

Sri Lanka Institute of Information Technology



KANDY UNI

Module: IE2012

Systems and Network Programming

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Aazaf Ritha. J – IT23151710

B.Sc. (Hons) in Information Technology

Specialized in Cyber Security

SNP Assignment

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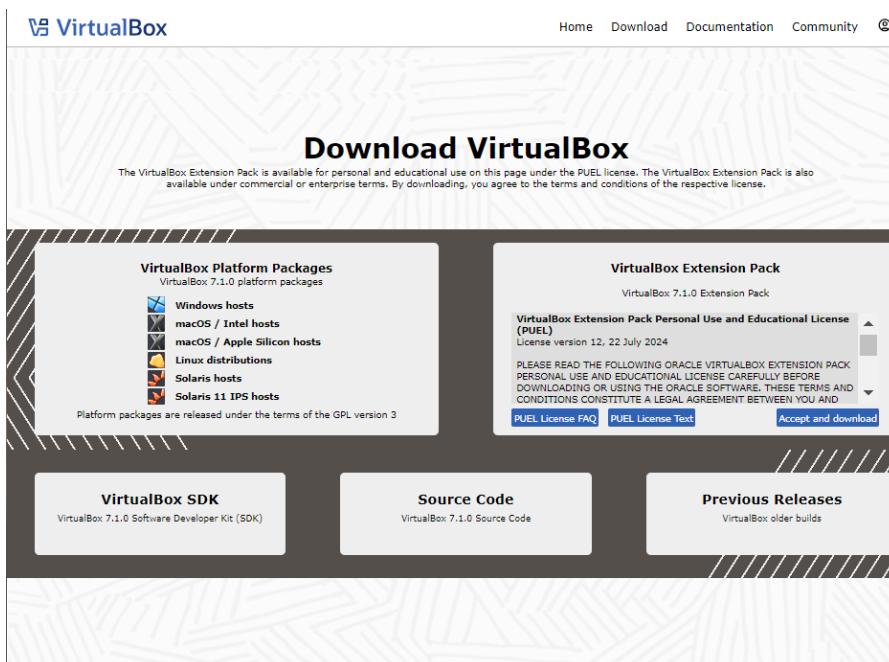
01. Virtual Machine Setup

1.1. Download and Install Virtual Machine

Download a virtual machine emulator for pc. Oracle VirtualBox in my preferences.

I opened my browser and searched for “Oracle VirtualBox.” After finding the correct website, I navigated to the VirtualBox download page. Once there, I selected the appropriate version for my PC's operating system and downloaded it. Additionally, I also downloaded the VirtualBox extension pack from the same site.

Link: <https://www.virtualbox.org/>

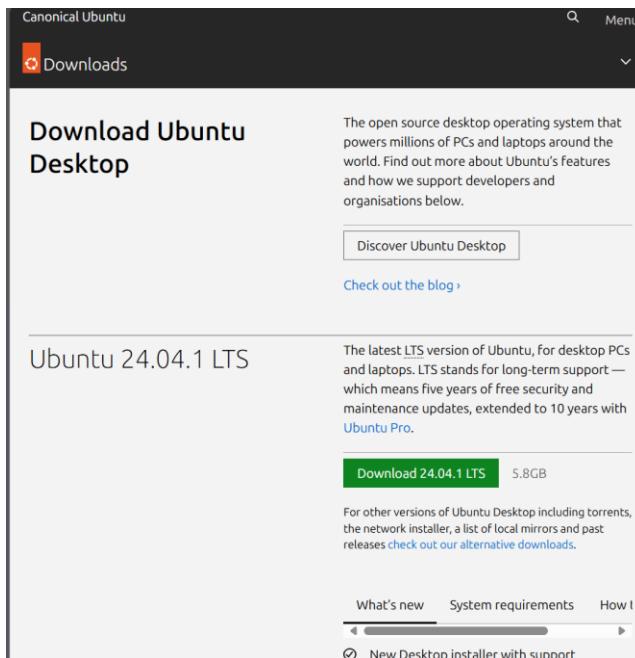


I installed VirtualBox by running the installer and following the instructions. Then, I opened VirtualBox, went to "Preferences," and installed the extension pack by selecting the downloaded file. Both installations were completed successfully.

1.2. Download Linux Distribution

I chose the desired Linux distribution for the project and selected Ubuntu 20.04.1 LTS. I navigated to the Ubuntu Downloads page, found the appropriate link, and downloaded the .iso file for Ubuntu.

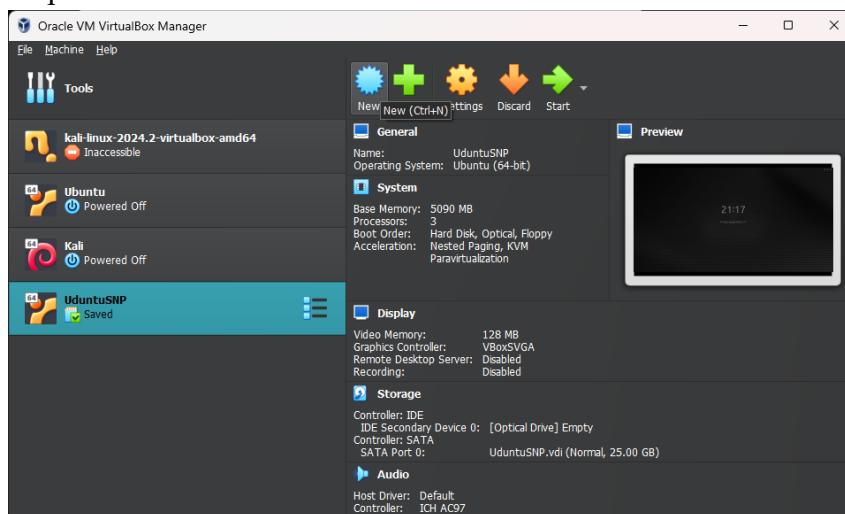
Link: [Ubuntu Downloads](#)



The screenshot shows the Canonical Ubuntu download page. At the top, it says "Download Ubuntu Desktop". Below that, "Ubuntu 24.04.1 LTS" is highlighted as the latest LTS version. A green button labeled "Download 24.04.1 LTS" is visible, along with a note about its size (5.8GB). There are also links for "What's new", "System requirements", and "How I".

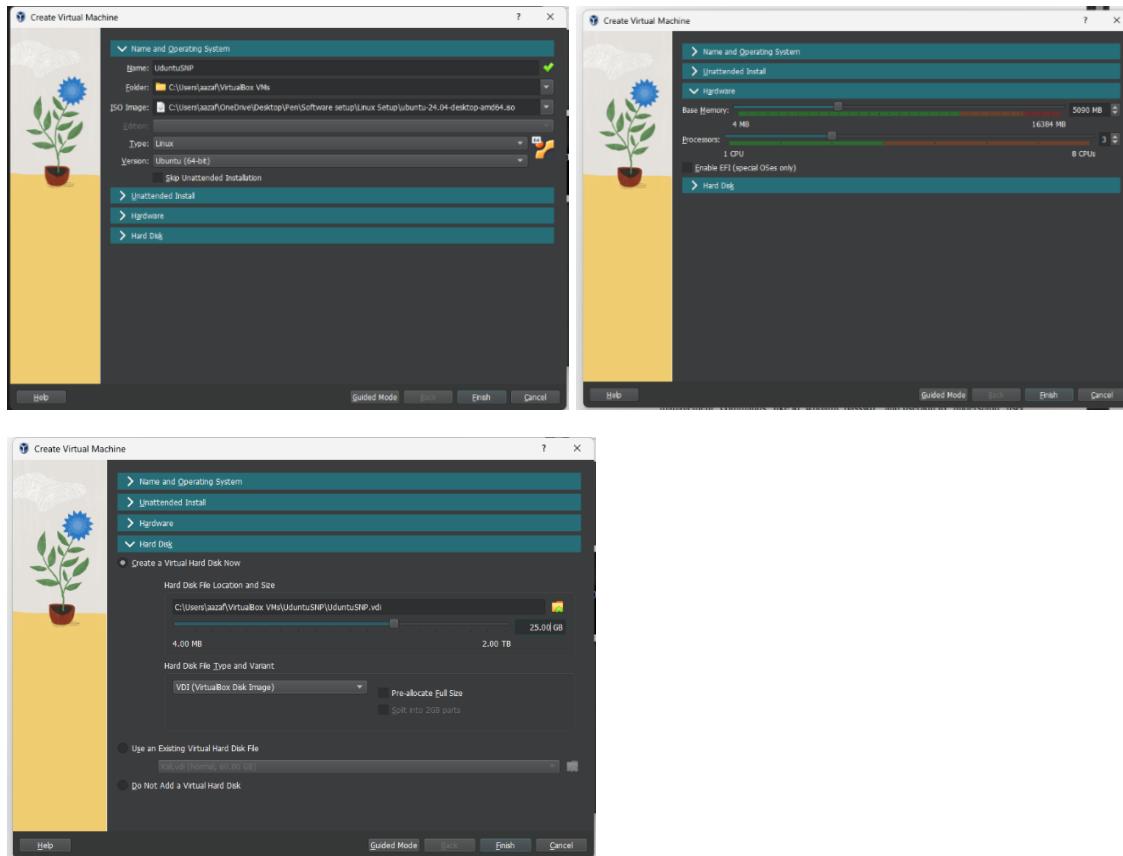
1.3. Resource Allocation and Initial Setup for Virtual Machine

I opened oracle VirtualBox and clicked on "New" to create a new virtual machine (VM).

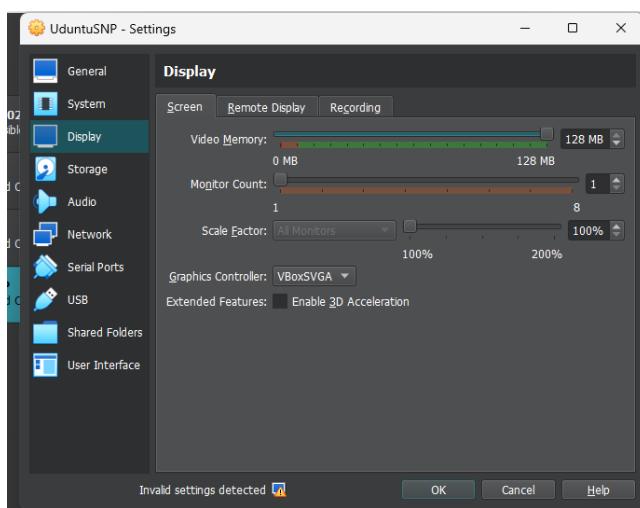


Set the following parameters:

- **Name:** UbuntuSNP
- **ISO Image:** select the downloaded Linux iso file
- **Type:** Linux
- **Version:** Ubuntu (64-bit)
- **Memory:** In my case I allocated 5090 MB of RAM. (for improved performance)
- **Processors:** In my case I allocated 3 CPU cores.
- **Hard Disk:** I created a new virtual hard disk with 25 GB of storage.

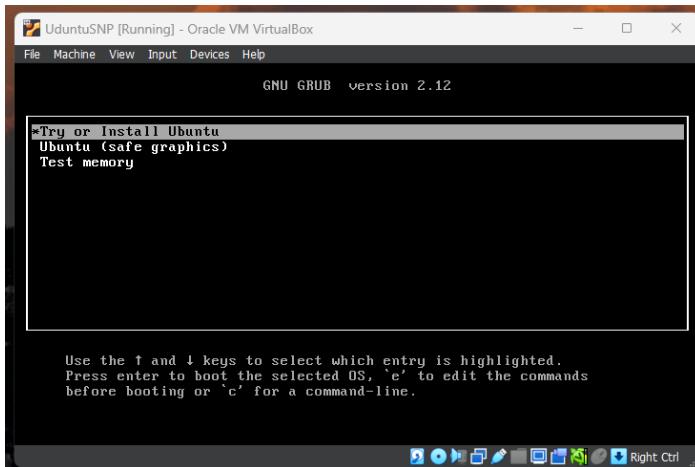


After setting up the VM environment, I clicked "Finish" to complete the configuration. Then, I selected the VM from the VirtualBox manager and went into the settings. I changed the video memory from **0 MB to 128 MB** to improve the VM's graphical performance. Increasing the video memory allows for smoother display rendering, better resolution, and enhanced support for graphical applications. Additionally, I set up the graphics controller to **VBoxSVGA**, which is optimized for the modern Linux distribution and ensures better compatibility with Ubuntu's graphical interface.

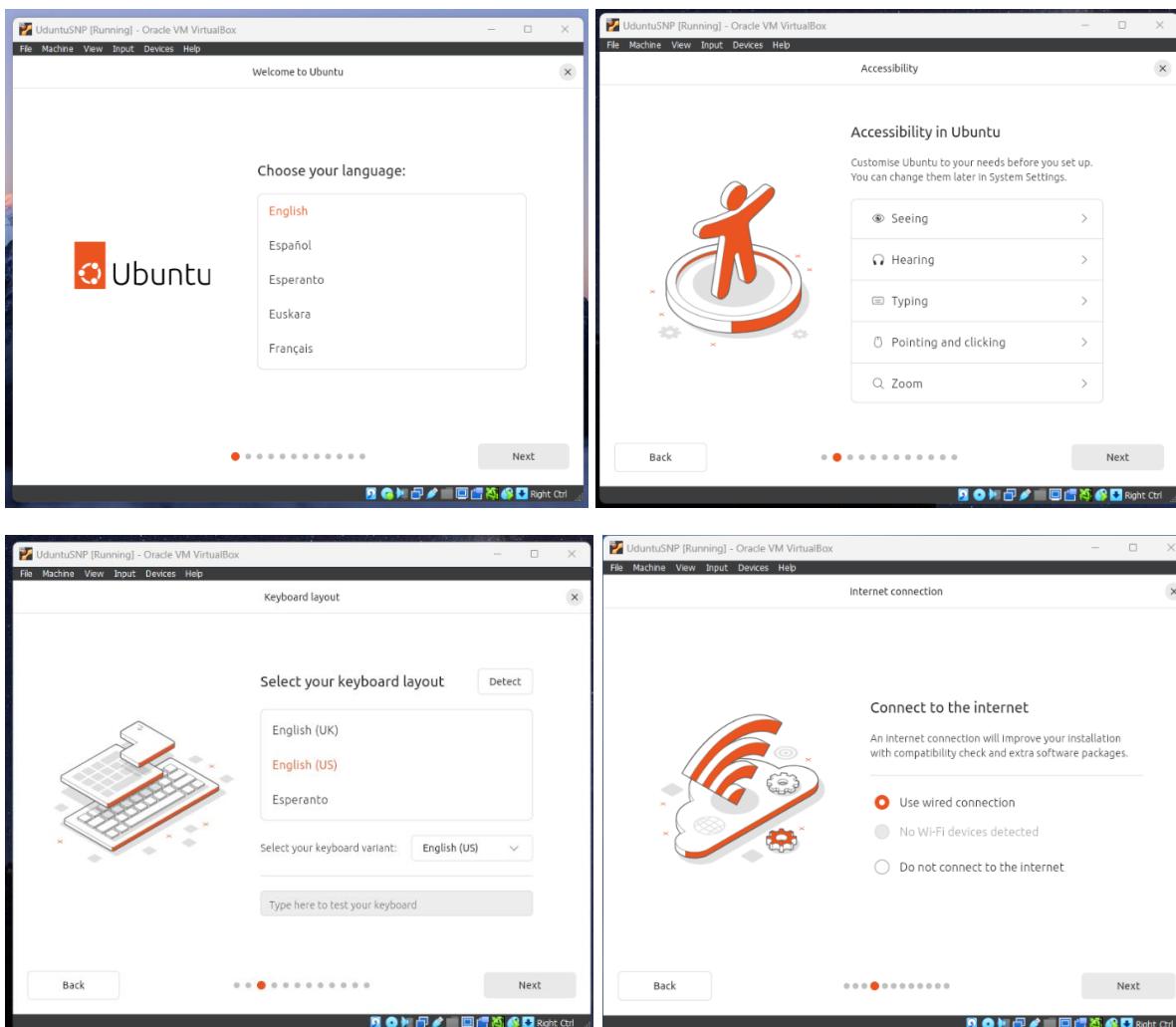


1.4. Install Linux on Virtual Machine

I started the VM from the Oracle VM VirtualBox Manager. Once the VM booted, I selected the "Try or Install Ubuntu" option to proceed with the installation process.



I chose the language and keyboard layout for the Ubuntu installation. Then, I set up the user account by entering the necessary details and selected the appropriate time zone. After configuring those settings, I clicked "Next" to begin the installation process.



UbuntuSNP [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Update available

An update is available for the installer
Update to the latest version for improved reliability and more features.

Update now

Back Skip

UbuntuSNP [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Try or install Ubuntu

What do you want to do with Ubuntu?

- Install Ubuntu**
Install Ubuntu alongside (or instead of) your current operating system. This shouldn't take too long.
- Try Ubuntu**
You can try Ubuntu without making any changes to your computer.

Back Next

UbuntuSNP [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Type of installation

How would you like to install Ubuntu?

- Interactive installation**
For users who want to be guided step by step through the installation.
- Automated installation**
For advanced users who have an autoinstall.yaml for consistent and repeatable system setups.

Back Next

UbuntuSNP [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Applications

What apps would you like to install to start with?

- Default selection**
Just the essentials, web browser and basic utilities.
- Extended selection**
An offline-friendly selection of office tools, utilities and web browser.

Warning: The computer is not plugged in to a power source.

Back Next

UbuntuSNP [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Optimise your computer

Install recommended proprietary software?

Ubuntu ships with no proprietary software by default. Installing additional software may improve your computer's performance.

- Install third-party software for graphics and Wi-Fi hardware**
Including but not limited to NVIDIA drivers and similar
- Download and install support for additional media formats**
Including but not limited to MP3, MP4, MOV and similar

Warning: The computer is not plugged in to a power source.

Back Next

UbuntuSNP [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

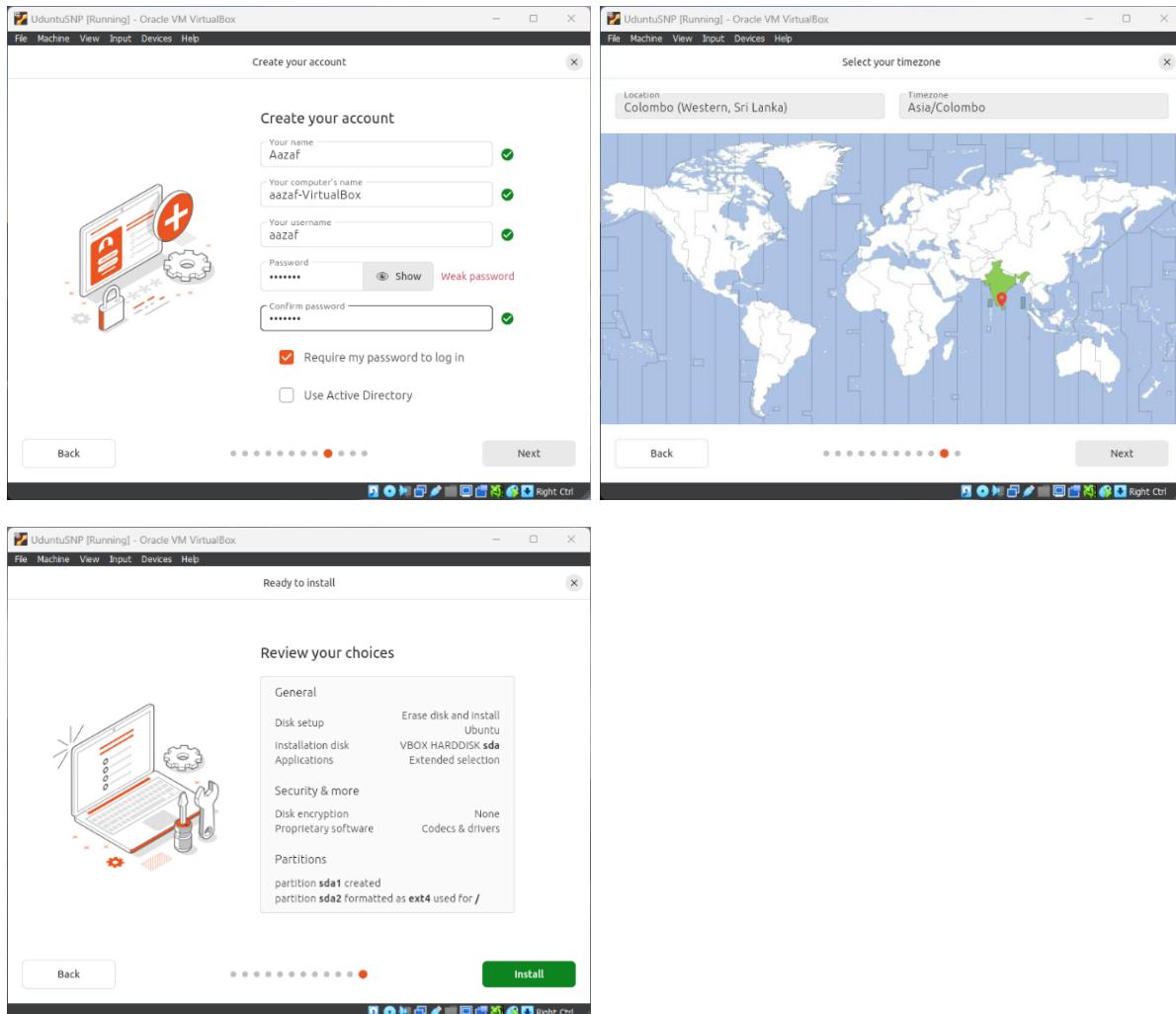
Disk setup

How do you want to install Ubuntu?

