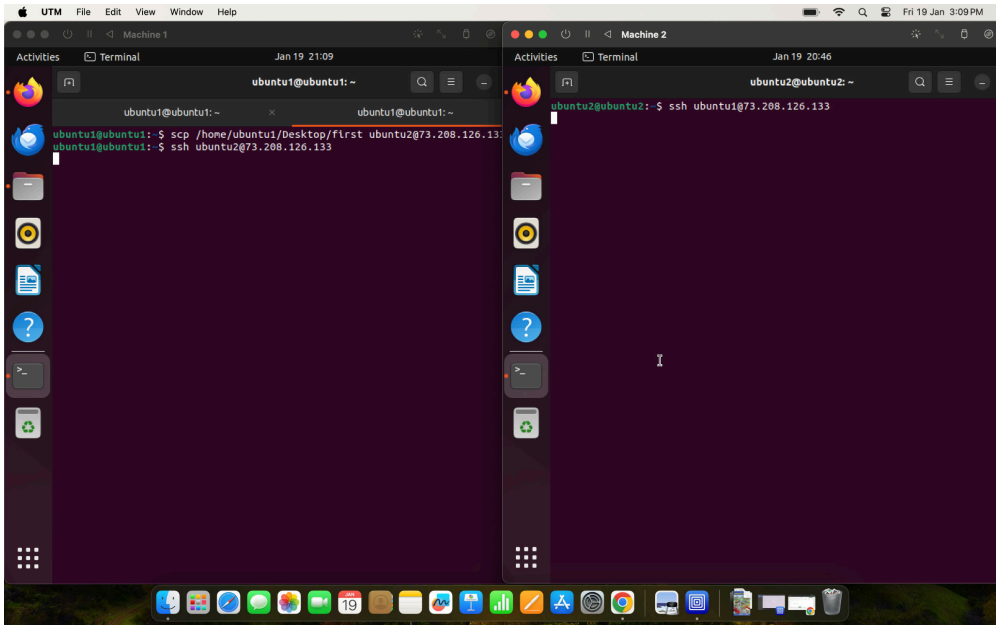
2)

a) ssh (Secure Shell)

It is used to communicate between 2 computers over a insecure network.

Syntax:

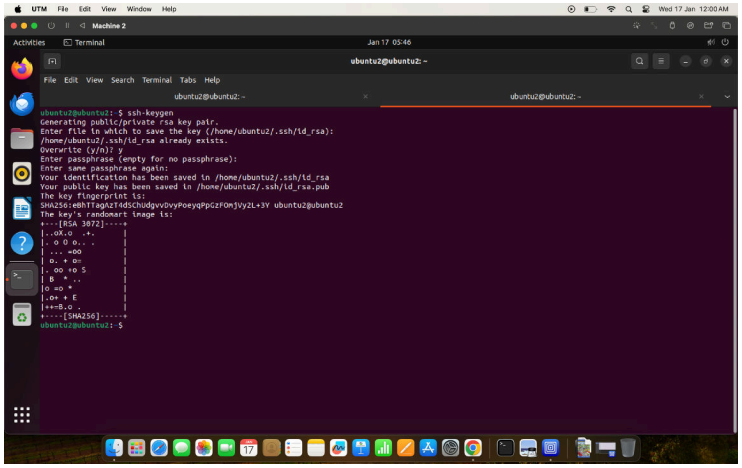
ssh username@host_ipAddress



---

b) ssh-keygen

It is used to generate, merge, and convert authentication keys for SSH connections.



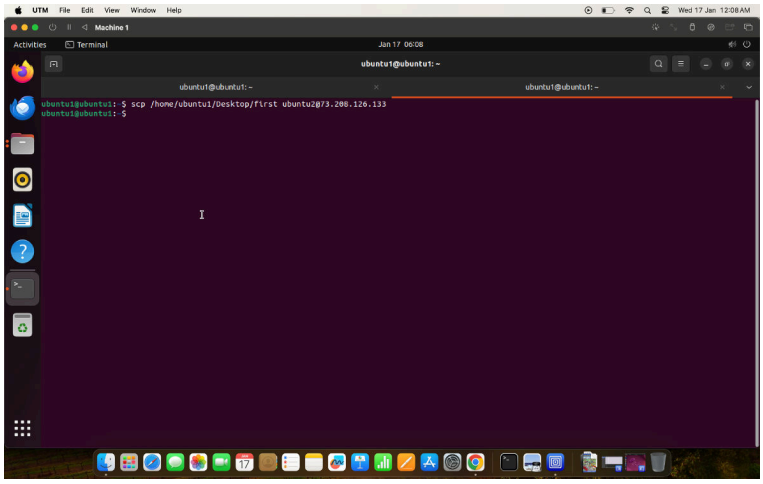
---

c) SCP (Secure Copy Protocol)

It is a secured transfer method used for copying files between hosts on the network.

Syntax:

Scp <local file path> username@remote_ipAddess:destination_directory



---

d) history

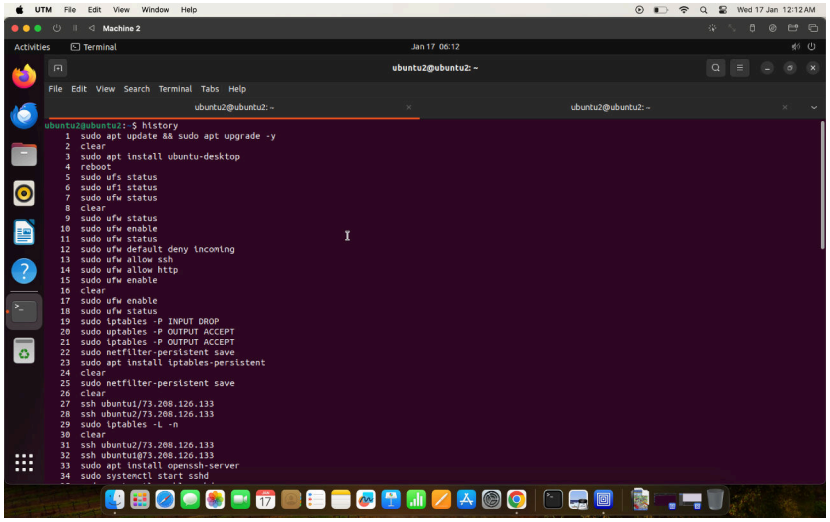
It provides all the previous commands that ae executed in the current command prompt.

Syntax:

history

history <no of cmd>

history | grep <name of the command>



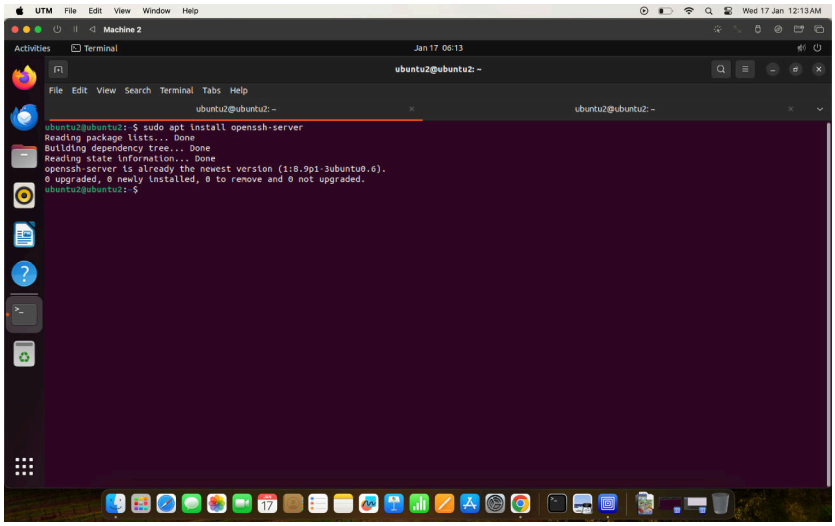
---

e) **sudo**

Sudo is an command-line utility which has special privileges temporarily and run commands in the root access. This is similar to Run as administrator in windows.\

Syntax:

sudo <command> [arguments]



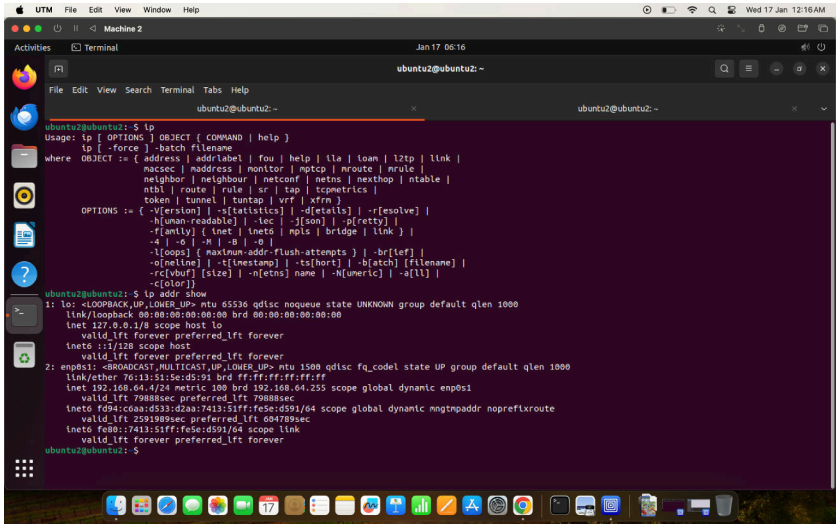
---

f) **ip**

It is used for configuration and managing network interfaces, routes and address in linux.

Syntax:

ip [object] [command] [options]



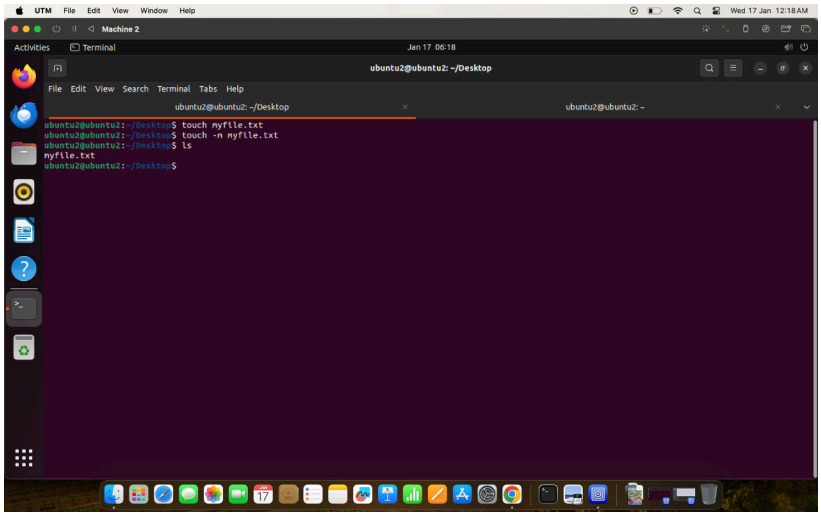
---

g) **touch**

This will create a new file at the current directory.

Syntax:

touch <file name with proper extension>

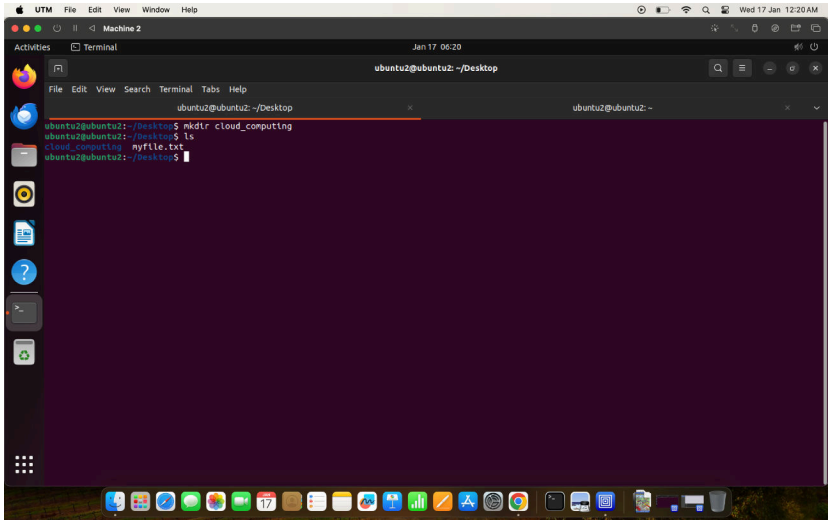


---

h) **ls**

.ls is used to list all folders and files under a directory.

Syntax: ls



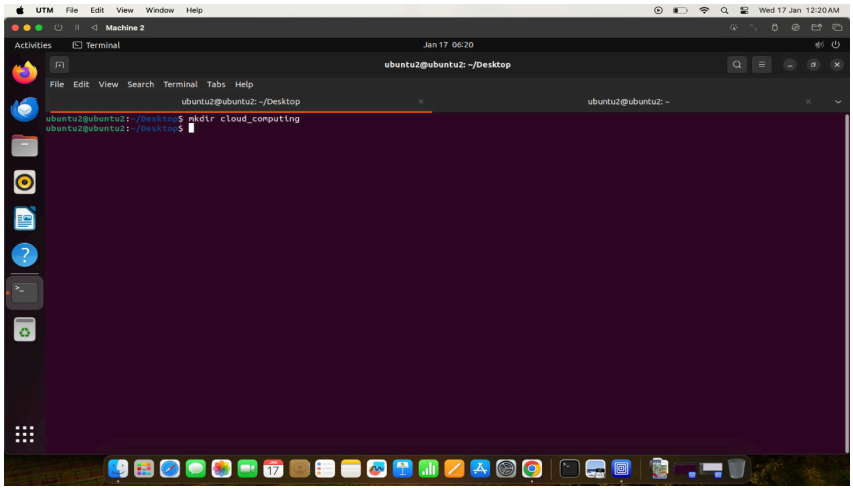
---

i) **mkdir**

This is used to create a new directory/ folder at a given path.

Syntax:

Mkdir <folder_name>



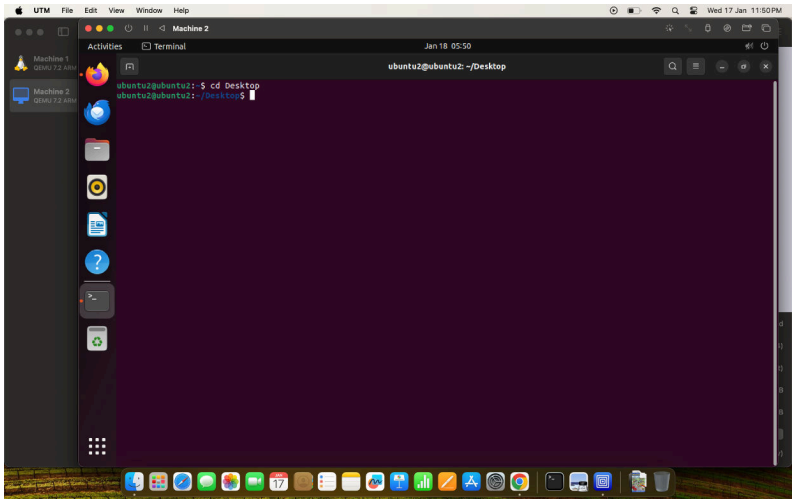
---

j) **cd**

The cd command in the linux is used to change directory. Here directory is nothing but a folder.

Syntax:

cd <directoryName>



---

k) **dd**

Convert, format and copy a file.

