1. To check the version of your name
   uname -r

2. To check OS
   uname

3. The man command in linux is used to display the manual page for any command
   The manual page contains other system utilities information also.
   The man page contains detailed information about how a command can be used and what are the various arguments that command has

   man command

   man uname
   man mkdir

4. **pwd:**
   pwd starts for the print working directory . It will print the full path of your current working directory . This command is useful for navigating through your system file structure.

   pwd

5. Check the version of pwd

   /bin/pwd - -version

6. To clear the screen

   clear

7. cal command is used to display the calendar for the given month and year . If you simply type cal , it will display the current month .

   cal

   To display calendar for specified month and year
   cal -m 2 2022

   To display calendar for current year
   cal -m 2

8. To display the calendar vertically , cal displays the calendar horizontally.

   Ncal

9. Date command displays the current date in linux

   date

10. whoami -
    This command is used to display the current user id and username of the user who is currently logged in . This will print the username of the user who is running the command.

    This command is useful when a number of users have logged in and you just want to know which user's account is currently using the system.

    whoami

11. whatis -
    whatis command is used to get one line of description of any command . This can be used for quick reference

    When you don’t know any command and don’t want to go to the manual page you use whatis.

    whatis

12. w -
    w command is used to display information about currently logged in users and their processes .

    When you type w command you will get information such as username , terminal , login session , the time they logged in and the current system load average.

    This command can be used when you have multiple users and you want to see who is currently using the system , what they are doing and how long they have been logged in.

    This command also helps you to check login history and activities of a user.

    w

13. To go to root user (i.e admin)
    To create new user , we need to login to root

    sudo -i

14. To add new user , we use this command **adduser username**

    adduser cdac

    To switch to the new user/different account we use **su username**
    su cdac

15. ps command will show all the processes that are running

    ps

16. ps aux -

    This command will display list of processes that is running on your system with additional information such as cpu and memory usage .

    ps aux

17. history -

    history command will list all the commands that you have previously used

    history

18. mkdir -

    The mkdir command allows you to create new directory in the file system

    mkdir directory_name

    When the permission is denied to create the directory , use below command

    sudo mkdir directory_name

    When we want to create multiple directories in single command ,

    sudo mkdir directory_name1 directory_name2

19. To get list of directories

    sudo ls

    sudo mkdir -p t4/t5/t6

We use curly brace {} to group directories

If we want to create directories on same level ,

mkdir -p t10/{a/{a1,a2,a3},b/{b1,b2,b3}}

If we want to create directories as parent directories ,

mkdir -p t10/{a/{a1/a2/a3},b/{b1/b2/b3}}

20. cd -

cd command is used to change the directory

If we simply type cd , it will move to home directory
cd

If we want to move to some other directory from home directory , use below command,

cd directory_name

To move back from current directory ,

cd ..

cd -
will move you to previous working directory

cd ~
will move you to home directory

cd /
will move you to system's working directory

cd ~ user
will move the user directory . This will work only when you are working in the root directory .

ls command will show a list of files/directories .

We can check the version of ls using below command ,
ls - - version

ls -l
shows files / directories , size , modified date , time, files and folder names , owner of the files and its permission.

ls -a
This command contains all the list of hidden files(hidden files starts with '.' and '..')

ls -lh
Displays all the information in human readable format

ls -lS
Displays all the information in sorted order(order by size of files and directories)

Another way to do the sorting ,
ls -S -l

ls -i
This checks for inodes (its a data structure that stores various information about files in linux such as the access modes and the owner file size , type , number of links)

ls -R
Shows the list in recursive order

ls - lt
This shows the list of files and directories by modified date in ascending order

ls -d */
This command will list you only the directories

ls ~
This contains list of directories and files that are present in home directory

ls *
This command will show you list of directories and their sub directories

ls -S
This will show you files and directories (sorting is done by date of time of file creation / directory creation) in descending order

ls -n
This command will show you user id (UId), group id(GId) of a file / directory

ls -G
This will give you the list of files and directories those who belong to same group

File Creation

How to create a file

1. touch:
   touch f.txt

2. cat
   cat > new.txt

   - Through cat command will create an empty file and you need to add contents in the text file

   - Once u have added the contents in the text file , PRESS CTRL + D to save the file

   - And to check the file whether it is created or not , write the command
     ls -l filename.txt

   - And to see the content of the file, write the command ,
     cat filename

3. echo command

   echo command will create a file in the current directory but we need to add the content / text in line of the command.

   echo “content” > filename.txt

   Similarly you can create a file using printf method

   printf “content” > filename.txt

4. nano

   nano filename.txt

5. VI Editor

   vi filename.txt

   a. To insert any text we need to enter into insert mode by pressing i

b. When you want to exit from the file , we have to PRESS ESC
c. When you want to exit from the file we have 2 modes
    1. Quit - :q
    2. Save and quit - :w
d. If we want to copy something , we PRESS CC and if you want to paste something , PRESS P
e. If you want to delete something PRESS DD
f. If you want to UNDO something PRESS u
g. To copy , paste , delete , undo we need to press the ESC button first.

6. VIM editor - It is similar to VI Editor

VI	VIM
It is the basic editor	It is advanced editor
Only available on Linux and Unix	Is available on other OS also Eg - Windows , MAC
VI editor doesn't provide multiple level of Undo	VIM editor provides multiple level of Undo

---

Remove

Files:

To remove or delete files/directory we have rm command or we can use unlink command

rm filename.txt

To delete multiple files,

rm file1.txt file2.txt file3.txt

To delete all the files with txt extension ,

rm *.txt

To force delete ,

rm -f filename.txt

To prompt and delete

rm -i filename.txt

To delete directories ,

rmdir directory_name

To delete directories using rm

rm -d directory_name

To delete parent directories along with their sub directories

rm -r directory_name

To remove Directory forcefully

rm -rf directory_name

If file size is too big ,

rm *.log

Copy

Copy command is used to copy a file from source to destination.

cp sourcefile/oldfile destinationfile/newfile

cp -i filename

If you want to copy a directory from one place to another , use -r or -R

cp -r fullPathoftheDirectory (/home/abc) destination(/home/xyz)

To not overwrite an existing file

cp -n srcfile destfile

Another way of copying ,

rsync is used to synchronize/transfer the file between two locations.
This command is mostly used between two different machines

Syntax

rsync -a “filename from source location” “destination”

---

mv command :
We use this command to move a file or a directory from one place to another

mv source destination

Cat > f1.txt

File is transferred to directory ,
mv f1.txt t1

File to file transfer ,
cp f1.txt f2.txt

mv *.txt dest_directory

Multiple files can be moved
Mv “t1.txt” “t2.txt” “t3.txt” abc(dir)

Difference between cp and mv command

cp	**mv**
Used to copy file / directory	To move file / directory to a new location
	Can be used for renaming a file
Cp command will copy the file but it will not delete the original file	In mv command , it will delete the original file while moving

If you don't want to overwrite an existing file

mv -n srcfile destfile

To take a backup of file ,

mv - -backup -S 01 source/the file you want to backup destination

Another way to create backup is ,

mv -b source destination

cp - -backup -S 01 source/the file you want to backup destination

---

RENAME

Rename command is used to rename a file.

We can rename by using mv command

mv file_to_be_renamed new_file

Eg : mv f3.txt file3.txt

Rename VS Move(mv)

Rename	mv
Rename is more advanced than mv command , we can use regular expression	Mv command don't have regular exp

rename ‘s/^/cdac_/’ *.txt

cdac_new1.txt

Grep Command

grep:

Grep command stands for global regular expression print.
It will check the entire text file for a pattern or it will search for a pattern in txt file.

grep “pattern” file_name.txt

OPTIONS

1. **grep -n “ pattern ” file_name.txt (-n)**
   will show the line number where we find
   the keyword.

2. **grep -c “ pattern ” file_name.txt: (-c)**
   will give you the count of how many times keyword have occurred.

3. **grep -v “ pattern ” file_name.txt: (-v)**
   It will display the line where it haven’t match the keyword.

4. **grep -e “ pattern ” file_name.txt: (-e)**
   It will specify the pattern for search. It is case sensitive

5. **grep -i “ pattern ” file_name.txt: (-i)**
   It will also specify the pattern for search but it is case insensitive.

6. **grep -r “ pattern ” file_name.txt: (-r)**
   It will search the pattern recursively in directories and subdirectories.

FIND:

It is used to search for a specific string of characters.

1. **find filename.txt**
   It will search for a file.

2. **find / filename.txt**
   It will search for a file in a whole system.

3. **find ~ filename.txt**
   It will search for a file in home directory.

4. **find . filename.txt**
   It will search for a file in the current directory.

5. **find . -name filename.txt**
   It will search for a file with the specific name.

6. **find . -name “*.txt(extension)”**
   It will return all the files with specific extensions

7. **find . -type d**
   It will return all the directories..

8. **find . -type -f -size +1M**
   It will return files having size greater than 1 MB.

9. **find -iname filename.txt**
   It will return your file irrespective of their uppercase or lowercase.

10. **find . -name “*.txt(extension)” delete**
    It will delete all the files with specific extensions.

11. **find / -name filename.txt**
    It will search for a file with the specific name in the whole system.

Grep	find
Grep is used to find a pattern inside a file.(contents of the file)	Find is used to find a file based on their name, size and permissions.

Locate:

Locate command is used to find files and directories.

locate filename.txt

locate directory_name (full path)

1. **locate -r full_path_of_the_directory**
   It is used to locate a file inside a directory.

2. **locate -r ‘\ *.txt’**

It is used to locate files with .txt extension.

3. **locate -u username:**
   This will return all the files owned by the particular user.

4. **locate -e filename:**
   This locates the updated files.

Find	**Locate**
Find is used to find a file based on their name, size and permissions.	The search in locate is according to a previously related database of files and directories.
Find is slower	Locate is faster than find.
Files once deleted cannot be found using find command.	Locate can show the files after they are deleted.

Imp : Difference between grep , find and locate

Sort:

This command is used to sort file contents.
sort filename.txt

1. **sort -r filename.txt**
   It will give you the content in reverse order.

2. **sort -n filename.txt**
   It will sort the line numerically.

3. **sort -k 5 filename.txt**
   It will sort the defined line.

4. **sort -u filename.txt**
   It will remove all the duplicate data.

Uniq

This command will remove adjacent duplicate lines in the files.

uniq filename.txt

1. **uniq -c filename.txt**
   (-c) will remove adjacent duplicates and give you the count of occurrence.

2. **uniq -u filename.txt**
   (-u) will give you the unique lines as output.

3. uniq -d filename.txt
   (-d) will only print the repeated lines.

Uniq	**Sort**
Uniq will remove adjacent duplicate lines in the files.	Sort will sort the file in alphabetical order.(A-Z)
It required a file to be sorted.	It is input as an unsorted file.
Uniq does not need any other command to remove duplicates from a file.	Sort command is a combination of commands like uniq, cut to manipulate and analyze data.

Kill

kill -9 process_id

TTY - It is Terminal Time in which the user has logged in.

TIME - It is estimated time the CPU takes to execute the processes.

1. **ps -a**
   It will give you all the processes that are not associated with the terminal.

2. **ps -e**
   It will give all the processes associated or not associated with the terminal.

3. **ps -r**
   It will give you all the running processes.

4. **ps -x**
   It will give the status of a particular process.

Cut:

This command is used to extract specific columns or fields from a file. This helps in manipulating the data.

1. **cut -d',' -f4 filename.txt**
   (-d) is a delimiter that is used in a file('-' , ',' , '_')

2. **cut -d',' -f4 filename.txt**
   (-f) is the field or column which you want to extract.

3. **cut -d',' -f1,2 filename.txt**
   To extract multiple fields.

4. **cut -d',' -f1-5 filename.txt**
   This will extract a file or field in that range.

Links:

Links work as a pointer to a file, when we create a link we are creating a shortcut for that file.
There are 2 types of links

1. **Hardlink**
   In this kind of link file even if the main file is deleted.
   (the content will be present even if the main file is deleted)
   ln filename.txt new_filename.txt

2. **Softlink**
   Softlink can also be called a symbolic link. This kind of link cannot be updated, if the main link file is deleted or if the path is changed.
   ln -s filename.txt new_filename.txt

This command is used to get the list of users.

1. **compgen -u**
2. **cat /etc/passwd**
3. **getent passwd**

Delete the user

    userdel user_name

rm -r path username

1. id command will prints the user id , group id , groups for the current user

   Id

2. id root - this will return userId, groupId and groups for the root by default 0 is reserved for root

   id root

3. **Uid** - It stands for user identifier . The number assigned to each user on the system , identify the user and determine which system resources the user can access.

   uid(0) - this is reserved for root
   uid(1….99) - this is reserved for predefined account
   uid(100 - 999) - these are reserved for system administrator , system accounts / group
   uid (1000-10000) - these are reserved for application account
   uid(above 10000) - user accounts

4. **Gid** - stands for group identifier . The number assigned to each group on the system , identify the group and determine which system resources the group can access.

   gid(0) - this is reserved for root groups
   gid(1-99) - this is reserved for system and application use
   gid(100 and above) - allocated to user groups

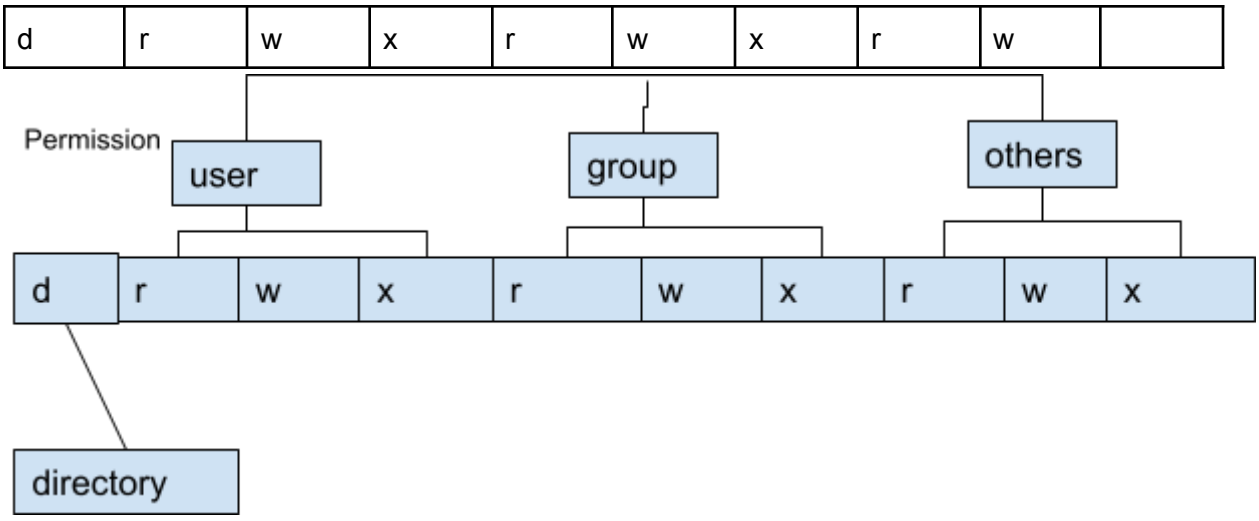
   There are 3 types of permissions that can be provided -

1. Owner
2. Group
3. Others

   Owner permissions are used by the assigned owner of the file/directory . Users belong to this group/class.

   Similarly , group permissions are used by members of the group that own the file or directory. A group is a collection of users . The main purpose of group is to set privileges like read , write , execute to other users

   Other : The permission used by all the users other than file owner , member of the group that owns the file / directory. All the users / groups who do not belong to any class will fall under this class.



7	r	w	x
6	r	w	-
5	r	-	x
4	r	-	-
3	-	w	x
1	-	-	x
0	-	-	-

777	rwx rwx rwx	Read,write,execute permission for all users
755	rwx r-x r-x	Read and execute permission for all the users and file owner/users have permission to write
750	rwx r-x - - -	Read, write , execute permission for users . Read and execute permission for the group and the user who doesn't belong to any group or who is not the owner . don’t have access to any file
700	rwx - - - - - -	Only the owner / user of the file has access to

		read,write,and execute the file. Groups and others don't have access to any file.
666	rw- rw- rw-	Read , write permission is given to the owner , group and others. No one is having access to execute the file.
664	rw- rw- r- -	Read , write permission is given to the owner and group. Whereas , read only permission is given to others.
644	rw- r- - r - -	Read and write permission is given to the owner . Read only permission is given to group and others
640	rw- r- - - - -	Read, write permission is given to the owner. Read only permission is given to group and there is no permission given to others.
600	rw- - - - - - -	Only user has the read,write permission , Group and others have no permission.
400	r - - - - - - - -	Owner has the permission to just read. Groups and others have no permission.