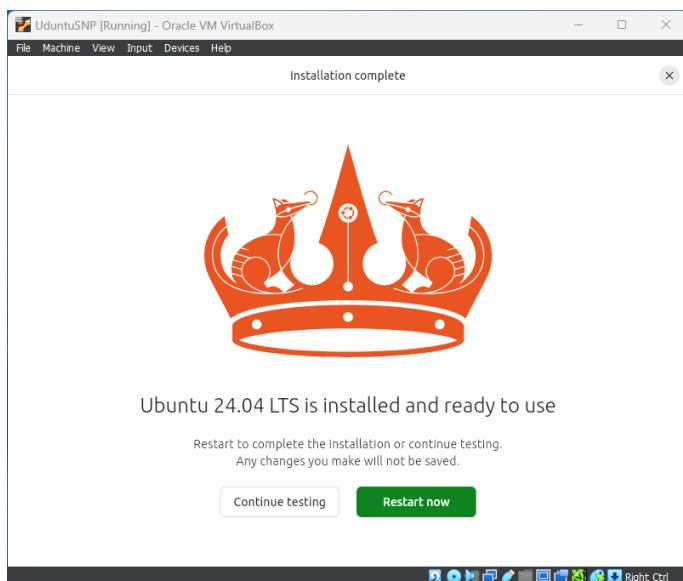
- Erase disk and install Ubuntu**
Start from scratch on your selected disk.
- Manual installation**
For advanced users seeking customized disk setups.

Advanced features... None selected

Back Next



After the installation was complete, I clicked "Restart now" to restart the VM and finalized the setup process.



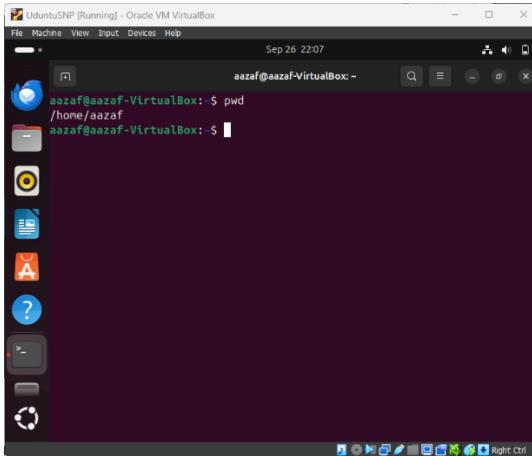
02. Basic of Linux Environments

In this section, I practiced some fundamental Linux commands in the terminal that helped me to navigate and manage files within the Linux environment.

2.1. Navigation Commands

1. **pwd**: This command displays the full path of the current directory.

To use the **pwd** command, I typed **pwd** and pressed enter. This command allowed me to see the full path of my current directory. For example, after the **pwd** is executed.

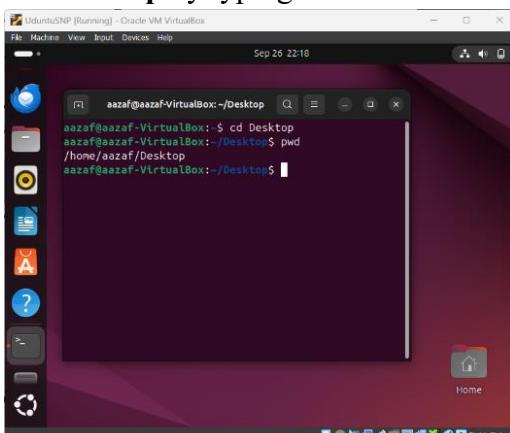


```
UbuntuSMP [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Sep 26 22:07
aaazaf@aaazaf-VirtualBox: ~
aaazaf@aaazaf-VirtualBox: ~$ pwd
/home/aaazaf
aaazaf@aaazaf-VirtualBox: ~$
```

This confirmed my current directory as **/home/aaazaf**.

2. **cd**: Changes the current working directory.

To use the **cd** command, I typed **cd** followed by the **name of the directory** I wanted to move into, and then I pressed enter. This command allowed me to navigate from my current directory to another one. For example, I navigated from my current directory to the **Desktop** by typing:

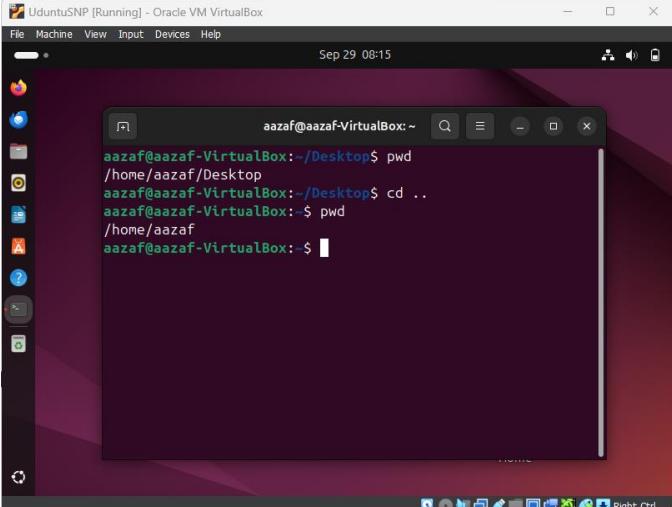


```
UbuntuSMP [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Sep 26 22:18
aaazaf@aaazaf-VirtualBox: ~$ cd Desktop
aaazaf@aaazaf-VirtualBox: ~/Desktop$ pwd
/home/aaazaf/Desktop
aaazaf@aaazaf-VirtualBox: ~/Desktop$
```

After pressing enter, I successfully moved to the **Desktop** directory.

cd .. : Moves up one directory.

When I wanted to move up one level in the directory structure, I used the **cd ..** command. For example, I was in the **Desktop** directory, and I needed to return to the home directory. I typed:

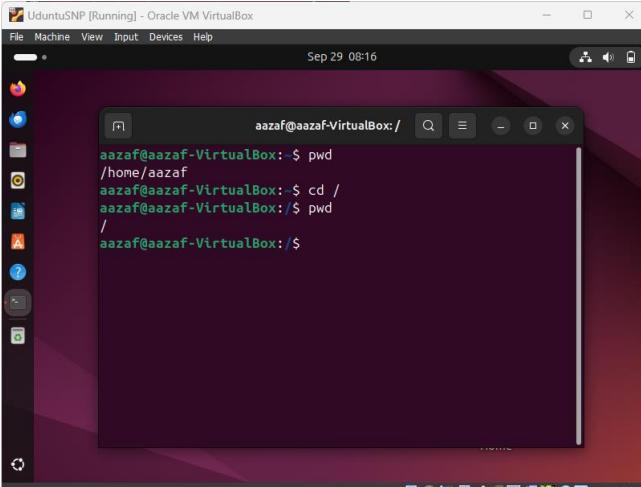


```
aazaf@aazaf-VirtualBox:~/Desktop$ pwd
/home/aazaf/Desktop
aazaf@aazaf-VirtualBox:~/Desktop$ cd ..
aazaf@aazaf-VirtualBox:~$ pwd
/home/aazaf
aazaf@aazaf-VirtualBox:~$
```

After executing the command, I was taken one level up from the Desktop directory to its parent directory, successfully navigated back to the home directory.

cd /: Moves to the root directory.

I typed **cd /** and pressed Enter. This command moved me to the root directory of the filesystem. After executing it, I was successfully navigated to the root directory.

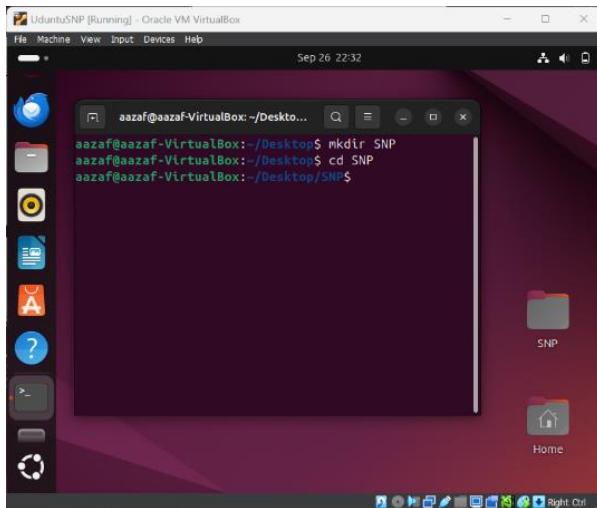


```
aazaf@aazaf-VirtualBox:~$ pwd
/home/aazaf
aazaf@aazaf-VirtualBox:~$ cd /
aazaf@aazaf-VirtualBox:/$ pwd
/
aazaf@aazaf-VirtualBox:/$
```

3. **mkdir:** Creates a new directory.

I used the **mkdir** command to create a new directory called **SNP** on the Desktop.

I typed **mkdir** and pressed Enter. Below is an example of the created **SNP** folder on Desktop:



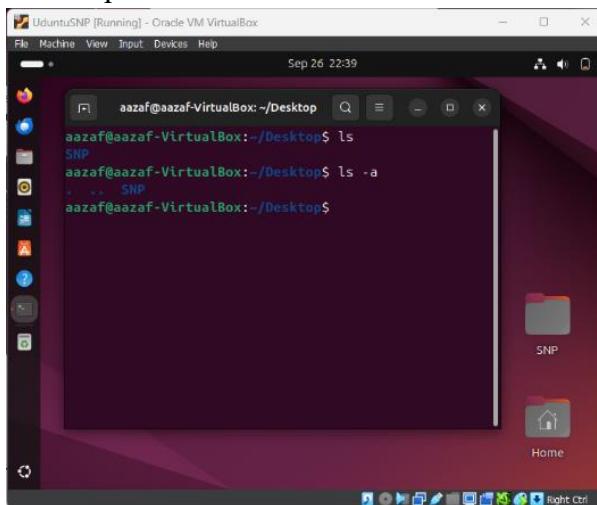
4. **ls**: Lists all the files and directories in the current directory.

ls -a: Lists all files, including hidden files, in the current directory.

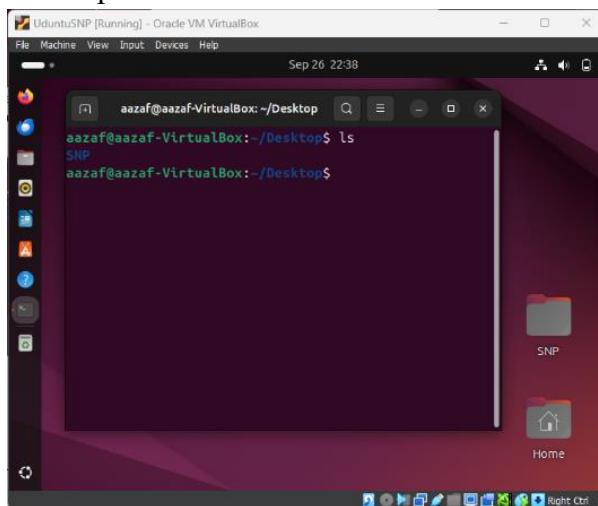
ls -la: Lists files in long format, including hidden files and details in the current directory.

In here I typed **ls**, **ls-a**, and **ls-la** and pressed Enter.

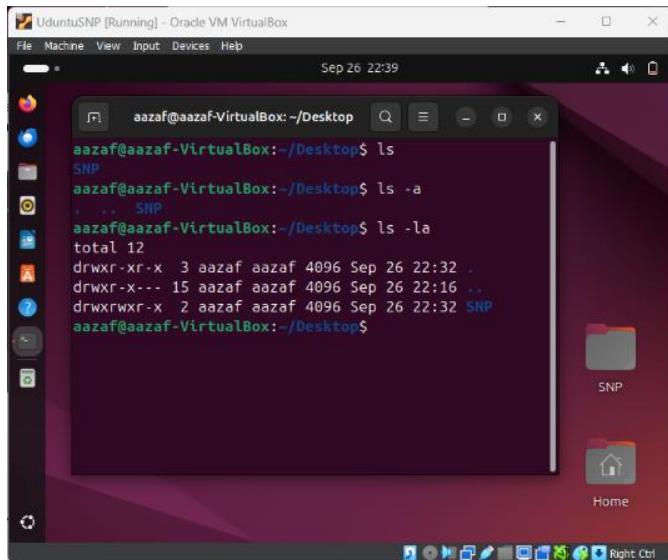
The output showed the details of the **SNP** directory.



The output showed additional hidden files in the **SNP** directory.



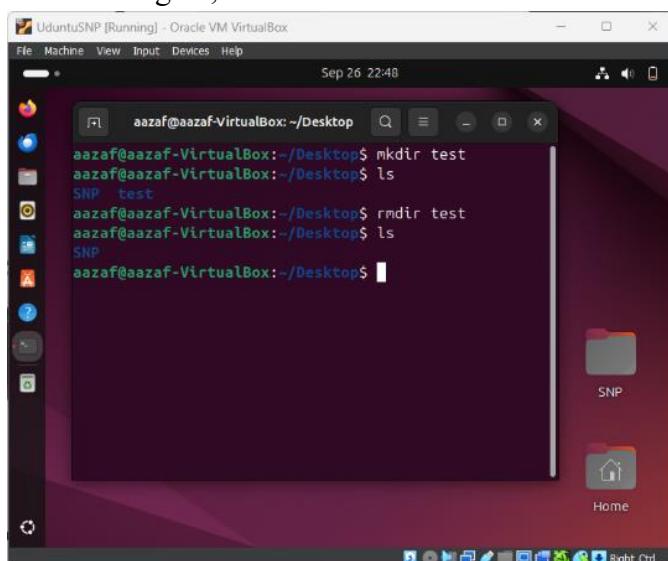
This command “**ls -la**” listed files in long format, shows detailed information such as file permissions, ownership, size, and modification dates, including hidden files. The output provides a detailed view of the contents of the SNP directory.



```
aazaf@aaazaf-VirtualBox:~/Desktop$ ls
SNP
aazaf@aaazaf-VirtualBox:~/Desktop$ ls -a
. . SNP
aazaf@aaazaf-VirtualBox:~/Desktop$ ls -la
total 12
drwxr-xr-x 3 aazaf aazaf 4096 Sep 26 22:32 .
drwxr-x--- 15 aazaf aazaf 4096 Sep 26 22:16 ..
drwxrwxr-x 2 aazaf aazaf 4096 Sep 26 22:32 SNP
aazaf@aaazaf-VirtualBox:~/Desktop$
```

5. **rmdir**: This command helps remove an empty directory.

This command removed the **test** directory as it is empty. Afterward, I ran the **ls** command again, and the **test** folder was not listed.

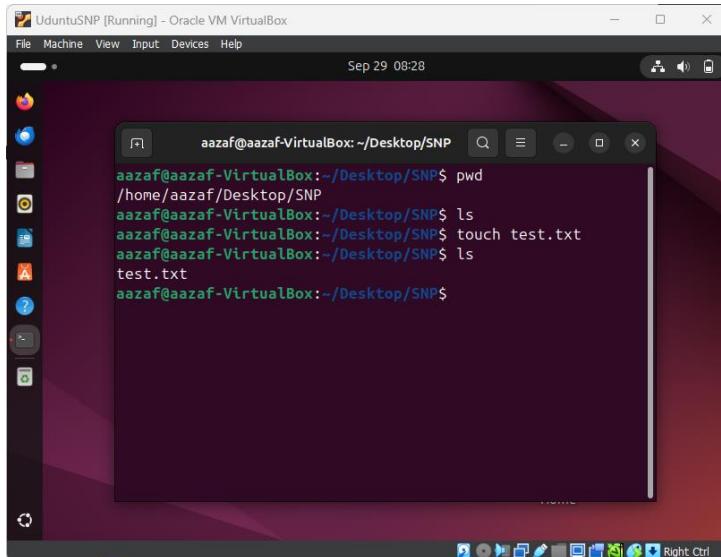


```
aazaf@aaazaf-VirtualBox:~/Desktop$ mkdir test
aazaf@aaazaf-VirtualBox:~/Desktop$ ls
SNP test
aazaf@aaazaf-VirtualBox:~/Desktop$ rmdir test
aazaf@aaazaf-VirtualBox:~/Desktop$ ls
SNP
aazaf@aaazaf-VirtualBox:~/Desktop$
```

2.2. File Manipulation Commands

1. **touch:** Create a new file.

I created an empty file called **test.txt** by using the **touch** command. I typed:

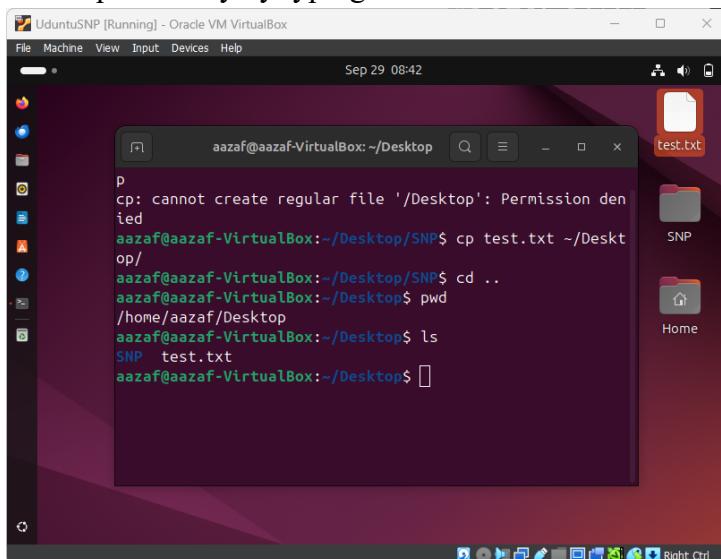


```
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ pwd
/home/aazaf/Desktop/SNP
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ ls
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ touch test.txt
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ ls
test.txt
aazaf@aazaf-VirtualBox:~/Desktop/SNP$
```

After executing the command, the file **test.txt** was successfully created in the **SNP directory**. I confirmed this by running the **ls** command and seeing the file listed.

2. **cp:** To Copy a file.

To copy a file, I used the **cp** command. I copied **test.txt** from the **SNP directory** to the **Desktop directory** by typing:

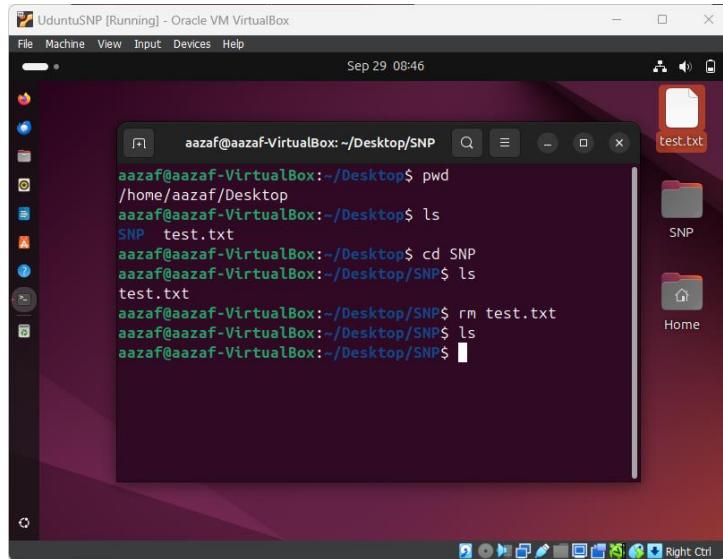


```
P
cp: cannot create regular file '/Desktop': Permission denied
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ cp test.txt ~/Desktop/
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ cd ..
aazaf@aazaf-VirtualBox:~/Desktop$ pwd
/home/aazaf/Desktop
aazaf@aazaf-VirtualBox:~/Desktop$ ls
SNP test.txt
aazaf@aazaf-VirtualBox:~/Desktop$
```

This duplicated the file into the **Desktop** directory. I confirmed the file was successfully copied by checking the contents of the **Desktop** directory using the **ls** command.