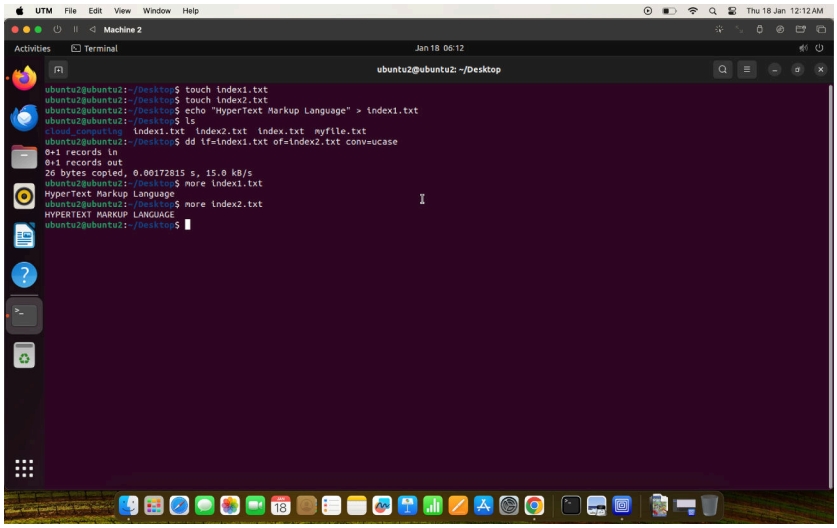
Syntax:

dd if=<inputFile> of=o<utputFile> [options]

inputFile : It specifies the source of the data which has to be read

outputFie: It specifies the destination where the data has to write.

Options : flag values like how the data need to be formatted or converted.



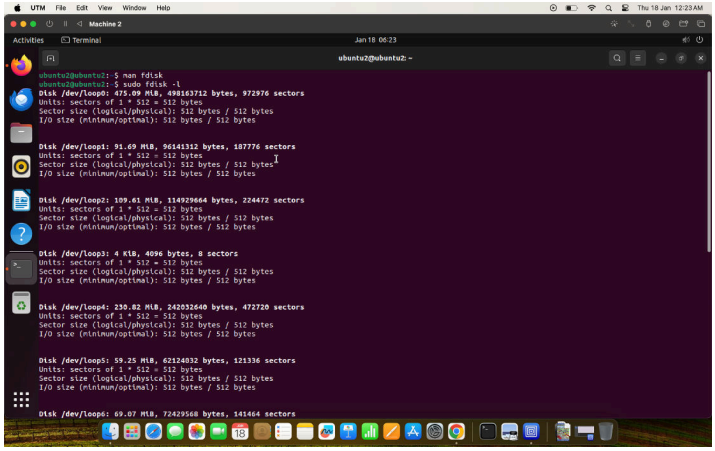
---

l) **fdisk**

Is used to manipulate the disk partition table. It has features like resize, delete, create, copy and move, change partition types and view partitions.

Syntax:

fdisk [options] /dev/Disk



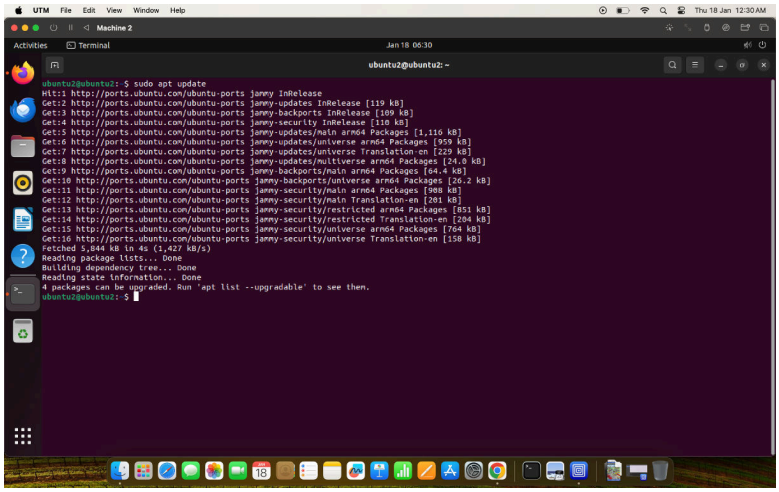
---

m) **apt (Advanced Packaging Tool)**

It is the core package management system in ubuntu which allows the features like install, update, upgrade and remove software packages through the command line.

Syntax:

Sudo apt <option> <package-name>



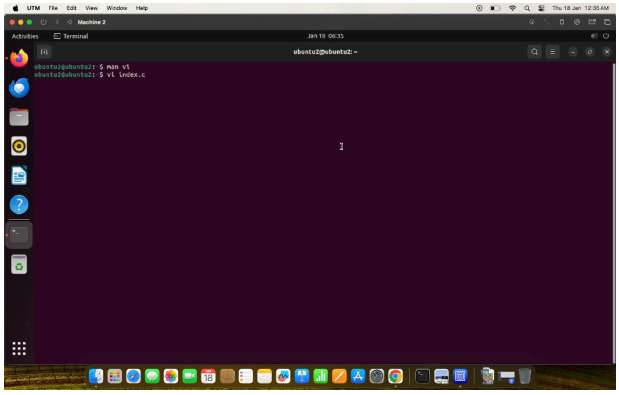
---

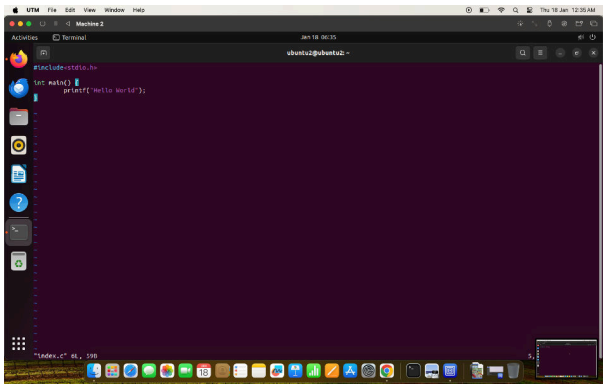
n) **vi**

vi stands visual which is used as a text editor. You can edit, delete lines of code after using vi filename.extension. You can only write your code in command line.

Syntax:

Vi <fileName.extension>



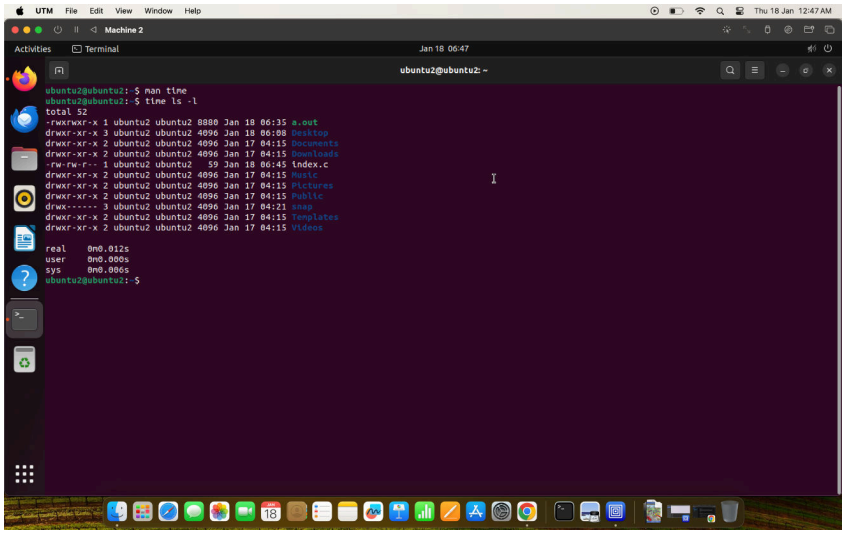


---

o) **time**

The time command is a built-in command to show the execution time of a command or a set of instructions. It can also show the details of resource usage like memory and CPU utilization.

Syntax:



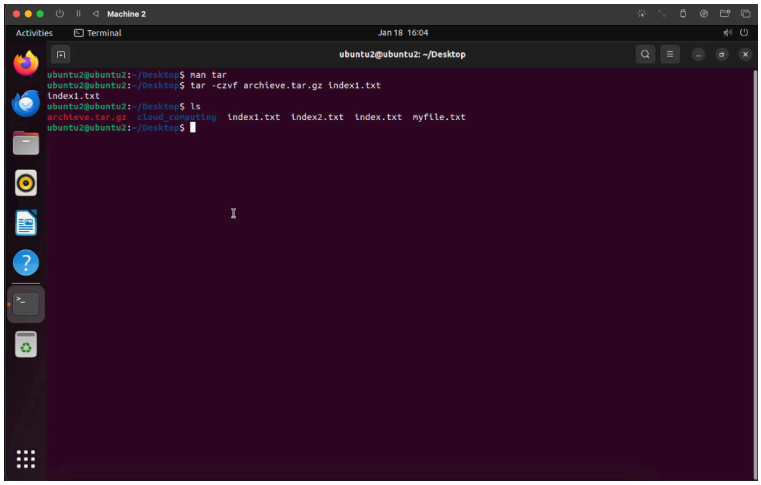
---

p) **tar**

It is a powerful tool to manage archive files. It can create, list, extract and manage the archive files.

Syntax:

tar [option] [operation] [archieveFiles]



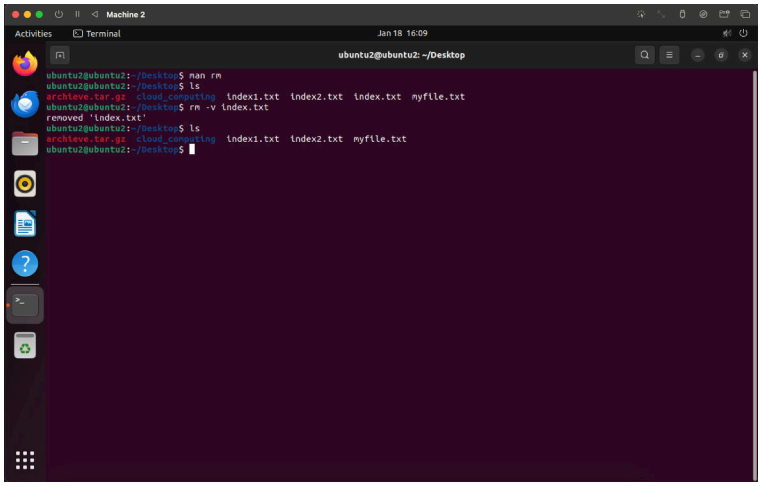
---

q) **rm**

It is a command line keyword which is used to permanently remove a file or directory from a filesytem.

Syntax:

rm [option] [file or directory name]



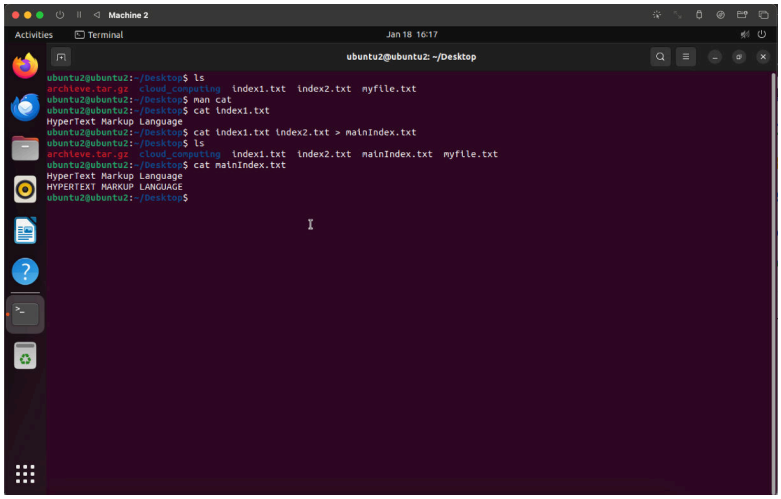
---

r) **cat**

It is a fundamental tool in ubuntu and linux commands which is used for 2 features. One, to print the content in the file and two, concatenates 2 or more files.

Syntax:

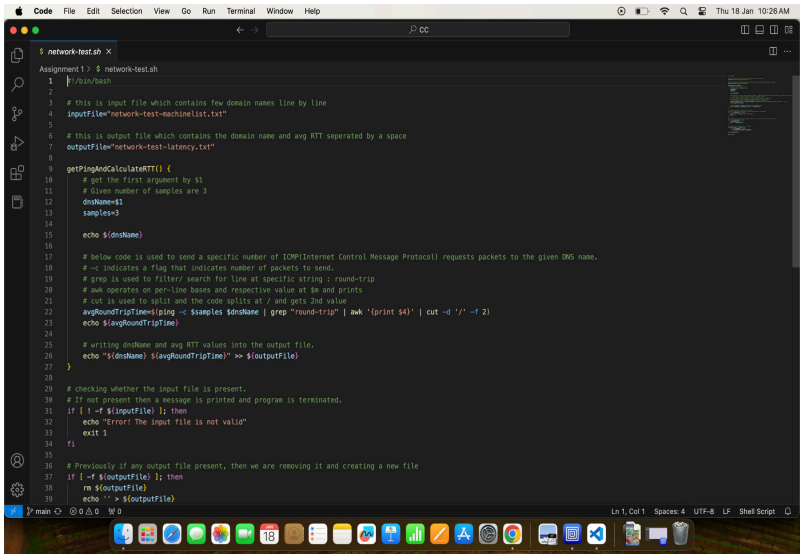
Cat [options => -n /-b /-v /-E] [file1] [file2]



---

s) **bash**

It has 2 broad features. First, it an understand and execute the instructions that rae provided the user. Second, you can write a file that has sequence of commands and execute it like a bash scripting.



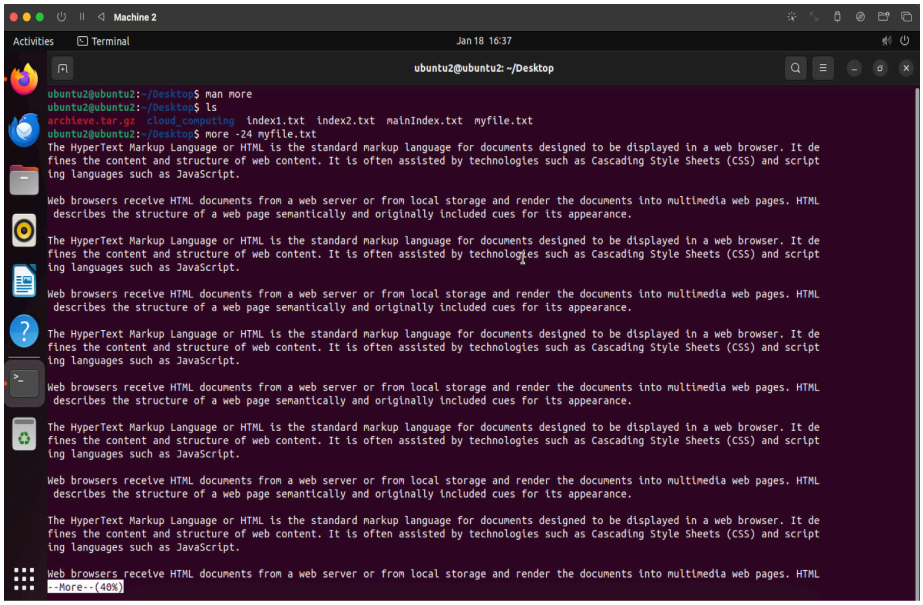
---

t) **more**

It allows us to view the the content of the file in one page at a time. It is basically used for larger files.