Note : Important question for module end exam

groupadd group_name
getent group
usermod -a -G "group_name" "group_name_to_be_added"

chmod 777 test.txt
chmod 400 test.txt

Owner change
chown cdac:check1 test.txt

Group change
Chgrp check1 test.txt

Chgrp vs chown

Chgrp	Chown
chgrp is used to change the ownership of the file	chown will change the ownership of any file / directory.
chgrp is only applicable for group	chown is applicable for both user and group

---

umask:

umask stands for user file creation mask.

We set the default permission of any file / directory to be changed to any specific permission by using umask.

777
543
-
234
W wx r

Shell Scripting

- It is a program to write a series of commands for commands to execute.
- It gathers input from users and executes a program based on the user inputs.
- We can manipulate files and directories
- We can process and manipulate text and files
- It can be held in system administration task such as backup , scheduling any task
- It is also helpful in networking , to ping into any server or download any files .

#!/bin/bash:This specifies the interpreter that we have to execute a script.
#!: this is called as shebang
$:this is shell variable that will hold any variable

```
#!/bin/bash
echo “what's your name”
read name
echo “hi,$name”
```

To find a pattern like “cdac” in a file and once you get the pattern redirect it to new file

```
#!/bin/bash
grep “cdac” filename.txt > out.txt
```

If else statement

```
if [condition]
then
        body
else
        body
fi
```

```
if [condition]
then
        Body
elif [condition]
then
        body
else
        body
fi
```

```
echo "enter your age"
read age
if [ $age -ge 18 ]
then
   echo "Your age is $age and you are eligible"
else
   echo "Your age is $age and you are not eligible"
fi
```

```
#!/bin/bash
echo "enter a number"
read num
if [ $num -gt 0 ]
then
   echo "the number $num is greater"
else
   echo "the number $num is less"
fi
```

```
for in list
do
        body
done
```

```
#!/bin/bash
echo "enter number"
read num
for ((i=0;i<=$num;i++))
do
   echo $i
done
```

```
while [ condition ]
do
        body
done
```

```
Case in
        Pattern 1) statement 1 ;;
        Pattern 2) statement 2 ;;
esac
```

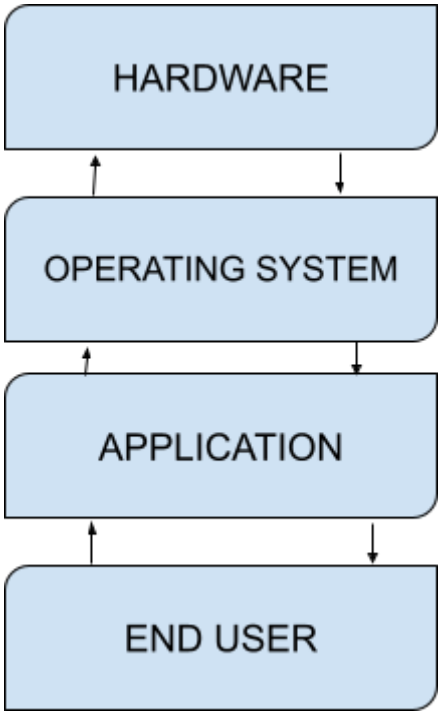
Linux Kernel

Operating System :

- ➔ Os is an interface that helps you to interact between hardware and software.
- ➔ Linux is a kind of operating system like Microsoft, MAC OS.
- ➔ OS enables the communication between computer hardware and software.

Kernel :

- ➔ Kernel is the heart of the OS which lets you communicate with the hardware.



Kernel vs OS

- ➔ Operating System is a software program that manages computer hardware resources while Kernel is the core part of the operating system that interacts directly with the computer hardware.
- ➔ In simpler words we can say OS is like a manager that controls all the resources of a computer whereas the kernel works as the worker who actually performs the task on computer hardware.
- ➔ OS is responsible for managing user level tasks like managing applications, it provides an interface to a user to compute, manage the system resources.

While the kernel is responsible for managing the system resources like CPU, Memory, I/O devices. Kernel is also responsible for handling system calls, interrupts and exceptions.

- ➔ OS is a large software program that includes kernel and other system level services which is responsible for managing the system resources while the kernel stays closer to hardware to handle system calls, interrupts.

CPU

- ➔ The CPU is the brain of the computer that is responsible for executing and controlling the operation of any system.

RAM

- ➔ It stores the data and program instructions temporarily.

Input Devices

- ➔ These devices are used to enter data or command into the systems like keyboard, mouse, touchscreen, scanners, etc.

Output Devices

- ➔ These devices are used to display the output from the system like monitor, printer, speaker, etc.

Kernel Module

- ➔ Kernel module is also known as device driver or loadable kernel.
- ➔ These are dynamic softwares or loadable components that can be loaded or unloaded into the kernel to add support to new hardware.
- ➔ Kernel module is basically written in C or assembly language.
- ➔ They are loaded into memory when needed and we can unload the resources when we don't need them.
- ➔ Eg. Graphic cards, network adapters

Kernel

- ➔ Kernel is a core component of an operating system that manages system resources like memory input output, CPU time.

➔ It provides essential services like process management, memory management, device driver and system calls.

System libraries

➔ System libraries are predefined or pre written codes that provide common functionality to programs and applications running on an operating system.

➔ System libraries are divided into two parts : -

Standard libraries: It is collection of language libraries that provides common functionalities for programming languages such as C,C++,Java

Platform specific libraries: These are designed to provide system level resources such as hardware devices, file system, networking.

User utility

➔ It is a set of tools and commands that are used to manage user accounts and their associated permissions.

➔ Eg. adduser, userdel, chgrp, chown, chmod, su, passwd, chsh

User processes

➔ They refer to programs or tasks that are initiated and managed by the user.

➔ When any user login into the system they are typically assigned user ID and when the user starts any processes that is typically associated with the user ID.

➔ Each user process is assigned with a process ID (pid) which is used to identify and manage the processes.

➔ User process typically runs in user mode which means that they have limited access to system resources and cannot directly access hardware devices/kernel functions.

➔ There are system processes also that are initiated and managed by the operating system, these are typically run in kernel mode. These kinds of processes are responsible for managing system resources, handling system level functions such as memory management, I/O operations, and process scheduling.

System Softwares

➔ There are large variety of applications that falls under this category

These are those software that is designed to manage and control the operation of a computer system.

- It includes programs like device driver, operating system, utility programs.

Types of kernel

➔ Monolithic Kernel

- It is a type of kernel where all operating system services operate in kernel space.
- It is the oldest type of kernel where the entire operating system is composed of a single large binary executable file that runs in kernel mode.
- It has direct access to all hardware resources and provide services such as memory management, process scheduling and device drivers
- Eg. Linux, UNIX

Advantage: It is very fast because it operates from kernel space.
Disadvantage: It has million lines of code, so anything gets corrupted the whole system is affected/stopped.

➔ Micro Kernel

- This is a type of kernel which provides essential services such as interprocess communication, basic memory management, and other services run as user mode processes.
- It is more stable than a monolithic kernel as any service gets affected/corrupted. We don't have to reinstall it/ it will not affect the whole system.

➔ Hybrid Kernel

- It is a combination of monolithic kernel and micro kernel, it combines in such a way where it avoids the non essential services like device driver into user mode and it keeps the critical services in kernel mode.
- Eg. Windows, MAC OS

Monolithic Kernel	Micro Kernel
Both user and kernel services are kept in same space (kernel space)	User services and kernel services are in separate spaces
They are larger than micro kernels	They are smaller in size

It is difficult to add new functionalities	It is easier to add any new functionalities
Failure of one component will affect the whole system	Failure of one component does not affect the working of micro kernel
Their execution speed is faster	Their execution speed is slower
Eg. Linux, UNIX	Eg. Windows, MAC

Device Management :

- ➔ Device management refers to the management of hardware devices by the operating system kernel.
- ➔ It involves handling device driver, allocating and freeing resources such as memory, I/O
- ➔ There are few tasks performed in device management
    1. It loads and initializes device drivers at system boot time and unloads them when they are not required.
    2. The kernel detects and configures hardware devices that are connected to the system.
    3. It also allocates system resources such as memory, I/O port to each device.
    4. It also ensures that different devices and applications do not conflict with each other when accessing shared resources.
    5. It enforces security policies to prevent unauthorized access to sensitive data/devices.

Memory Management :

- ➔ Memory management in kernel refers to management of system memory by operating system kernel. It involves allocating and deallocating memories for different applications.
- ➔ Following are the task that are done under memory management:
    1. The kernel manages allocation and deallocation of memory.
    2. It keeps track of available memories and allocates the memories to process when requested.
    3. The kernel provides memory protection to ensure that processes don’t interfere with each other's spaces.

4. It provides the mechanism of sharing memory between processes.
5. The kernel uses **paging**, **virtual memory** to manage the system memory more efficiently.

Process Management :

- ➔ Process management in kernel refers to management of processes, this include creating, scheduling and termination of any process.
- ➔ Following are the few tasks that are performed under process management:
    1. Kernel creates a process when a program is executed by user or another process.
    2. Each process has a unique process ID and are allocated resources such as memory and file descriptor.
    3. Kernel schedules processes for execution on the CPU using scheduling algorithms.
    4. Kernel provides a synchronization mechanism that multiple processes can access shared resources without interfering each other.
    5. Kernel terminates the processes when they have finished executing or when they are terminated by the users.

Handling System call:

- ➔

Shell :

- ➔ Shell is a command line interface that allows users to interact with the operating system.
- ➔ It is a program that interprets user input and execute the command.
- ➔ Following are the tasks that are performed by shell:
    1. We can execute the commands.

2. The shell provides I/O redirection which allows the users to redirect the input and output of the command to and fro from the file.
3. The shell manages system or environment variables (these are the variables that stores the variables about system environment)
4. User can modify the system variables using shell
5. The shell allows users to write a script which is collection of commands that can be executed as single unit.
6. Shells are divided into two type:
    a. Graphical : This shell specifies the manipulation of a program using a graphical interface that provides operations like moving, closing, resizing, switching between different applications.
    b. Command line : It is a program that provides a command line interface for interacting with the operating system. It allows users to enter any command on prompt and execute them.

Bash :

➔ Bourne again shell
➔ The extension for bash is .sh
➔ This is usually installed in /bin/sh

Root user default prompt is #
Non-root user default prompt is $

Linux File System :

➔ In linux, files are ordered in tree structure where root is considered as the start of file system and root is denoted by */*
➔ There are 3 different types of files :
    ○ **General**: They contain files like images, text, configuration files.

- **Directory**: They are special type of files that contain files and directories
- **Device**: These are special files that represent physical and virtual devices in system such as printer, hard drive, CD ROM, etc

---

Types of users in linux :

➔ **Regular user**:
Regular user is created whenever you install ubuntu. In this, all files and folders are stored in the home directory.
These kinds of users don't have access to the directory or files of any other user.

➔ **Root user/ admin**:
Root users are the super users that have access to all the restricted files and have all the administrative privileges.

➔ **Service users**:
Linux is widely used as a server operating system and services like email and other applications have their own service account.

Linux File System:

In linux directories are created in /home
If you create any user in Linux their files and directories will be saved in /home/username

In windows all the program files are usually stored in C: drive while in linux the system and program files are stored in different directories like boot files are stored in /boot directory, all the program files can be stored in /bin and many more.

Windows	Linux
Windows use different data drives like C: , D:	While linux use tree like structure
In windows peripheral devices like CD ROM, printers, are considered as device	While in linux all the peripheral devices are considered as file
In windows there are 5 different kinds of users: ● Admin ● Child ● Guest	While in linux we have 3 different kinds of users: ● Regular ● Root ● Service

: - this is separator

~ - home directory

$- signs suggest that you are working as a regular user in Linux.

- this signs suggest that you are working as root user in Linux

/ - sign for root

Path: It is a location of any file or folder in the file system.
There are 2 different types of path:

- **Relative path**: These are the paths related to the present working directory. It starts at your current directory.
    - Eg. /directory_name(current)

- **Absolute path**: Absolute path defines the location of any file or directory from the root directory.
    - eg. /home/user/filename

In linux files are stored in tree structure or free format.
On the top we have root directory and under directory we have many other directory and subdirectories like bin, boot, etc, var.

/etc : It contains all the configuration files used by system services. This contains startup and shutdown shell scripts that are used to start and stop individual programs.

/boot : This contains all the files needed to start the boot process.

/usr : This contains all the shared libraries, installed softwares and read only program data

/home : This stores all the program files by the user. This contains all the user stored data, personal configuration, user documents, music, videos, etc.

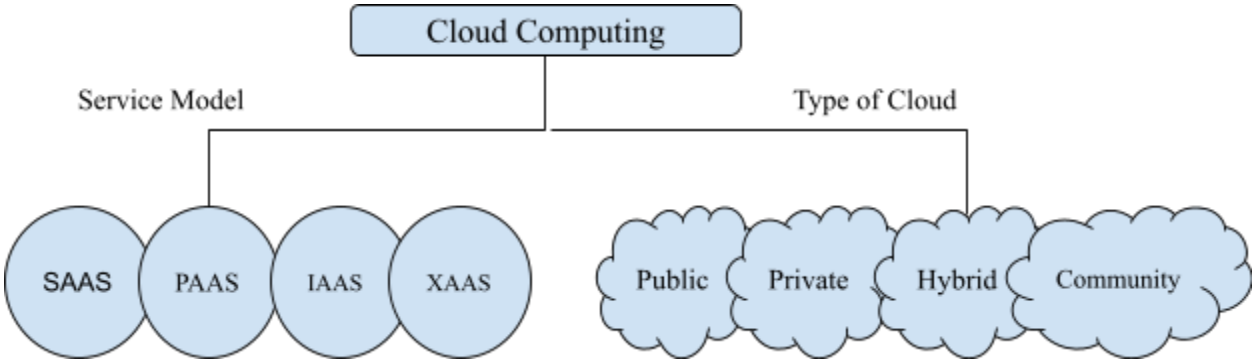
/bin : This contains all the user commands in binary format like ls, cp, pwd and others.

/dev : This contains all the device files used to access hardware.

CLOUD COMPUTING

Cloud refers to network or internet and computing refers to accessing any data, modifying the data.

Cloud computing is delivery on demand computing services over the internet on pay-as-use basis (The user only have to pay for the services that he/she uses)
Cloud refers to the internet and computing means to process the data, the processing of data can happen on hardware, database, storage, network, and server.
This refers to delivery of services like processing storage, database, manipulation, networking, and server side programs, to users and organizations based on their requirements.



Few cloud service providers:

- AWS (Amazon Web Services)
- Microsoft Azure
- GCP (Google Cloud Platform)
- IBM Cloud
- VMware

Benefits of using Cloud Services :

- This reduces the maintenance cost as we don't have to invest in hardware.
- You only have to pay for the services that you use.
- By using cloud services we eliminate the setup cost.
- This offers you data storage space. It provides you more secure data storage.
- By using cloud based services it is more scalable.

- The services and the data can be accessed globally.
- We can have less staff or employees.

On premises: It is a traditional approach where all data, hardware, software, are hosted at physical location.

Off premises: This uses cloud provider premises which means you have to pay for services that you use.

On premises	Off premises
You have to buy all licensed software, hardware, security, servers, and provide maintenance and security.	You don't have to buy these software, hardware, security, servers, and you don't have to bother about maintenance and security.
A lot of server space is required, physical space and security is required to maintain the server room	In off premises as the server are in data center so there is no need for physical space and security
It is difficult to do team collaboration	It is much easier to do team collaboration
Deploying projects/implementation of projects takes longer time	While it is much faster in off premises, since we don't have to worry about underlying hardware
Data recovery is difficult	Data recovery is easier
The data cannot be accessed remotely	Data can be accessed from anywhere
A team is required to maintain the hardware, software and servers	No team is required for maintenance

Data center:

It is a facility that is used to store, manage, and distribute large amounts of data. It typically includes a large number of computers, servers, networking equipment, storage devices which work together to support processing and storage of data.

A data center can be used for various purposes.

1. Storing and processing data: A data center is used to store and process large amounts of data including file, database and other digital information.
2. Running application and services: We can run many applications and services like email, online banking and social media platforms.
3. Backup and data recovery: Data centers can also be used to backup important data and provide disaster recovery in the event of system failure or natural disaster.
4. Cloud Computing: This allows business to access and compute the resources over the internet.