3. **rm:** Delete a file.

To delete a file, I used the **rm** command. I removed **test.txt** from the **SNP directory** by typing:

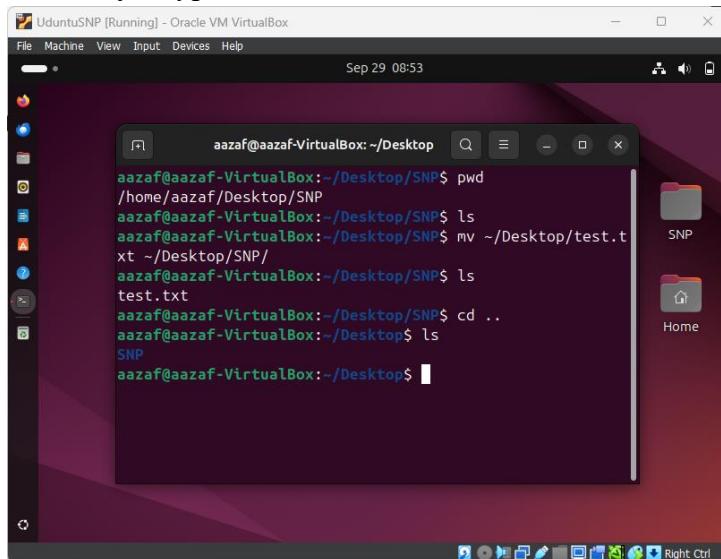


```
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ pwd
/home/aazaf/Desktop/SNP
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ ls
SNP test.txt
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ cd SNP
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ ls
test.txt
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ rm test.txt
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ ls
aazaf@aazaf-VirtualBox:~/Desktop/SNP$
```

After executing the command, the file **test.txt** was successfully deleted from **the SNP directory**. I confirmed this by using the **ls** command to check the contents of the SNP directory, and test.txt was no longer listed.

4. **mv:** Move a file.

I used the **mv** command to move **test.txt** from the Desktop directory to the **SNP directory**. I typed:

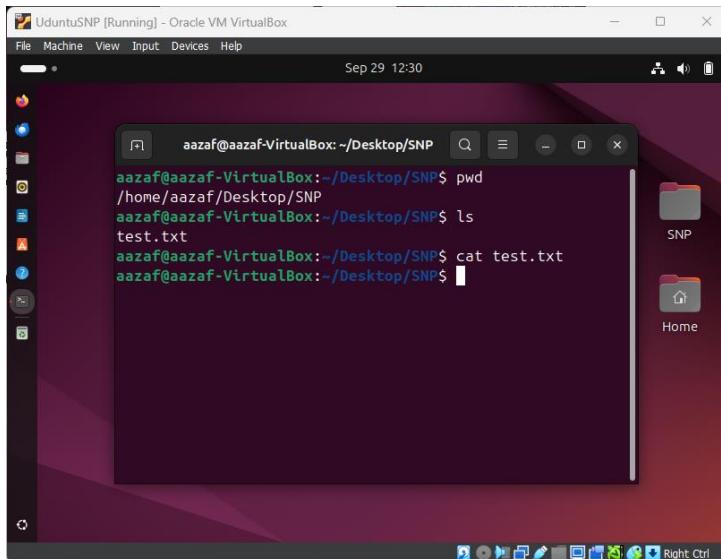


```
aazaf@aazaf-VirtualBox:~/Desktop$ pwd
/home/aazaf/Desktop/SNP
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ ls
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ mv ~/Desktop/test.txt ~/Desktop/SNP/
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ ls
test.txt
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ cd ..
aazaf@aazaf-VirtualBox:~/Desktop$ ls
SNP
aazaf@aazaf-VirtualBox:~/Desktop$
```

This command successfully moved the file into the **SNP directory**. I confirmed the file has been moved by checking the contents of both the Desktop and SNP directories using the **ls** command.

5. **cat:** Displays the contents.

I used the cat command to display the contents of the file test.txt. I typed:

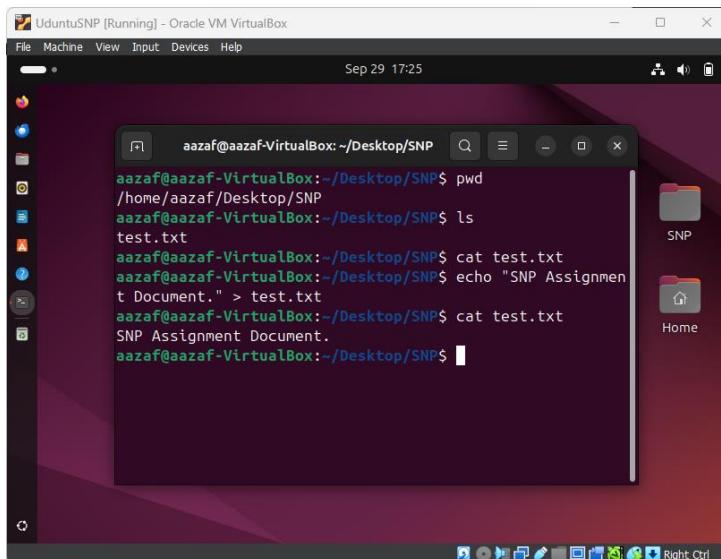


```
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ pwd
/home/aazaf/Desktop/SNP
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ ls
test.txt
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ cat test.txt
aazaf@aazaf-VirtualBox:~/Desktop/SNP$
```

After running the command, the terminal did not display any content because test.txt is an empty file. This confirmed that there was no data inside the file.

6. **echo:** For displaying lines of text or string which are passed as arguments on the command line

I used the **echo** command to write text into the file **test.txt**. I typed:



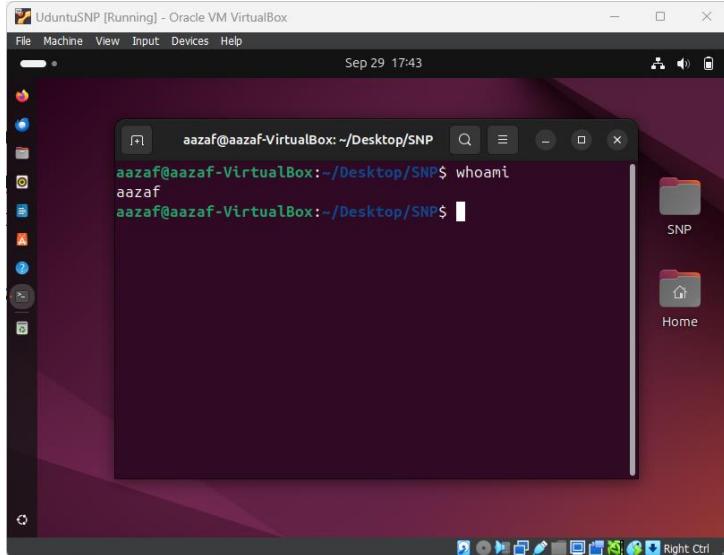
```
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ pwd
/home/aazaf/Desktop/SNP
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ ls
test.txt
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ cat test.txt
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ echo "SNP Assignment Document." > test.txt
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ cat test.txt
SNP Assignment Document.
aazaf@aazaf-VirtualBox:~/Desktop/SNP$
```

After running the command, the text "SNP Assignment Document." was written into test.txt. I confirmed this by using the **cat** command to view the contents of the file, which now displayed the text I had written.

2.3. System Information Commands

1. **whoami:** Print current User

To verify the current logged-in user, I executed the **whoami** command. The system promptly returned my username, **aazaf**, confirming the identity of the user account under which the commands were being executed. This command is essential for ensuring that operations are being conducted under the correct user account.

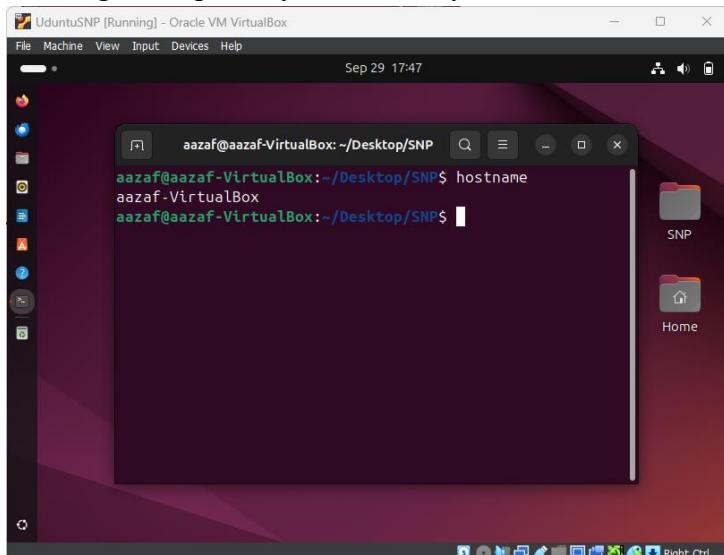


The screenshot shows a terminal window titled "UbuntuSNP [Running] - Oracle VM VirtualBox". The terminal prompt is "aazaf@aazaf-VirtualBox: ~/Desktop/SNP\$". The user has run the "whoami" command, and the terminal displays "aazaf" as the current user. The desktop environment is visible in the background, showing icons for Home and SNP.

```
aazaf@aazaf-VirtualBox: ~/Desktop/SNP$ whoami
aazaf
aazaf@aazaf-VirtualBox: ~/Desktop/SNP$
```

2. **hostname:** System Hostname

I executed the **hostname** command to identify the system's network name. The output provided the hostname as **aazaf-VirtualBox**, which helped to distinguish this system within a network. This command was particularly useful in confirming the device I was working on, especially in a multi-system environment.

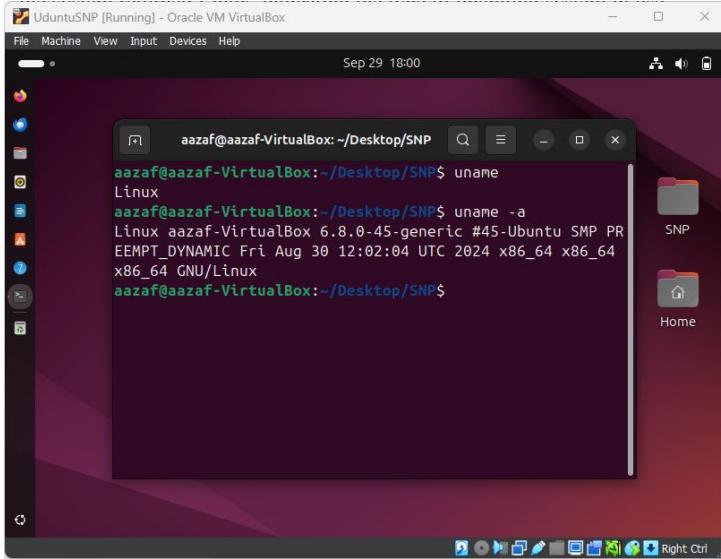


The screenshot shows a terminal window titled "UbuntuSNP [Running] - Oracle VM VirtualBox". The terminal prompt is "aazaf@aazaf-VirtualBox: ~/Desktop/SNP\$". The user has run the "hostname" command, and the terminal displays "aazaf-VirtualBox" as the system's network name. The desktop environment is visible in the background, showing icons for Home and SNP.

```
aazaf@aazaf-VirtualBox: ~/Desktop/SNP$ hostname
aazaf-VirtualBox
aazaf@aazaf-VirtualBox: ~/Desktop/SNP$
```

3. **uname**: System Information

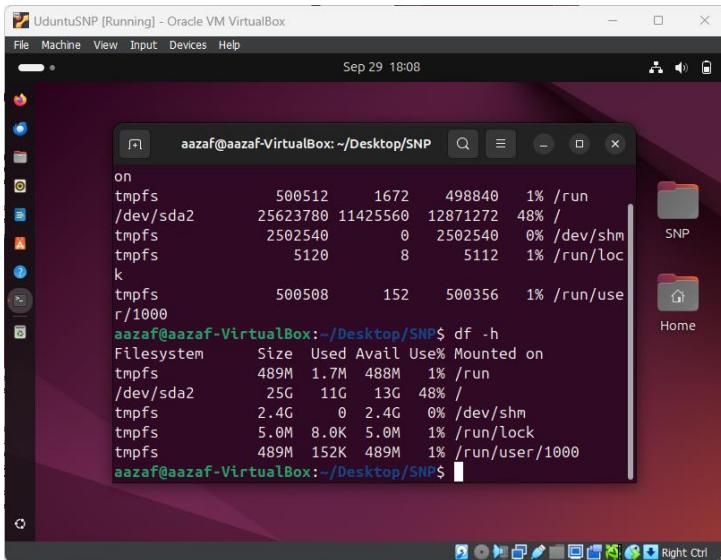
I ran the **uname** command, which returned Linux as the operating system. For more details, I used **uname -a**, which provided information such as the kernel version, machine type, and OS specifics. This output helped to identify key system characteristics.



```
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ uname
Linux
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ uname -a
Linux aazaf-VirtualBox 6.8.0-45-generic #45-Ubuntu SMP PREEMPT_DYNAMIC Fri Aug 30 12:02:04 UTC 2024 x86_64 x86_64
x86_64 GNU/Linux
aazaf@aazaf-VirtualBox:~/Desktop/SNP$
```

4. **df**: Disk Space Usage

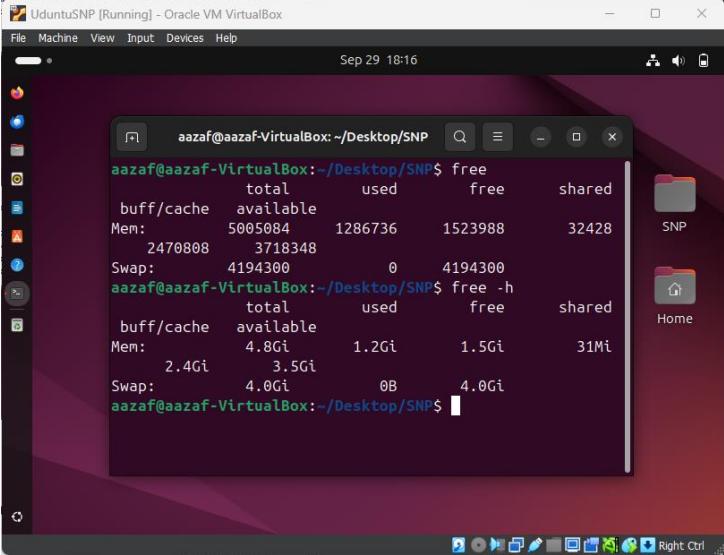
I used the **df -h** command to check disk space usage in a human-readable format. The output showed the total, used, and available space for each mounted filesystem. For example, **/dev/sda2** had 25G total space, with 11G used and 13G available, indicating 48% usage. This command provided a quick overview of storage capacity.



```
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ df -h
Filesystem      Size  Used Avail Use% Mounted on
tmpfs          489M   1.7M  488M  1% /run
/dev/sda2        25G   11G   13G  48% /
tmpfs          2.4G     0  2.4G  0% /dev/shm
tmpfs          5.0M  8.0K  5.0M  1% /run/lock
tmpfs          489M  152K  489M  1% /run/user/1000
aazaf@aazaf-VirtualBox:~/Desktop/SNP$
```

5. **free**: Memory Usage

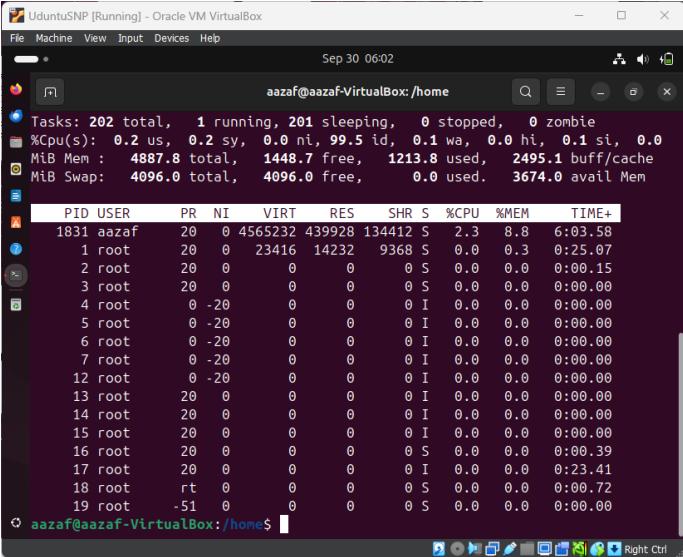
I used the **free -h** command to display the system's memory usage in a human-readable format. The output provided a breakdown of total, used, and available memory, as well as swap space. For example, the system had 4.8Gi of total memory, with 1.2Gi used and 1.5Gi free. This command helped me assess the current memory utilization and the available resources.



```
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ free
total        used        free      shared
buff/cache   available
Mem:      5005084       1286736      1523988       32428
        2470808       3718348
Swap:     4194300           0       4194300
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ free -h
total        used        free      shared
buff/cache   available
Mem:      4.8Gi       1.2Gi       1.5Gi       31Mi
        2.4Gi       3.5Gi
Swap:     4.0Gi          0B       4.0Gi
aazaf@aazaf-VirtualBox:~/Desktop/SNP$
```

6. **top**: Real-Time Process Monitoring

I used the **top** command to monitor system processes in real-time. After running:



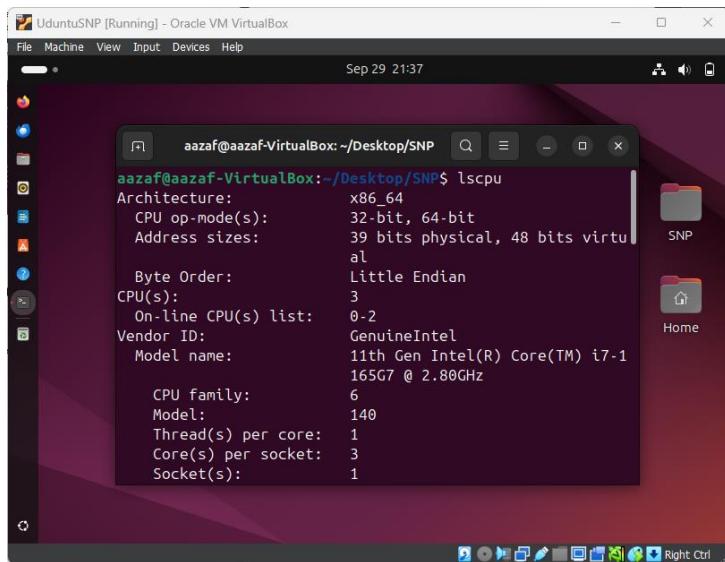
```
Tasks: 202 total,  1 running, 201 sleeping,  0 stopped,  0 zombie
%Cpu(s):  0.2 us,  0.2 sy,  0.0 ni, 99.5 id,  0.1 wa,  0.0 hi,  0.1 si,  0.0
MiB Mem : 4887.8 total, 1448.7 free, 1213.8 used, 2495.1 buff/cache
MiB Swap: 4096.0 total, 4096.0 free,    0.0 used. 3674.0 avail Mem

 PID USER      PR  NI    VIRT    RES    SHR S %CPU %MEM     TIME+
 1831 aazaf     20   0 4565232 439928 134412 S  2.3  8.8  6:03.58
  1 root      20   0  23416  14232  9368 S  0.0  0.3  0:25.07
  2 root      20   0      0      0      0 S  0.0  0.0  0:00.15
  3 root      20   0      0      0      0 S  0.0  0.0  0:00.00
  4 root      0 -20      0      0      0 I  0.0  0.0  0:00.00
  5 root      0 -20      0      0      0 I  0.0  0.0  0:00.00
  6 root      0 -20      0      0      0 I  0.0  0.0  0:00.00
  7 root      0 -20      0      0      0 I  0.0  0.0  0:00.00
 12 root      0 -20      0      0      0 I  0.0  0.0  0:00.00
 13 root     20   0      0      0      0 I  0.0  0.0  0:00.00
 14 root     20   0      0      0      0 I  0.0  0.0  0:00.00
 15 root     20   0      0      0      0 I  0.0  0.0  0:00.00
 16 root     20   0      0      0      0 S  0.0  0.0  0:00.39
 17 root     20   0      0      0      0 I  0.0  0.0  0:23.41
 18 root      rt   0      0      0      0 S  0.0  0.0  0:00.72
 19 root     -51   0      0      0      0 S  0.0  0.0  0:00.00
aazaf@aazaf-VirtualBox:/home$
```

The command displayed a dynamic, real-time view of active processes, showing details such as CPU and memory usage, process IDs (PIDs), and the resource consumption of each process. This helped me monitor system performance and identify any processes consuming excessive resources. I exited the **top** interface by pressing **q**.