Syntax:

more [options -n/-s/-u] fileName



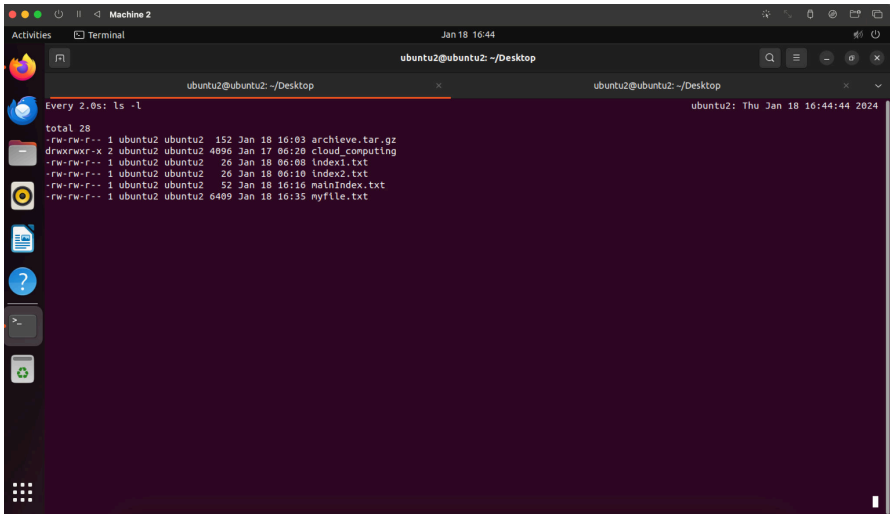
---

u) **watch**

It observes the changes in the output file of any command over time.

Syntax:

watch [options => -n/ -b/ -d/ -h/ -t] <command>



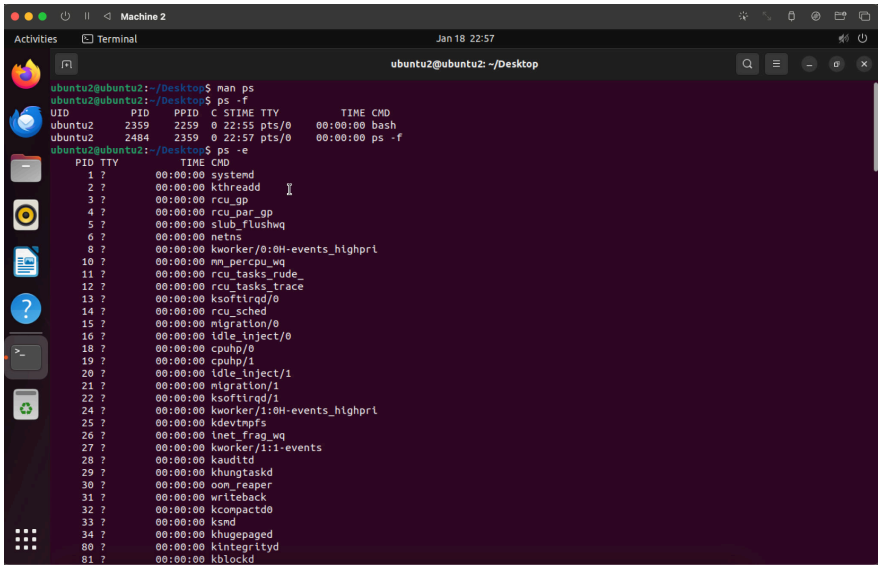
---

v) **ps**

ps refers to Process Status which gives us an idea or the snapshot of currently running processes. It displays few columns like PID,owner, CPU usage, memory usage and etc.,

Syntax:

ps [options]



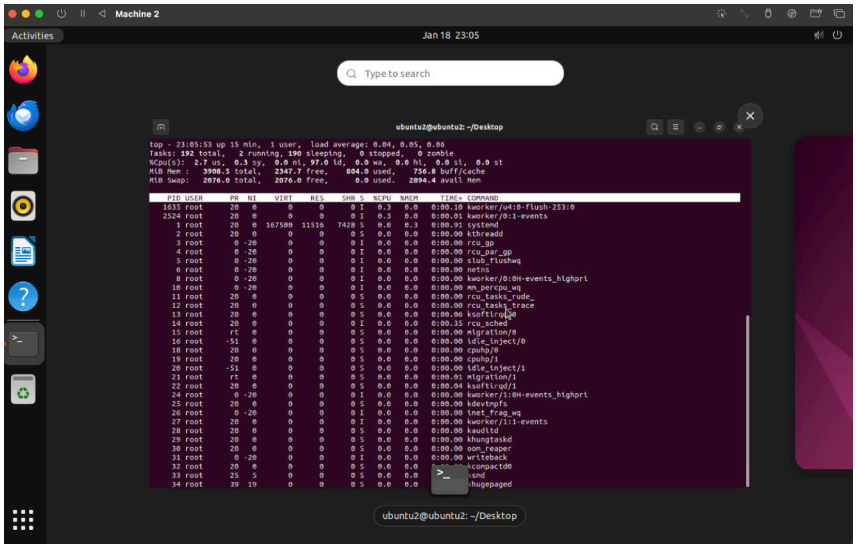
---

w) **top**

It displays dynamic and real-time processes and system resource usage. It provides information about CPUs, PIDs, memory usage, etc information while showing in the terminal.

Syntax:

top -u root -%CPU, %PID, USER, COMMAND, %MEM, TIME+

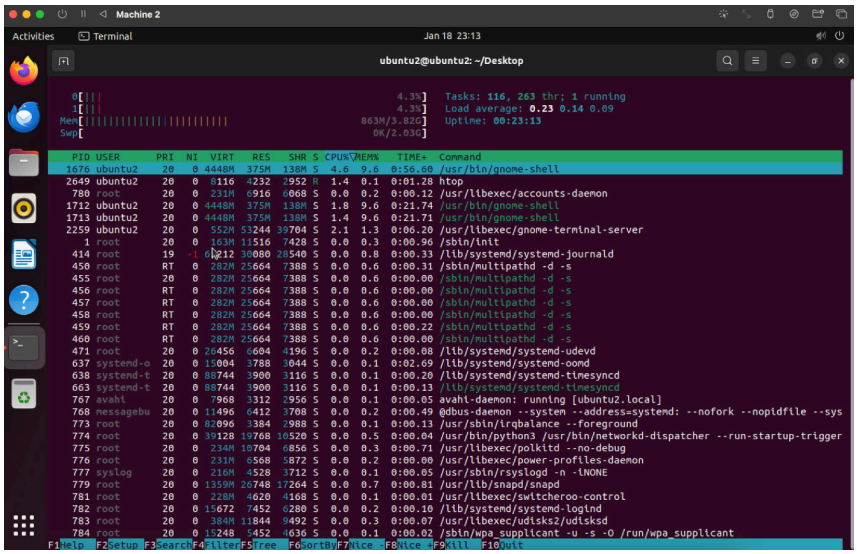


---

x) **htop**

It is used to monitor and manage processes like it provides information about the core usage RAM memory usage. It is very much similar to top but it has additional features like mouse support, process tree view, virtual and horizontal scrolling.

Syntax:



htop

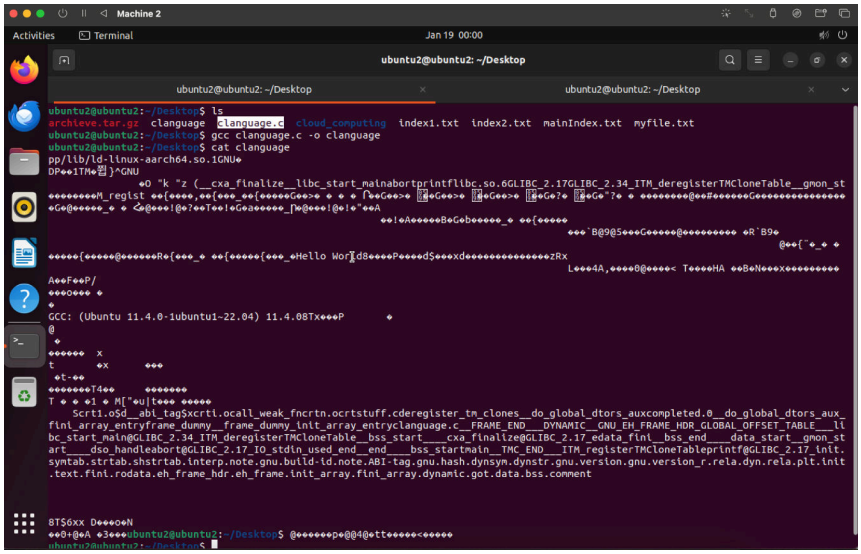
---

y) **gcc**

gcc stands for GNU Compiler Collection. It has a set of compilers and development related tools such as C, C++, Objective-C, objective-C++, fortran.

Syntax:

gcc [fileName.extension]



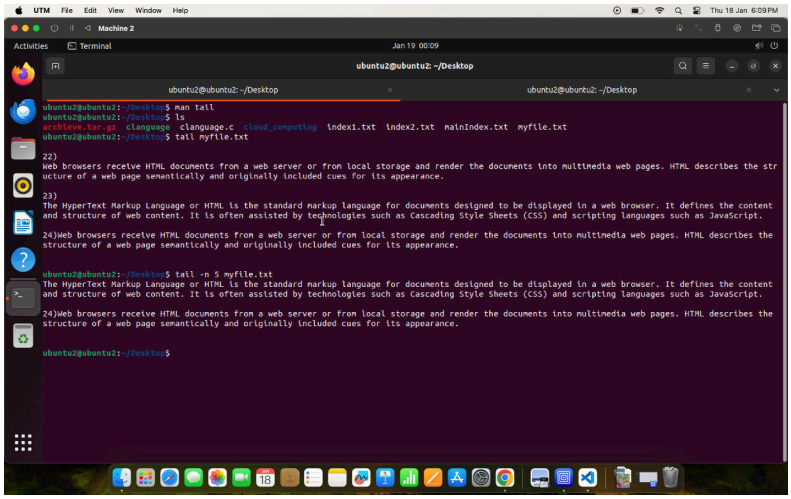
---

z) **tail**

tail is a utility tool which is used to display last part/ chunks of a file or multiple files.

Syntax:

tail [options] [file]



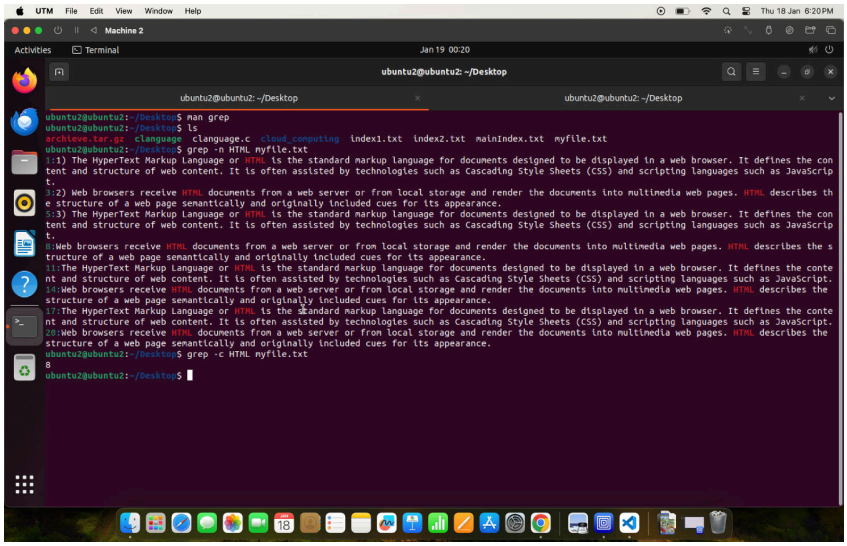
---

aa) **grep**

grep stands for Global Regular Expression Print. It is used to search or filter a text and extract text patterns from a file.

Syntax:

grep [options -i/ -c/ -n/ -v/ -r] pattern [file]



---

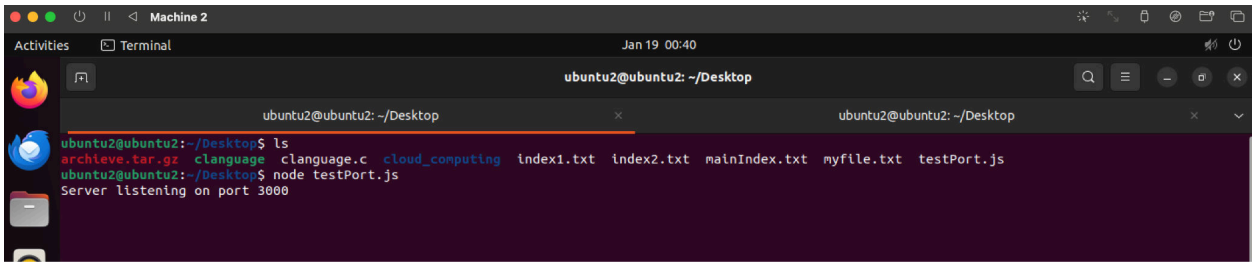
bb) **kill**
It is a command-line utility which is used to terminate or stop a process.
Syntax:
Kill [options] <PID>

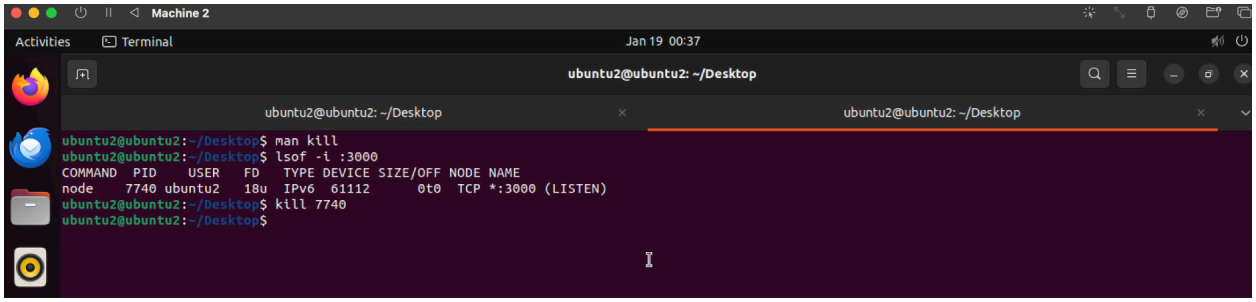
Code in javascript:

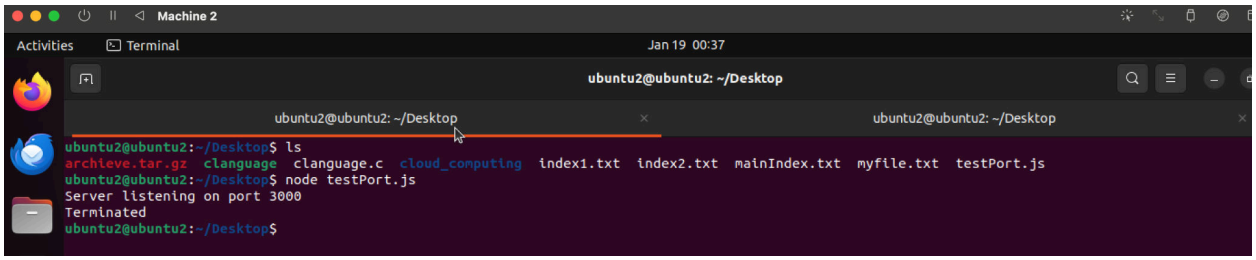
```
const http = require('http');

const server = http.createServer((req, res) => {
    // Handle incoming requests
});

server.listen(3000, () => { console.log('Server listening on port 3000'); });
```