To maintain a data center we require a lot of electricity, cooling system, and power backup.

- The largest data center in the world is China Telecom, Beijing.
- In India the largest data center is NTT (Nippon Telegraph and Telephone).
- The largest data center of AWS is North Virginia.

Different type of data centers:

➔ Traditional Data centers: These kinds of data centers are established/ setup within the organization itself where the organization owns all the hardware, software and server.

➔ Colocation Data Centers: These data centers used by an organization are hosted by a third party firm. The third party firm provides power, cooling, to the data center. And the organization provides server, hardware, storage and networking. The company can have equipment located at multiple geographical locations. The company can have its own devices and maintenance, security and power will be handled by a third party.

Benefits:

- It is low cost as some of the resources are rented.
- As few resources are rented we need less manpower.

- We have freedom to set up data centers in any geographical region.

➔ Enterprise Data Centers: These data centers are built only for a particular organization, the organization's own their infrastructure storage, server, networking equipment, IT components. These kinds of data centers can be on premises or off premises. The primary function of an enterprise data center is to provide secure, reliable access to data and applications that are critical to an organization operating a business. These kinds of data centers can range from small server rooms to large complex multiple buildings and thousands of servers.
These kinds of data centers are owned by the company itself.
Eg. Amazon, Apple, IBM, Tesla, Microsoft, Meta.

The key component for enterprise data centers:

1. **Power and cooling system**: These are critical to maintain optimal operating conditions for the computing infrastructure and prevent hardware failure.

2. **Serve hardware**: These are physical servers that run the organization's application and store the data.

3. **Backup and Disaster Recovery**: It ensures that critical data and applications can quickly be restored in the event of system failure.

Service provided by data centers can be divided into 4 tiers:

1. Tier 1: Basic capacity that includes power supply.

2. Tier 2: Basic capacity that includes power supply and cooling facilities.

3. Tier 3: Basic capacity that includes power supply and cooling facilities along with maintenance.

4. Tier 4: Basic capacity that includes power supply,cooling facilities along with maintenance and backup / protection of data.

Cloud	Data Center
Cloud is used only to fetch the resources when needed	Data centers are physically present
In cloud it is much less as compared to data center	Maintenance cost in data center is higher
It is much easier to operate, and anyone can operate	Data centers are handled by much experienced developer and it is more complex to operate than cloud
Full time internet connection is required	Power supply is required to run data center

Data centers comprises of :

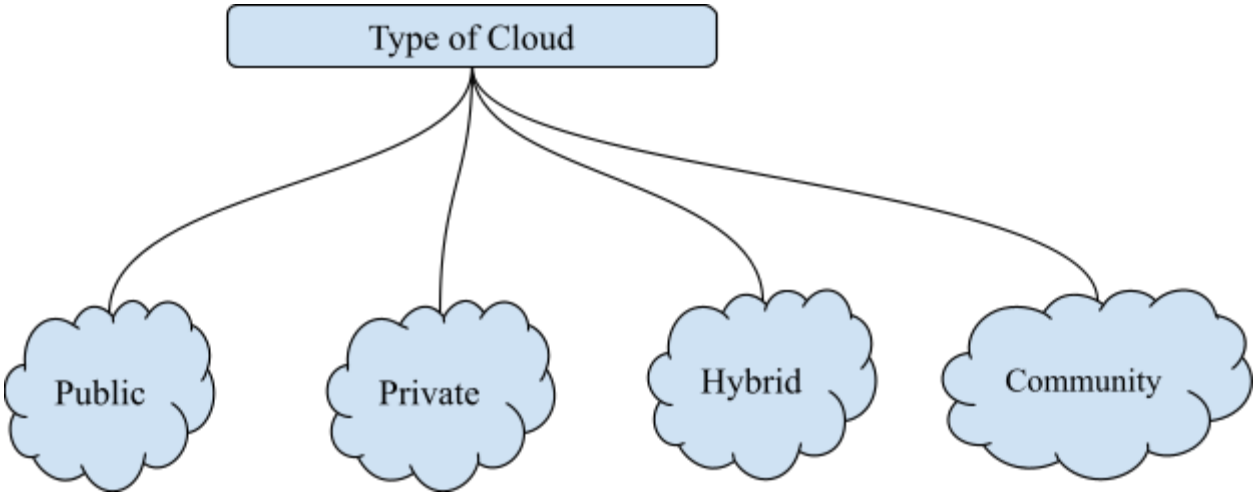
- Servers : Server is designed to process the requests and deliver the response over cloud.

- Networking Equipments :

  Switch - Switches are used to connect multiple network devices.
  Router - A router is connected to multiple switches. A router is used to receive and send data over a network.

- Server Racks : Server racks are used to organize multiple server and internet equipment.

- Cooling devices and backup generator :



Different types of cloud:

- **Public**: This kind of cloud is open for all, the cloud infrastructure is made available to the general public over the internet and owned by cloud providers. These kinds of clouds can be accessed by any users, they can access the information or store the information by paying per use.
  These cloud computing resources are managed and operated by cloud server providers.
  Eg. Amazon EC2, Google App

  Advantages:
  - Highly Scalable. It offers the user to scale up and down as per the usage and demand of the resource.
  - It is also cost effective, the user only has to pay for the resources they have used.

  Disadvantages:
  - As the users are public, there are chances of security breach.
  - It cannot be 100% customized as per organizations requirement.

Key point:

- **Resources owned and operated by third parties.**
- **Resources and services provided to the users or companies over the internet.**
- **Used for hosting a website or an application or adding data to a storage or database.**

- **Private**: Cloud resources are operated by a single organization. The cloud is operated by the organization itself or by a third party.
  This is further divided into:
    On premises:
    Out source private cloud:
  Eg. IBM, Oracle, VMware, etc

  Advantages:
  - It provides high security as only authorized users can access the resources.
  - These kinds of infrastructure are generally preferred in financial institutes like the banking sector.
  - In this organization has full control over the cloud resources.

  Disadvantages:
  - Skilled people are required to manage and operate the cloud.
  - Scaling up and scaling down is a bit difficult in this kind of cloud.
  - As the cloud is accessible only within the organization, so the area of operation is limited.

Key points:
- **It is operated by a single organization.**
- **It is used by organizations with sensitive data (banking sector).**

- **Hybrid**: Hybrid is a combination of public and private cloud. It allows the organization to share data between them. Hybrid cloud is partially secured because services running on public cloud can be accessed by anyone while services running on private can be accessed by organization users.

- These kind of cloud can be combination of :
  - At Least 1 public and 1 private
  - 2 or more private cloud
  - 2 or more public cloud

These kinds of clouds should be able to move workload between one cloud to another as it is a combination of 2 or more kinds of clouds. Performance of hybrid cloud is dependent on development and management of its connection (networking connection)
The linking between private and public cloud is done either through LAN, API or VPN.
In this cloud provider gives the customer a pre configured connection.

Eg.

- Dedicated interconnection - Google Cloud
- Direct connected - AWS
- Express Cloud - Microsoft Azure

Advantages:

- Private cloud is secure hence public is also secure.
- As the public cloud is used, it is scalable.
- Users can access both the cloud, as it provides flexibility.
- Hybrid Cloud helps to deliver new products and services more effectively in less time.

Disadvantages:

- As we have both public and private clouds the connection can be a bit complex. Hence there are chances of security breach.

- **Community**: It allows systems and services to be accessible by a group of several organizations to share information between organizations or any specific group.
  - It is owned managed and operated by many more organizations in a community (Even third party can be involved in this)
  - The infrastructure of community cloud can be shared between organizations which have common concern or interest like the healthcare department, media, etc.

  Advantages:

  - The maintenance can be shared by different organizations which fall under the same community or group.

- It is more secure than public cloud and less expensive than private cloud.

Disadvantages:

- It is difficult to distribute the responsibilities among and organization between different communities.
- It is difficult to segregate the data between organizations of a community.

Key points:

- **Different cloud services are integrated into a single cloud.**
- **These are designed for a specific need of an industry or a community or group.**
- **Infrastructure is shared among the different organizations in the community.**

Multi Cloud Strategy:

Public	Private	Hybrid	Community
Host are service providers	Third party are the hosts	Third party are the hosts	Third party are the hosts
User are general public in this	Authorized users	Authorized users	Users that belong to same interest/group/community
Can be accessed through internet	Internet and VPN	Internet and VPN	Internet and VPN
Owners in public are service providers	Organizations are the owners	Organizations are the owners	Group / community are the owners

Service model:
Over the cloud the remote server have to process, manage and store the data locally at data center and the cloud provider typically charge for the services user use and these services are further divided into 5 categories:

- SAAS: Software as a service
- PAAS: Platform as a service
- IAAS: Infrastructure as a service
- FAAS: Function as a service
- XAAS: Anything/Everything as a service

IAAS : Infrastructure as a service :

These services are a set of compute, storage and network that are virtualized by cloud providers so that users can access and configure resources according to their needs. A user can rent infrastructure in IAAS. This is also called Hardware as a service as it provides compute/infrastructure over the network.
In this customer pay on the services based on their hourly, weekly and monthly usage. Customers are even charged the amount of virtual space they use.

IAAS provides the user operating system,security, server, deployment tools, and database.

Eg. AWS EC2, Google Compute Engine, Digital Ocean.

Advantages:

- This service provides the infrastructure and users just have to install the operating system.
- The user can modify the architecture as per their requirement.
- Users have full control over the computing resources.
- Users don't have to worry about maintenance.
- Web hosting is less expensive than the traditional way of hosting.

The companies that provide infrastructure as services are AWS, Bluestack, IBM, Openstack, Rackspace and VMware, etc.

Key Points:

- **It allows the user to rent infrastructure like servers, routers, compute, etc.**
- **IAAS providers manage the data center.**

PAAS: Platform as a service:

This platform is created for the programmers to develop, test and manage the applications. Here cloud providers provide an on demand environment for developing the software application.
In PAAS users can build, run, manage application program interface (API).
PAAS services are hosted in the cloud and accessed by the user via browser.
The provider hosts the hardware and software on their own infrastructure as a result users are free from installing in house hardware and software to develop and run the application. Here the user has full control over deployed application and configuration files and setting up the application.

Eg. Windows Azure, Google App Engine, AWS BeanStalk, Openshift, etc

Advantages:

- Pre-built platforms are provided in PAAS where users only have to access the application.
- It is a way simpler module to use and deploy any application/services.
- As platforms are already built, the user only has to access the services and create the application.
- It is more time efficient.

Disadvantages:

- Migrating one user application from one PAAS provider to another PAAS provider is very complex.

Key points:

- **It integrates web services and databases.**
- **Platforms are built on virtual technology so users can scale up and scale down as per their requirement.**

SAAS: Software as a service:

These cloud services provide the user with complete software applications over the internet. All infrastructure, application tools, data, etc are located at a data center, managed by a service provider.
Here the users don't have to install or maintain any software. They only have to use it. These services are available to users over the cloud.

Following are the service provider:
Document management, mail services, social networks, business services.

Eg. Google App, Azure, Dropbox

SAAS is further divided into 2 models :

Simple multi tenancy:
Each user has independent resources. That is different from other users.
Fine grain multi tenancy:
The resources are shared among several users but the functionalities remain the same.

Advantages:

- Easy to access, users can access the application from anywhere.
- Low cost maintenance, user don't have to update and maintain the application
- Users don't require hardware to install the application.
- SAAS services can be accessed from multiple devices.

Disadvantages:

- Users don't have control over SAAS applications.
- Users can only access when they have internet connection.
- Switching between different SAAS providers is very difficult.

Key Points:

- **A complete software application is provided over the internet.**

- **Components such as infrastructure tools, data are located at data centers and managed by service or cloud providers.**

IAAS	PAAS	SAAS
It provides you a virtual data center to store information and provide a platform for app development, testing and deployment	It provides a virtual platform, tools to test and deploy virtual application.	It provides an application to compute business tasks.
It is used by system administrators or IT administrators.	It is used by developers	It is used by the end users
It provides you infrastructure	It provides you infrastructure and platform	It provides you infrastructure, platform and software

On Premise	IAAS	PAAS	SAAS
This is managed by user or an organization	Till OS it is managed by user/organization	Till Data user/ organization manages everything	Everything is managed by vendors
Application	Application	Application	Application
Data	Data	Data	Data
Runtime	Runtime	Runtime	Runtime
Middleware	Middleware	Middleware	Middleware
OS	OS	OS	OS
Virtualization	Virtualization	Virtualization	Virtualization

Server	Server	Server	Server
Storage	Storage	Storage	Storage
Networking	Networking	Networking	Networking

FAAS: Function as a service:

In this kind of model, users are allowed to develop or create a piece of code in the cloud without worrying about the infrastructure. Microservices are developed over here.

Advantages:

- You can scale up the application as per the requirement so developers don't have to worry about the capacity and server management.
- It is cost effective.

XAAS: Anything and Everything as a service:

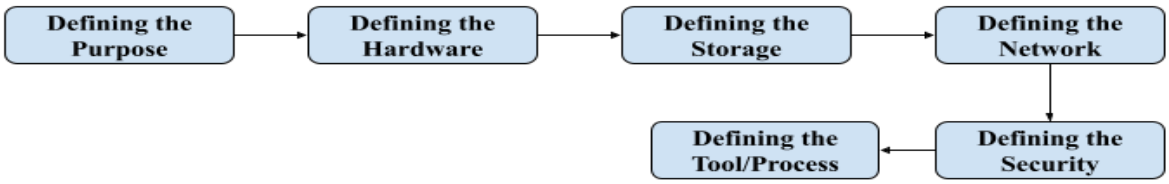
These models provide widely used services to the user, users can take the benefit of a large number of software tools, hardware resources, products, technologies at affordable cost without buying them.
XAAS provides different kind of services like IAAS, PAAS, SAAS, FAAS, CAAS (Communication as a service), DBAAS (Database as a service), SECAAS (Security as a service), STAAS (Storage as a service), DRAAS (Disaster Recovery as a service), etc.

Advantages:
All the above service model's advantages ^

Disadvantages:

- It gets slower when there are n number of users using the same resource.
- Users or organizations rely on XAAS service providers for maintenance (if they are not available, users/organization's problem will not be sort)

Life Cycle of Cloud Solution:



Defining the purpose:

This means to understand the requirements of business and determine what type of application/ what type of programs, user/organization need to build or run a application on cloud

Defining the hardware:

Choose a compute service that will provide the right support where you can scale up or scale down according to the requirement to run an application.
Eg. EC2, Lambda(Serverless computing), Elastic Containers

Defining the storage:

Choose storage services where you can backup and archive your data over the internet.
Eg. S3, EFS(Serverless elastic file system), Glacier (For archives)

Defining the network:

Defining the network that will securely deliver data and applications with low latency and high transfer speed.
Eg. VPC (Virtual private cloud that re used to provide you network routes), Route53 (This provides domain name services DNS, this connect the user request to internet application running on AWS port 53), Direct Connection(Set a pipeline between organization to data center)

Defining the Security:

We set up security for authentication and authorization of users, this provides limited access to the user on certain AWS resources.
Eg. IAM (Identity and Access Management - To manage which user will have the access to our application), KMS (This is AWS Key Management Service,

provides centralized control using crypto key to protect your data), Cognito (The user can sign in using mobile phone or web apps)

Defining the management process and tool:

You can have complete control on cloud management by defining the management tool which monitors AWS resources and customer applications running on the platform.
Eg. Cloud Watch(This monitor and manage the service provided by cloud platforms like infrastructure, data storage, etc), Auto Scaling (This continuously monitors your application and checks if it is running properly or not)

Cloud Based Architecture

There are two main components Frontend and Backend.