7. **lscpu**: CPU Architecture

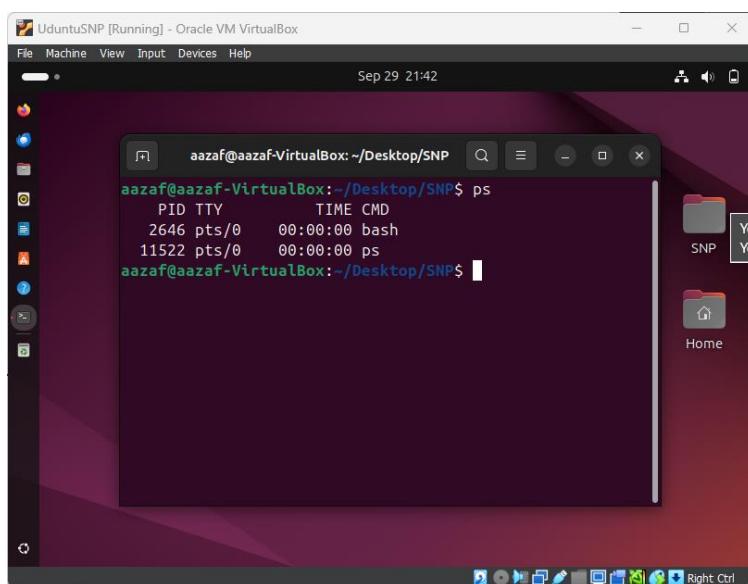
I executed the **lscpu** command to retrieve detailed information about the CPU architecture. The command provided specifics such as the number of cores, CPU family, model name, and clock speed. This information was useful for understanding the processing capabilities of the system.



```
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ lscpu
Architecture:          x86_64
CPU op-mode(s):        32-bit, 64-bit
Address sizes:         39 bits physical, 48 bits virtual
Byte Order:            Little Endian
CPU(s):                3
On-line CPU(s) list:   0-2
Vendor ID:             GenuineIntel
Model name:            11th Gen Intel(R) Core(TM) i7-1165G7 @ 2.80GHz
CPU family:            6
Model:                 140
Thread(s) per core:    1
Core(s) per socket:    3
Socket(s):             1
```

8. ps: Process Status

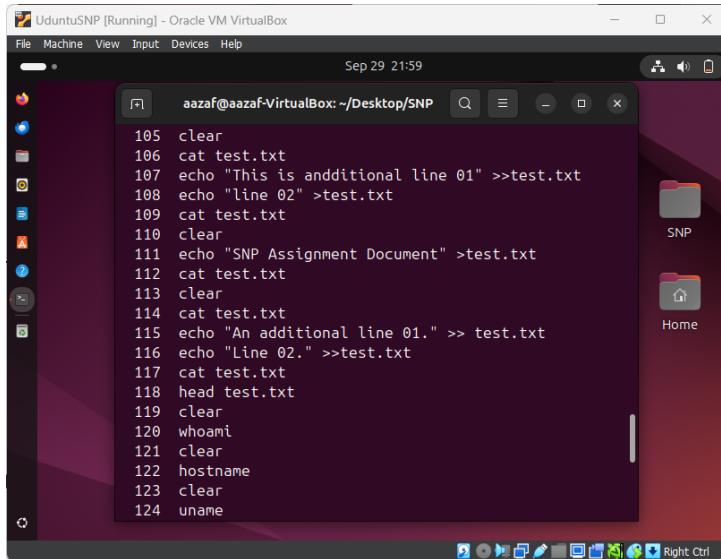
I ran the **ps** command to view active processes in my session. The output showed the process ID (PID), terminal (TTY), CPU time, and the command for each process. For example, **bash** had a PID of 2646, and the **ps** command had a PID of 11522. This gave me a quick snapshot of the current processes.



```
aazaf@aazaf-VirtualBox:~/Desktop/SNP$ ps
  PID TTY      TIME CMD
 2646 pts/0    00:00:00 bash
11522 pts/0    00:00:00 ps
aazaf@aazaf-VirtualBox:~/Desktop/SNP$
```

9. history: Command History

I used the **history** command to display the list of previously executed commands in the terminal. This command allowed me to review past commands, making it easier to repeat or troubleshoot previous actions. The output showed me a numbered list of commands, by showing the recent ones at the bottom.



```

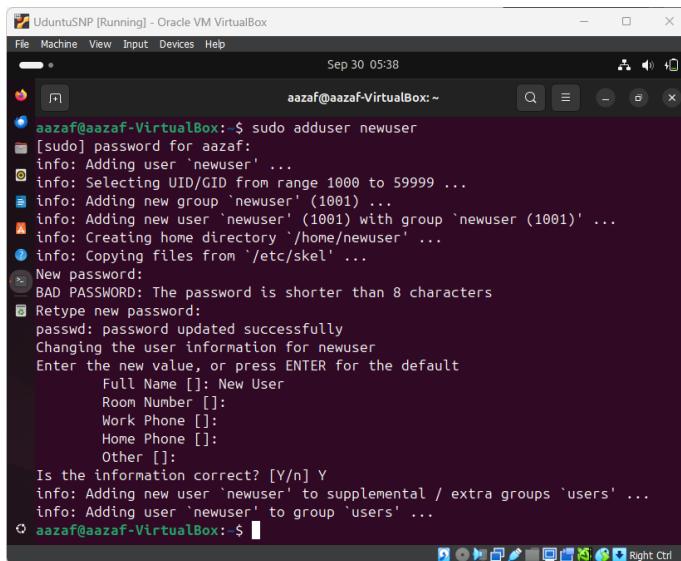
aazaf@aazaf-VirtualBox: ~/Desktop/SNP
File Machine View Input Devices Help
Sep 29 21:59
aazaf@aazaf-VirtualBox: ~/Desktop/SNP
105 clear
106 cat test.txt
107 echo "This is an additional line 01" >>test.txt
108 echo "line 02" >test.txt
109 cat test.txt
110 clear
111 echo "SNP Assignment Document" >test.txt
112 cat test.txt
113 clear
114 cat test.txt
115 echo "An additional line 01." >> test.txt
116 echo "Line 02." >>test.txt
117 cat test.txt
118 head test.txt
119 clear
120 whoami
121 clear
122 hostname
123 clear
124 uname

```

2.4. User Management Commands

1. adduser: Create a New User.

I used the **adduser** command to create a new user account named **newuser**. After running:



```

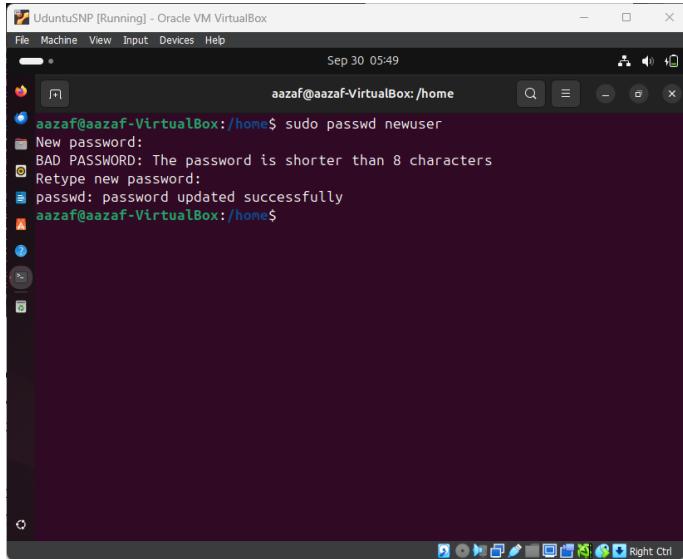
aazaf@aazaf-VirtualBox:~$ sudo adduser newuser
[sudo] password for aazaf:
info: Adding user 'newuser' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group 'newuser' (1001) ...
info: Adding new user 'newuser' (1001) with group 'newuser (1001)' ...
info: Creating home directory '/home/newuser' ...
info: Copying files from '/etc/skel' ...
New password:
BAD PASSWORD: The password is shorter than 8 characters
Retype new password:
passwd: password updated successfully
Changing the user information for newuser
Enter the new value, or press ENTER for the default
    Full Name []: New User
    Room Number []:
    Work Phone []:
    Home Phone []:
    Other []:
Is the information correct? [Y/n] Y
info: Adding new user 'newuser' to supplemental / extra groups 'users' ...
info: Adding user 'newuser' to group 'users' ...
aazaf@aazaf-VirtualBox:~$ 

```

The system prompted me for details like a username and password. It automatically created a home directory, set up default configurations, and added the user to the **users** group. I confirmed the information and completed the process successfully.

2. **passwd**: Change User Password

I used the **passwd** command to set or update the password for a user. After entering the following command:

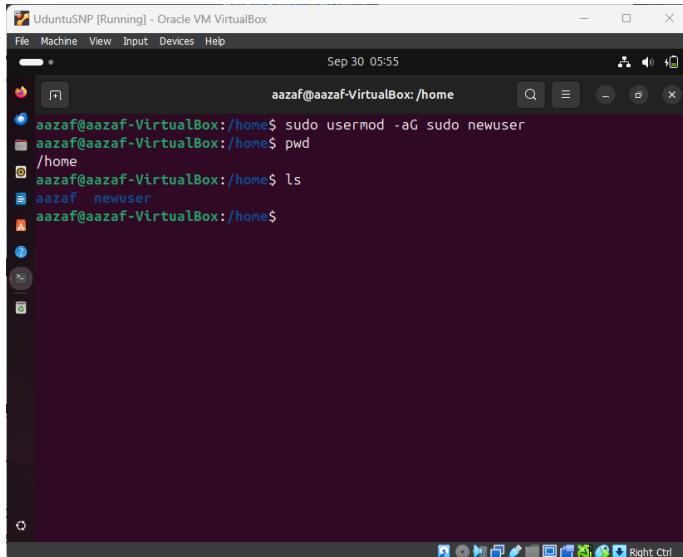


```
UbuntuSNP [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Sep 30 05:49
aazaf@aazaf-VirtualBox:~$ sudo passwd newuser
New password:
BAD PASSWORD: The password is shorter than 8 characters
Retype new password:
passwd: password updated successfully
aazaf@aazaf-VirtualBox:~$
```

The system prompted me to enter and confirm the new password. Once confirmed, the password for **newuser** was successfully updated.

3. **usermod**: Modify User Account

I used the **usermod** command to modify the user account **newuser**. After running the following command:

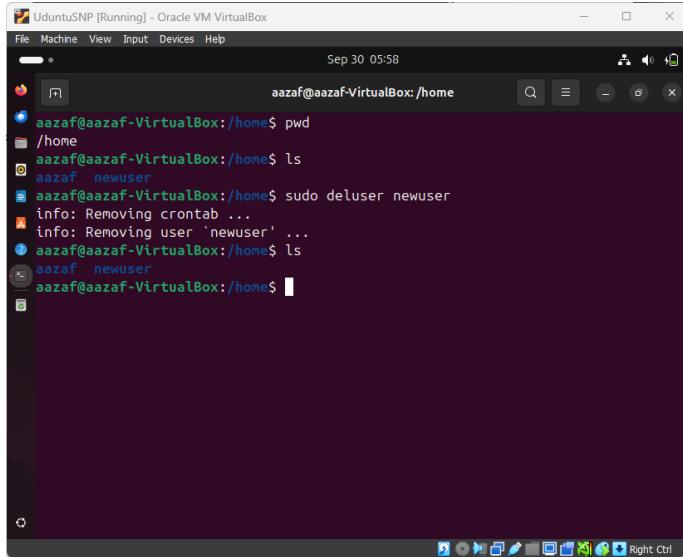


```
UbuntuSNP [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Sep 30 05:55
aazaf@aazaf-VirtualBox:~$ sudo usermod -aG sudo newuser
aazaf@aazaf-VirtualBox:~$ pwd
/home
aazaf@aazaf-VirtualBox:~$ ls
aazaf newuser
aazaf@aazaf-VirtualBox:~$
```

This command added **newuser** to the **sudo** group, providing the user administrative privileges. The **usermod** command allowed me to easily update the user's group memberships and account settings.

4. deluser: Delete a User

I used the **deluser** command to remove the **newuser** account from the system. After running:

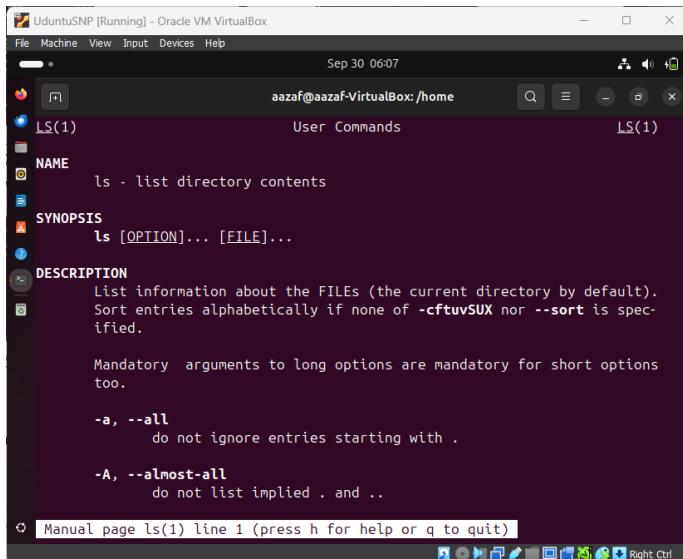


```
UbuntuSNP [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Sep 30 05:58
aazaf@aazaf-VirtualBox:/home$ pwd
/home
aazaf@aazaf-VirtualBox:/home$ ls
aazaf newuser
aazaf@aazaf-VirtualBox:/home$ sudo deluser newuser
info: Removing crontab ...
info: Removing user 'newuser' ...
aazaf@aazaf-VirtualBox:/home$ ls
aazaf newuser
aazaf@aazaf-VirtualBox:/home$
```

The system successfully removed **newuser**, as confirmed by the output. The process also involved removing the user's crontab entries. However, the **home** directory for **newuser** remained unchanged, as it was not deleted by default.

2.5. Documentation and help command

1. man: Display Manual Pages



```
UbuntuSNP [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Sep 30 06:07
aazaf@aazaf-VirtualBox:/home$ LS(1) User Commands LS(1)
NAME
ls - list directory contents
SYNOPSIS
ls [OPTION]... [FILE]...
DESCRIPTION
List information about the FILEs (the current directory by default).
Sort entries alphabetically if none of -cftuvSUX nor --sort is specified.

Mandatory arguments to long options are mandatory for short options too.

-a, --all
      do not ignore entries starting with .

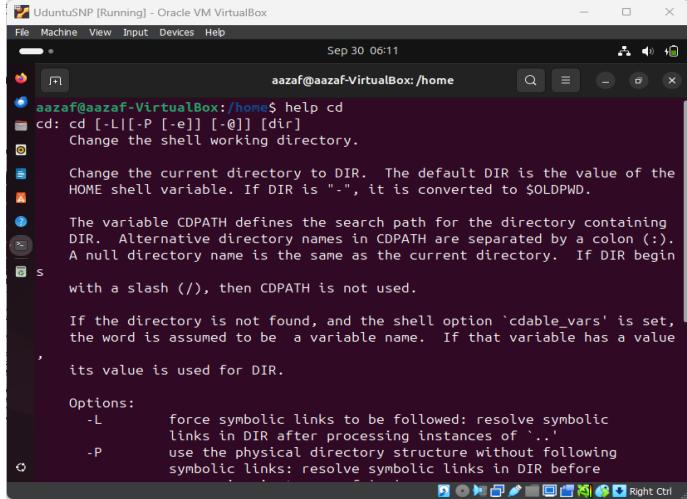
-A, --almost-all
      do not list implied . and ..
```

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

I opened the manual for the **ls** command, providing the detailed information about its usage, options, and syntax. The **man** command is an essential tool for understanding different commands directly within the terminal, offering comprehensive documentation and examples. To exit the manual, I pressed **q**.

2. help: Quick Assistance for Shell Commands

I used the **help** command when I needed for a quick information on how to use specific built-in shell commands. For instance, when I wanted to learn more about the cd command, I simply typed:



```
aazaf@aazaf-VirtualBox:~/home$ help cd
cd: cd [-L|[-P [-e]] [-@]] [dir]
      Change the shell working directory.

      Change the current directory to DIR.  The default DIR is the value of the
      HOME shell variable.  If DIR is "-", it is converted to $OLDPWD.

      The variable CDPATH defines the search path for the directory containing
      DIR.  Alternative directory names in CDPATH are separated by a colon (:).
      A null directory name is the same as the current directory.  If DIR begins
      with a slash (/), then CDPATH is not used.

      If the directory is not found, and the shell option `cdable_vars' is set,
      the word is assumed to be a variable name.  If that variable has a value
      its value is used for DIR.

      Options:
        -L      force symbolic links to be followed; resolve symbolic
               links in DIR after processing instances of `..'
        -P      use the physical directory structure without following
               symbolic links; resolve symbolic links in DIR before
```

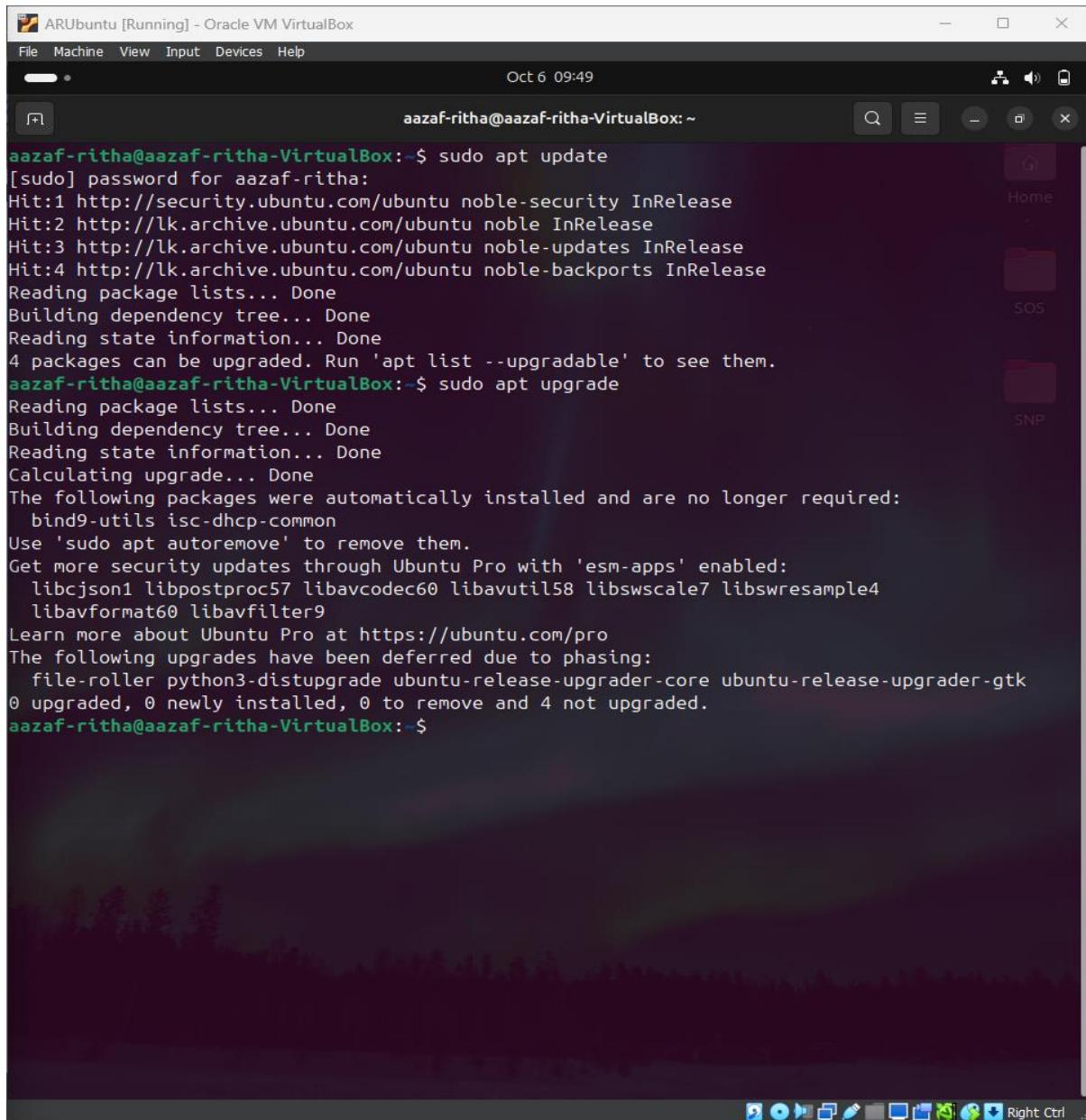
This gave me a brief explanation of how cd works, including its options and syntax. The **help** command is an easiest way to get details on built-in shell commands directly in the terminal without opening the full manuals. It's easy for me to take reference to know how something works.