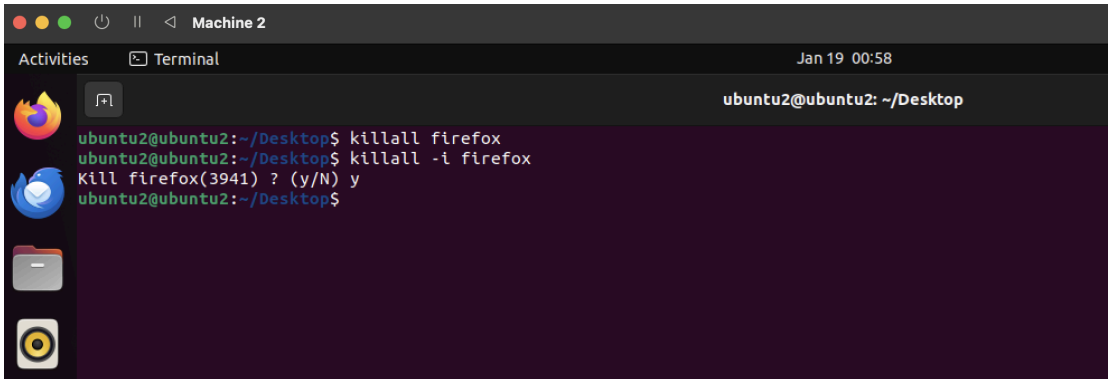
---

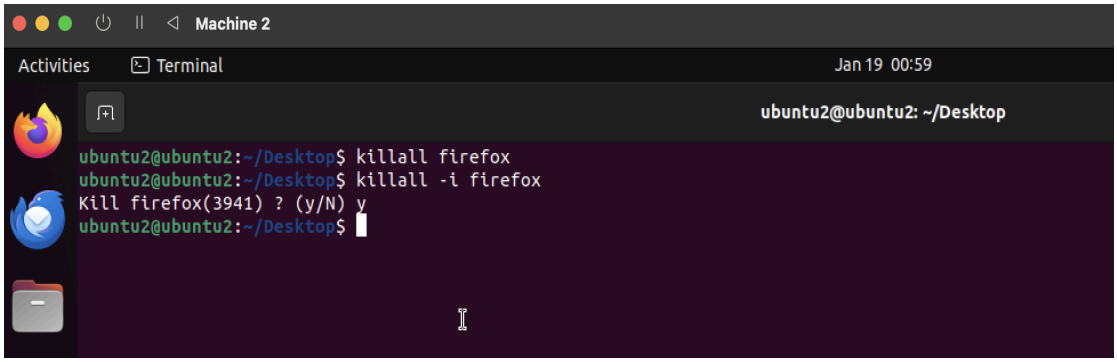
cc) **killall**

killall command terminates a set of signals or processes by name.

Syntax:

killall [options] <port name>





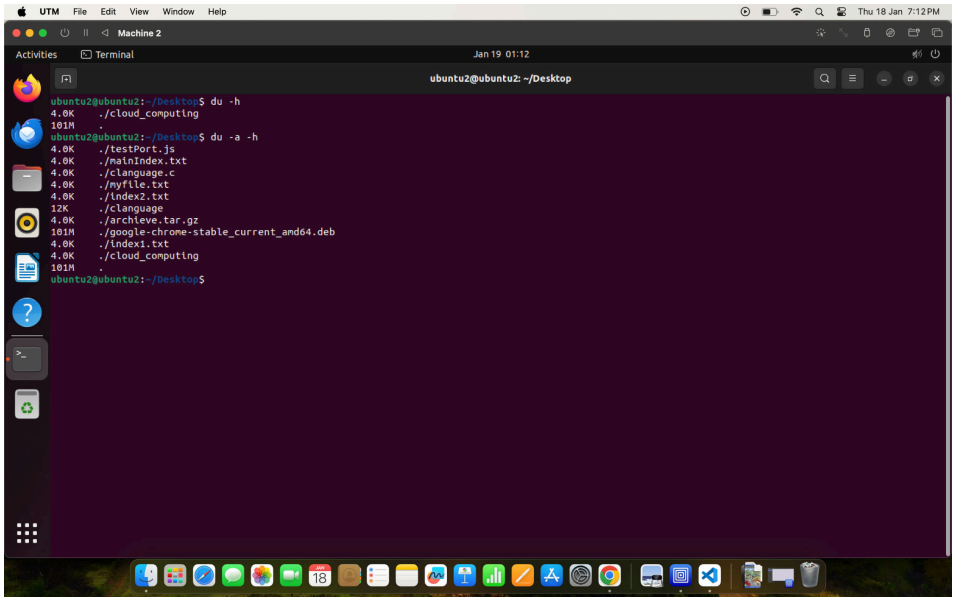
---

dd) **du**

It is used to estimate the disk space uage of files and directories.

Syntax:

du [options] [files or directory]



---

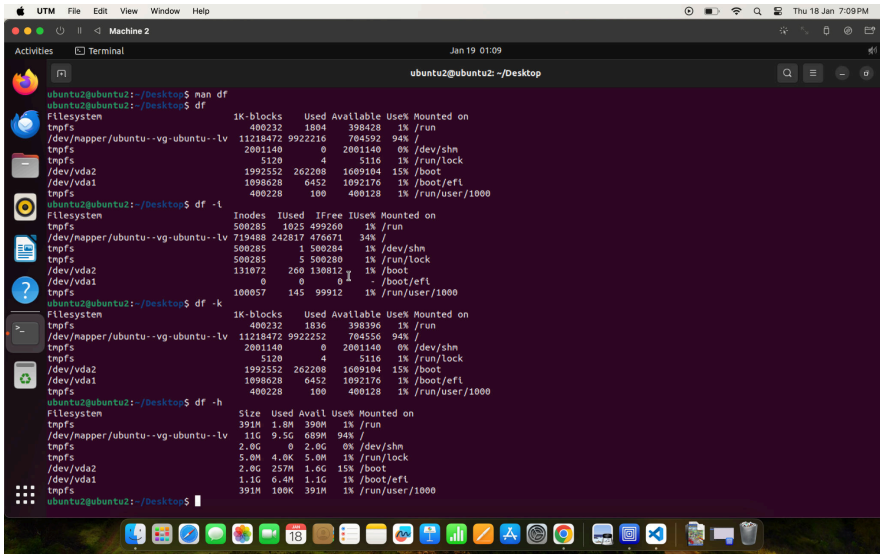
ee) **df**

df stands for disk free which tells us about the disk space usage on the mounted file system.

Syntax:

df [option] [file]

options such as -h (for displaying KB, MBs), -T (dislays file type)



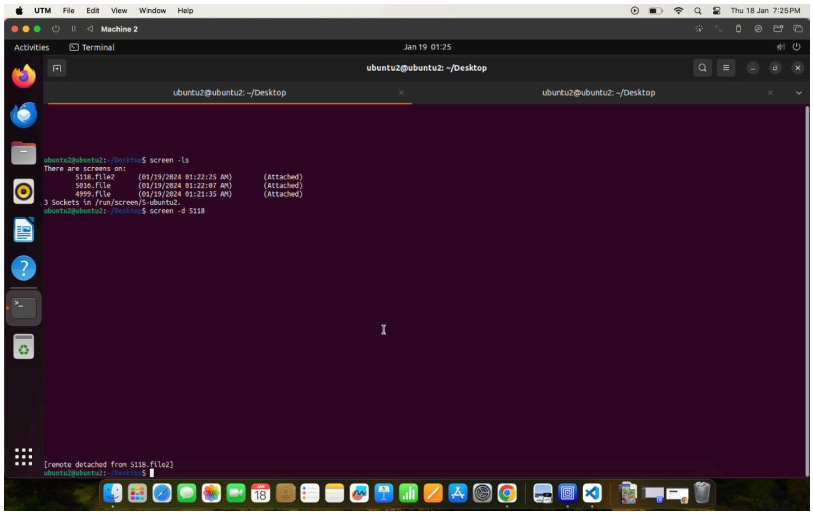
---

ff) **screen**

It allows yo t create multiple virtual terminals with in a single virtual terminals window.

Syntax:

Screen [options] [cmd [args]]



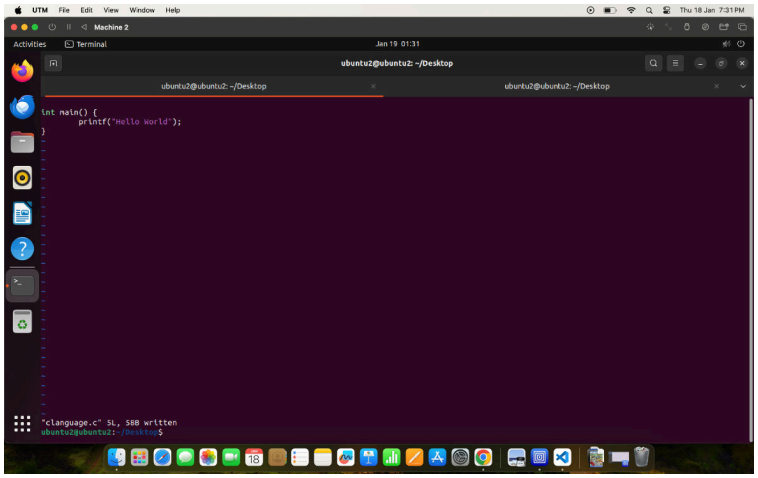
---

gg) **vim**

Vim (vi improved) is very similar to vi command. The

Syntax:

vim <fileName.extension>



---

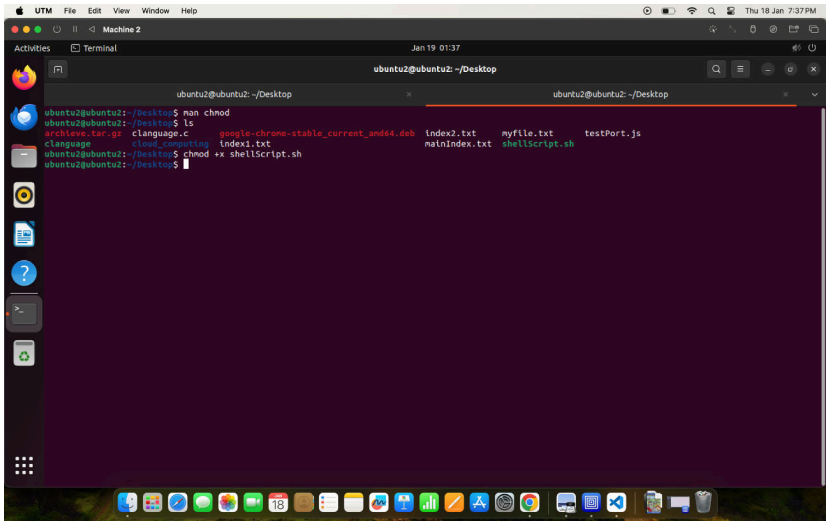
hh) **chmod**

chmod stands for change mode, it modifies the access permissions of a file or a directory and determine them with read, write and execute permissions.

Syntax:

chmod +x fileName.extension

r-> read, w->write, x-> execute



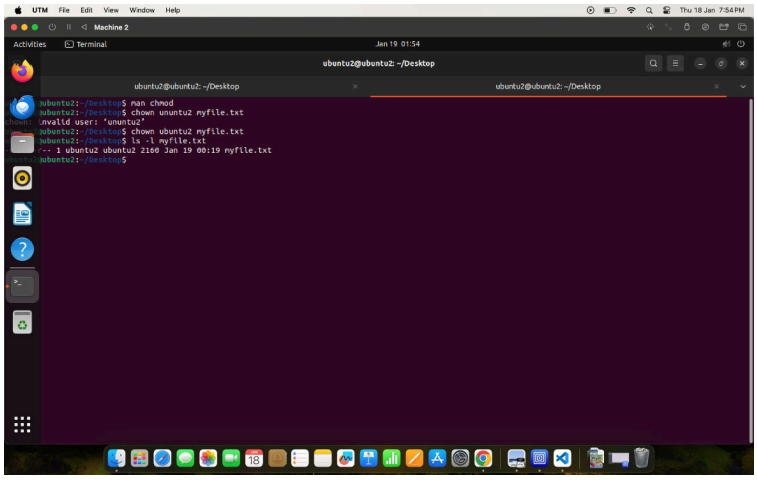
---

ii) **chown**

It is used to change ownership of a file or directory. It allows you to specify new owners or group for file and directories.

Syntax:

chown [OPTIONS] USER:[GROUP] fileName



---

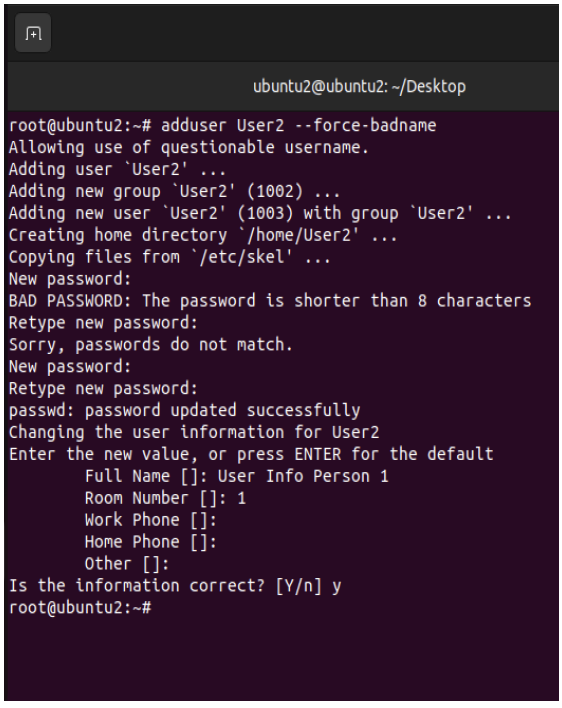
jj) **useradd**

It is used to add a new user account in ubuntu.

Syntax:

useradd [options] USERNAME

Options such as -d for specifics a custom home directory for the user, -s for set a users login. It is only done in root mode of shell, -u creates a unique ID number for a user. It is only done in root mode of ubuntu.



---

kk) **mv**

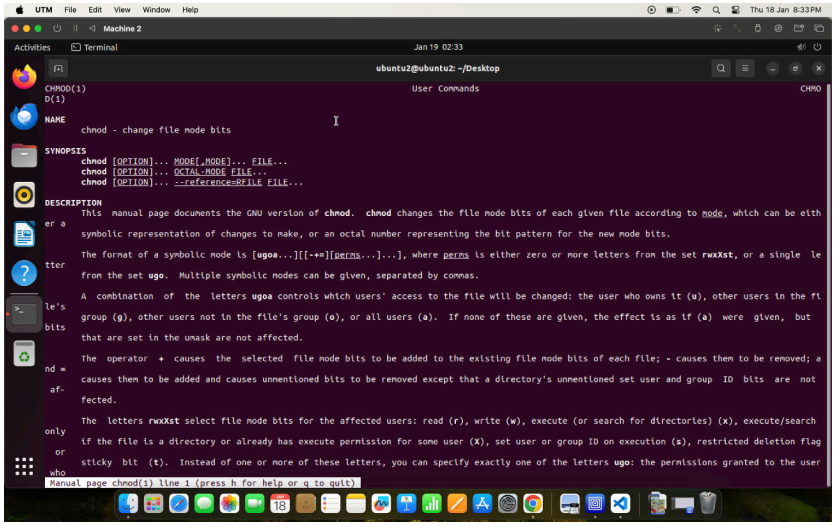
It is a command which moves and renames a file or a directory.