Frontend:

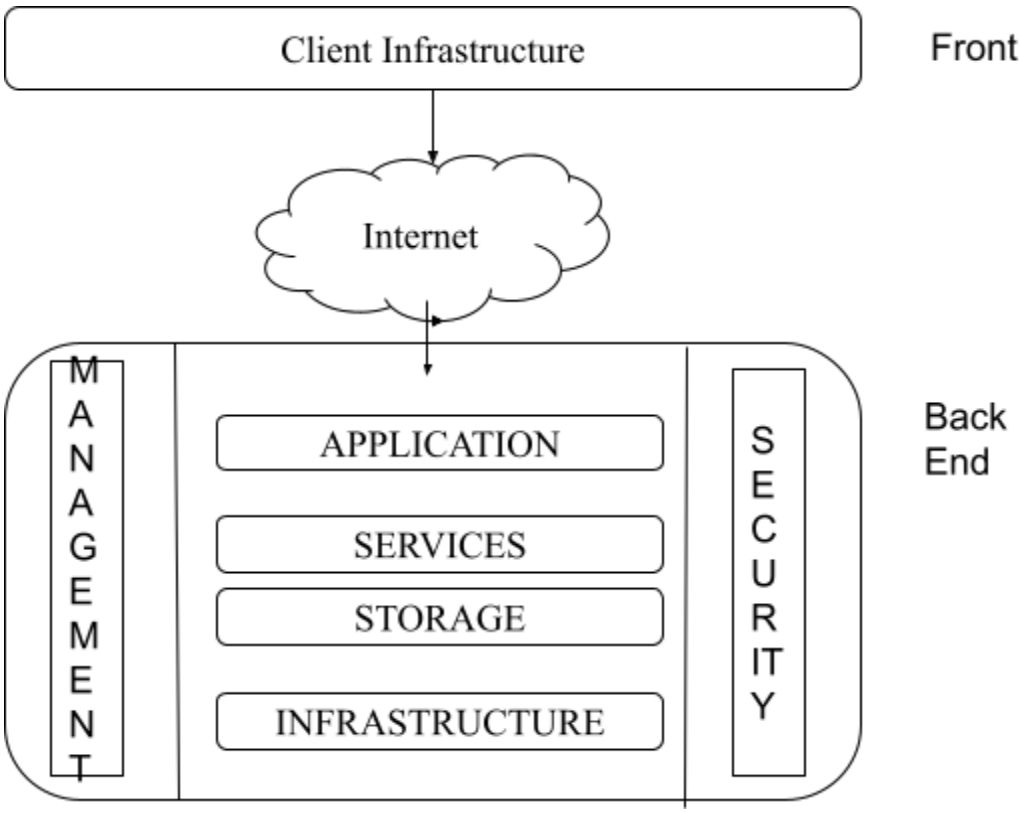
(Client/end user), It consists of all the applications and interfaces that are used by clients to access the cloud resources. A frontend can be a web server, user, mobile devices.

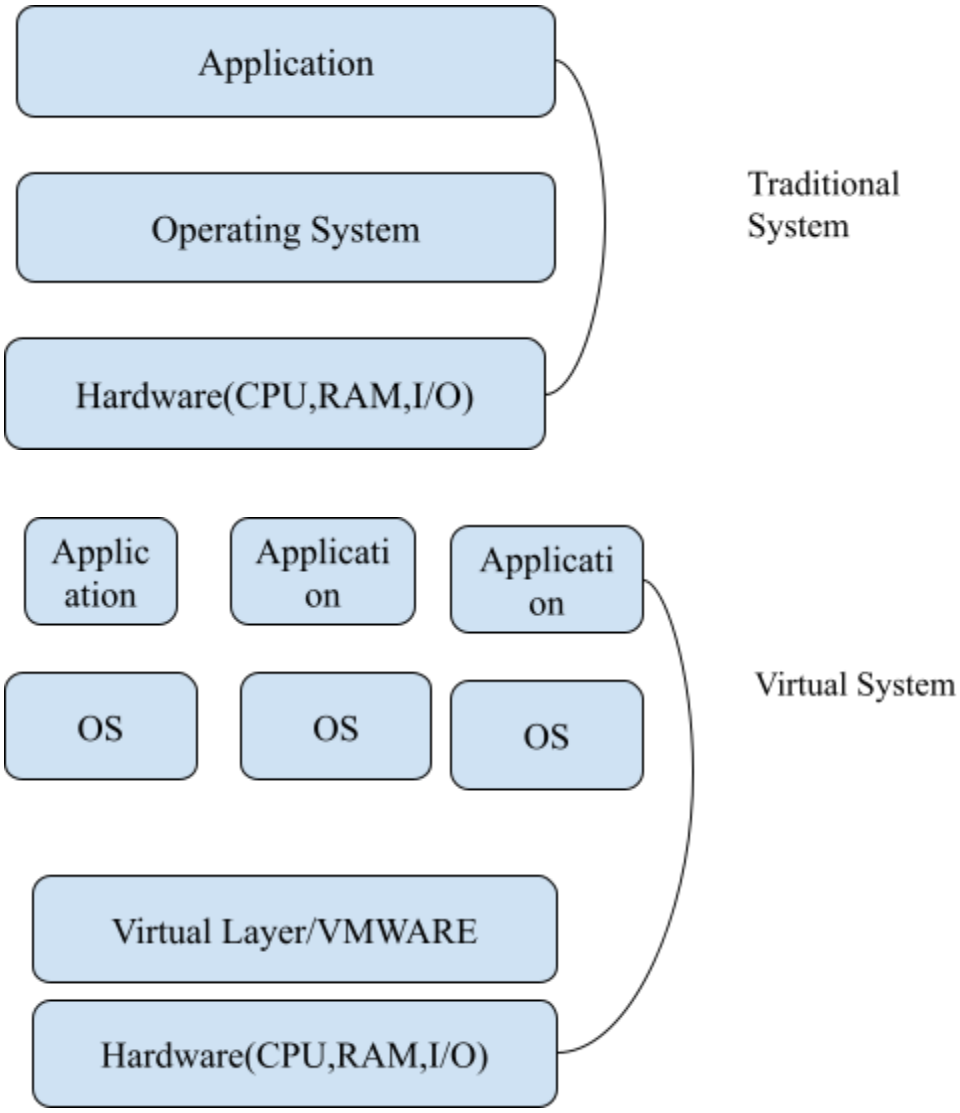
Backend:

It is a cloud itself and it consists of infrastructure such as database, computing resources, deployment model, that are required to build a cloud.
Components of backend:

1. **Infrastructure**: Compute, hardware devices, server, network equipments
2. **Storage**: Over cloud, we need huge amounts of data to manage. These are managed through S3, EFS and Glacier.
3. **Services**: These are services provided by the cloud providers to manage cloud according to user/organization's requirement (IAAS,PAAS,SAAS,FAAS,XAAS)
4. **Applications**: These are the software or platform that the client wants to access.

5. **Management**: This provides you coordination between all the backend components. This also monitors whether all the resources in the cloud are working properly or not.
6. **Security**: This provides security for infrastructure, provides authentication and authorization to define who can use the



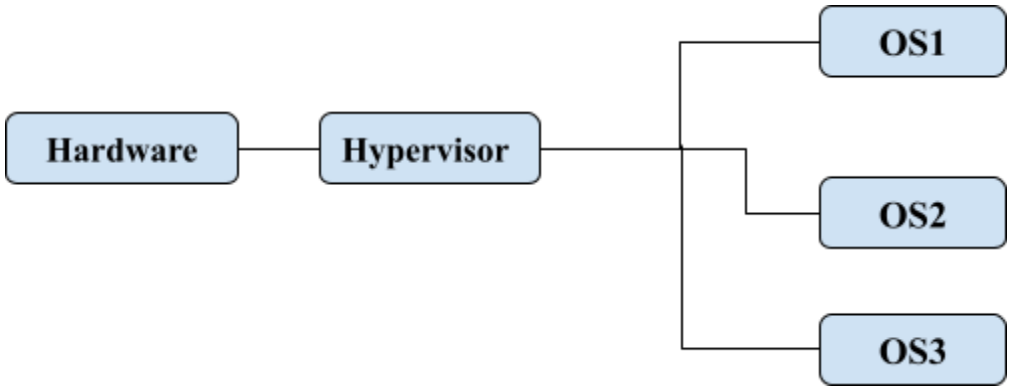


Virtualization:
It creates a virtual system which actually uses storage,operating compute (CPU, RAM) network resources of the host machine. A single computer can have multiple operating systems running parallely all because of the virtualization layer.

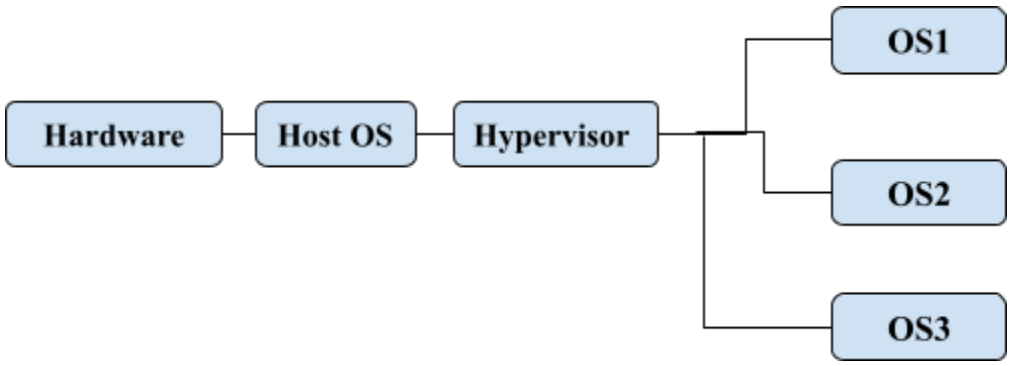
Hypervisor:
It is a form of virtualization software that is used to allocate the resource. It is hardware virtualization technique that allows multiple guest operating system to run on a single host machine at the same time.
It can also be referred to as virtual machine manager.

There are 2 types of hypervisor:

- **Type 1**:
  This runs directly on the host machine and it does not require any server based OS. It has direct access to hardware resources.

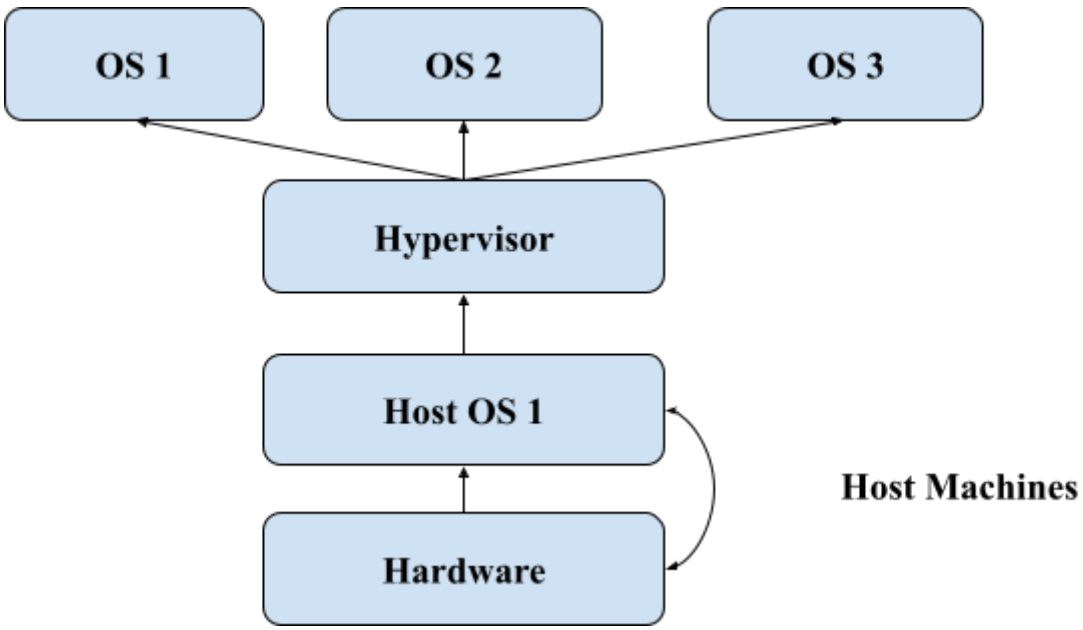


  Eg. VMware
- **Type 2**:
  Host operating systems run on the host system. This kind of hypervisor does not run directly on hardware. Rather than they require application on the host system. The software is installed on the operating system, the hypervisor makes hardware calls.
  Eg. Oracle Virtual Box, VMware workstation



Type of virtualization:

1. Hardware
2. Operating System
3. Server and storage OS



EC2:

EC2 is a web service that provides secure and resizable compute capacity in the cloud. EC2 allows you to configure the capacity and also provide the complete control of computing resources. In this user can scale up and scale down resources as per their requirement. As user create an

environment or instance as per their requirement, this leads to less wastage of capacity. EC2 is a virtual machine hosted on AWS.

There are many pricing options in EC2.

1. **On demand**: These instances are mostly used for short term application or for unpredictable workload. Here we pay by hours or minutes or seconds depending upon the type of instance.
   Application: Being developed on EC2.
   This is the most flexible option to scale up and scale down.

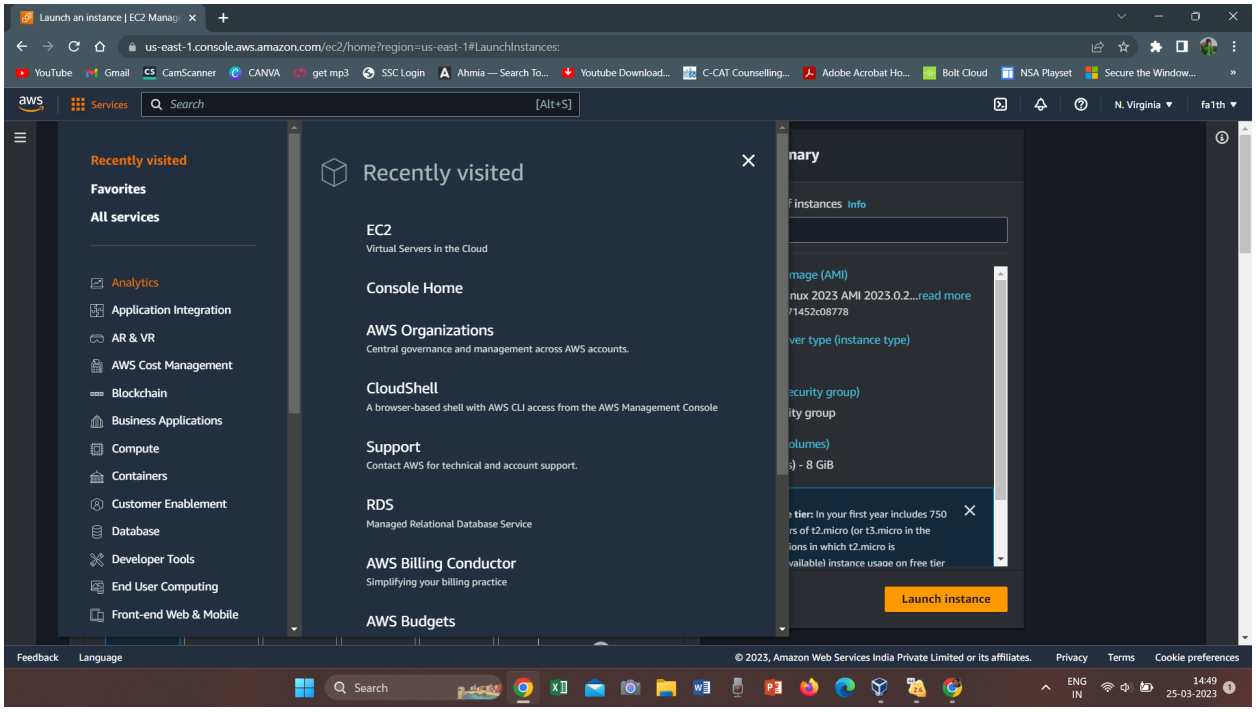
2. **Reserved instance**: When the workload is fixed and the extra requirement is known then we use these kinds of pricing instances.
   a. Standard Reserved Instance: Up to 70% of discount
   b. Convertible Reserved Instance: Up to 55% of discount
   c. Scheduled Reserved Instance: No discount

3. **Spot instance**: If you urgently need a large amount of computing capacity this is the best instance. You can purchase unused capacity at a discount of 90% as well. The fluctuation of pricing will be dependent on supply and demand.