03. DHCP, DNS, and NTP Configuration

3.1. DHCP (Dynamic Host Configuration Protocol)

Installing Updates

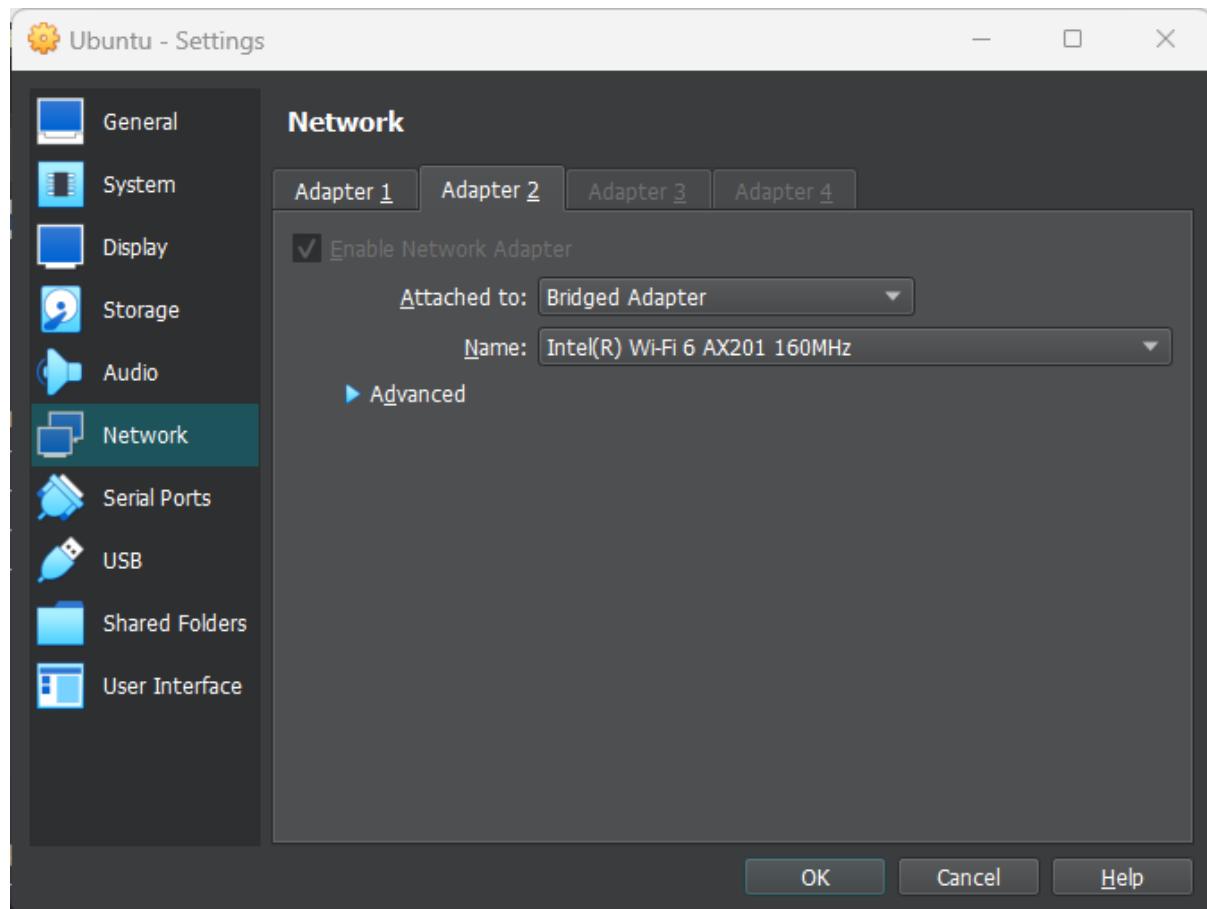
Before installing any new packages, I ensured the system was up to date. Then I ran the **sudo apt update**, **sudo apt upgrade** commands in the terminal



```
ARUbuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 09:49
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo apt update
[sudo] password for aazaf-ritha:
Hit:1 http://security.ubuntu.com/ubuntu noble-security InRelease
Hit:2 http://lk.archive.ubuntu.com/ubuntu noble InRelease
Hit:3 http://lk.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:4 http://lk.archive.ubuntu.com/ubuntu noble-backports InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
4 packages can be upgraded. Run 'apt list --upgradable' to see them.
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo apt upgrade
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following packages were automatically installed and are no longer required:
  bind9-utils isc-dhcp-common
Use 'sudo apt autoremove' to remove them.
Get more security updates through Ubuntu Pro with 'esm-apps' enabled:
  libcurl4-openssl-dev libcurl4-openssl-dev libcurl4-openssl-dev libcurl4-openssl-dev
  libcurl4-openssl-dev libcurl4-openssl-dev libcurl4-openssl-dev libcurl4-openssl-dev
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following upgrades have been deferred due to phasing:
  file-roller python3-distupgrade ubuntu-release-upgrader-core ubuntu-release-upgrader-gtk
0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded.
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

This updated the package lists and installed the latest versions of all the installed packages on the system.

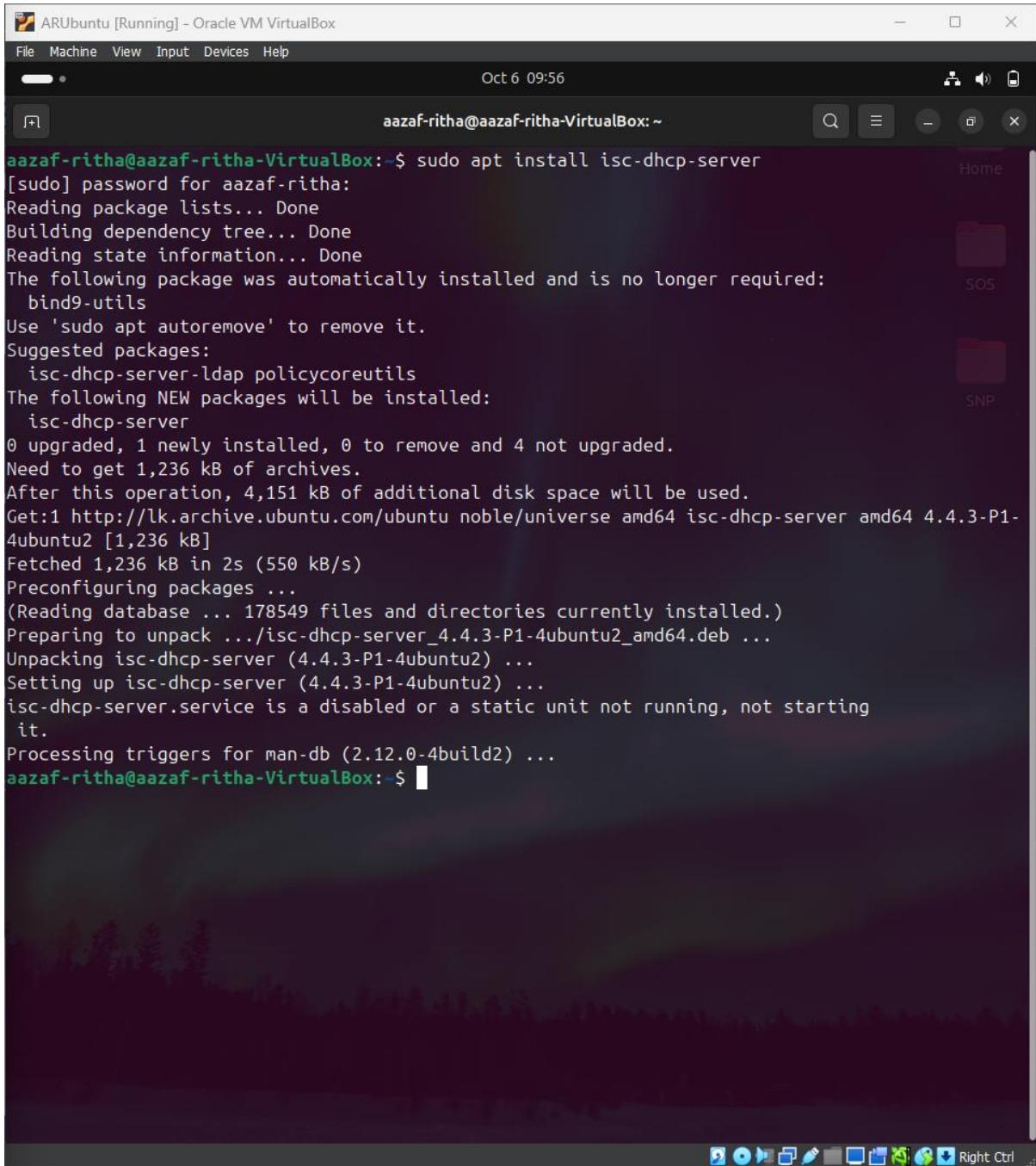
shutdown the vm and added new network adapter by following settings.



Default adapter 1 is enabled to share my Windows network with the VM instance. Therefore, for DHCP, I enabled adapter 2 and made my own listening network to handle this.

Installing the DHCP Server

I began by updating the system and installing the DHCP server. I proceeded to install the DHCP server by running the **sudo apt install isc-dhcp-server** command in the terminal.



ARUbuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 09:56

```
aazaf-rita@aazaf-rita-VirtualBox:~$ sudo apt install isc-dhcp-server
[sudo] password for aazaf-rita:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following package was automatically installed and is no longer required:
  bind9-utils
Use 'sudo apt autoremove' to remove it.
Suggested packages:
  isc-dhcp-server-ldap policycoreutils
The following NEW packages will be installed:
  isc-dhcp-server
0 upgraded, 1 newly installed, 0 to remove and 4 not upgraded.
Need to get 1,236 kB of archives.
After this operation, 4,151 kB of additional disk space will be used.
Get:1 http://lk.archive.ubuntu.com/ubuntu noble/universe amd64 isc-dhcp-server amd64 4.4.3-P1-4ubuntu2 [1,236 kB]
Fetched 1,236 kB in 2s (550 kB/s)
Preconfiguring packages ...
(Reading database ... 178549 files and directories currently installed.)
Preparing to unpack .../isc-dhcp-server_4.4.3-P1-4ubuntu2_amd64.deb ...
Unpacking isc-dhcp-server (4.4.3-P1-4ubuntu2) ...
Setting up isc-dhcp-server (4.4.3-P1-4ubuntu2) ...
isc-dhcp-server.service is a disabled or a static unit not running, not starting
it.
Processing triggers for man-db (2.12.0-4build2) ...
aazaf-rita@aazaf-rita-VirtualBox:~$
```

This successfully installed the required package for the DHCP server.

To Verify whether the 2 network adapters are working or not by using the **ifconfig** command.

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 12:44

exitting.

```
aazaf-ritha@aazaf-ritha-VirtualBox ~ [1]> sudo nano /etc/dhcp/dhcpd.conf
aazaf-ritha@aazaf-ritha-VirtualBox ~> ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
        inet 10.0.2.15 netmask 255.255.255.0 broadcast 10.0.2.255
        inet6 fe80::a00:27ff:febf:11e4 prefixlen 64 scopeid 0x20<link>
              ether 08:00:27:fb:11:e4 txqueuelen 1000 (Ethernet)
              RX packets 37 bytes 7145 (7.1 KB)
              RX errors 0 dropped 0 overruns 0 frame 0
              TX packets 119 bytes 13584 (13.5 KB)
              TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
        inet 192.168.8.196 netmask 255.255.255.0 broadcast 192.168.8.255
        inet6 fe80::71c0:559:f6a5:d360 prefixlen 64 scopeid 0x20<link>
              inet6 2402:4000:2370:349f:9ce6:18e4:8e36:7ec5 prefixlen 64 scopeid 0
x0<global>
        inet6 2402:4000:2370:349f:e08b:5629:7f97:5229 prefixlen 64 scopeid 0
x0<global>
              ether 08:00:27:16:8c:84 txqueuelen 1000 (Ethernet)
              RX packets 120 bytes 18975 (18.9 KB)
              RX errors 0 dropped 0 overruns 0 frame 0
              TX packets 191 bytes 25405 (25.4 KB)
              TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
      inet 127.0.0.1 netmask 255.0.0.0
      inet6 ::1 prefixlen 128 scopeid 0x10<host>
        loop txqueuelen 1000 (Local Loopback)
        RX packets 64 bytes 8481 (8.4 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 64 bytes 8481 (8.4 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

aazaf-ritha@aazaf-ritha-VirtualBox ~>
```

Right Ctrl

I ensured the service is **enabled to start on boot**. by typing **sudo systemctl enable isc-dhcp-server** this command on terminal.

ARUbuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 10:03

aazaf-ritha@aazaf-ritha-VirtualBox:~\$ sudo apt install isc-dhcp-server

```
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
isc-dhcp-server is already the newest version (4.4.3-P1-4ubuntu2).
The following package was automatically installed and is no longer required:
  bind9-utils
Use 'sudo apt autoremove' to remove it.
0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded.
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

after the installation of the of the dhcp server I typed the following command “**dhcpd**” to see the files related to the dhcp server

ARUbuntu [Running] - Oracle VM VirtualBox

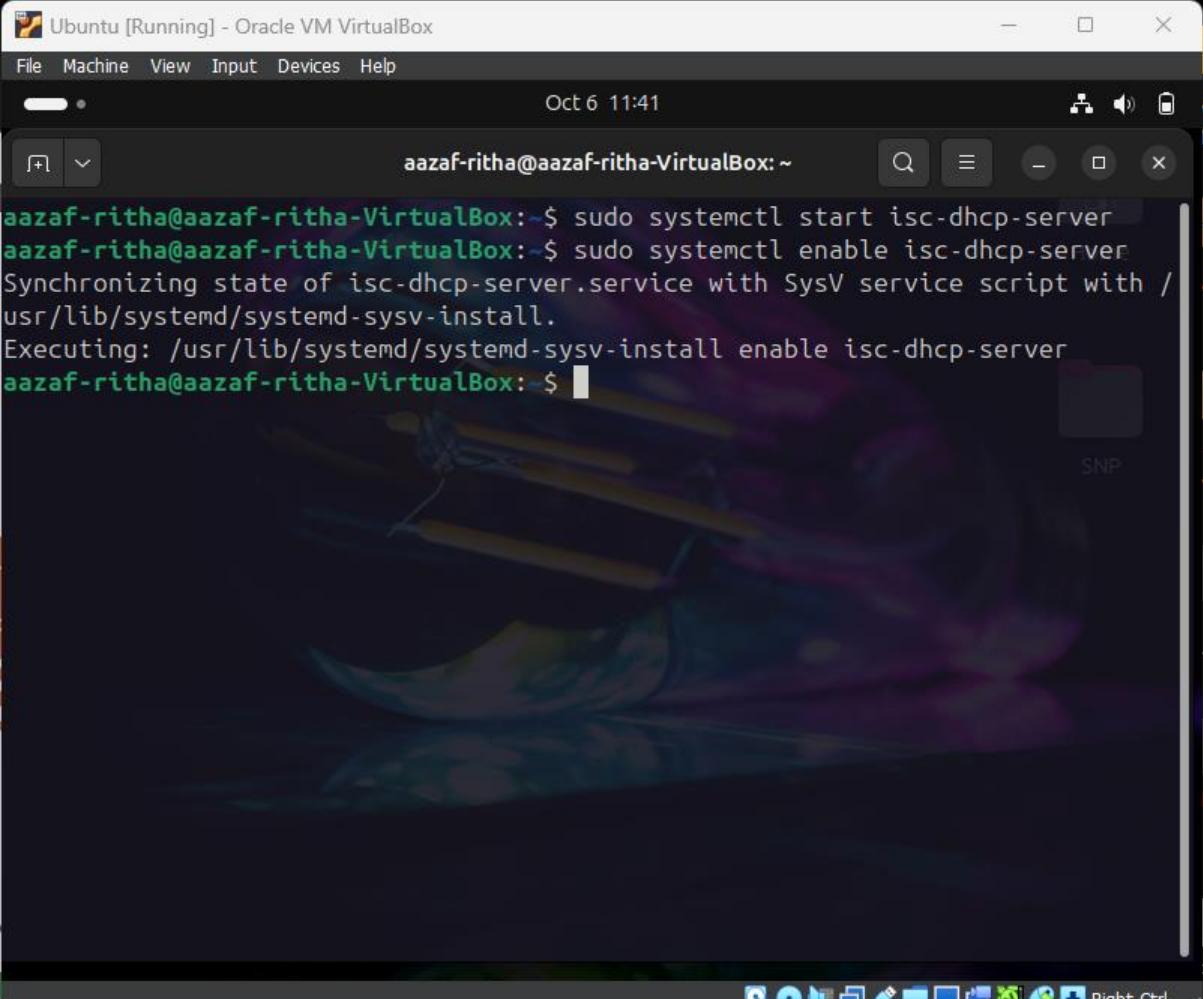
File Machine View Input Devices Help Oct 6 10:05

aazaf-ritha@aazaf-ritha-VirtualBox:~\$ dhcpcd

```
Internet Systems Consortium DHCP Server 4.4.3-P1
Copyright 2004-2022 Internet Systems Consortium.
All rights reserved.
For info, please visit https://www.isc.org/software/dhcp/
unable to create icmp socket: Operation not permitted
Can't open /etc/dhcp/dhcpd.conf: No such file or directory

If you think you have received this message due to a bug rather
than a configuration issue please read the section on submitting
bugs on either our web page at www.isc.org or in the README file
before submitting a bug. These pages explain the proper
process and the information we find helpful for debugging.

exiting.
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```



Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 11:41

aazaf-ritha@aazaf-ritha-VirtualBox: ~

```
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo systemctl start isc-dhcp-server
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo systemctl enable isc-dhcp-server
Synchronizing state of isc-dhcp-server.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable isc-dhcp-server
aazaf-ritha@aazaf-ritha-VirtualBox:~$ █
```

The system confirmed that the DHCP server service was synchronized with the SysV service management system and enabled successfully.

Configure the DHCP server

Edit Interface Configuration

Then I navigated to the “isc-dhcp-server” file in the “/etc/default” directory and then I altered the file with the nano text editor and added my network interface name in the “**INTERFACESv4=**” to

INTERFACESv4=”enp0s8”

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 11:50

aazaf-ritha@aazaf-ritha-VirtualBox: ~

```
GNU nano 7.2          /etc/default/isc-dhcp-server *

# Defaults for isc-dhcp-server (sourced by /etc/init.d/isc-dhcp-server)

# Path to dhcpcd's config file (default: /etc/dhcp/dhcpcd.conf).
#DHCPDV4_CONF=/etc/dhcp/dhcpcd.conf
#DHCPDV6_CONF=/etc/dhcp/dhcpcd6.conf

# Path to dhcpcd's PID file (default: /var/run/dhcpcd.pid).
#DHCPDV4_PID=/var/run/dhcpcd.pid
#DHCPDV6_PID=/var/run/dhcpcd6.pid

# Additional options to start dhcpcd with.
#       Don't use options -cf or -pf here; use DHCPD_CONF/ DHCPD_PID instead
#OPTIONS="""