Syntax:
mv [options] source destination
Options such as -i => prompt confirmation before overriding the existing files, -f => overwrites the existing files with any permissions, -n => Prevents overriding the existing files.

```
ubuntu2@ubuntu2:~/Desktop$ ls
archieve.tar.gz  clanguage.c      google-chrome-stable_current_amd64.deb  index2.txt     myfile.txt      testPort.js
clanguage        cloud_computing  index1.txt                              mainIndex.txt  shellScript.sh
ubuntu2@ubuntu2:~/Desktop$ mv testPort.js ../Downloads/testing.js
ubuntu2@ubuntu2:~/Desktop$ cd ..
ubuntu2@ubuntu2:~$ cd Downloads
ubuntu2@ubuntu2:~/Downloads$ ls
testing.js
ubuntu2@ubuntu2:~/Downloads$
```

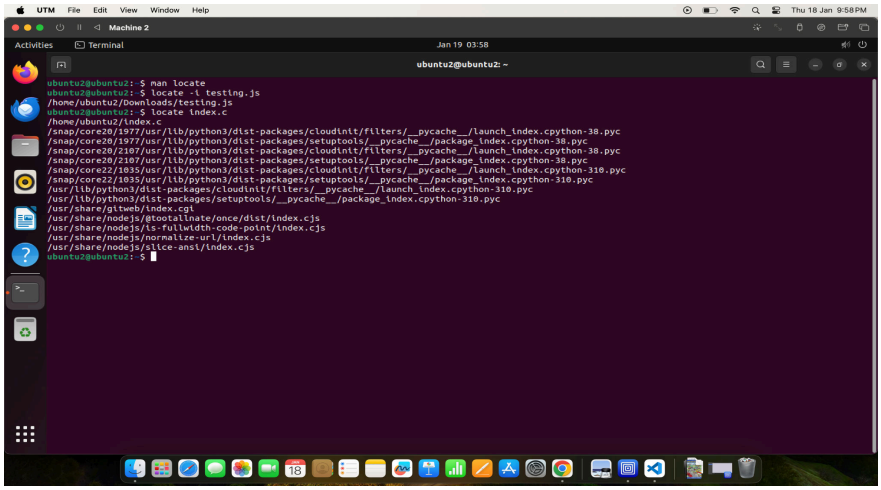
---

ll) **man**
Man refers to manual.
It is used to describe command names with definition, syntax and its usage.
Syntax:
man <commandName>



---

mm) **locate**
locate command is the fast and efficient way of finding files and directories in the ubuntu system.
Syntax:
locate [options] pattern
Here pattern is nothing but a part file name.
It has options like -i which indices case sensitive search, -c => count the number of entries which match.



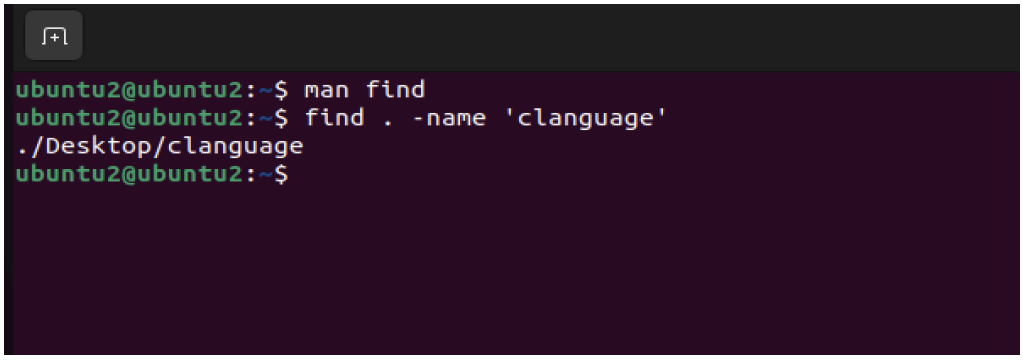
---

nn) **find**

find command is used to locate files and directories in the file system based on specific criteria

Syntax:

Find [start-directory] expression



---

oo) **sed**

sed stands for stream editor which usually modifies the text files non-interactively, making all the changes in a single go.

Syntax:

sed [options] command file

Options here include

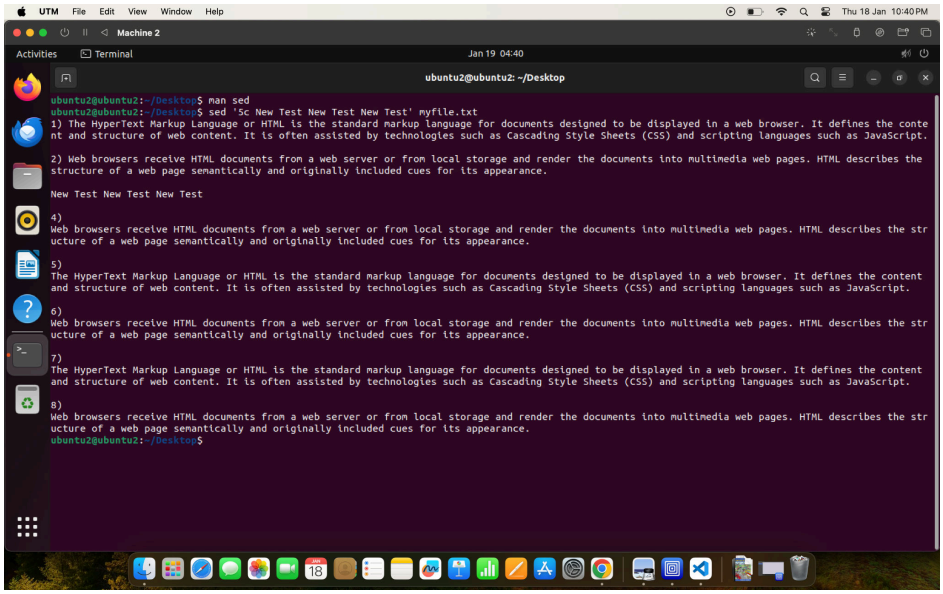
s => substitute text, d for deleting lines pattern matching,

a => appending text after a line is matching a pattern,

d => deleting a line after a line is matching a pattern,

i => inserting a text before a line is matched.

c => change the entire matching row.



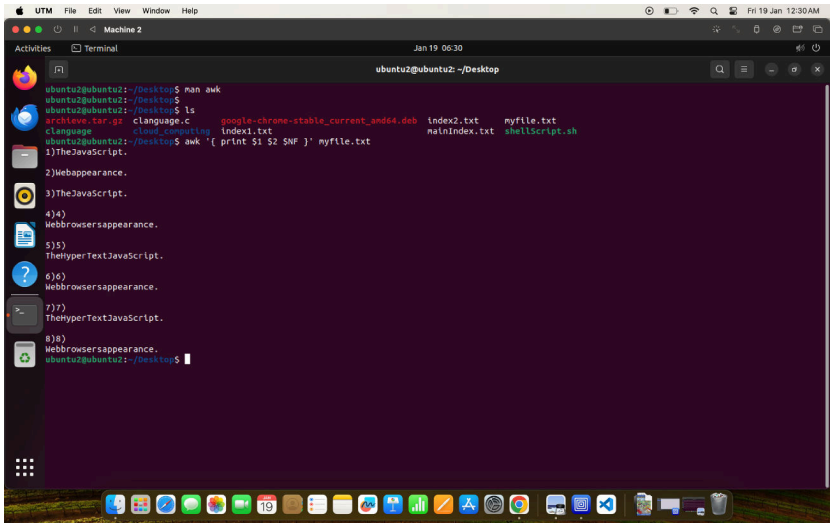
---

pp) **awk**

awk is a command line tool which is used for scanning patterns and processing text files.

Syntax:

awk '{pattern action}' file



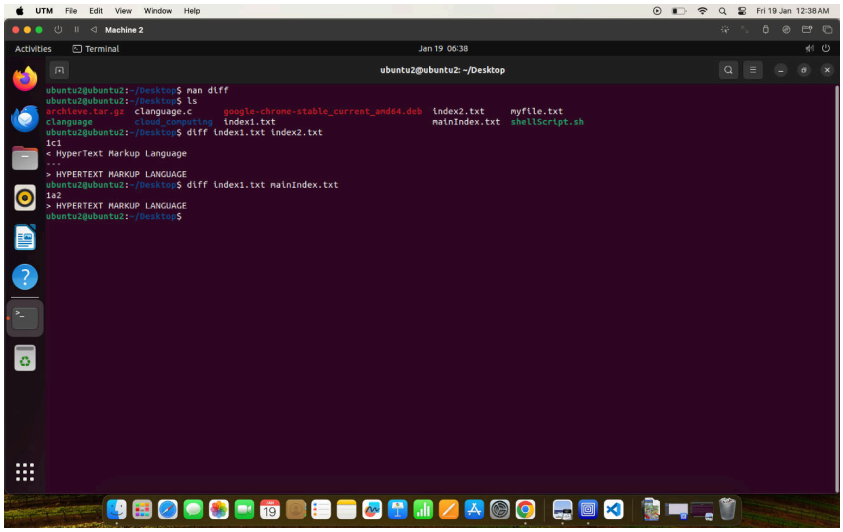
---

qq) **diff**

diff is a command line utitlity which is used to compare the contents of 2 files or directories.

Syntax:

diff [options] FILE1 FILE2



---

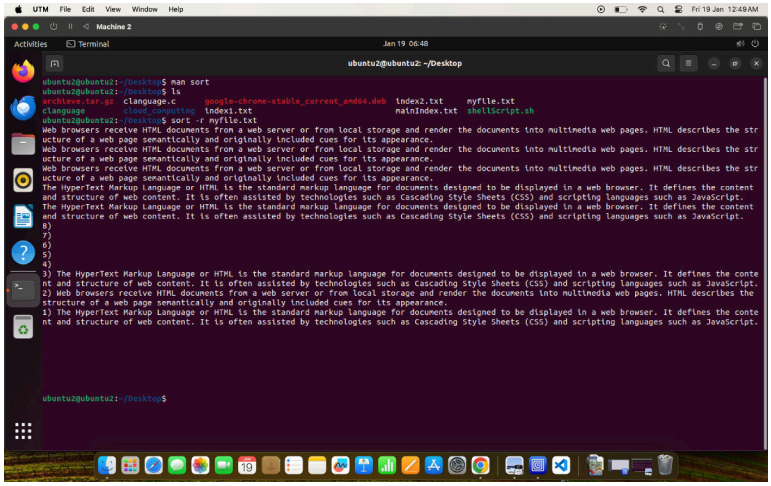
rr) **sort**

sort command line utility which is used to sort lines of a specified file.

Syntax:

Sort [options] fileName

Here options are -n for numeric string and -r for reverse string



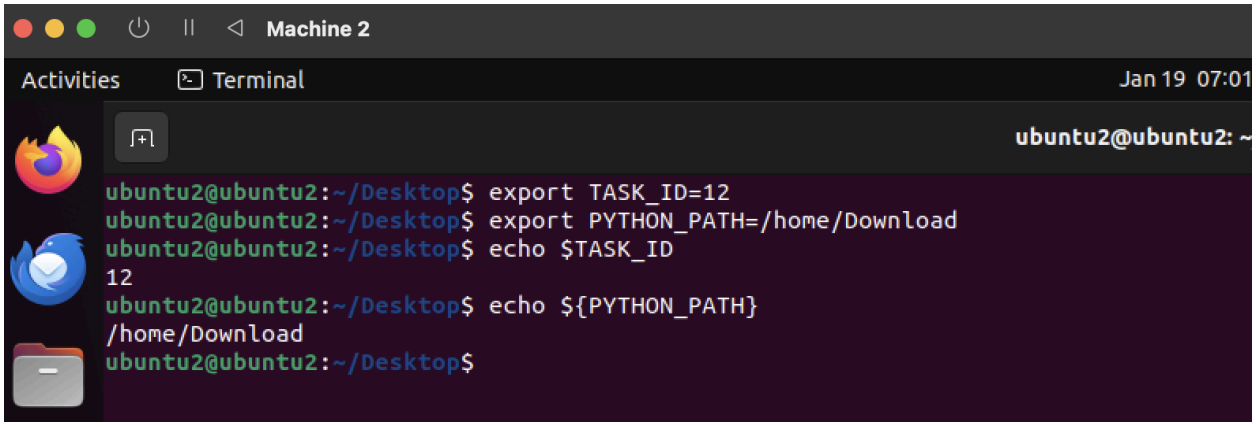
---

ss) **export**

The in-built command export promotes a local variable to global environment variable where this variable is accessible to all programs inside a current shell session.

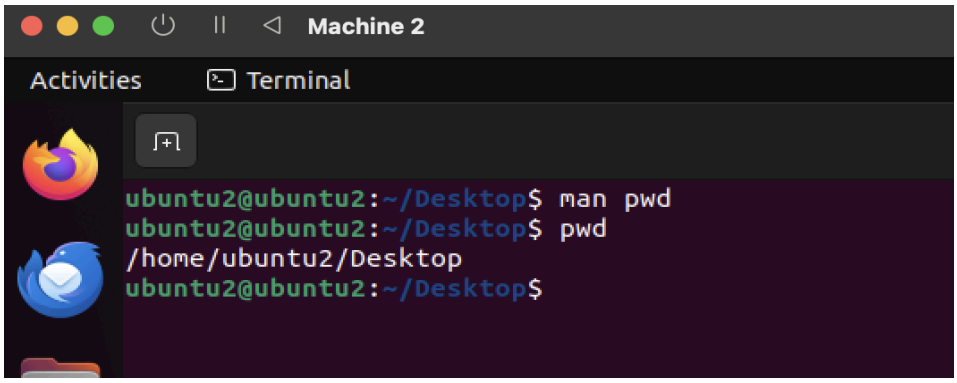
Syntax:

export [name=[value]]



---

tt) **pwd**
The command line utility pwd stands for print name of current/working directory
Syntax:
pwd



---

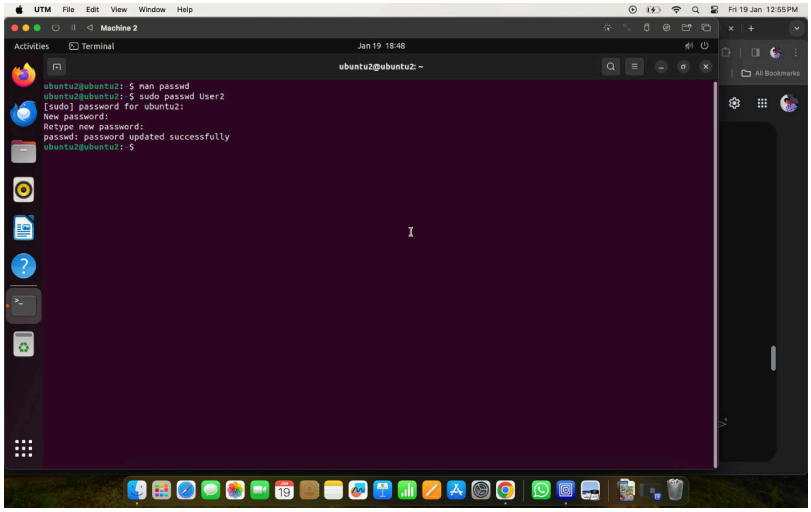
uu) **crontab**
crontab is a command line utility which is used to execute a particular task called as cron job, at a scheduled time and intervels.
Syntax:
Min hours dayOfMonth month dayOfWeek
Min -> 0 to 59
Hours -> 0 to 23
dayOfMonth -> 1 to 31
Month -> 1 to 12
dayOfWeek -> 0 to 6

---

vv) **mount**
The mount command is used attaches a file system from a remote server or storage device. This makes the files to be accessible through the directories.This process is called mount point.
Syntax:
mount [options] device mountpoint
It has options like -t which explicitly indicates file system type and ro => read-only, rw => read-write.