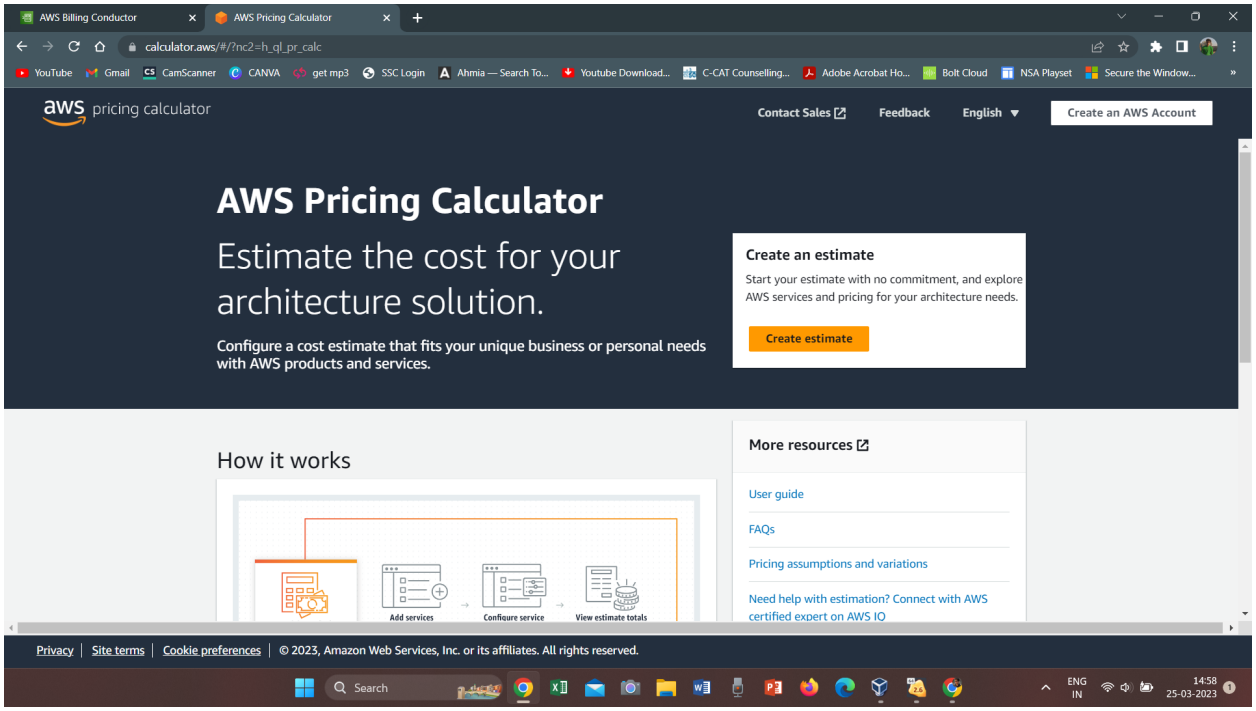
4. **Dedicated instance**: A physical EC2 server is dedicated for the use, and this is the most expensive option.

5. **Saving plans**: Users get up to 72% of discount regardless of their instance type. The user can commit to specific requirements for 2-3 years.

Services in AWS

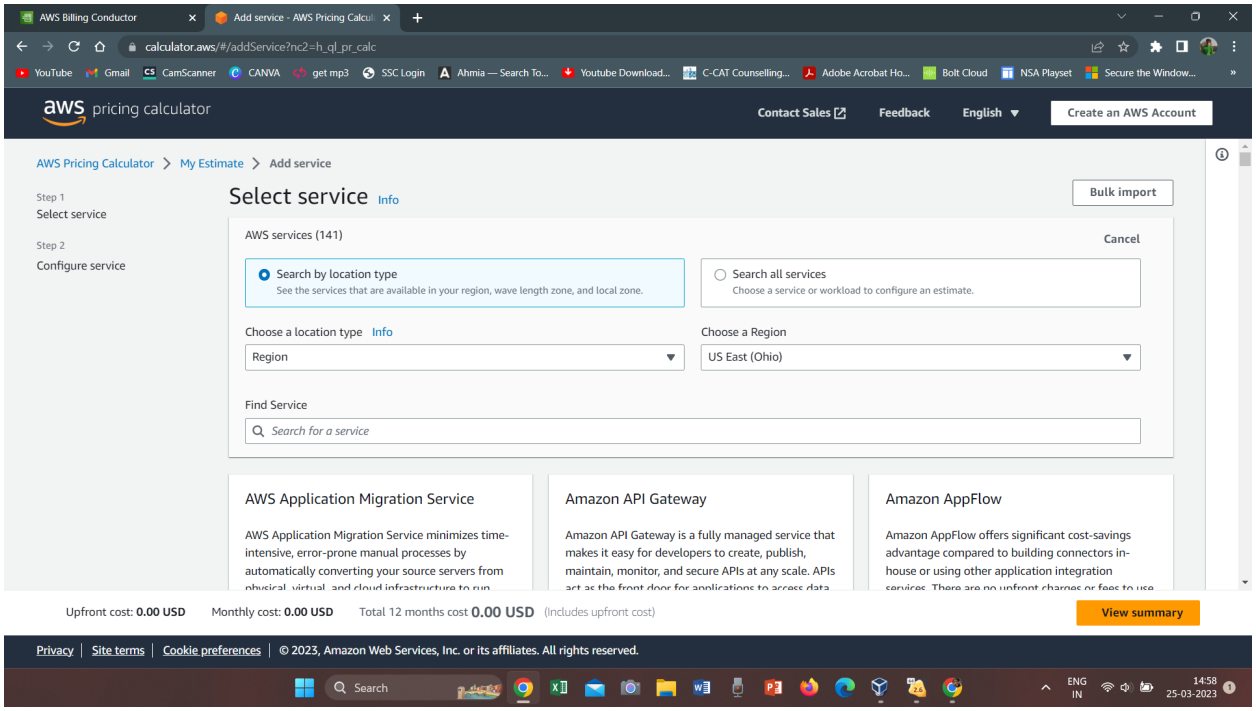


Pricing Calculator

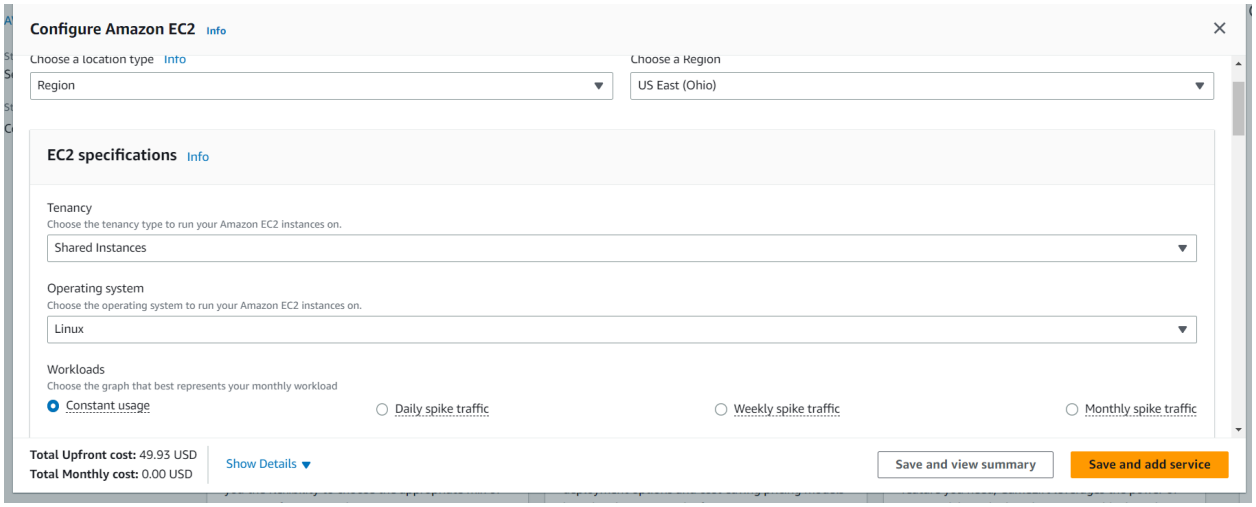


Create estimate

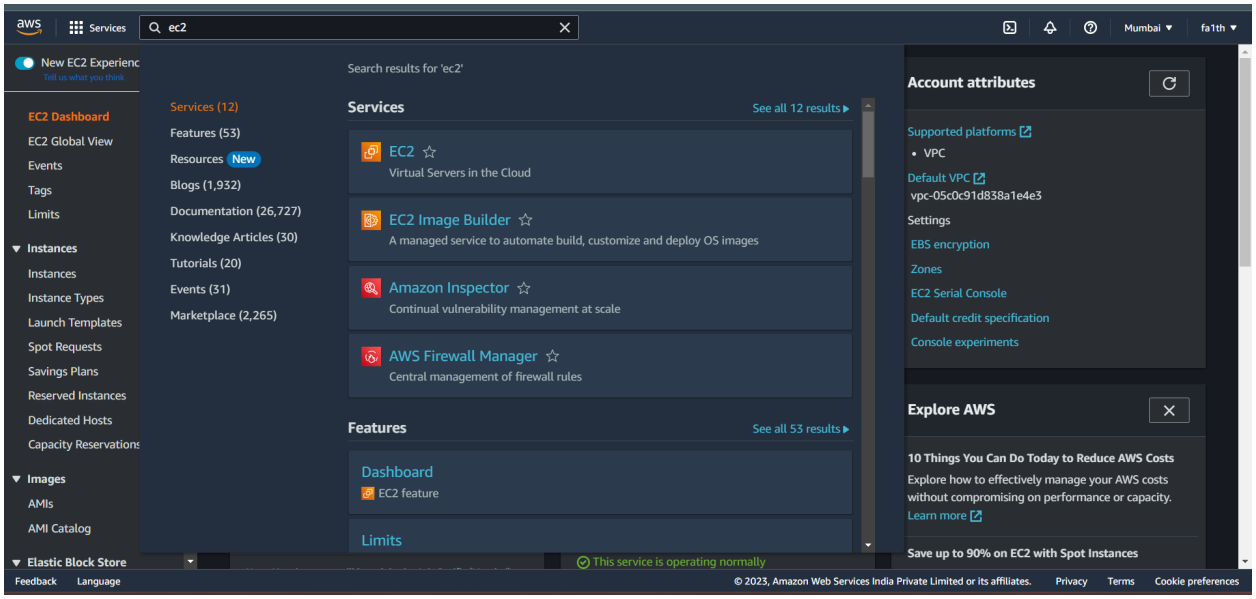
Select Service



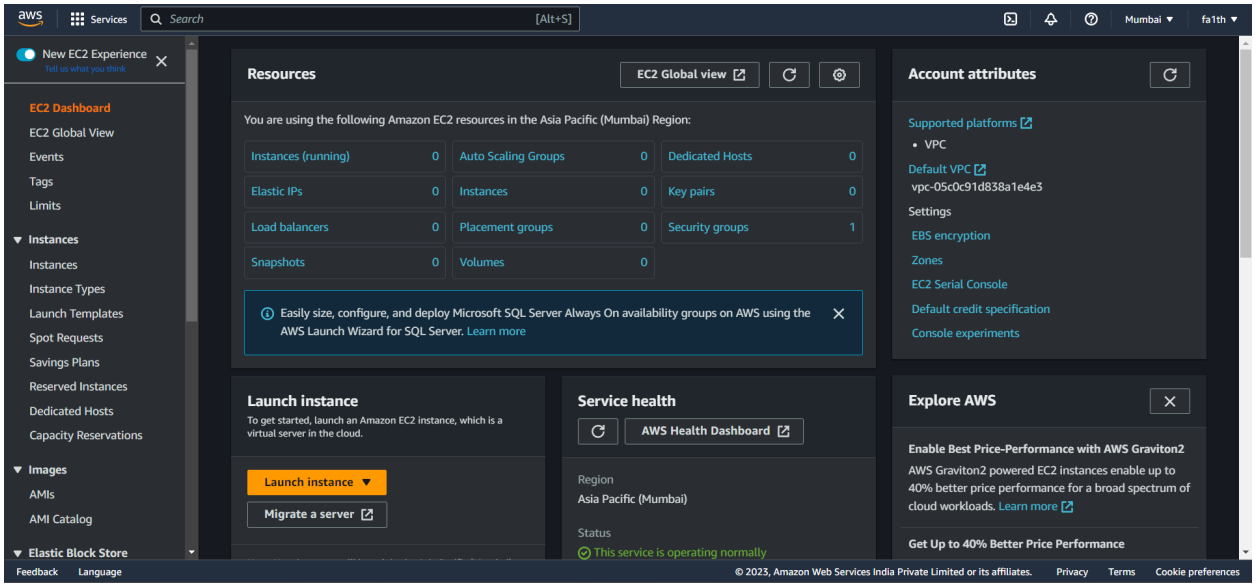
Configure the service and see the pricing