# On what interfaces should the DHCP server (dhcpcd) serve DHCP requests?
#       Separate multiple interfaces with spaces, e.g. "eth0 eth1".
INTERFACESv4="enp0s8"
INTERFACESv6=""
```

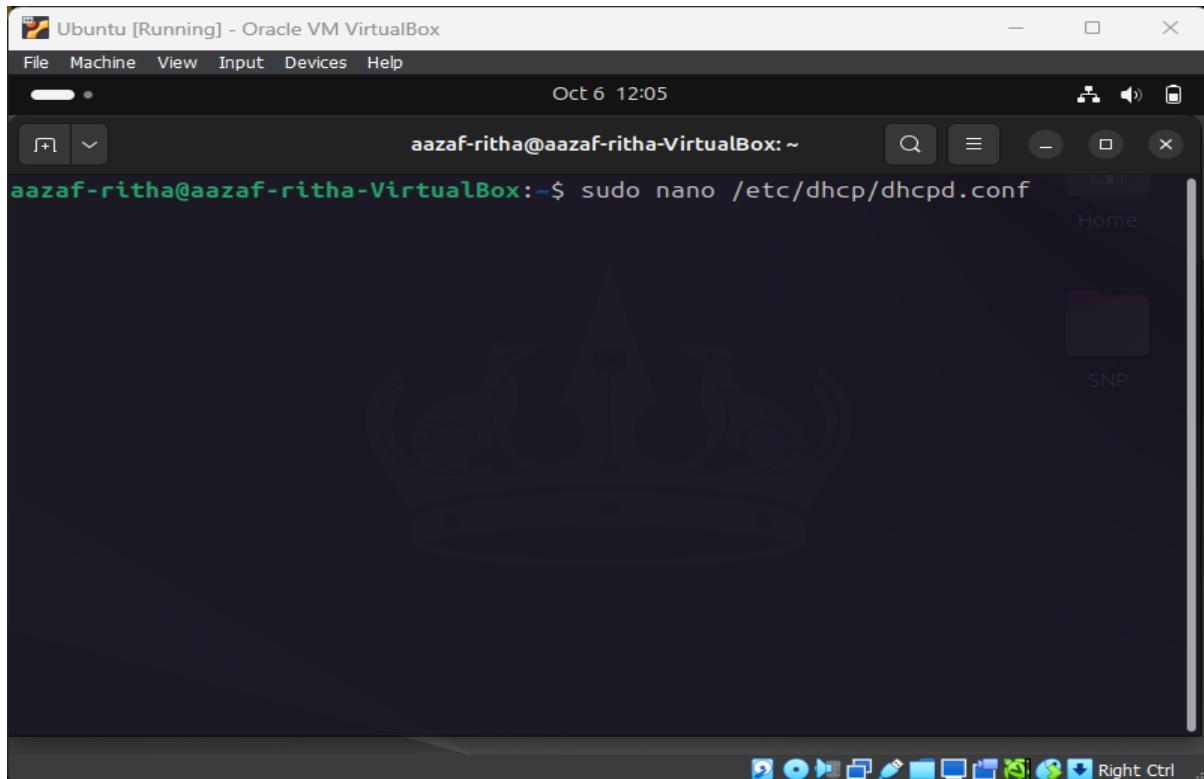
^G Help ^O Write Out ^W Where Is ^K Cut ^T Execute
 ^X Exit ^R Read File ^\ Replace ^U Paste ^J Justify

Right Ctrl

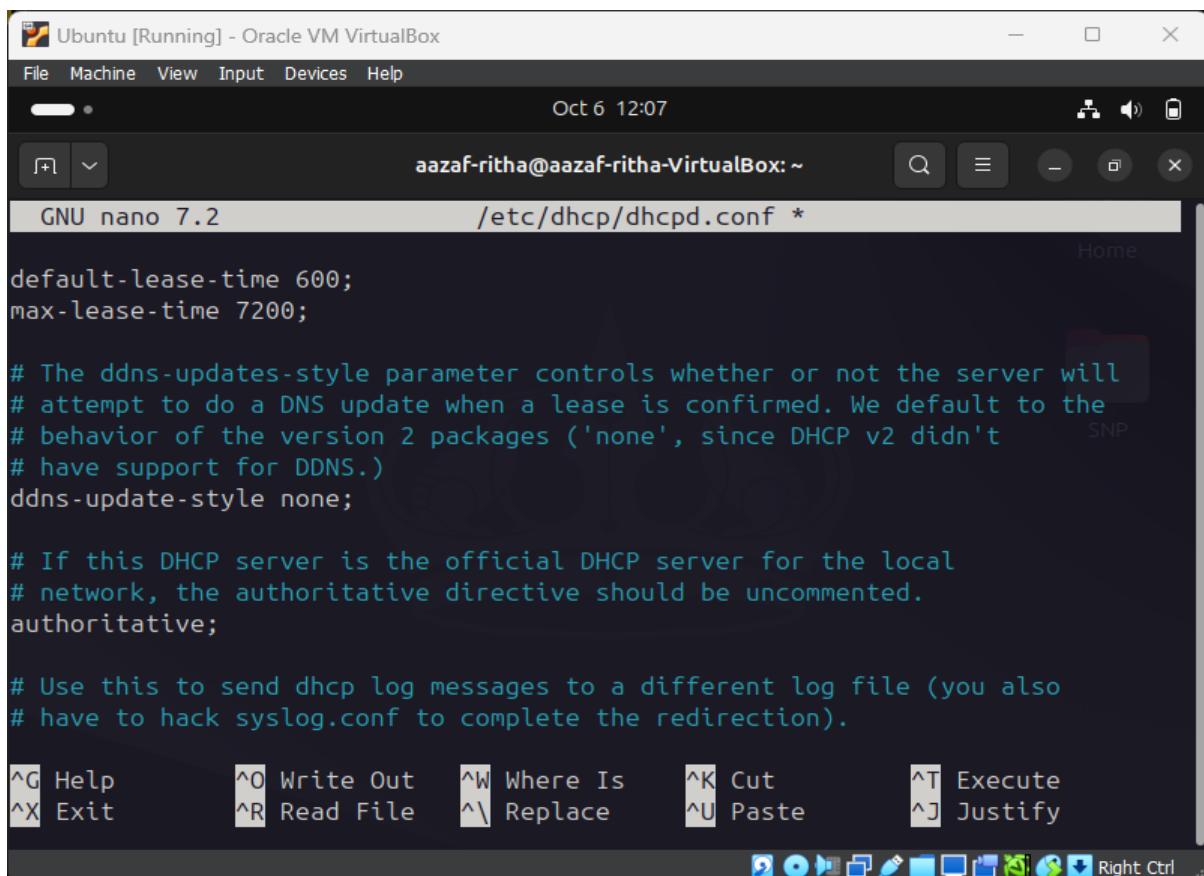
Edit the DHCP Configuration file

The main configuration file for the DHCP server is located at `/etc/dhcp/dhcpcd.conf`. I edited this file to define the network parameters such as the IP range, subnet, DNS servers, and gateway.

Then I opened the configuration file using the preferred text editor (for example, nano):



I un-commanded **authoritative** and commanded all other except **ddns-update-style none;**



```

default-lease-time 600;
max-lease-time 7200;

# The ddns-updates-style parameter controls whether or not the server will
# attempt to do a DNS update when a lease is confirmed. We default to the
# behavior of the version 2 packages ('none', since DHCP v2 didn't
# have support for DDNS.)
ddns-update-style none;

# If this DHCP server is the official DHCP server for the local
# network, the authoritative directive should be uncommented.
authoritative;

# Use this to send dhcp log messages to a different log file (you also
# have to hack syslog.conf to complete the redirection).

```

Inside the configuration file, I added the following configuration



Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 12:42

sudo nano /etc/dhcp/~

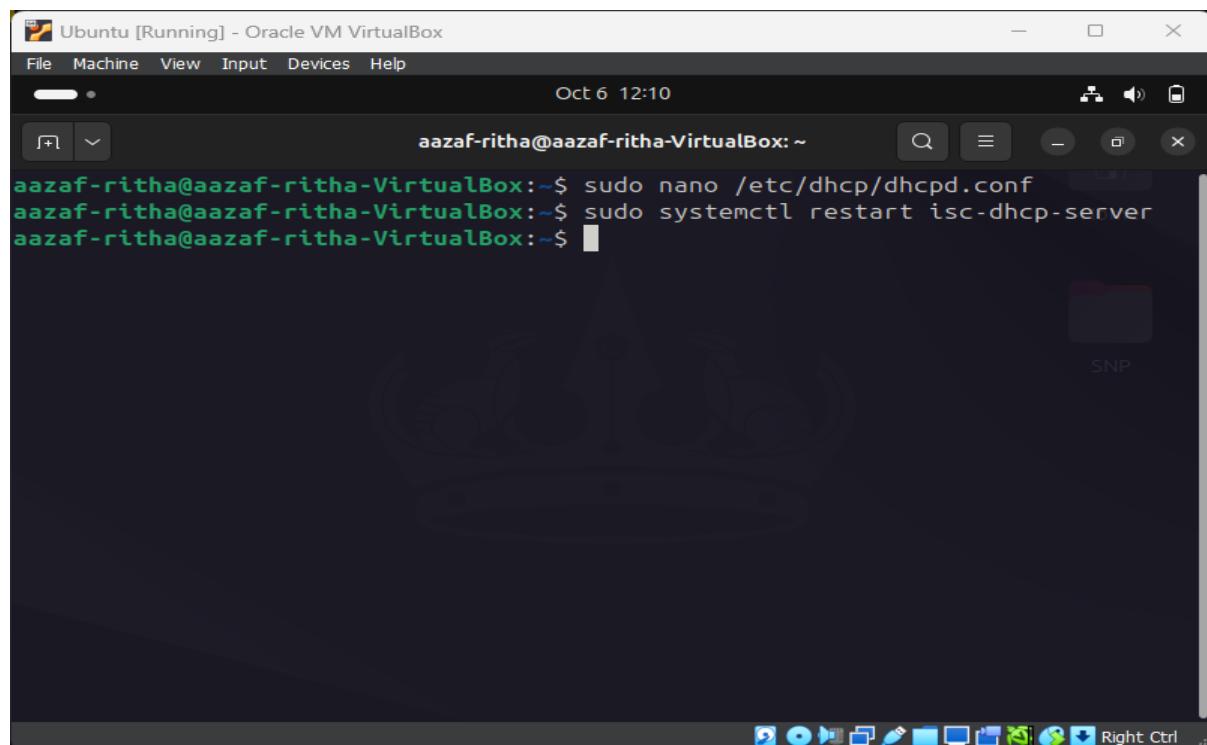
GNU nano 7.2 /etc/dhcp/dhcpd.conf

```
# }
#
subnet 192.168.8.0 netmask 255.255.255.0 {
    range 192.168.8.100 192.168.8.200;
    option routers 192.168.8.1;
    option subnet-mask 255.255.255.0;
    option domain-name-servers 8.8.8.8, 8.8.4.4;
    option broadcast-address 192.168.8.255;
}
```

Help Write Out Where Is Cut Execute
Exit Read File Replace Paste Justify

Restart the DHCP Server

After making configuration changes, I restarted the DHCP service to apply the changes:



Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 12:10

aazaf-ritha@aazaf-ritha-VirtualBox: ~

```
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo nano /etc/dhcp/dhcpd.conf
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo systemctl restart isc-dhcp-server
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

I checked the status to ensure whether it's running without any issues. By using this command **sudo systemctl status isc-dhcp-server** and **dhcpd**. The steps that follow information will be shown by them.

```
Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 12:42
Q E X

● isc-dhcp-server.service - ISC DHCP IPv4 server
   Loaded: loaded (/usr/lib/systemd/system/isc-dhcp-server.service; enabled)
   Active: active (running) since Sun 2024-10-06 12:39:48 +0530; 5s ago
     Docs: man:dhcpd(8)
 Main PID: 3208 (dhcpd)
    Tasks: 1 (limit: 7804)
   Memory: 3.8M (peak: 4.0M)
      CPU: 19ms
     CGroup: /system.slice/isc-dhcp-server.service
             └─3208 dhcpcd -user dhcpcd -group dhcpcd -f -4 -pf /run/dhcp-server

Oct 06 12:39:48 aazaf-ritha-VirtualBox dhcpcd[3208]: Database file: /var/lib/dhcpd/leases
Oct 06 12:39:48 aazaf-ritha-VirtualBox dhcpcd[3208]: PID file: /run/dhcp-server.pid
Oct 06 12:39:48 aazaf-ritha-VirtualBox dhcpcd[3208]: Wrote 0 leases to leases database
Oct 06 12:39:48 aazaf-ritha-VirtualBox dhcpcd[3208]: Listening on LPF/enp0s8/0
Oct 06 12:39:48 aazaf-ritha-VirtualBox sh[3208]: Listening on LPF/enp0s8/0:0
Oct 06 12:39:48 aazaf-ritha-VirtualBox sh[3208]: Sending on LPF/enp0s8/0:0
Oct 06 12:39:48 aazaf-ritha-VirtualBox sh[3208]: Sending on Socket/fallback
Oct 06 12:39:48 aazaf-ritha-VirtualBox dhcpcd[3208]: Sending on LPF/enp0s8/0
Oct 06 12:39:48 aazaf-ritha-VirtualBox dhcpcd[3208]: Sending on Socket/fallback
Oct 06 12:39:48 aazaf-ritha-VirtualBox dhcpcd[3208]: Server starting service.
aazaf-ritha@aazaf-ritha-VirtualBox ~> dhcpcd
Internet Systems Consortium DHCP Server 4.4.3-P1
Copyright 2004-2022 Internet Systems Consortium.
All rights reserved.
For info, please visit https://www.isc.org/software/dhcp/
unable to create icmp socket: Operation not permitted
Config file: /etc/dhcp/dhcpcd.conf
Database file: /var/lib/dhcp/dhcpcd.leases
PID file: /var/run/dhcpcd.pid
Can't open /var/lib/dhcp/dhcpcd.leases for append.

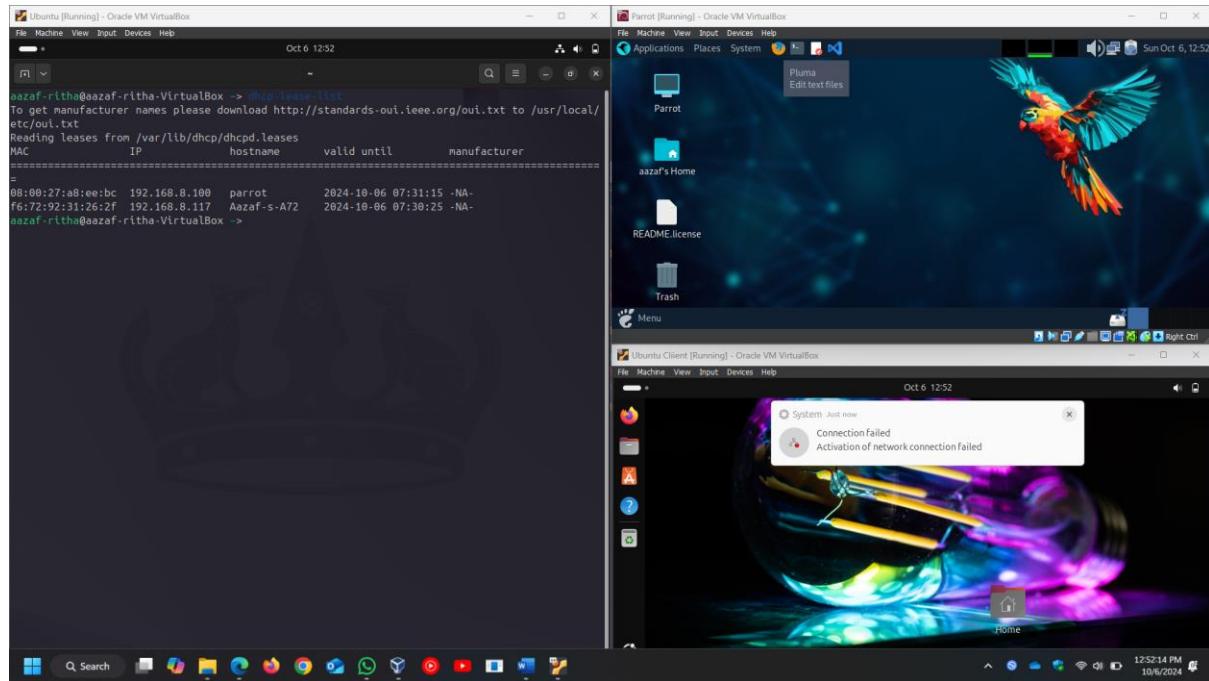
If you think you have received this message due to a bug rather
than a configuration issue please read the section on submitting
bugs on either our web page at www.isc.org or in the README file
before submitting a bug. These pages explain the proper
process and the information we find helpful for debugging.

exiting.
aazaf-ritha@aazaf-ritha-VirtualBox ~ [1]>
```

1.1. Testing the DHCP Server

On a client machine, configure it to obtain an IP address automatically from DHCP and verify it receives the correct settings.

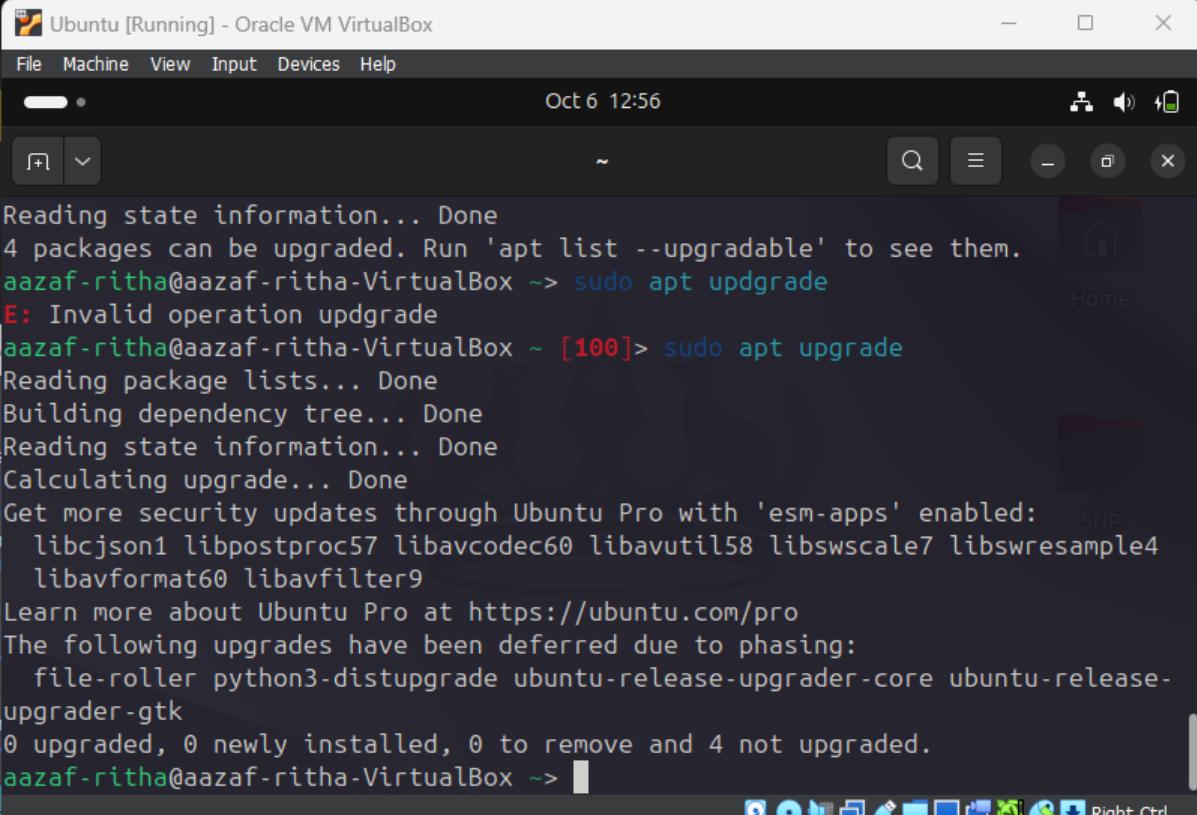
I used **dhclient** command in my server Linux machine to check connected client machine. I opened 3 extra VMs and checked the connection.



3.2. DNS (Domain Name System)

1.2. Install BIND DNS Server

First, I updated the linux system by used **sudo apt update** and **sudo apt upgrade** commands on terminal.