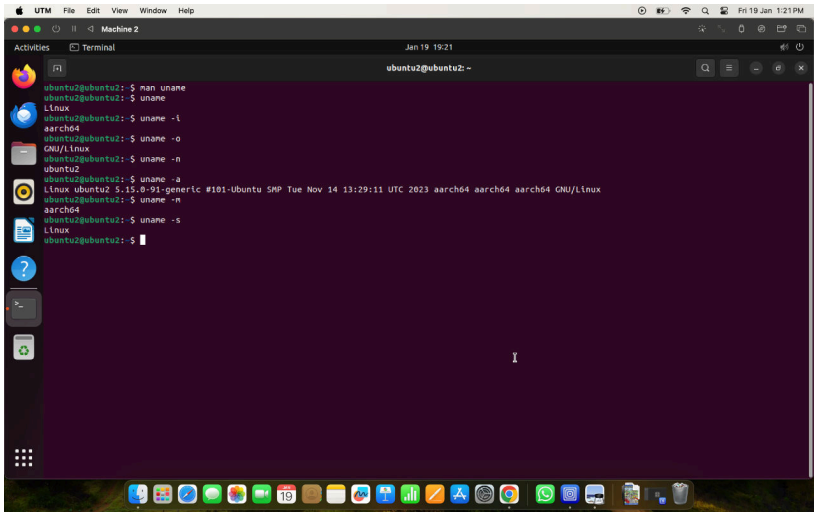
---

ww) **passwd**
The passwd command line utility is used to manage user passwords. It is used to change, view status, set a new password and lock and unlock user accounts.
Syntax:
passwd [option] [username]



---

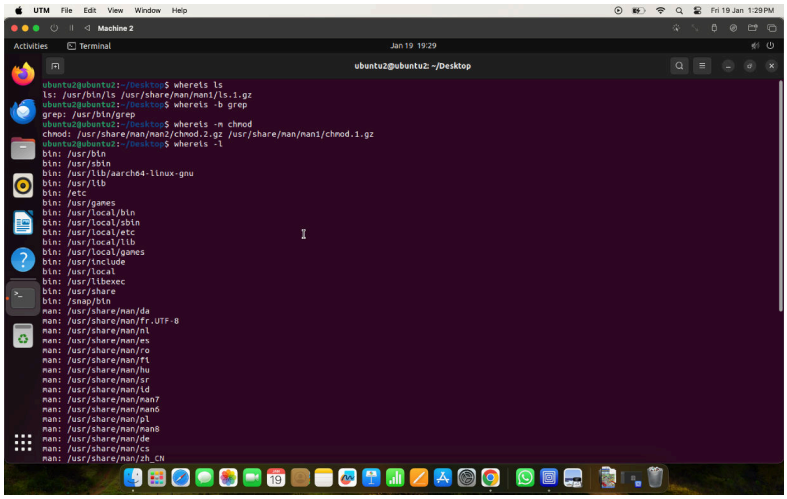
xx) **uname**
uname command gives the information about the operating system and hardware of the system.
Syntax:
uname [option]
It has options like
-a => print all available information of the system,
-n => print network node hostname,
-o => prints OS name,
-i => prints hardware platform,
-s => prints kernel name



---

yy) whereis

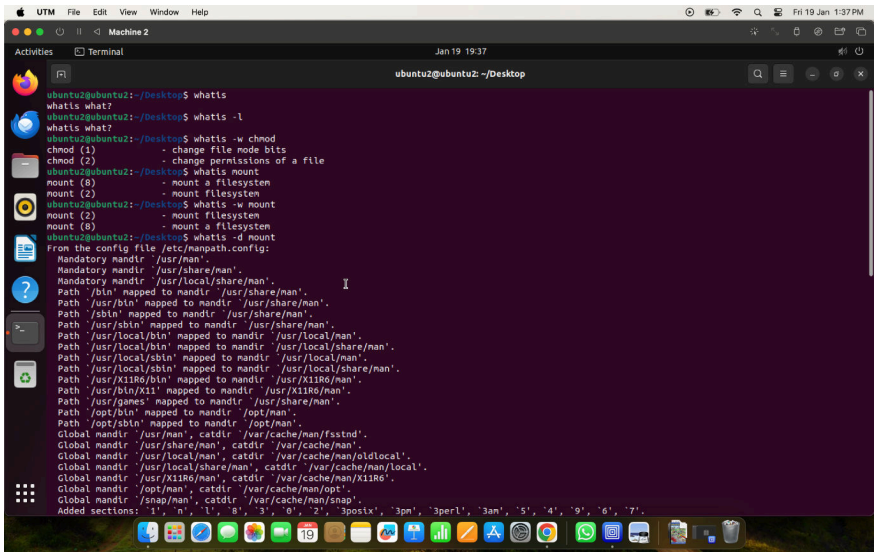
It quickly identifies the binary, source code and manual pages files in a program or a command
Syntax:
whereis [options] commandName
It has options such as
-b -> Search for only binary file
-s -> Search for only source code file
-m -> Search for only manual page file



---

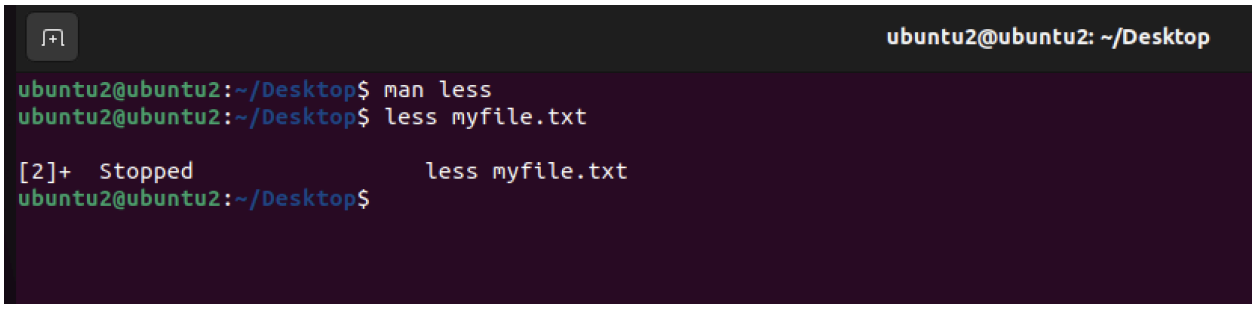
zz) **whatis**
It gives a single-line brief information of a command or a function from the manual pages.

Syntax:
whatis [options] commandName
-w => This flag is used to search for complete words.
-l => get list all occurrences of the command or function



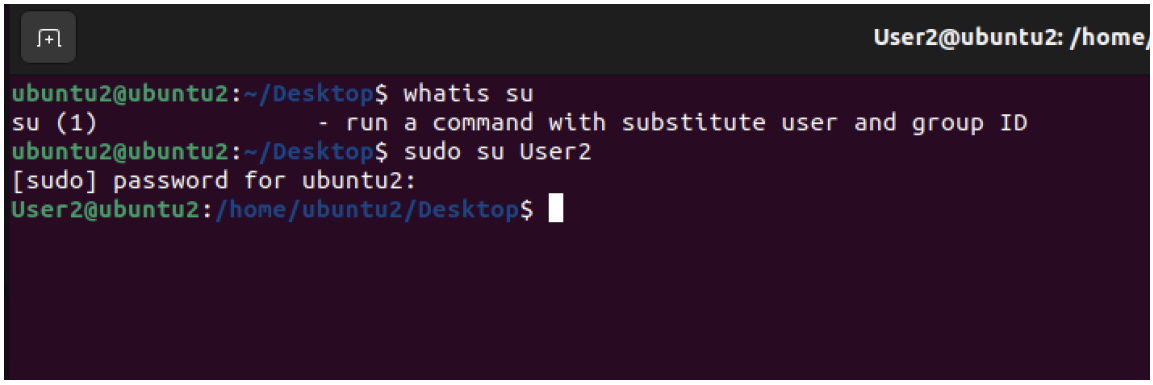
---

aaa) **less**
It is a text file viewer, which helps in viewing the content of a file in one screen or page.
Syntax:
less [options] fileName



---

bbb) **su**
su stands for switch user, which allows you to change the current user ro another user with in single shell session.
Syntax:
su [options] username



---

ccc) **ping**

Ping tells whether a host of IP is reached. It is handled by Internet Control Message Protocol (ICMP).

Syntax:

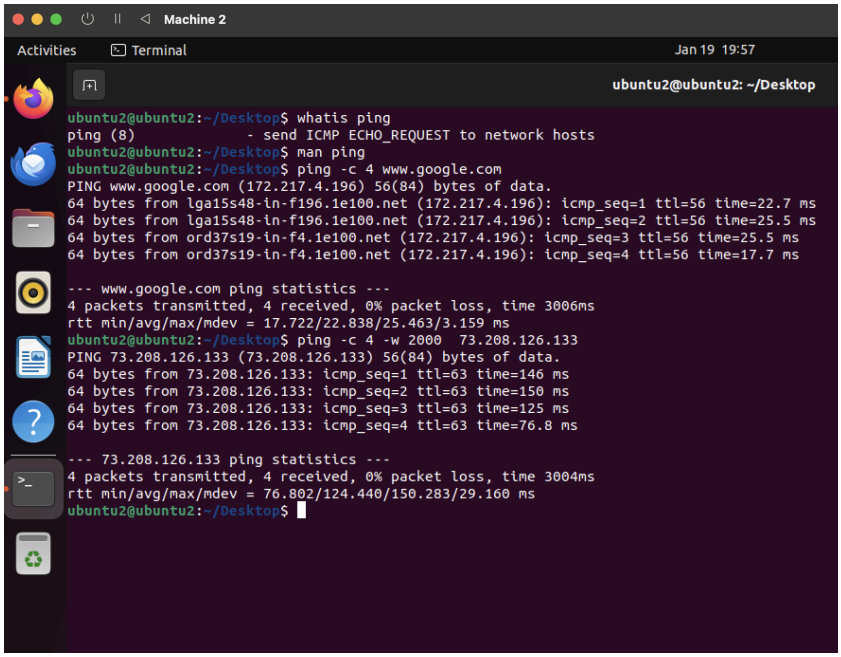
ping [options] hostName_or_IP_Address

It has options like

-c number => which servers ping for number times.

-t => It continuously ping the host until it is interrupted.

-w => wait or timeout



---

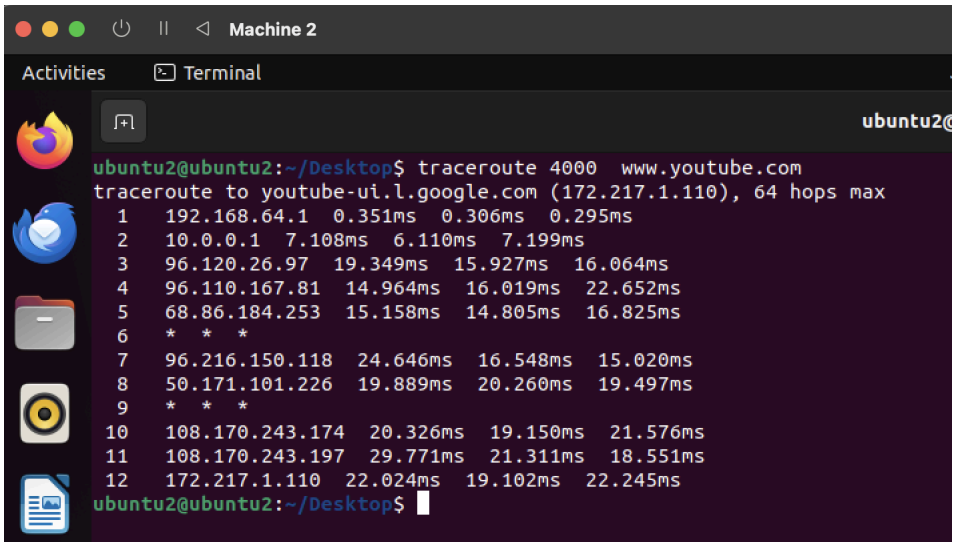
ddd) **traceroute**

It is a network diagnostic tool which tracks the location or path of the packet from where the data is moving towards i.e from one computer to a host of the network.

Syntax:

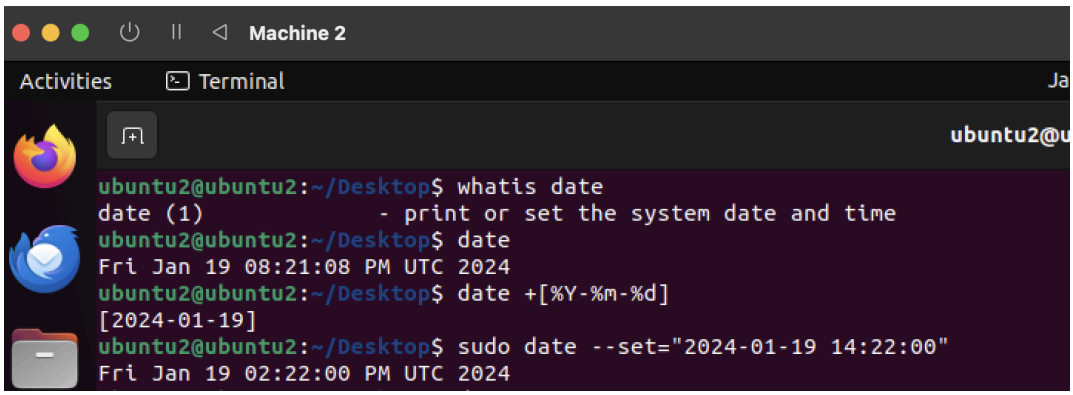
traceroute [options] hostName_or_IP_Address

The options include:
-c => trace a set a maximum number of hops
-w => wait or timeout



---

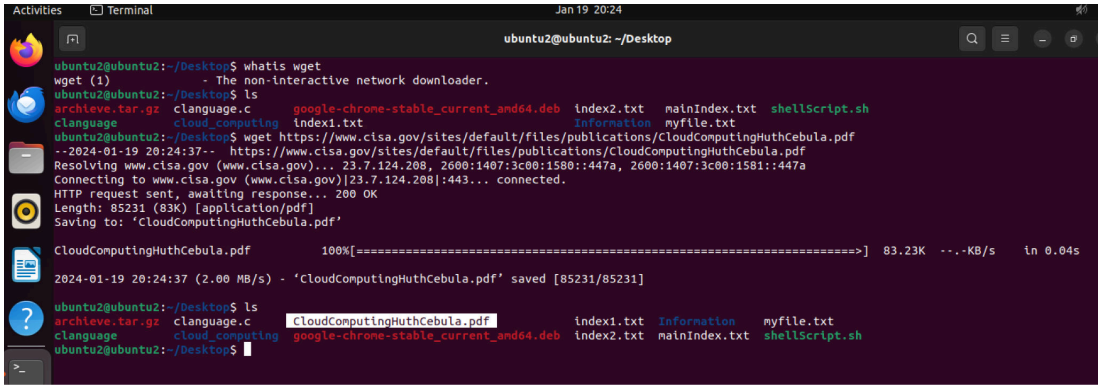
eee) **date**
It is used to display current date and time. It can also be formatted according to the user.
Syntax:
date [options] [+format]
Formatting patterns are -> %Y : for year, %m: for month, %d for Day, %H for hours, %M for minutes and %S for seconds.