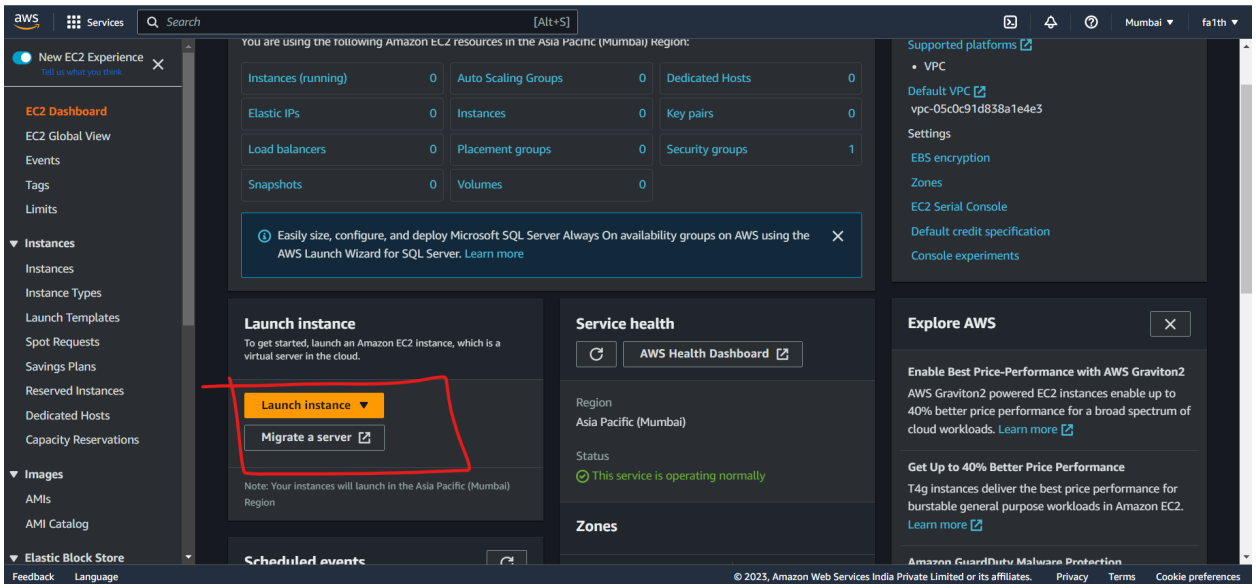
Search EC2

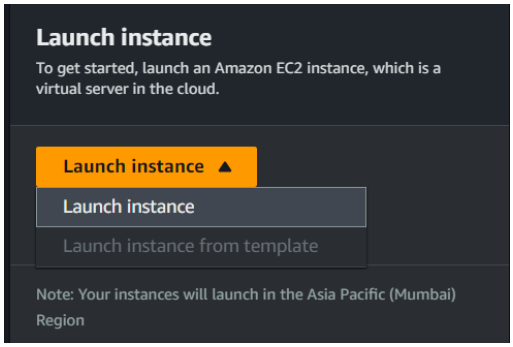


Dashboard

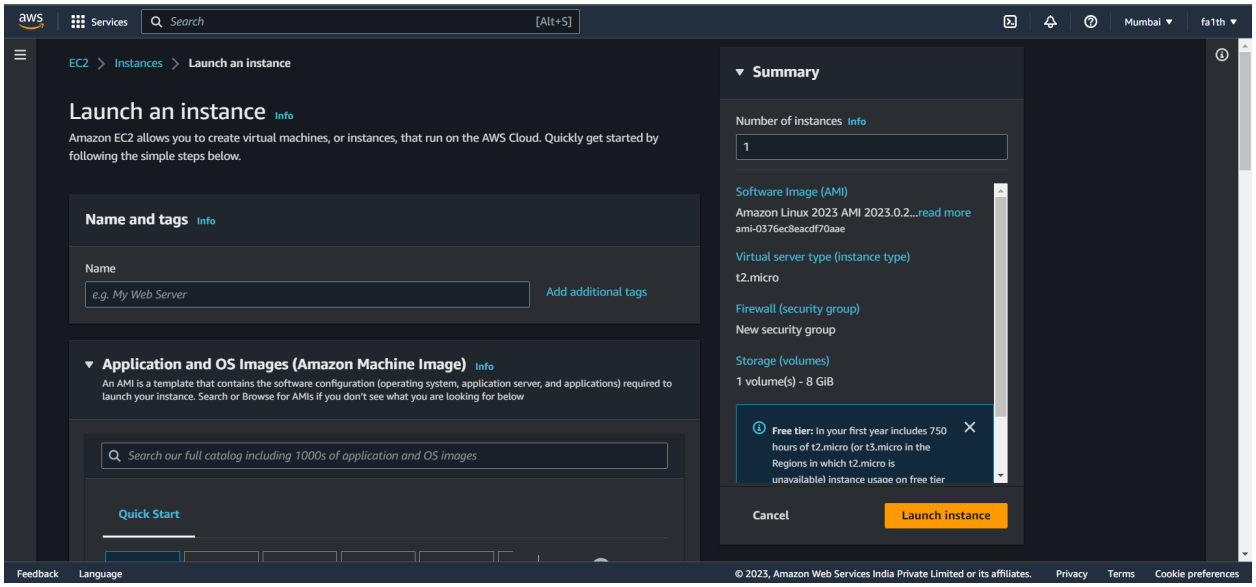


Click Launch Instance

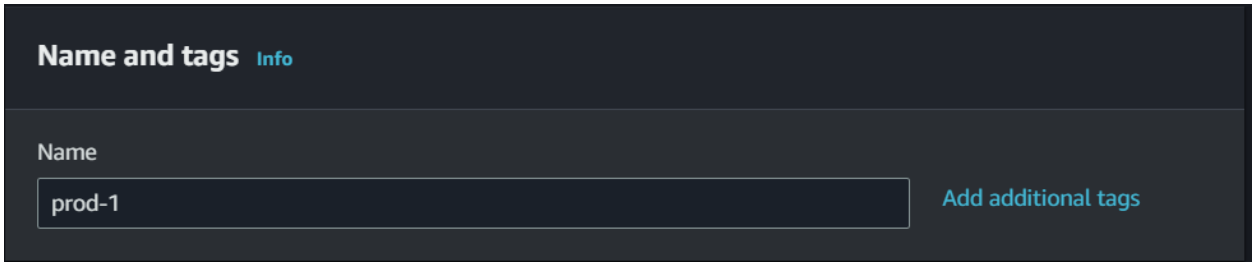




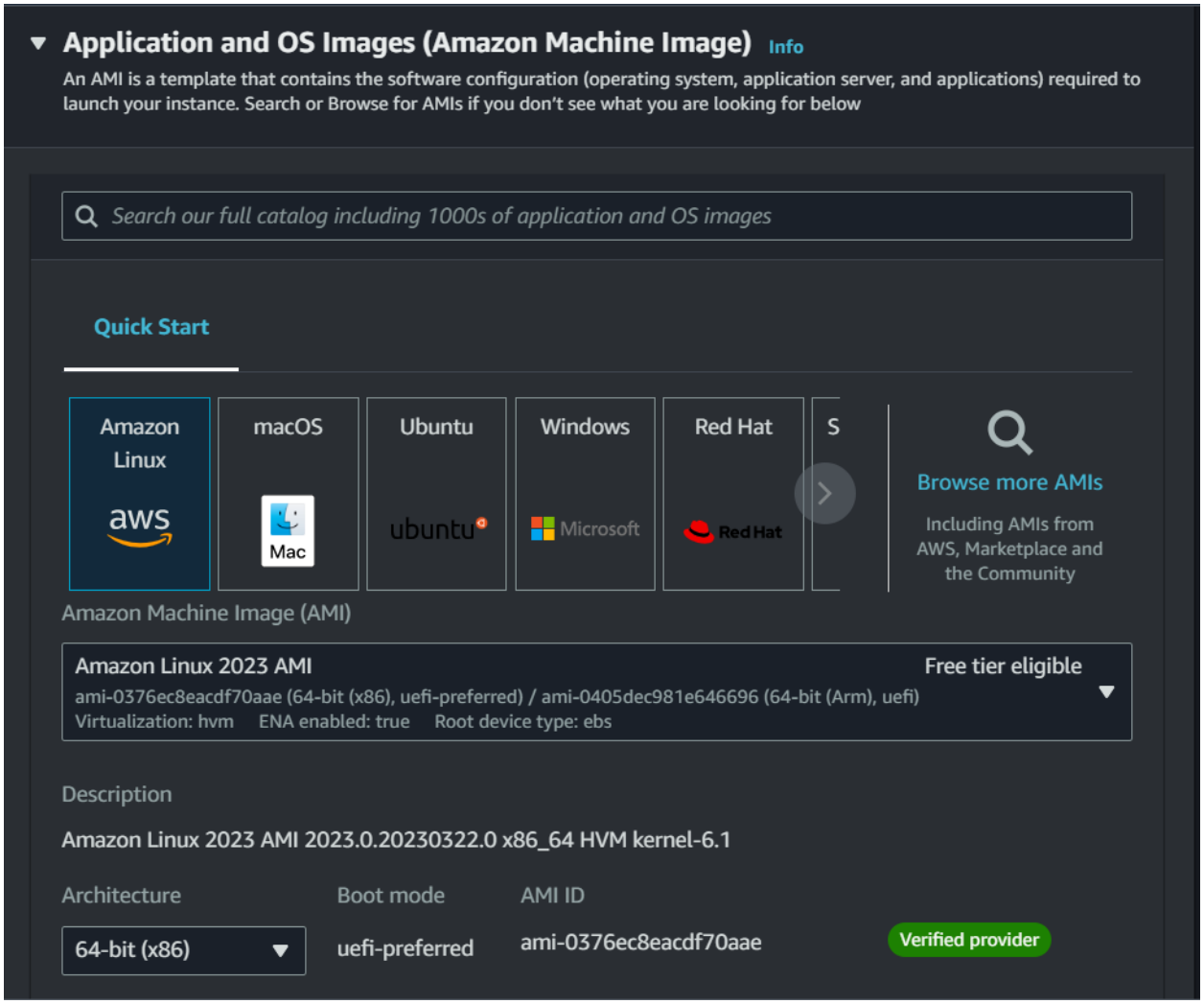
This screen will show up



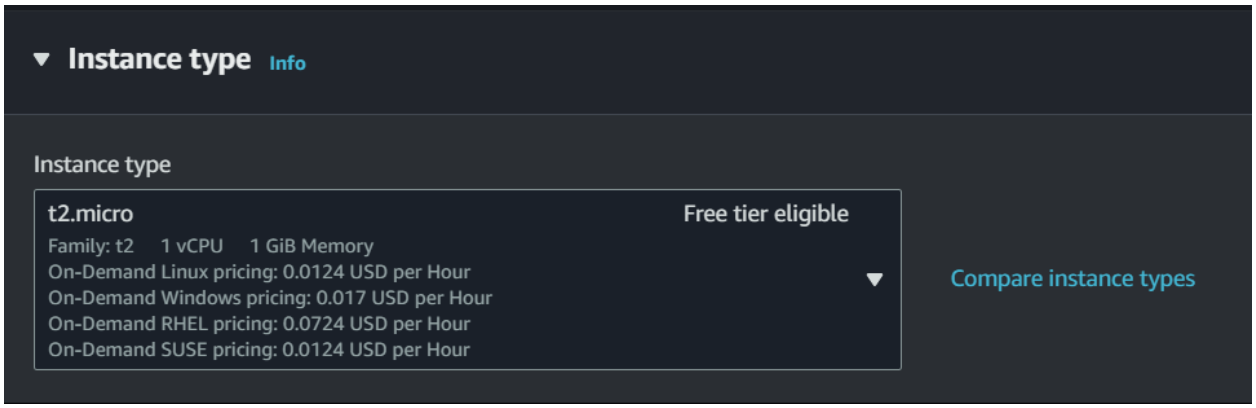
Give a suitable name to the instance



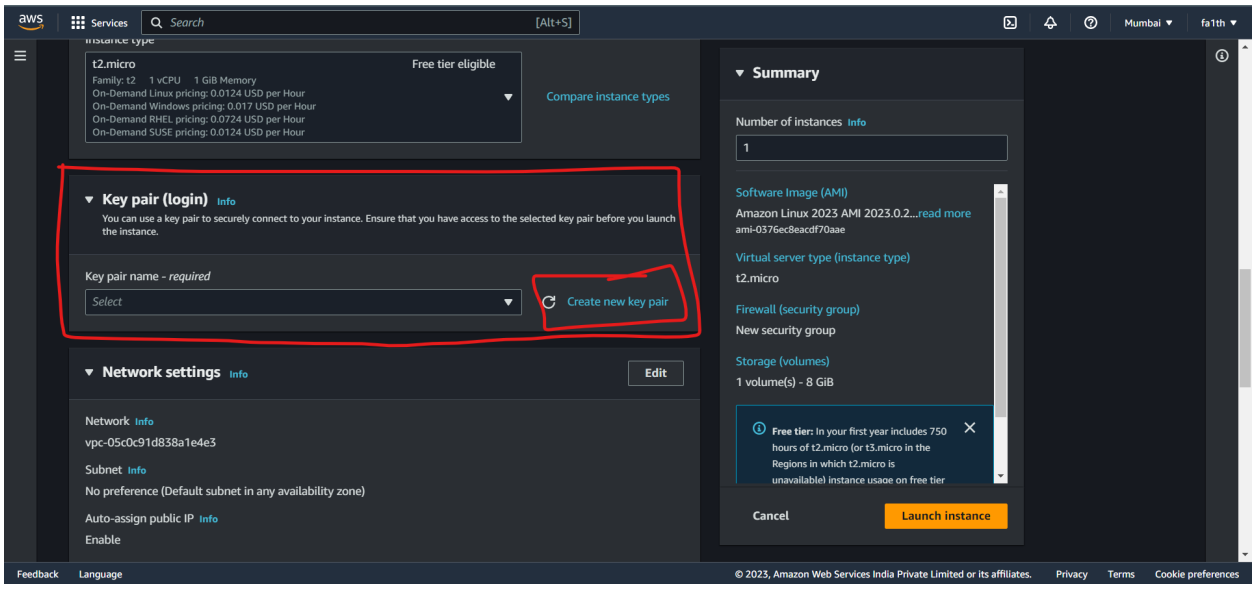
Select from variety of OS images (AMI- Amazon Machine Image)
Use free-tier eligible



Select the instance type
Use free-tier eligible

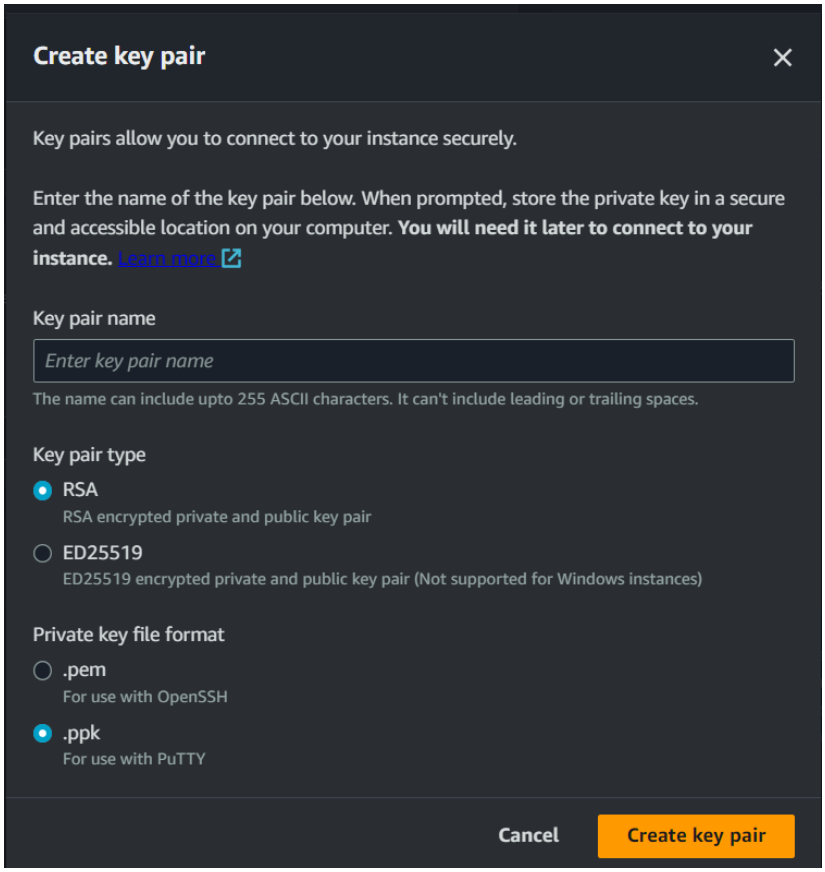


Select new key pair

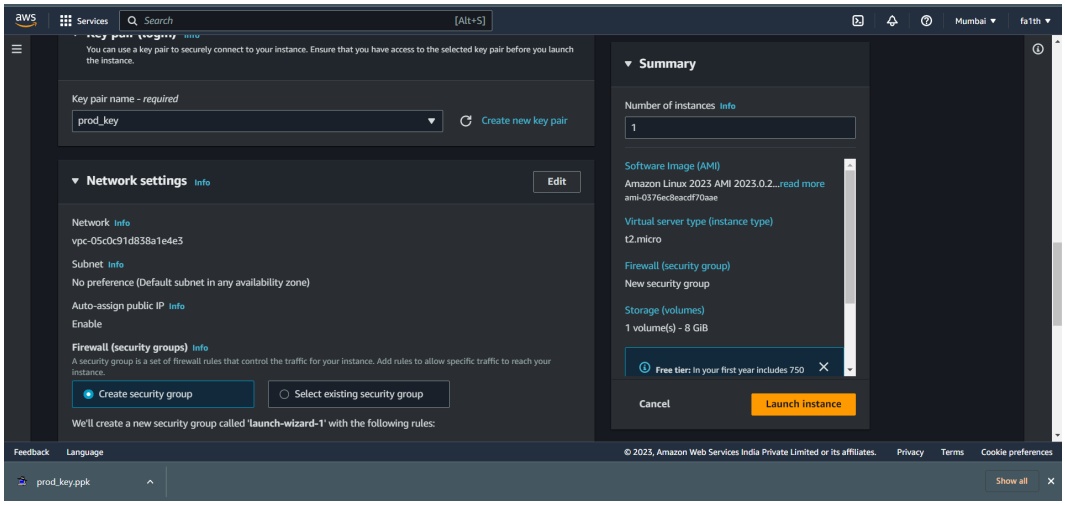


Give key pair name
Select .ppk
Save it in a safe folder

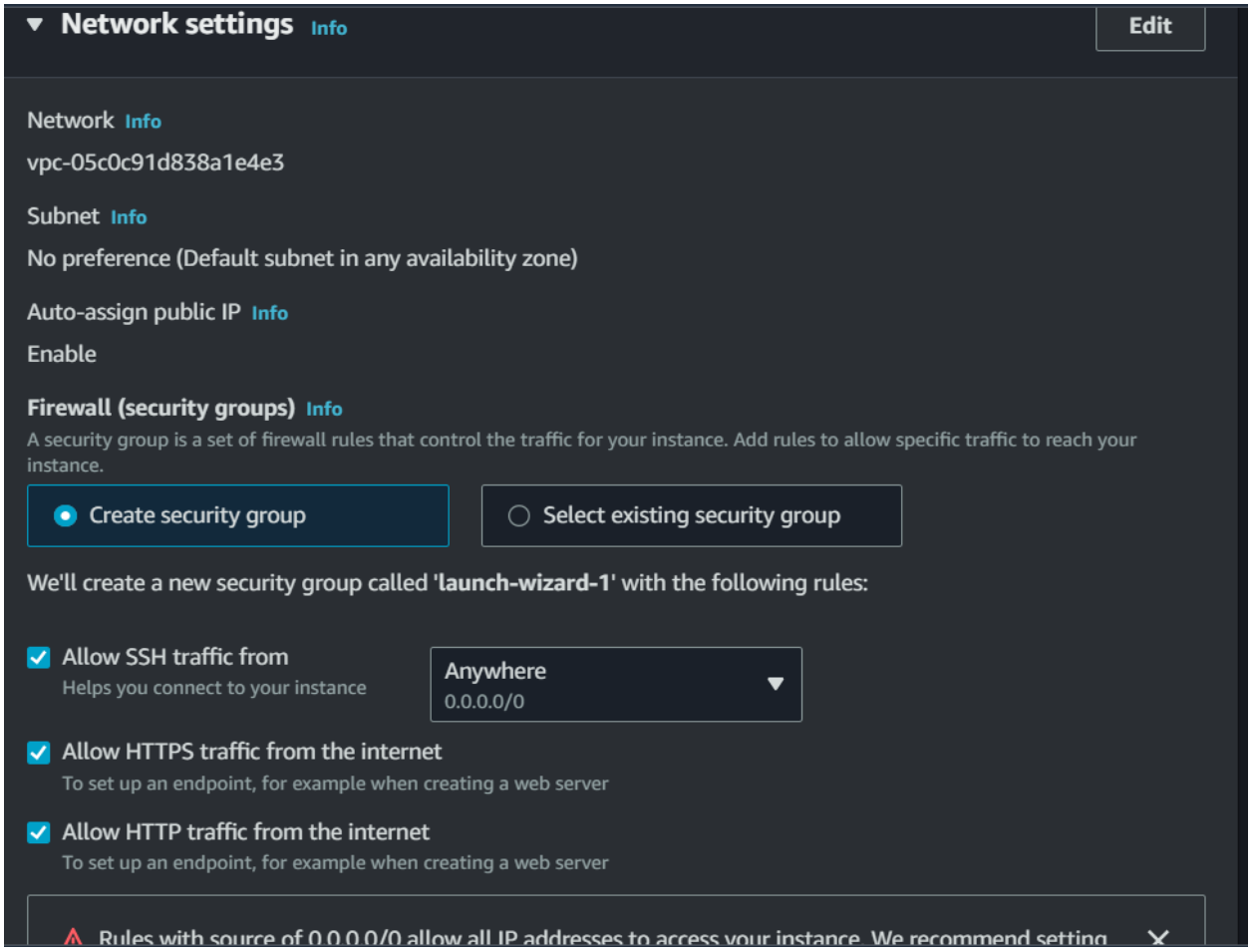
This key pair will be used to connect to the instance using putty.