The screenshot shows a terminal window titled "Ubuntu [Running] - Oracle VM VirtualBox". The terminal displays the output of the "sudo apt upgrade" command. The output shows that 4 packages can be upgraded, and it lists several packages being upgraded, including libcjson1, libpostproc57, libavcodec60, libavutil58, libswscale7, libswresample4, libavformat60, and libavfilter9. It also mentions that more security updates are available through Ubuntu Pro. The command concludes with "0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded." The terminal window has a dark theme with light-colored text and icons.

```
Reading state information... Done
4 packages can be upgraded. Run 'apt list --upgradable' to see them.
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo apt upgrade
E: Invalid operation upgrade
aazaf-ritha@aazaf-ritha-VirtualBox ~ [100]> sudo apt upgrade
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
Get more security updates through Ubuntu Pro with 'esm-apps' enabled:      SNP
  libcjson1 libpostproc57 libavcodec60 libavutil58 libswscale7 libswresample4
  libavformat60 libavfilter9
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following upgrades have been deferred due to phasing:
  file-roller python3-distupgrade ubuntu-release-upgrader-core ubuntu-release-
upgrader-gtk
0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded.
aazaf-ritha@aazaf-ritha-VirtualBox ~>
```

Then I installed BIND (Berkeley Internet Name Domain) the most common DNS server software. By useing **sudo apt install bind9** command.

Ubuntu [Running] - Oracle VM VirtualBox

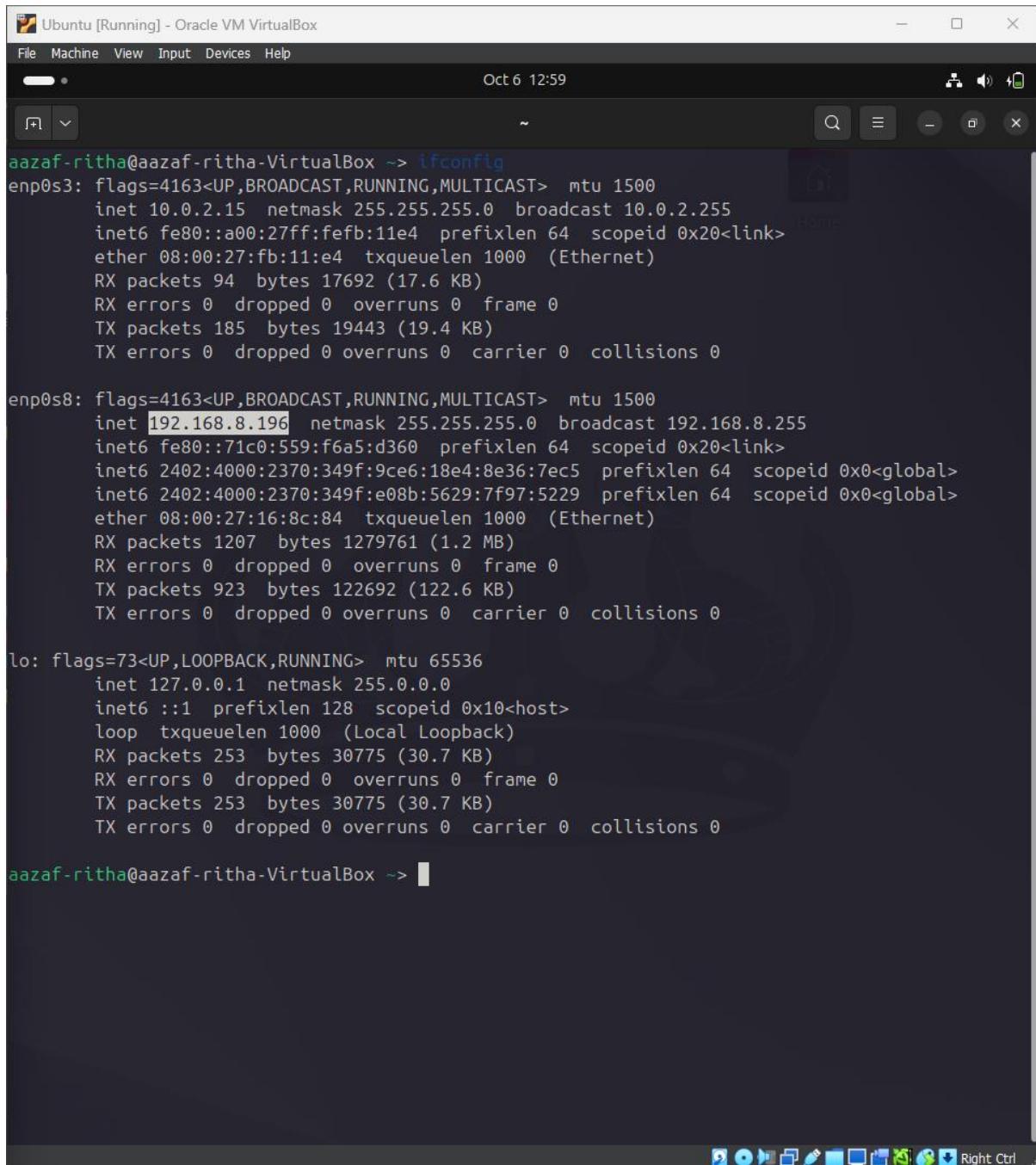
File Machine View Input Devices Help Oct 6 12:58

```
aazaf-ritha@aazaf-ritha-VirtualBox ~ > sudo apt install bind9
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  bind9-utils
Suggested packages:
  bind-doc
The following NEW packages will be installed:
  bind9 bind9-utils
0 upgraded, 2 newly installed, 0 to remove and 4 not upgraded.
Need to get 413 kB of archives.
After this operation, 1,599 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://lk.archive.ubuntu.com/ubuntu noble-updates/main amd64 bind9-utils amd64 1:9.18.28-0ubuntu0.24.04.1 [159 kB]
Get:2 http://lk.archive.ubuntu.com/ubuntu noble-updates/main amd64 bind9 amd64 1:9.18.28-0ubuntu0.24.04.1 [254 kB]
Fetched 413 kB in 4s (118 kB/s)
Selecting previously unselected package bind9-utils.
(Reading database ... 215044 files and directories currently installed.)
Preparing to unpack .../bind9-utils_1%3a9.18.28-0ubuntu0.24.04.1_amd64.deb ...
Unpacking bind9-utils (1:9.18.28-0ubuntu0.24.04.1) ...
Selecting previously unselected package bind9.
Preparing to unpack .../bind9_1%3a9.18.28-0ubuntu0.24.04.1_amd64.deb ...
Unpacking bind9 (1:9.18.28-0ubuntu0.24.04.1) ...
Setting up bind9-utils (1:9.18.28-0ubuntu0.24.04.1) ...
Setting up bind9 (1:9.18.28-0ubuntu0.24.04.1) ...
info: Selecting GID from range 100 to 999 ...
info: Adding group 'bind' (GID 125) ...
info: Selecting UID from range 100 to 999 ...

info: Adding system user 'bind' (UID 123) ...
info: Adding new user 'bind' (UID 123) with group 'bind' ...
info: Not creating home directory '/var/cache/bind'.
wrote key file "/etc/bind/rndc.key"
named-resolvconf.service is a disabled or a static unit, not starting it.
Created symlink /etc/systemd/system/bind9.service → /usr/lib/systemd/system/named.service.
Created symlink /etc/systemd/system/multi-user.target.wants/named.service → /usr/lib/systemd/system/named.service.
Processing triggers for man-db (2.12.0-4build2) ...
```

Right Ctrl

Then I typed **ifconfig** and checked my Ip Address.



```
aazaf-ritha@aazaf-ritha-VirtualBox ~> ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
        inet 10.0.2.15 netmask 255.255.255.0 broadcast 10.0.2.255
        inet6 fe80::a00:27ff:fe1e:4 prefixlen 64 scopeid 0x20<link>
          ether 08:00:27:fb:11:e4 txqueuelen 1000 (Ethernet)
            RX packets 94 bytes 17692 (17.6 KB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 185 bytes 19443 (19.4 KB)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

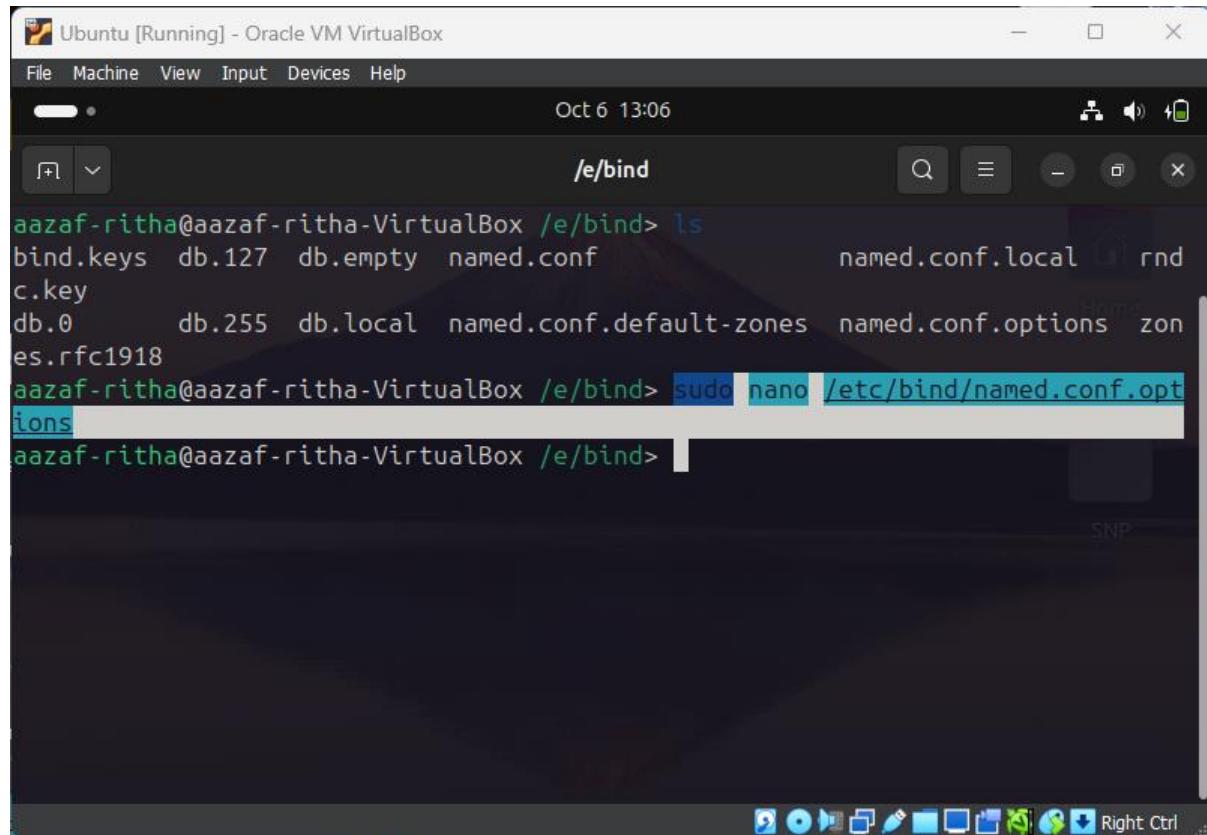
enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
        inet 192.168.8.196 netmask 255.255.255.0 broadcast 192.168.8.255
        inet6 fe80::71c0:559:f6a5:d360 prefixlen 64 scopeid 0x20<link>
        inet6 2402:4000:2370:349f:9ce6:18e4:8e36:7ec5 prefixlen 64 scopeid 0x0<global>
        inet6 2402:4000:2370:349f:e08b:5629:7f97:5229 prefixlen 64 scopeid 0x0<global>
          ether 08:00:27:16:8c:84 txqueuelen 1000 (Ethernet)
            RX packets 1207 bytes 1279761 (1.2 MB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 923 bytes 122692 (122.6 KB)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
        inet 127.0.0.1 netmask 255.0.0.0
        inet6 ::1 prefixlen 128 scopeid 0x10<host>
          loop txqueuelen 1000 (Local Loopback)
            RX packets 253 bytes 30775 (30.7 KB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 253 bytes 30775 (30.7 KB)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

aazaf-ritha@aazaf-ritha-VirtualBox ~> 
```

1.3. Configure the BIND DNS Server

Once BIND was installed, I began to configure it. I started by editing the primary configuration file, which is located at **/etc/bind/named.conf.options**.



```

Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 13:06
/e/bind
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind> ls
bind.keys db.127 db.empty named.conf
c.key
db.0 db.255 db.local named.conf.default-zones named.conf.options zones.rfc1918
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind> sudo nano /etc/bind/named.conf.options
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind>

```

Inside the file, I located the forwarders section and edited it to use **Google's DNS servers (8.8.8.8 and 8.8.4.4)** as the fallback

```

forwarders{
    8.8.8;
    8.8.4.4;
}
nssec-validation auto;
auth-nxdomain no;
listen-on { 192.168.8.196; };
listen-on-v6 { any; };

```

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 13:06

sudo nano /etc/bind//e/bind

GNU nano 7.2 /etc/bind/named.conf.options *

```
options {
    directory "/var/cache/bind";

    // If there is a firewall between you and nameservers you want
    // to talk to, you may need to fix the firewall to allow multiple
    // ports to talk. See http://www.kb.cert.org/vuls/id/800113

    // If your ISP provided one or more IP addresses for stable
    // nameservers, you probably want to use them as forwarders.
    // Uncomment the following block, and insert the addresses replacing
    // the all-0's placeholder.

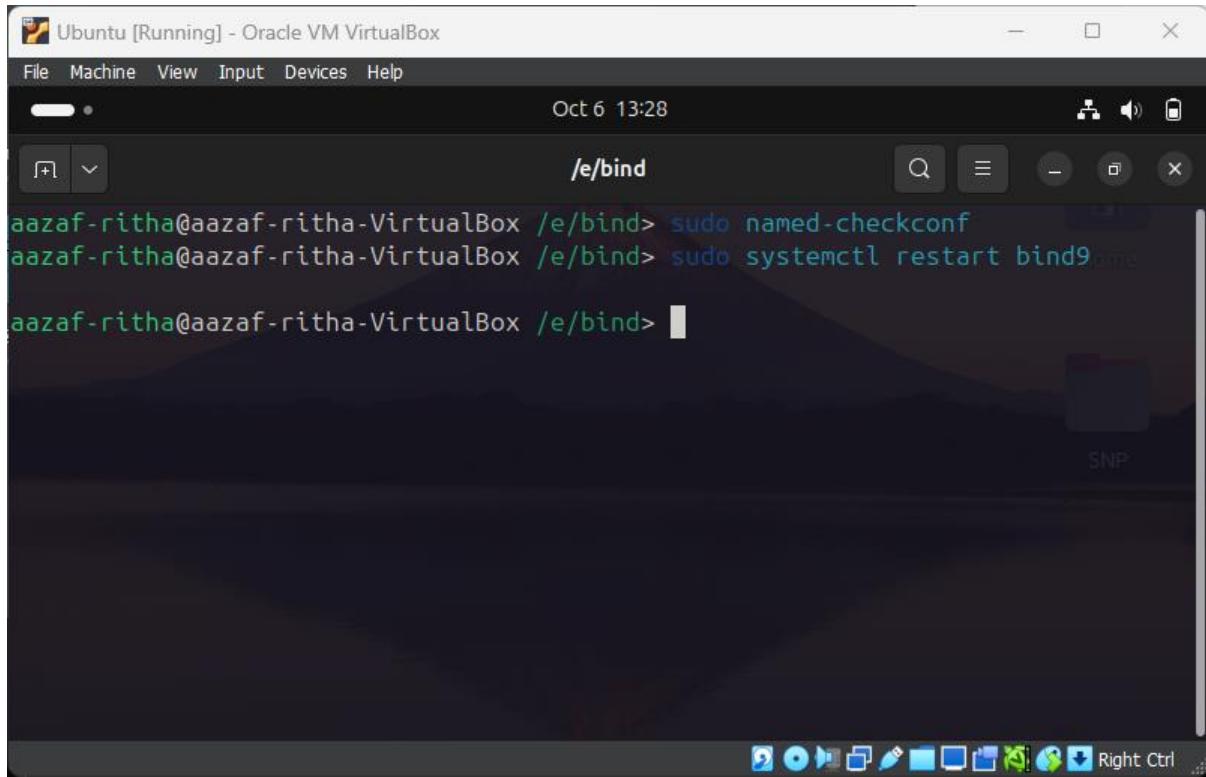
    // forwarders {
    //     0.0.0.0;
    // };
    forwarders{
        8.8.8.8;
        8.8.4.4;
    }
    //========================================================================
    // If BIND logs error messages about the root key being expired,
    // you will need to update your keys. See https://www.isc.org/bind-keys
    //=====
    dnssec-validation auto;
    auth-nxdomain no;
    listen-on { 192.168.8.196; };
    listen-on-v6 { any; };
};

^G Help      ^O Write Out   ^W Where Is   ^K Cut       ^T Execute   ^C Location
^X Exit      ^R Read File   ^\ Replace    ^U Paste     ^J Justify   ^/ Go To Line
                                         Right Ctrl
```

- **forwarders:** This tells your BIND server that if it cannot resolve a query on its own, it should forward that query to the listed DNS servers (e.g., Google DNS servers).
- **dnssec-validation auto:** This enables DNSSEC validation, which ensures the authenticity of DNS responses.
- **auth-nxdomain no;:** This setting ensures that BIND will behave according to DNS RFC1035, which specifies that it should not automatically claim authority over non-existent domains.
- **listen-on-v6 { any; };** This makes sure that BIND listens on all available IPv6 addresses.

I saved the file and exited the editor by pressing **Ctrl+X**, then **Y**, and Enter.

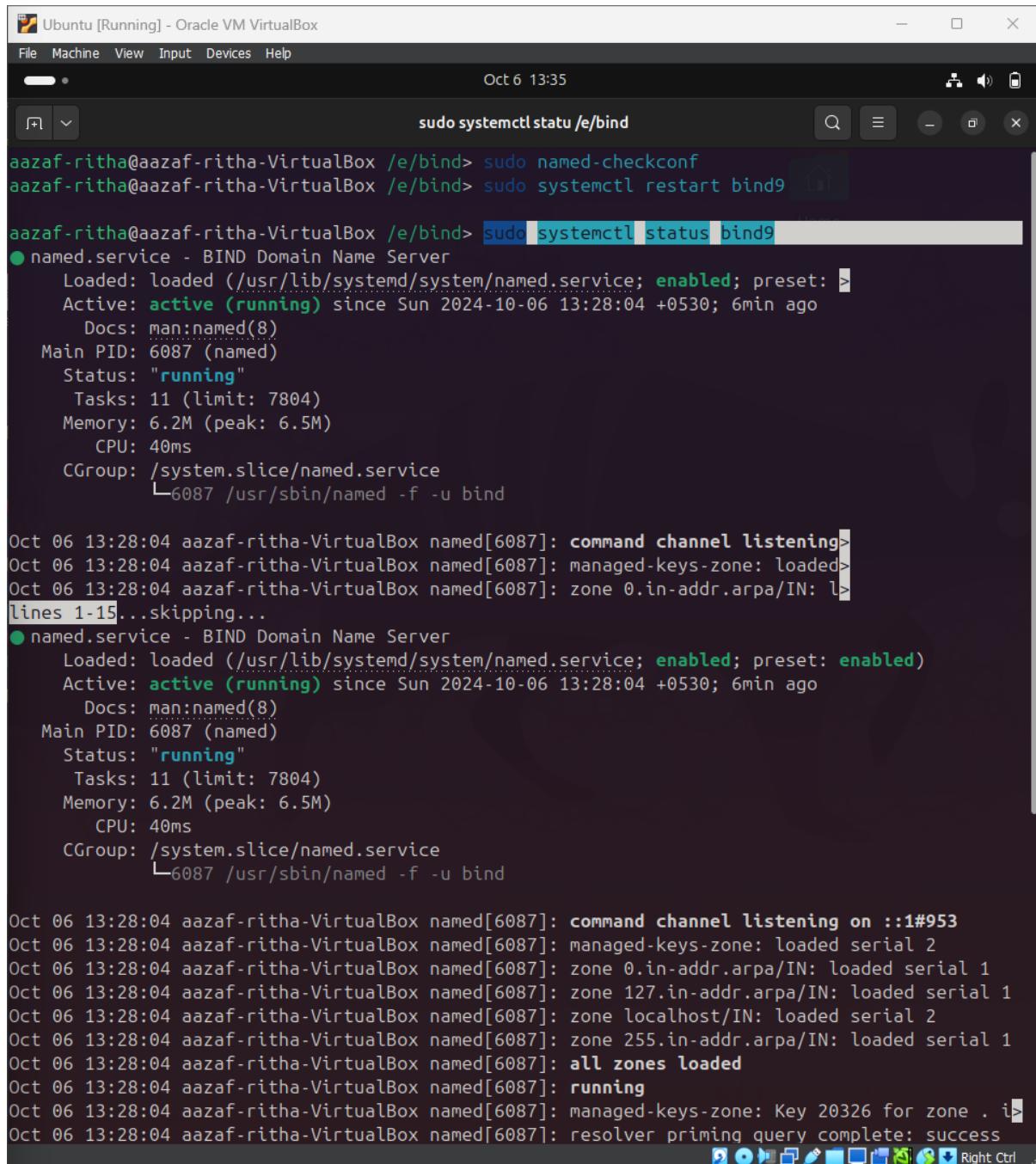
To check the conformation. I restarted the DNS server.