---

fff) **wget**
It is used to download files from internet and supports different protocols like HTTP, HTTPS and FTP, etc
Syntax:

wget [options] URL



---

ggg) **wc**

The wc stands for “word count”. It gets the count of the words, characters, bytes and number of lines from a given file.

Syntax:

wc [options] [file(s)]

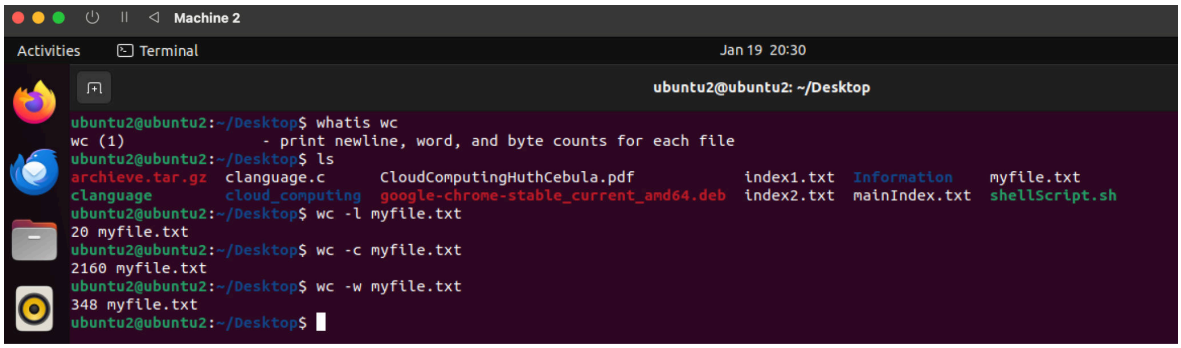
It has options such as

-w => count of number of words

-l => count of number of lines

-m => count of number of characters

-c => count of number of bytes



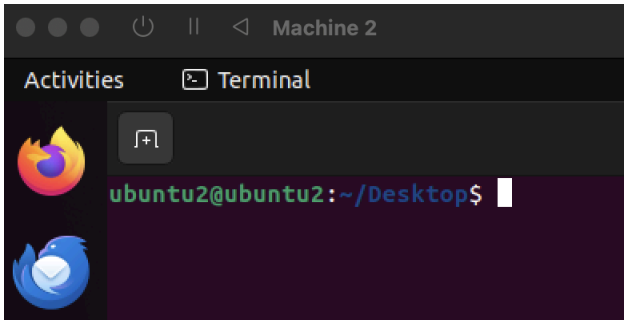
---

hhh) clear

This command is used to clear all the pre-executed commands in a terminal.

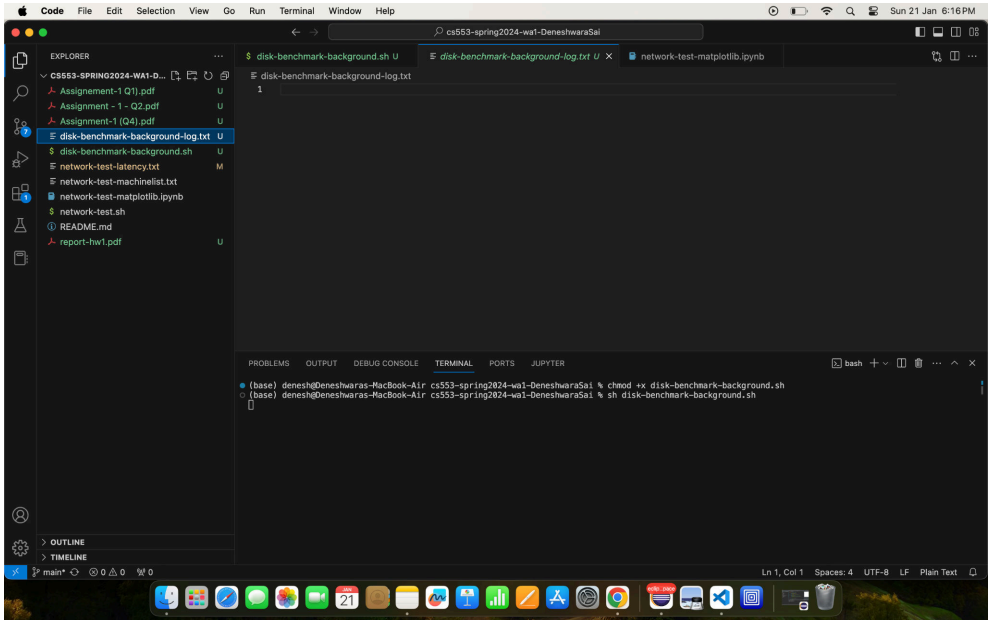
Syntax:

clear

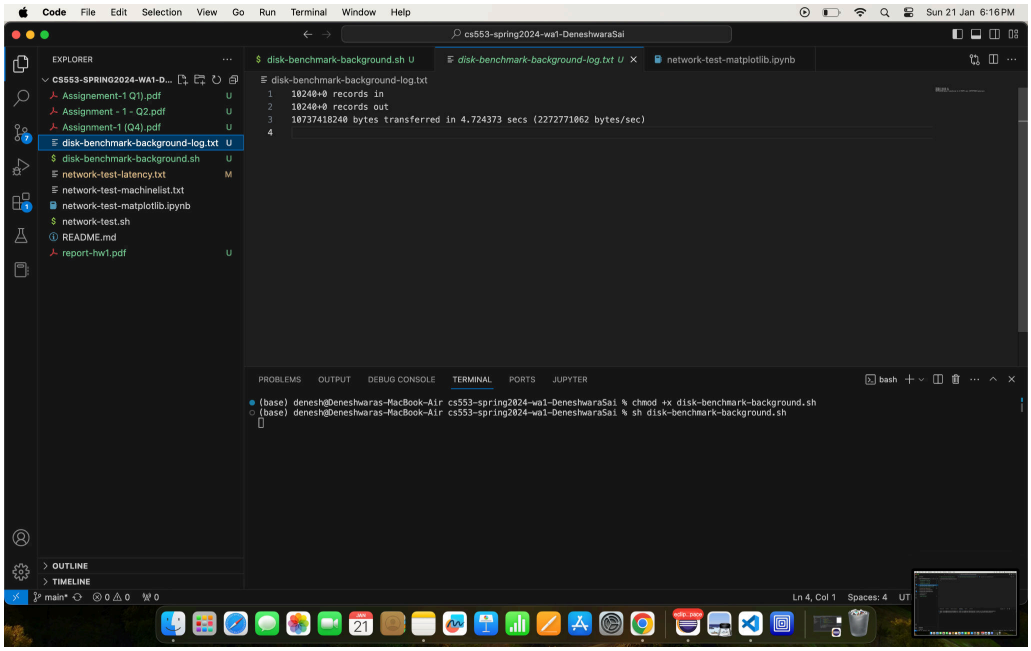

Machine 2
Activities
Terminal
ubuntu2@ubuntu2:~/Desktop$

---

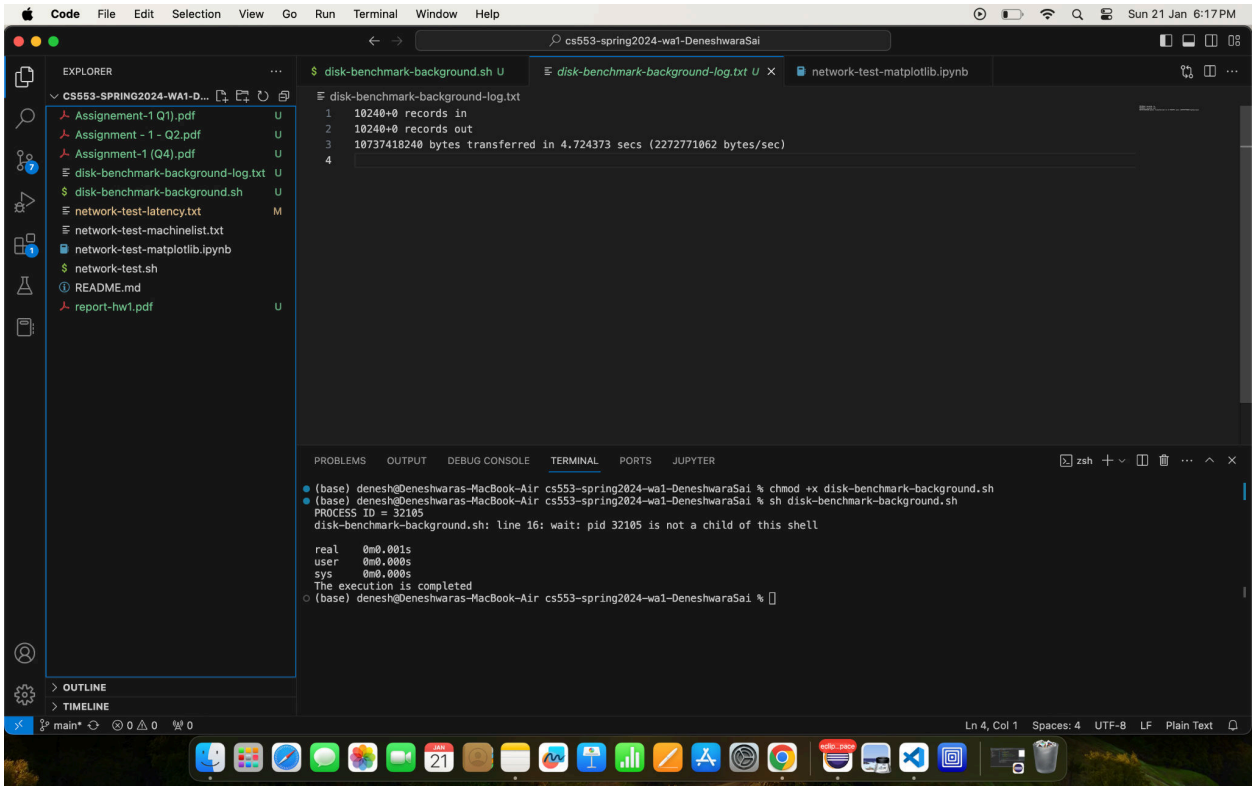
3)
a)



A empty output file **(disk-benchmark-background-log.txt)** is created.



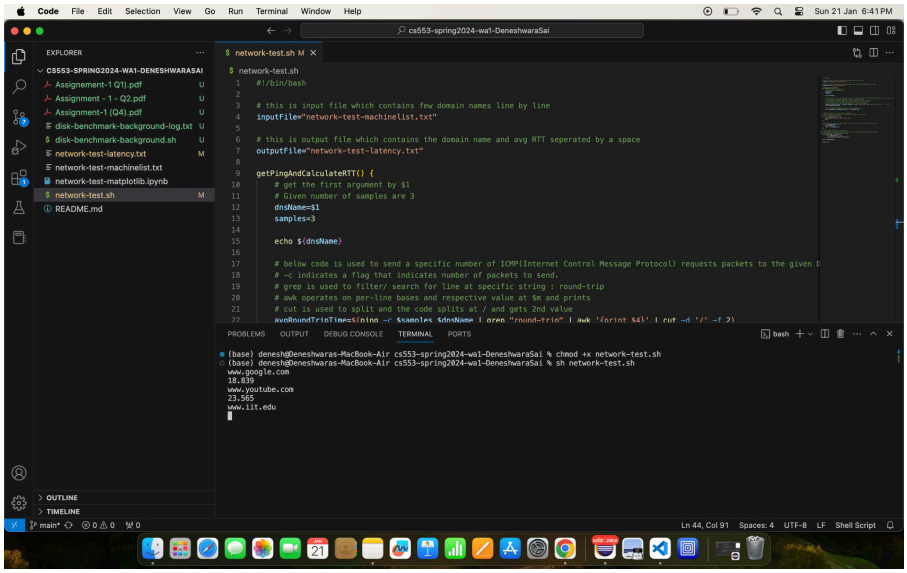
The script is in the process of executing and it runs for 10 seconds. The output is printed even though the executing is continuing.



Now, execution is completed successfully and output is stored in **(disk-benchmark -background-log.txt)** file

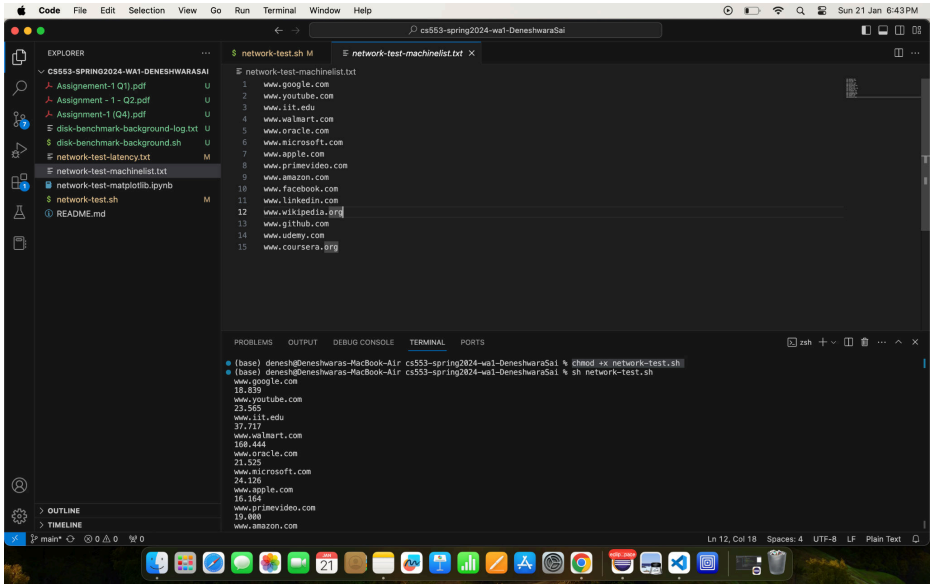
---

3)
b)