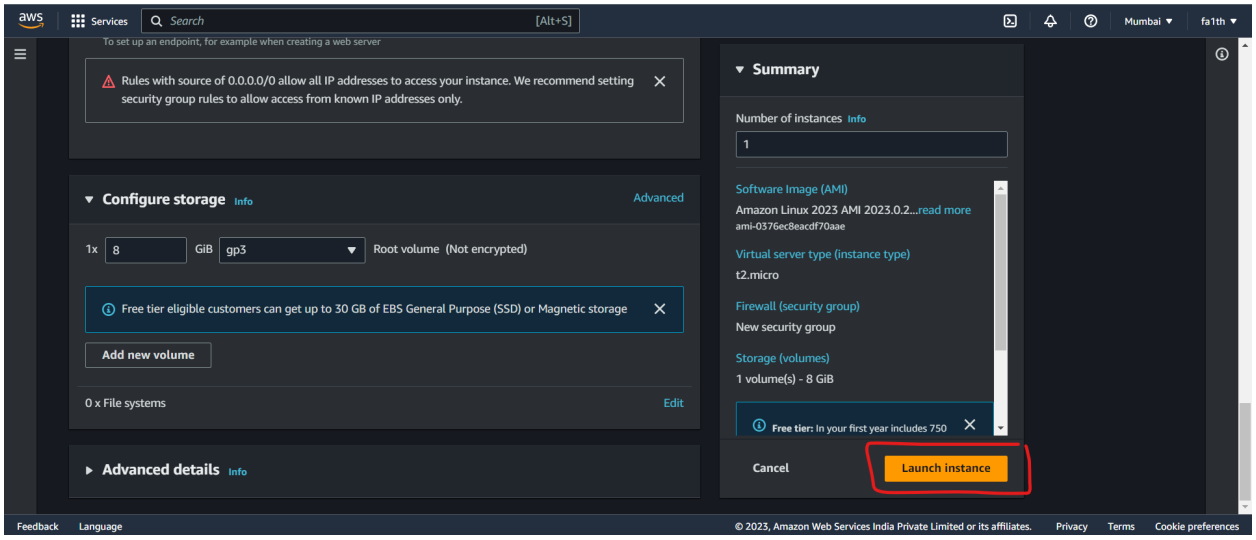
Click on create key pair
The key file will be downloaded



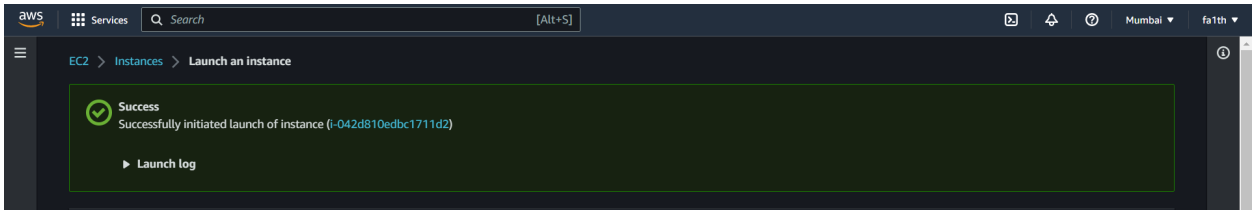
Keep the network settings as it is
Allow traffic - tick mark all 3 boxes



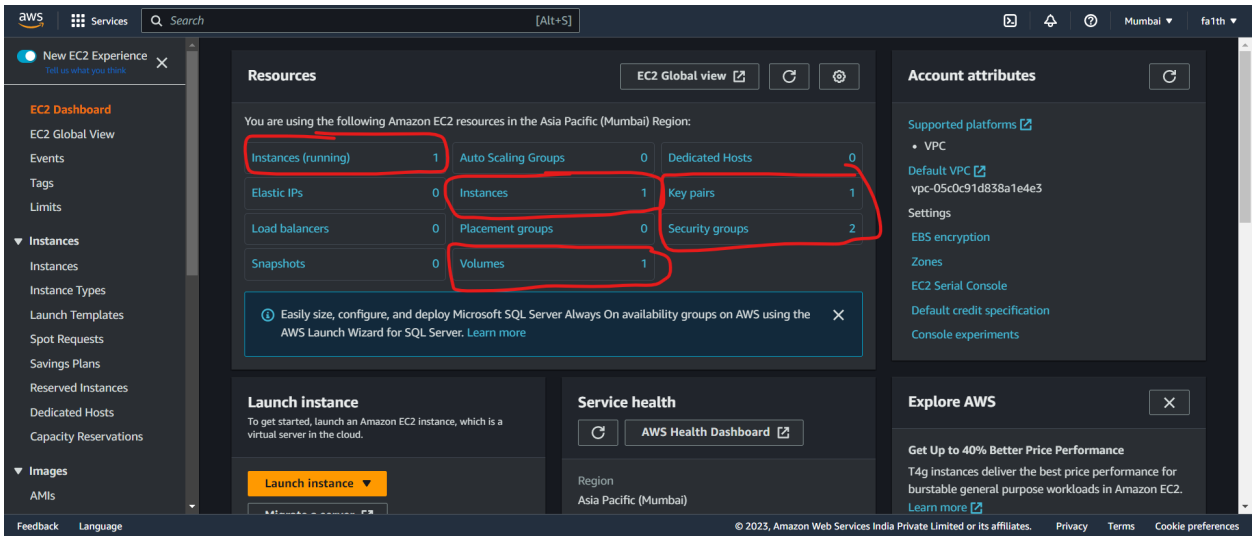
Keep rest of the settings same



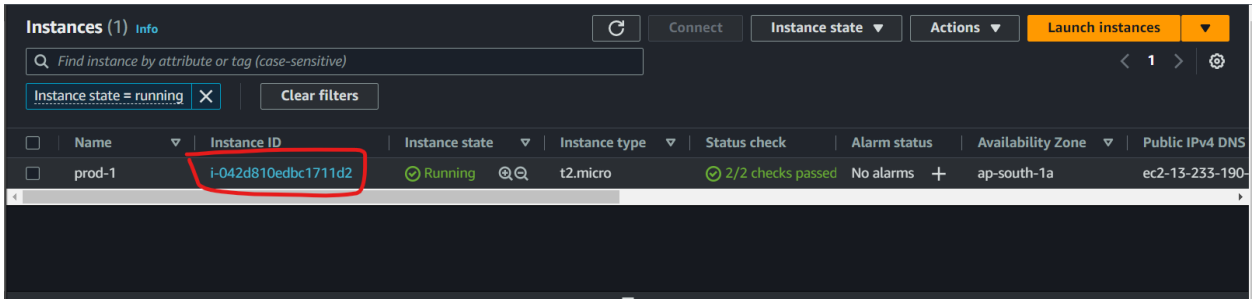
Launch instance

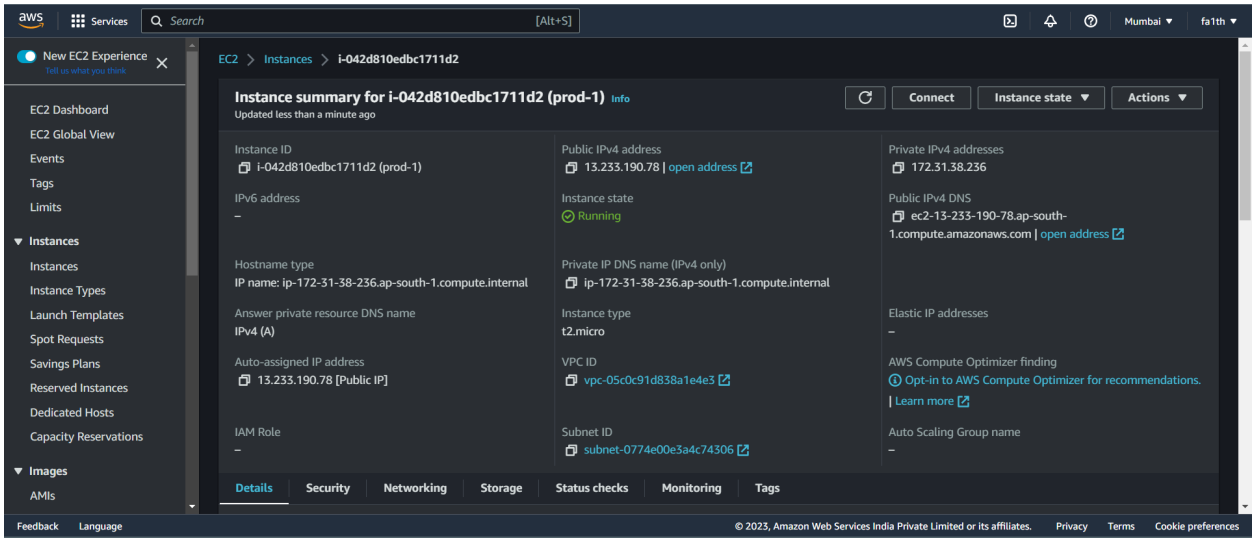


Go to dashboard and check if the instance is running

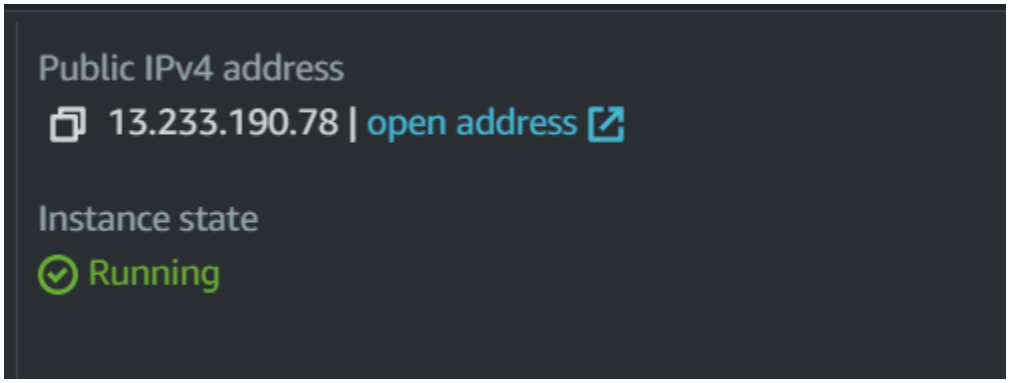


Click on running instances
Click on instance ID



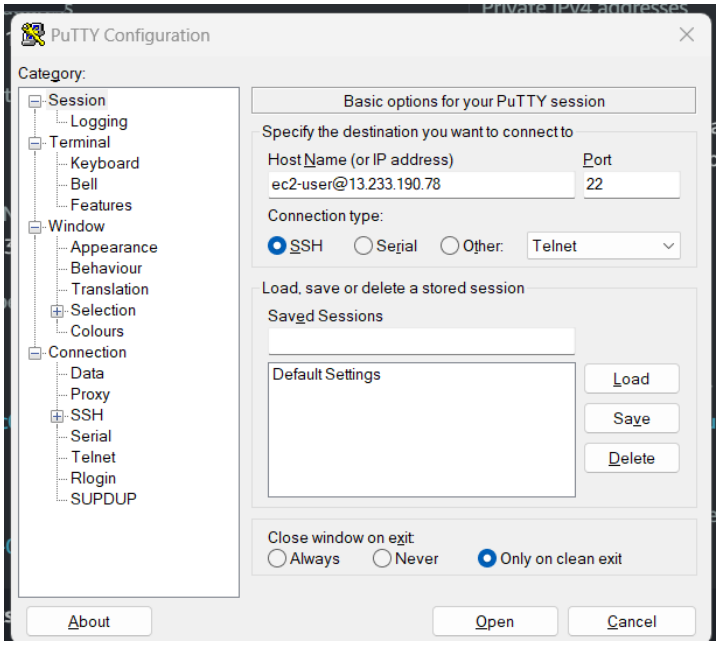


Copy Public ipv4 address

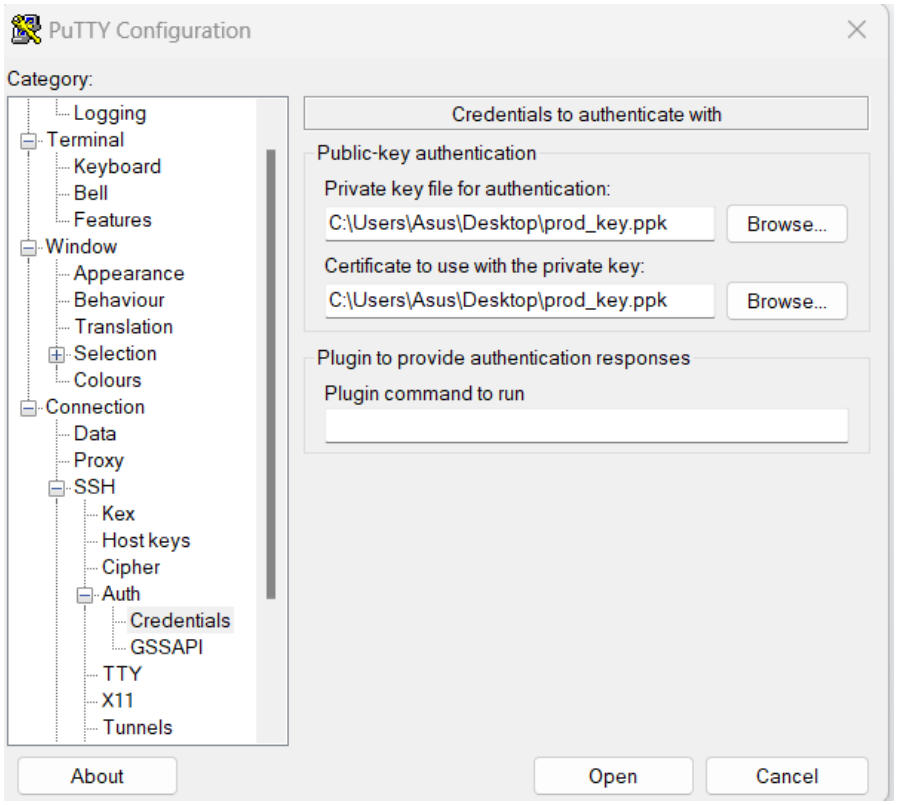


Open putty and write the ip in hostname

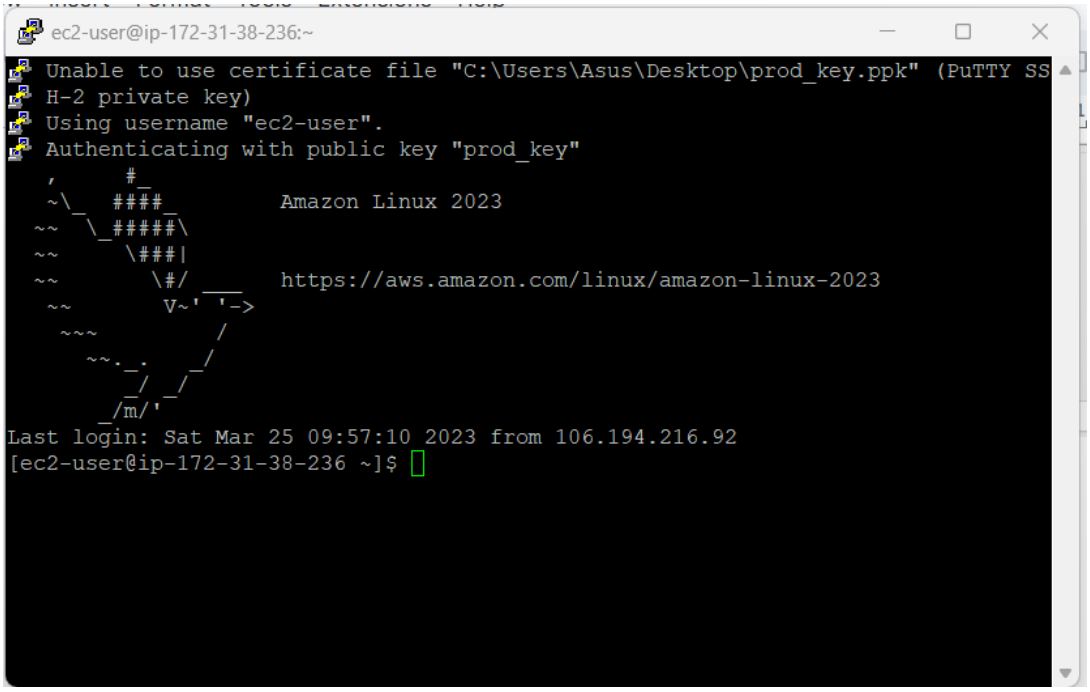
ec2-user@ipaddress



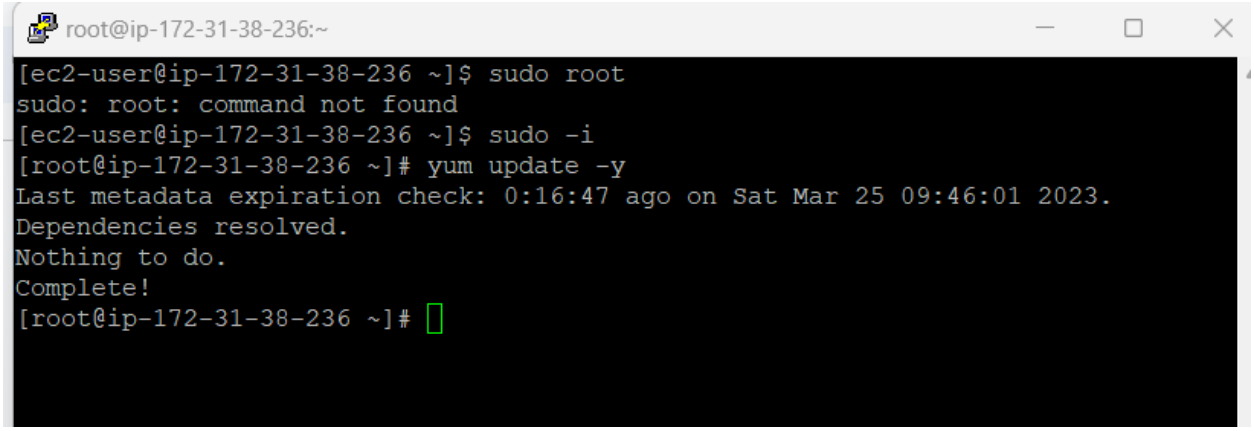
Add key and certificate
Select SSH from left panel
SSH>Auth>Credentials



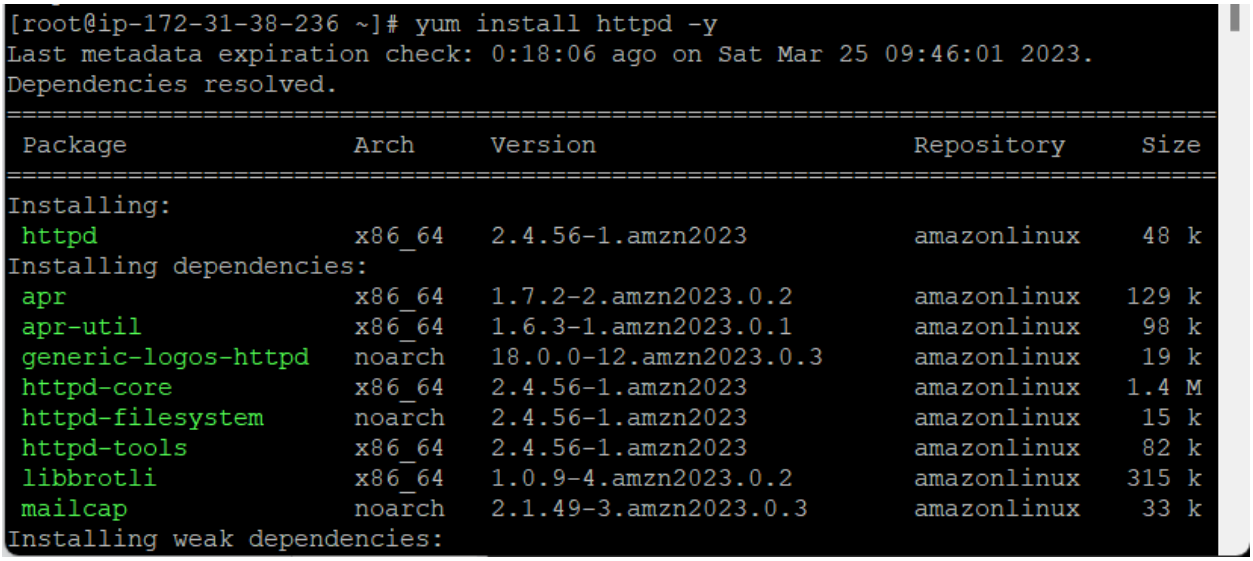
Hit open and it will open up



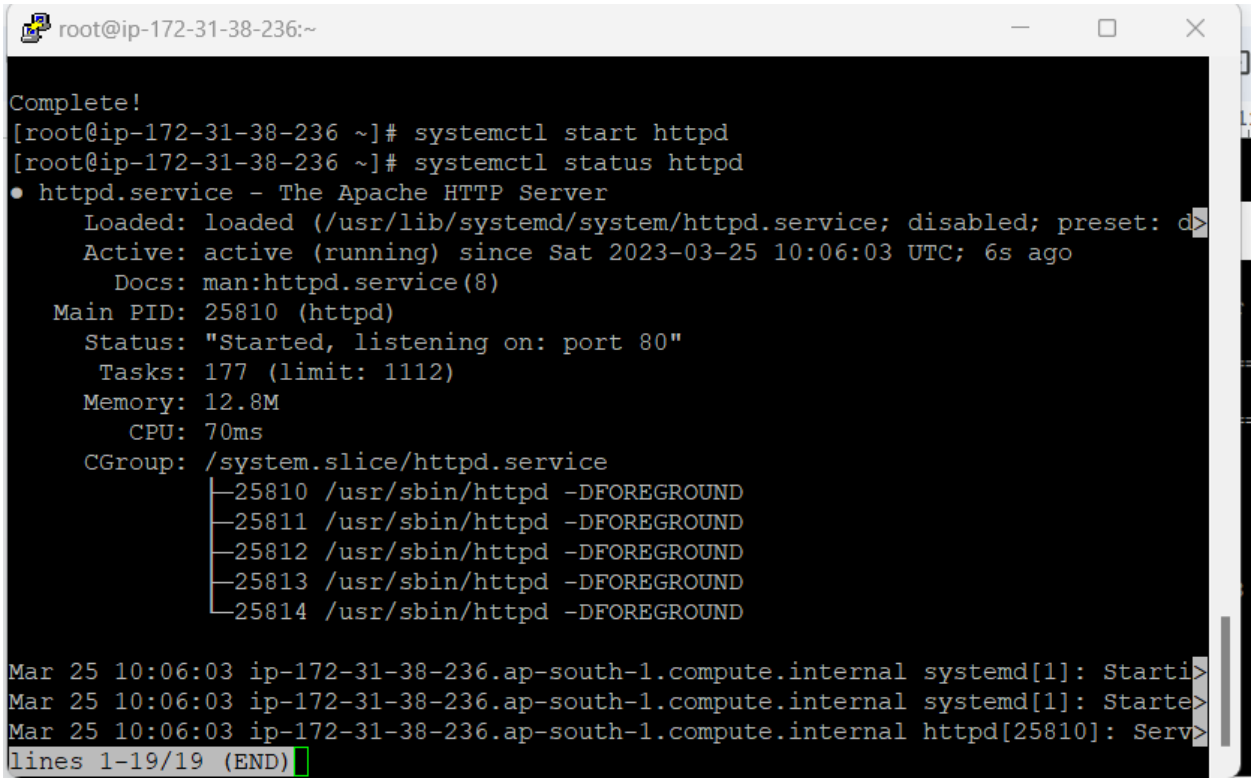
Enter root : sudo -i
Update : yum update -y



Install httpd : yum install httpd -y



Install httpd : yum install httpd -y
Start httpd : systemctl start httpd
Check httpd service running : systemctl status httpd

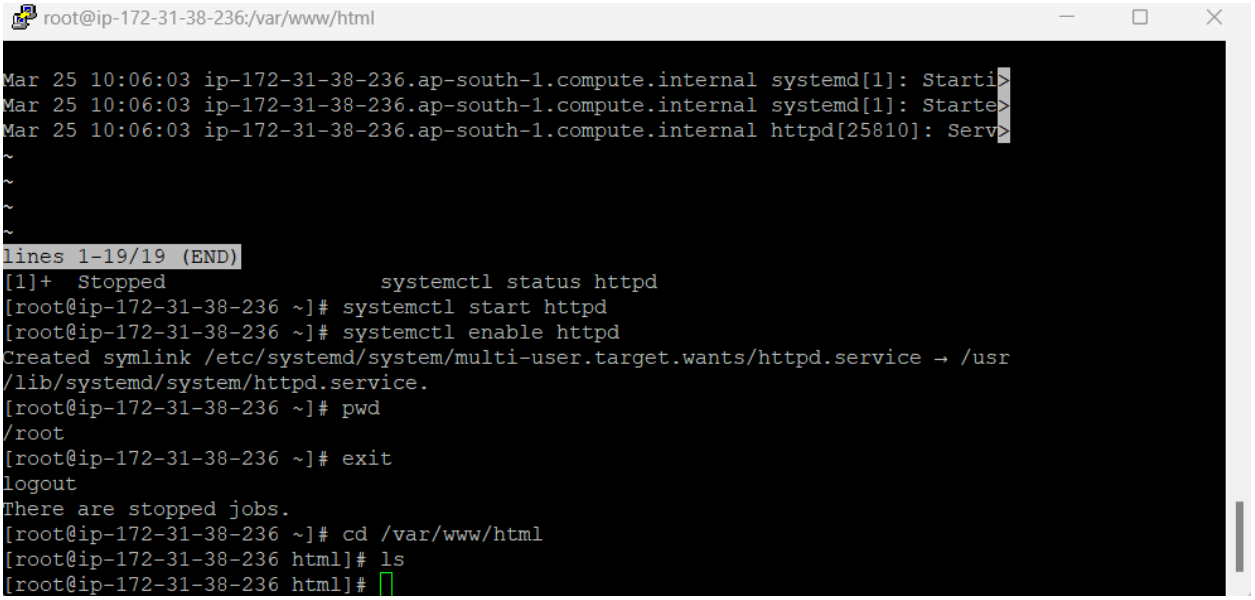


systemctl enable httpd

```
[root@ip-172-31-38-236 ~]# systemctl start httpd
[root@ip-172-31-38-236 ~]# systemctl enable httpd
Created symlink /etc/systemd/system/multi-user.target.wants/httpd.service → /usr
/lib/systemd/system/httpd.service.
[root@ip-172-31-38-236 ~]#
```

cd /var/www/html

vi index.html



Write a small html code inside the file

root@ip-172-31-38-236:/var/www/html

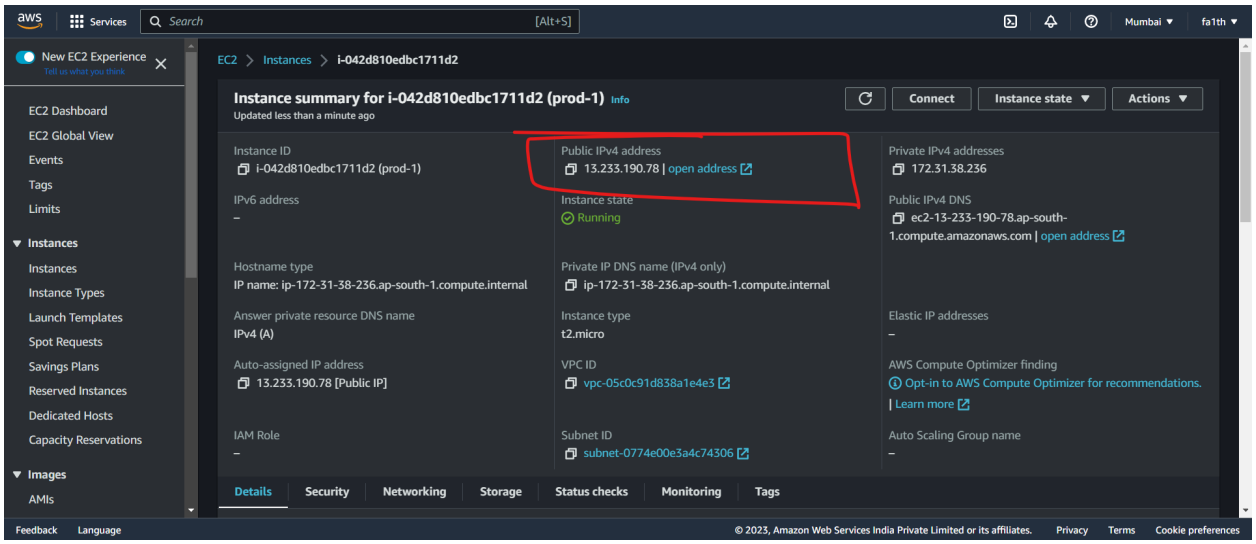
```
<html>
<body>
        <h1> Hello this is heading </h1>
</body>
</html>
~
~
~
~
~
~
~
~
~
~
~
~
~
~
```

systemctl start httpd
systemctl enable httpd

root@ip-172-31-38-236:/var/www/html

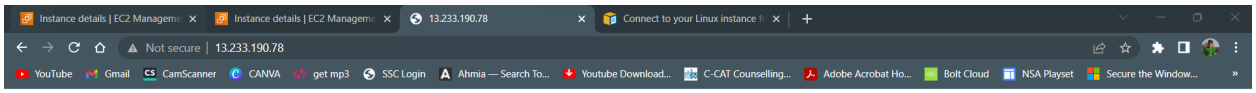
```
[root@ip-172-31-38-236 html]# systemctl status httpd
● httpd.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/httpd.service; enabled; preset: disabled)
     Active: active (running) since Sat 2023-03-25 10:06:03 UTC; 7min ago
       Docs: man:httpd.service(8)
   Main PID: 25810 (httpd)
     Status: "Total requests: 0; Idle/Busy workers 100/0;Requests/sec: 0; Bytes served/sec:   0 >
      Tasks: 177 (limit: 1112)
     Memory: 12.8M
        CPU: 340ms
     CGroup: /system.slice/httpd.service
             ├─25810 /usr/sbin/httpd -DFOREGROUND
             ├─25811 /usr/sbin/httpd -DFOREGROUND
             ├─25812 /usr/sbin/httpd -DFOREGROUND
             ├─25813 /usr/sbin/httpd -DFOREGROUND
             └─25814 /usr/sbin/httpd -DFOREGROUND

Mar 25 10:06:03 ip-172-31-38-236.ap-south-1.compute.internal systemd[1]: Starting httpd.service >
Mar 25 10:06:03 ip-172-31-38-236.ap-south-1.compute.internal systemd[1]: Started httpd.service ->
Mar 25 10:06:03 ip-172-31-38-236.ap-south-1.compute.internal httpd[25810]: Server configured, li>
lines 1-19/19 (END)
[2]+  Stopped                 systemctl status httpd
```

Open dashboard
Copy the public ip address



Paste it in browser

The html code will run and show the output



Hello this is heading