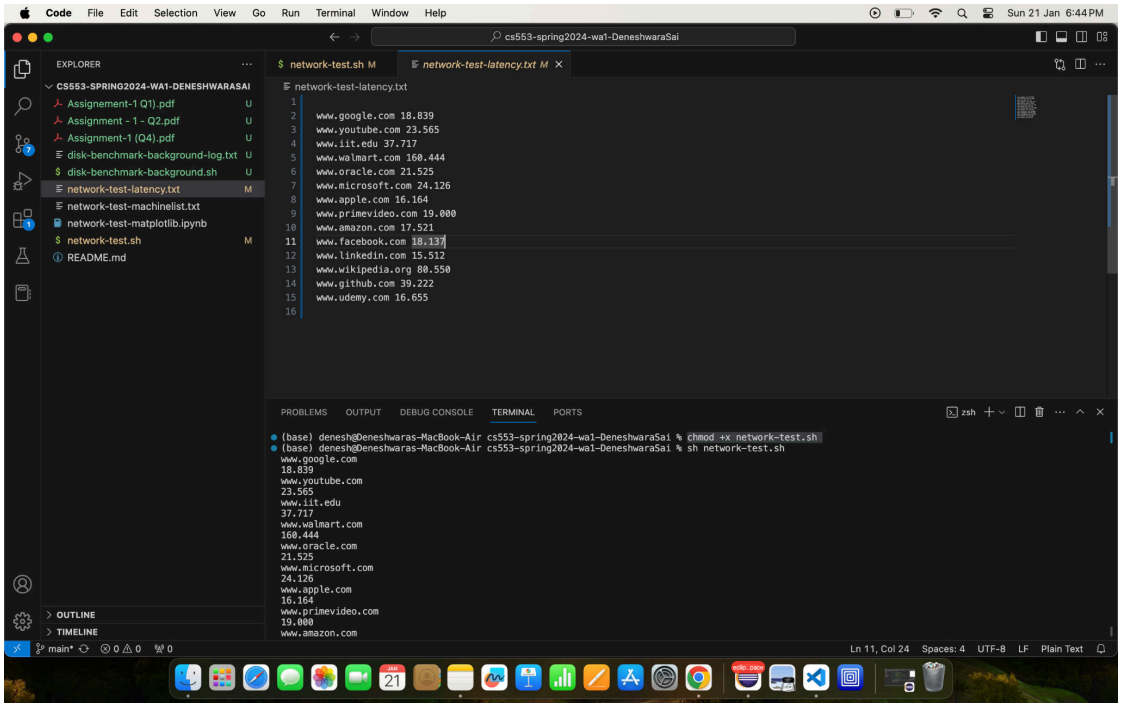


Lets give executable permission to network-test.sh file by **chmod +x network-test.sh** and get output by using **sh network-test.sh.**

Input File :



Output File :



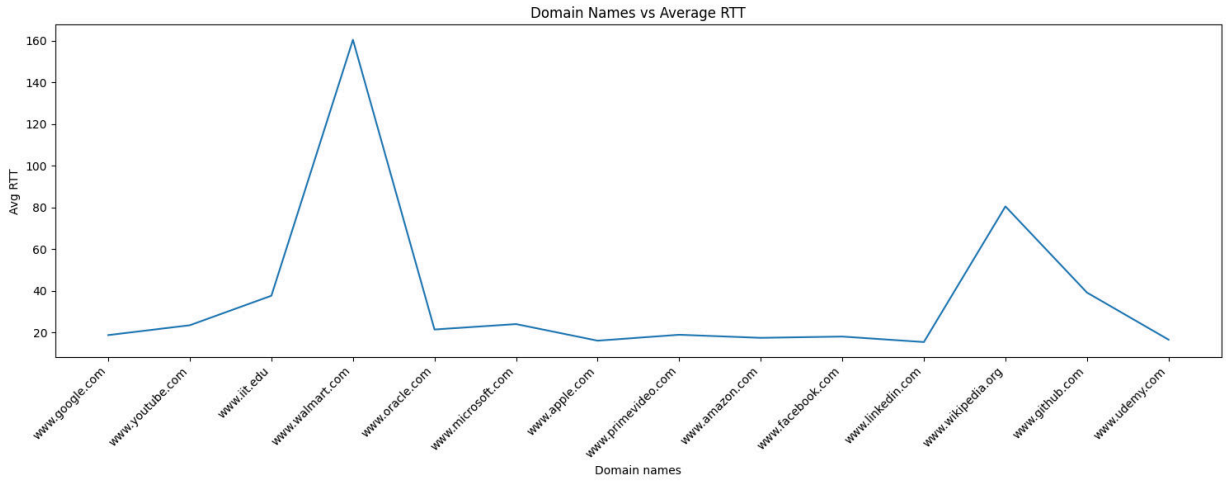
---

3)
c)

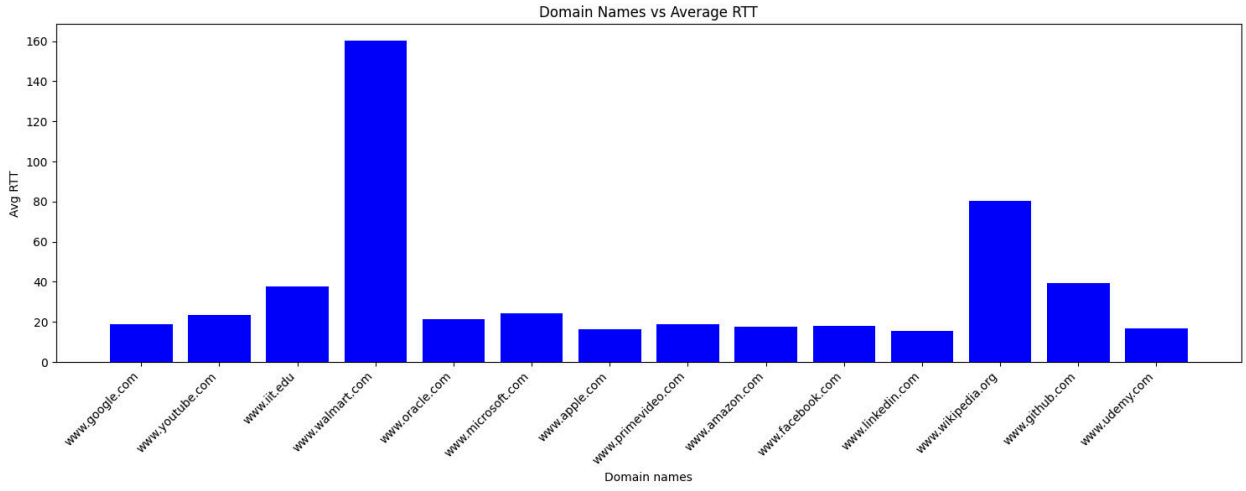
Use the file **network-test-matplotlib.ipynb** for running the program. For every cell use shift + enter to execute.
This program takes **network-test-latency.txt** as input and generates the below graphs.

The output screen indicates the domain name and its average RTTs.

Line Graph :



Bar Graph:



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4)
a)
In the system configuration of the virtual machines, changing the number of processors may significantly impact their behavior. The change may directly affect performance, resource allocation, resource contention, and parallel processing.

Changing the number of processors:

- **Increasing Processors:**
  This creates a virtual machine with high computing power, allowing the tasks to distribute their workload and perform parallel jobs. It leads to improved performance and latency and makes use of cores efficiently for parallel jobs.
- **Decreasing processors:**
  Allocating less number of processors reduces the computational power of virtual machines slows the performance and cannot handle parallel tasks.

Scenario for Maximum Processors:
Scenario: Considering a high-traffic web microservice system that is responsible for handling incoming HTTP requests for a web application and performing various tasks like calculation, billing, authentication, and CRUD operations.

To handle such a high volume of incoming requests and ensure consistency in performance, it is mandatory to maximize the allocation of processors to the microservice.
By maximizing the allocation of processors, the microservice can distribute its workload across all threads and cores to handle the high traffic efficiently, ensuring responsiveness, transaction management, and scalability.

Scenario for Minimum Processors:
Scenario: Background Task Processor
Considering a microservice responsible for executing background tasks, such as generating reports, transmitting emails, or processing data asynchronously. These tasks are not scheduled and can be processed in a deferred manner.

Here, we can restrict or minimize the usage of processors as it is an asynchronous job and executes the jobs one after the other. Doing this helps optimize the resource utilization, and allows for more virtual machines to coexist on the host without causing resource contention.

Potential issues with setting a maximum processor:

- **Resource Contention:**
  Allocating a maximum number of processors to multiple virtual machines on the same host and if physical cores are insufficient then it leads to resource contention. It results in degradation of performance and dependency on the core to free up.

- **Resource wastage:**
  Allocating more processors for fewer computational jobs may lead to resource wastage, may not utilize the hardware up to the mark, and may cost high.
- **Management complexities :**
  Managing virtual machines with a high volume of processors is a complex task for cloud administrators. Troubleshooting, monitoring, and resource allocation become more difficult, which leads to an imbalance and unstable virtual environment.
- **Cost/ budget:**
  In cloud environments, when dealing with or allocating a maximum number of resources may result in higher expenses than expected.

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4)
b)

Virtualization: Virtualization is a process of creating a virtual environment or instance of something such as operating systems, cloud servers, storage devices and network resources.

Paravirtualization:
A paravirtualization is a technique that allows the guest operating system running inside a virtual machine to communicate more efficiently with the hypervisor by using hypercalls.

Hypervisor:
A hypervisor is otherwise called as VMM(Virtual Machine Monitor), is a firmware or software layer that enables the virtualization of physical hardware, allowing multiple OS to run on multiple virtual machines. This hypervisor is at the middle of hardware and OS or VMs, managing and allocation resources to the host system to the individual virtual machines.

None, Legacy, Minimal, Hyper-V, and KVM refer to different types of paravirtualization interfaces.

Feature	**None**	**Legacy**	**Minimal**	**Hyper-V**	**KVM**
Hypervisor	There is no hypervisor	It uses Type-1 Hypervisor.	It uses Type-1 Hypervisor.	It uses Type-1 Hypervisor.	It uses Type-1 Hypervisor.
Purpose	There is no virtualization.	Server virtualization.	Lightweight virtualization.	Server virtualization	Server virtualization
Host OS	It directly communicates with the Hardware.	N/A (Bare-metal)	N/A (Bare-metal)	windows server.	Linux
Guest OS	N/A	Various OS	Various OS	Windows/ Linux	Various OS

Supported OS	None doesn't support any specific OS because it is not a virtualization platform.	Legacy virtualization platforms may have very limited options of support for modern operating systems.	These platforms supports a quite range of operating systems but with minimal features.	Hyper-V is primarily supports microsoft and windows based operating systems.	KVM supports wide range of operating systems including windows, linux.
Open source	These are not open source.	These may or may not be a open source platforms.	Minimal virtualization platforms may or may not be open source and it depends on the specific implementati on.	Hyper-V is not open source as it is owned by microsoft.	KVM is open source and a part of linux kernel. It has strong community development and support.
Integration	None doesnot integrate with any other virtualization technologies.	Legacy may not integrate with modern technologies and cloud platforms.	Minimal virtualization have limited integration features, capabilities with other systems.	Hyper- V can integrate well with microsoft related technologies and often used in windows centric environments	KVM integrates well in any linux ecosystems.
Performance	N/A	High	Moderate	High	High
Management	N/A	Using GUI	Minmal (CLI)	GUI (Hyper-V manager)	CLI (virsh)
Live migration	No live migration	Yes, it has live migration.	Yes, it has live migration.	Yes, it has live migration.	Yes, it has live migration.
Resource	N/A	Dedicated resources	Shared resources	Shared resources	Shared resources
Networking	N/A	Networking through virtual switches.	Networking through Bridged.	Networking through virtual switches.	Bridged networking.
Examples	Basic	VMware	Xen.	Microsoft	KVM/ QEMU

	General purpose PC.	ESXi (Elastic Sky X integrated)		Hyper-V on windows server machine.	(Quick emulator) on a linux server.

KVM (Kernel-based Virtual machine) are best recommended paravirtualization option for Ubuntu Linux.

Reasons :

The Linux kernels are integrated with KVM ensuring seamless compatibility and performance optimization that provides a scalable and robust virtualization solution to the Linux environments. KVM is an open-source virtualization technology, which is benefitted from regular updates, patches, maintenance, and strong community support, ensuring reliability, scalability, and stability. It offers both command line and Graphical User Interface(GUI) tools for flexibility management, includes security features from the Linux kernel, and is broadly inherited with the Linux virtualization ecosystem.

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4)

c) The differences between IDE, SATA and NVMe :

Features	**IDE Controller**	**SATA Controller**	**NVMe Controller**
Full Forms and Compatibility	IDE stands for Integrated Drive Electronics controllers are widely usedin older computer systems.	SATA stands for Serial Advanced Technology Attachment controllers are widely used in modern systems.	NVMe stands for Non-Volatile Memory Express are widely designed for high-performance solid state drives(SSDs).
Data Transfer	They provide a slower data transfer rates and limitations on drive size and operations. Rate is upto 133MB/s (IDE)	They provide a faster data transfer rates, larger drive size and better performance. Rates are upto 600MB/s in SATA-II and 6Gb/s in SATA-III	They provide ultra fast data transfer rates, high performance storage controller for SSDs and low latency. Rates are upto 32Gb/s and beyond
Cable Length	Limited by cable interference and signal degradation	Longer cable length and minimal interference	Shorter cable length and less susceptible to interference.
Hot-swapping	IDE does not support.	SATA supports hot-swappping.	NVMe supports hot-swapping.

Power Consumption	Consumes more power.	Consumes moderate power.	Power efficient and consumes less power.
Latency	Higher latency compared to SATA and NVMe.	Lower latency than IDE.	Lowest latency, gives high performance.
Error Handling	Limited error-handling techniques.	Improved error-checking and correction	Advanced error-handling and has a mechanism of reliability.
Form Factor	Larger and bulkier	More streamlined and smaller.	Compact, Suitable for space-contrained systems.
Scenario/Examples	Using an older version of desktop computer with IDE hard drive. Like a PC in early 2000s.	Using a computer system such as consumer-graded systems which is equipped with SATA SSD for reliable and fast storage.	Systems demanding high-speed and high-performance oriented data transfer machines such as gaming PCs, Play /work stations and high-end laptops.

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4)

d) The difference between NAT, Bridged Adaptor, Internal Network and Host-only Network:

Features	**NAT (Network Address translation)**	**Bridged Adaptor**	**Internal Network**	**Host-only network**
Network Type	It is shared with host's IP	It is directly connected with physical network.	It creates closed network for virtual machines.	It allows network between hosts and virtual machines.
IP Address	Virtual machines use the IP Addess for external Communication.	It gets its own IP Address on the physical network.	Virtual machines have their own IP address within the internal network.	In the host-only network, Virtual machines and host communicate using IP addresses.

Internet Access	Virtual machines can access the internet from host's connection.	Virtual machines get direct internet access from physical network.	No direct internet access	No direct internet access
Isolation	Virtual machines can communicate with each other.	Virtual machines are part of physical network.	Virtual machines can communicate within internet network.	Virtual machines and host can communicate within host-only network.
Communication Scope	Virtual machines can communicate with external networks.	VMs can communicate externally and locally.	VMs are limited fo communicate within network.	VMs are limited fo communicate within network.
DHCP usage	It uses hosts DHCP	Can use either DHCP or static IP assignment.	VMs uses internal DHCP	VMs either use DHCP or static IP assignment.
Security	Adds security by hiding VMs behind the host's IP.	The VMs are exposed to local network andthey do require security meansures.	Provides isolation with minimized external threads.	They are more secure than Bridged mode.
Examples	Running multiple virtual machines with Internet access.	VMs as web services on the local network.	Testing environments with isolated VMs.	Secure network for host and VMs.

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4)
e)
The difference between USB(Universal Serial Bus) 1.1, 2.0 and 3.0 are :

Features	**USB 1.1 Controller**	**USB 2.0 Controller**	**USB 3.0 Controller**
Introduced Year	It was introduced in 1998	It was introduced in 2000	It was introduced in 2008
Data Transfer	The data transfer rate is upto 12Mbps.	The data transfer rate is upto 480Mbps.	The data transfer rate is upto 5Gbps.

Backward Compatability	USB 1.1 has a backward compatibility with USB 1.0.	USB 2.0 has a backward compatibility with all previous version like USB 1.1, 1.0	USB 3.0 has a backward compatibility with all previous version like USB 2.0, 1.1, 1.0.
Maximum Power output	Low-power devices with 2.5mA	Standard power devices with 500mA	Standard with 900mA and battery charging with 1.5A.
Connection Types	Standard-A and standard-B.	Standard-A and standard-B.	Standard-A, standard-B, Micro-B, Type-A and Type-B Superspeed.