The screenshot shows a terminal window titled "Ubuntu [Running] - Oracle VM VirtualBox". The terminal is running on a virtual machine with the IP address 192.168.56.111. The user is logged in as "aazaf-ritha". The terminal window has a dark background with light-colored text. The command entered by the user is:

```
sudo named-checkconf  
sudo systemctl restart bind9
```

I rechecked the status that ensure there are any errors



```

Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 13:35
sudo systemctl status /e/bind
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind> sudo named-checkconf
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind> sudo systemctl restart bind9
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind> sudo systemctl status bind9
● named.service - BIND Domain Name Server
   Loaded: loaded (/usr/lib/systemd/system/named.service; enabled; preset: >
   Active: active (running) since Sun 2024-10-06 13:28:04 +0530; 6min ago
     Docs: man:named(8)
 Main PID: 6087 (named)
    Status: "running"
      Tasks: 11 (limit: 7804)
     Memory: 6.2M (peak: 6.5M)
        CPU: 40ms
       CGroup: /system.slice/named.service
                   └─6087 /usr/sbin/named -f -u bind

Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: command channel listening>
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: managed-keys-zone: loaded>
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: zone 0.in-addr.arpa/IN: l>
lines 1-15...skipping...
● named.service - BIND Domain Name Server
   Loaded: loaded (/usr/lib/systemd/system/named.service; enabled; preset: enabled)
   Active: active (running) since Sun 2024-10-06 13:28:04 +0530; 6min ago
     Docs: man:named(8)
 Main PID: 6087 (named)
    Status: "running"
      Tasks: 11 (limit: 7804)
     Memory: 6.2M (peak: 6.5M)
        CPU: 40ms
       CGroup: /system.slice/named.service
                   └─6087 /usr/sbin/named -f -u bind

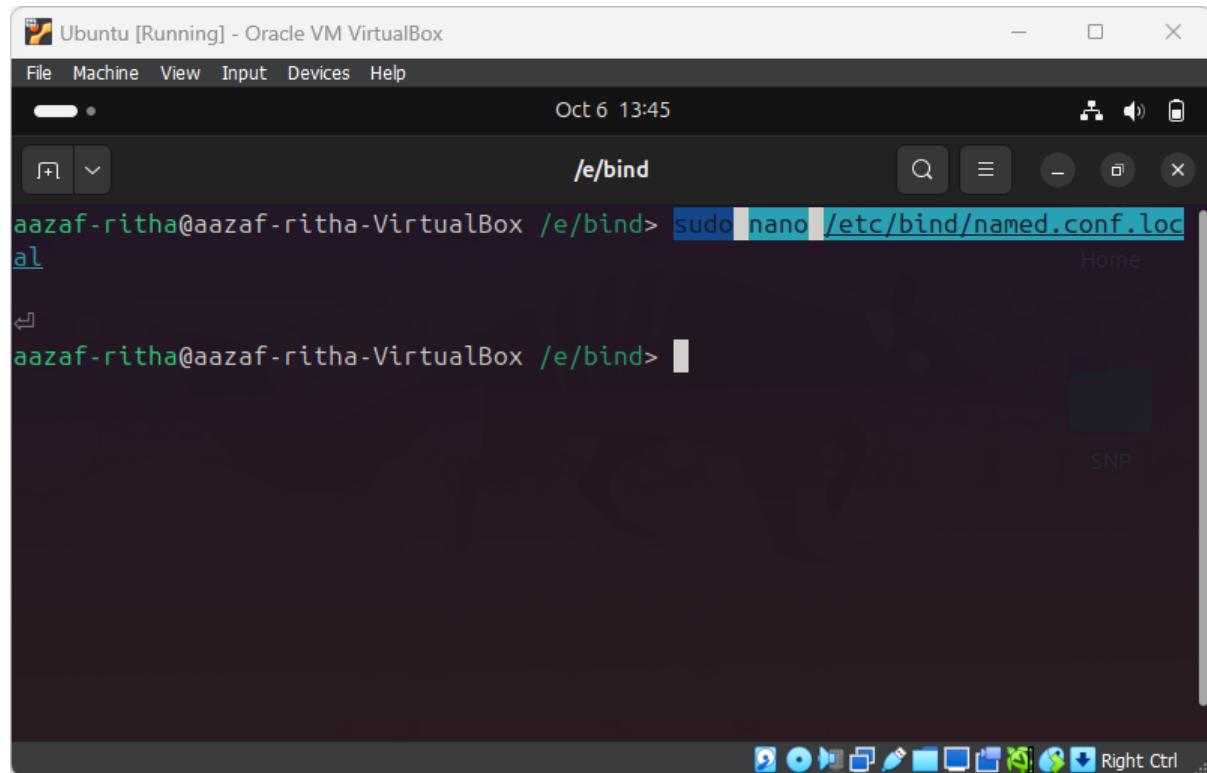
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: command channel listening on ::1#953
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: managed-keys-zone: loaded serial 2
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: zone 0.in-addr.arpa/IN: loaded serial 1
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: zone 127.in-addr.arpa/IN: loaded serial 1
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: zone localhost/IN: loaded serial 2
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: zone 255.in-addr.arpa/IN: loaded serial 1
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: all zones loaded
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: running
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: managed-keys-zone: Key 20326 for zone . is loaded
Oct 06 13:28:04 aazaf-ritha-VirtualBox named[6087]: resolver priming query complete: success

```

Configure the Domain zone

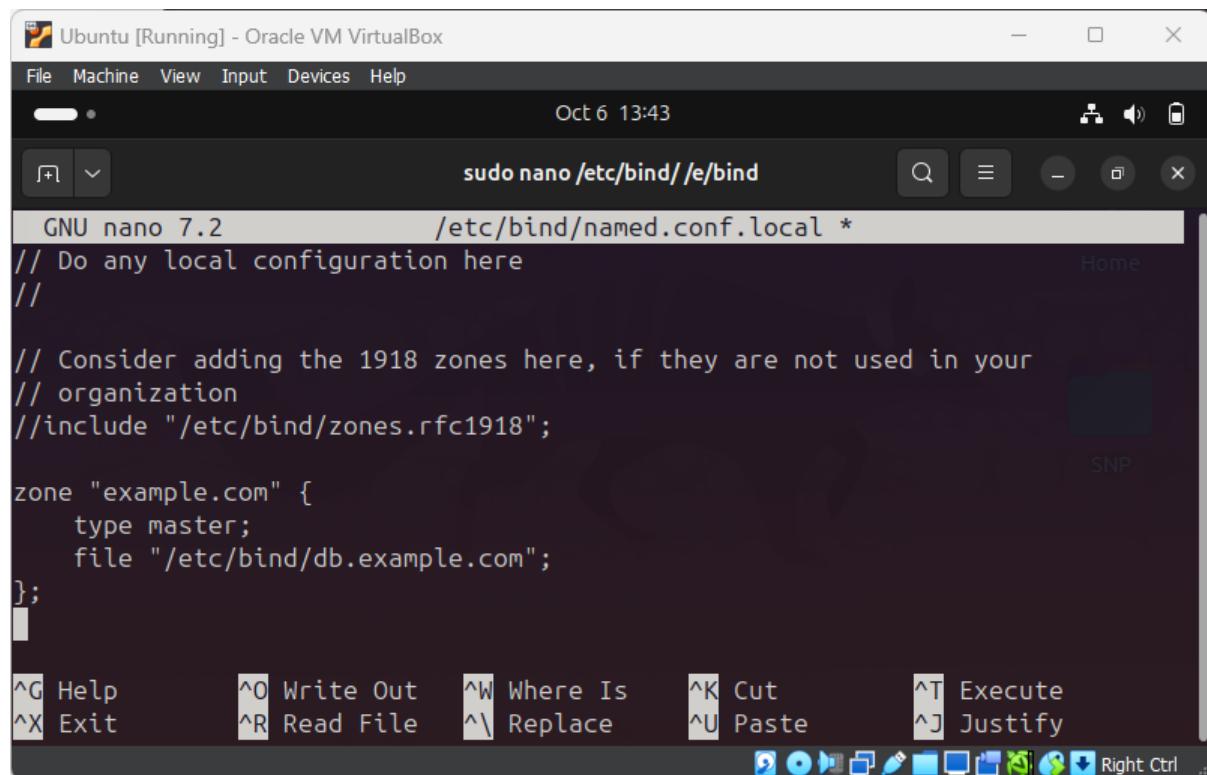
After configuring the global settings, I moved on to define my domain and set up the DNS records.

I edited the **/etc/bind/named.conf.local** file



```
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind> sudo nano /etc/bind/named.conf.local
```

I added the following command to define a zone:

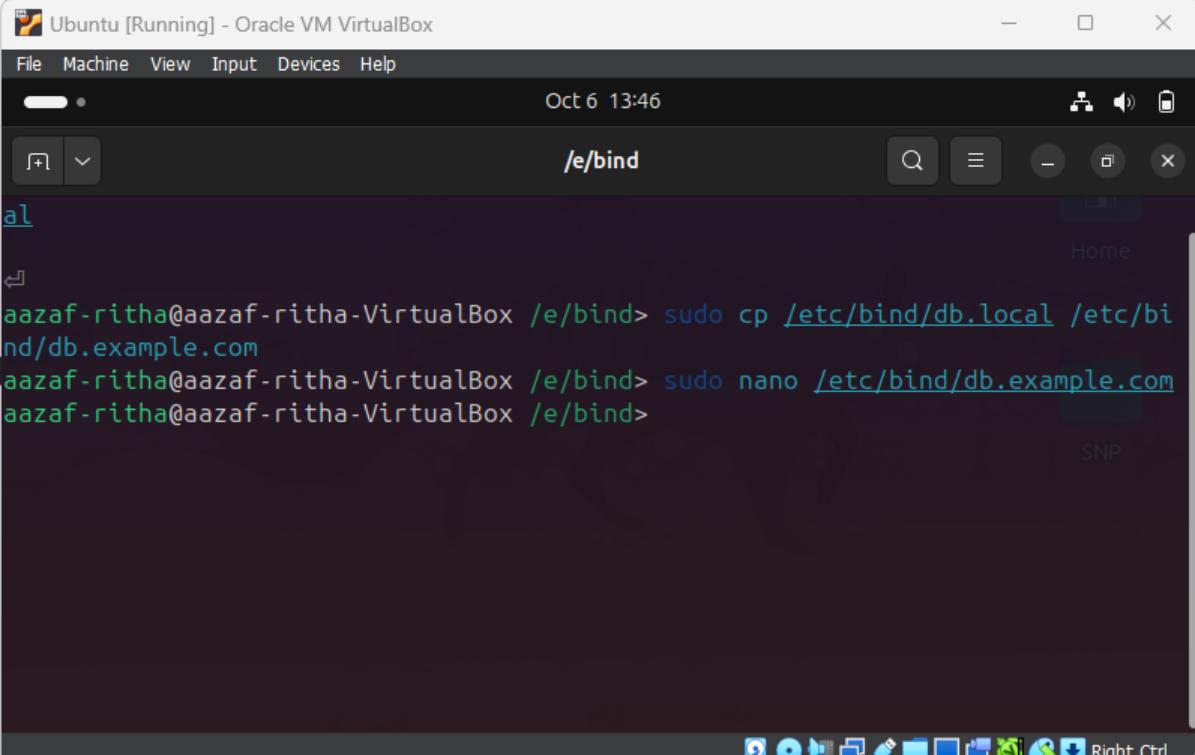


```
GNU nano 7.2          /etc/bind/named.conf.local *
// Do any local configuration here
//

// Consider adding the 1918 zones here, if they are not used in your
// organization
//include "/etc/bind/zones.rfc1918";

zone "example.com" {
    type master;
    file "/etc/bind/db.example.com";
};
```

Then I Created and configured the zone file



Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 13:46

/e/bind

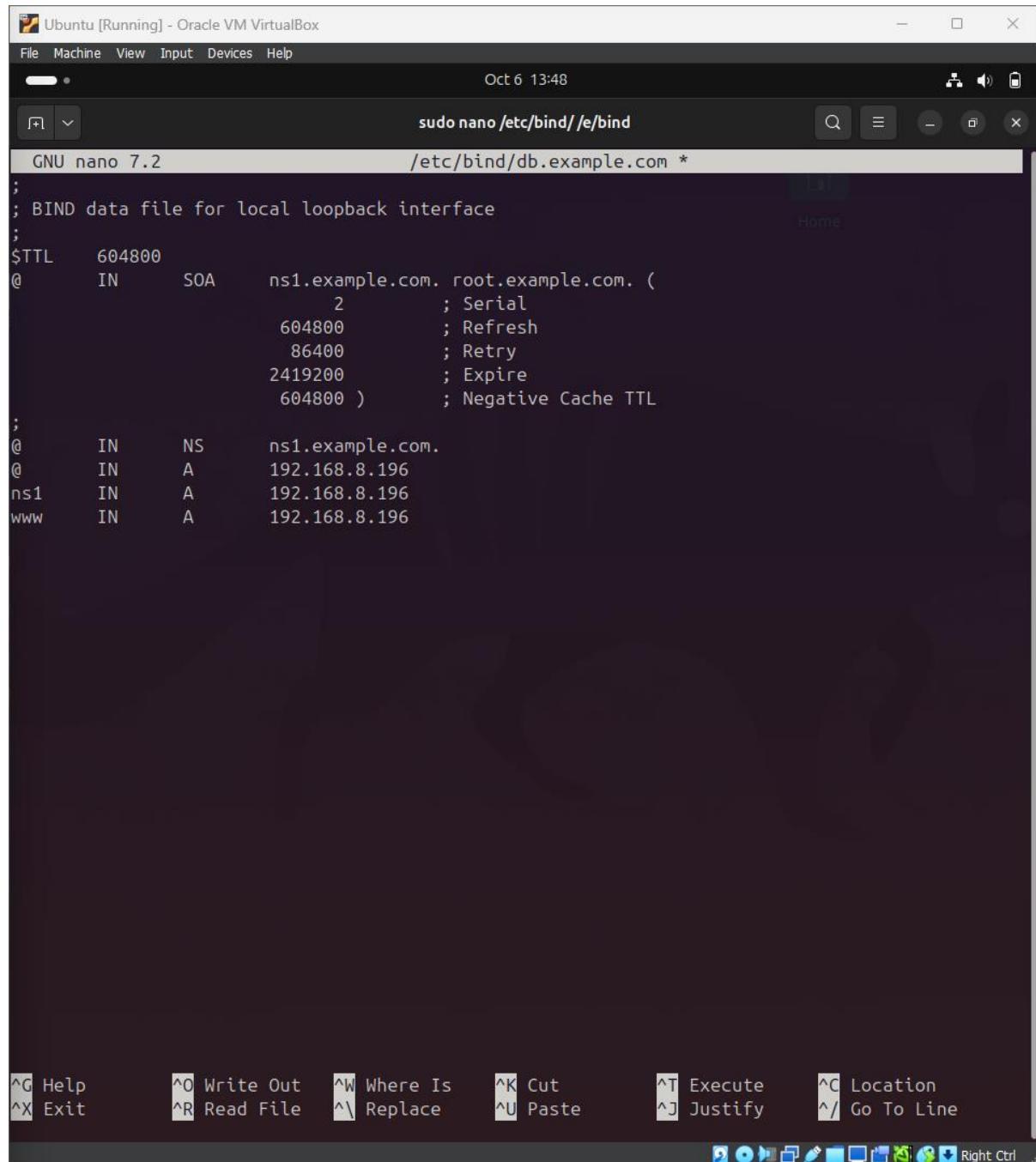
al

azaf-ritha@azaf-ritha-VirtualBox /e/bind> sudo cp /etc/bind/db.local /etc/bind/db.example.com

azaf-ritha@azaf-ritha-VirtualBox /e/bind> sudo nano /etc/bind/db.example.com

azaf-ritha@azaf-ritha-VirtualBox /e/bind>

After creating I modified the zone file to reflect my domain and IP configuration



The screenshot shows a terminal window titled "Ubuntu [Running] - Oracle VM VirtualBox". The window title bar includes "File Machine View Input Devices Help", a date/time "Oct 6 13:48", and standard window controls. The terminal window has a dark background and displays the following BIND configuration file content:

```
sudo nano /etc/bind//e/bind
/etc/bind/db.example.com *

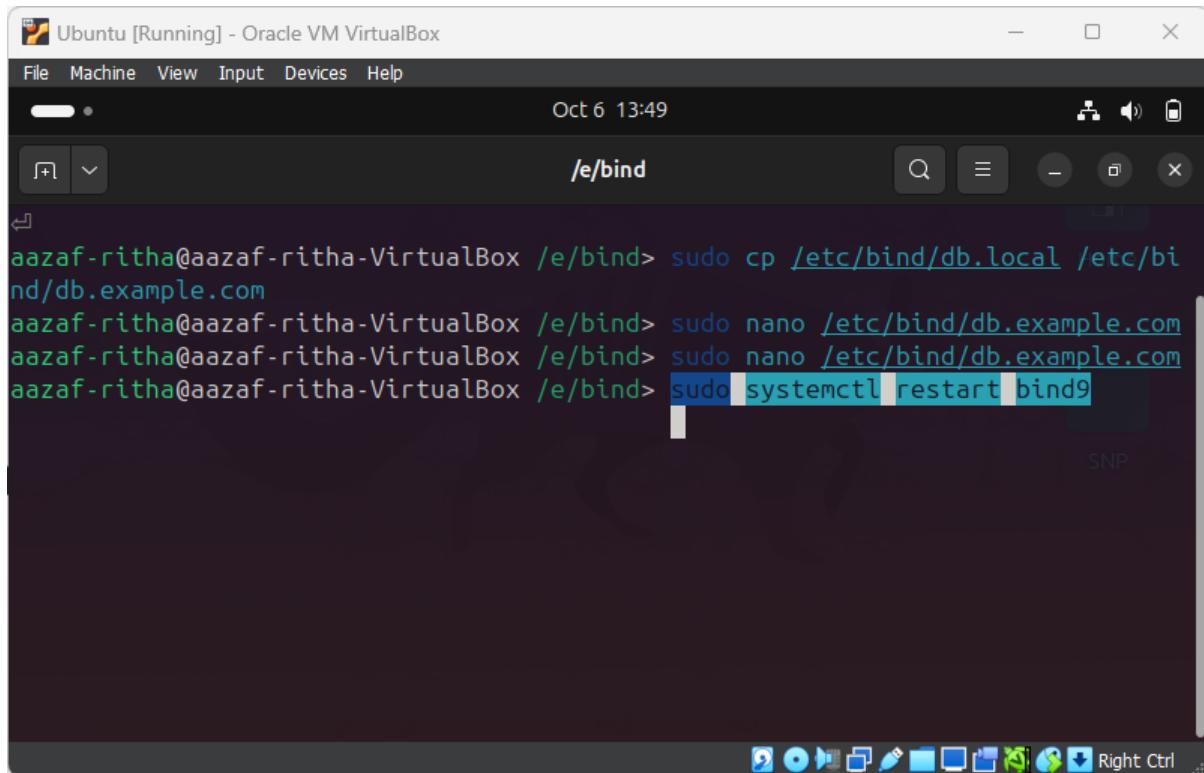
;
; BIND data file for local loopback interface
;
$TTL    604800
@       IN      SOA     ns1.example.com. root.example.com. (
                      2           ; Serial
                      604800      ; Refresh
                      86400       ; Retry
                     2419200     ; Expire
                     604800 )     ; Negative Cache TTL
;
@       IN      NS      ns1.example.com.
@       IN      A       192.168.8.196
ns1    IN      A       192.168.8.196
www   IN      A       192.168.8.196
```

At the bottom of the terminal window, there is a menu of keyboard shortcuts:

- ^G Help
- ^O Write Out
- ^W Where Is
- ^K Cut
- ^T Execute
- ^C Location
- ^X Exit
- ^R Read File
- ^\\ Replace
- ^U Paste
- ^J Justify
- ^/ Go To Line

Below the menu, there is a toolbar with various icons.

After configuring your DNS server, I restarted BIND to apply the following changes

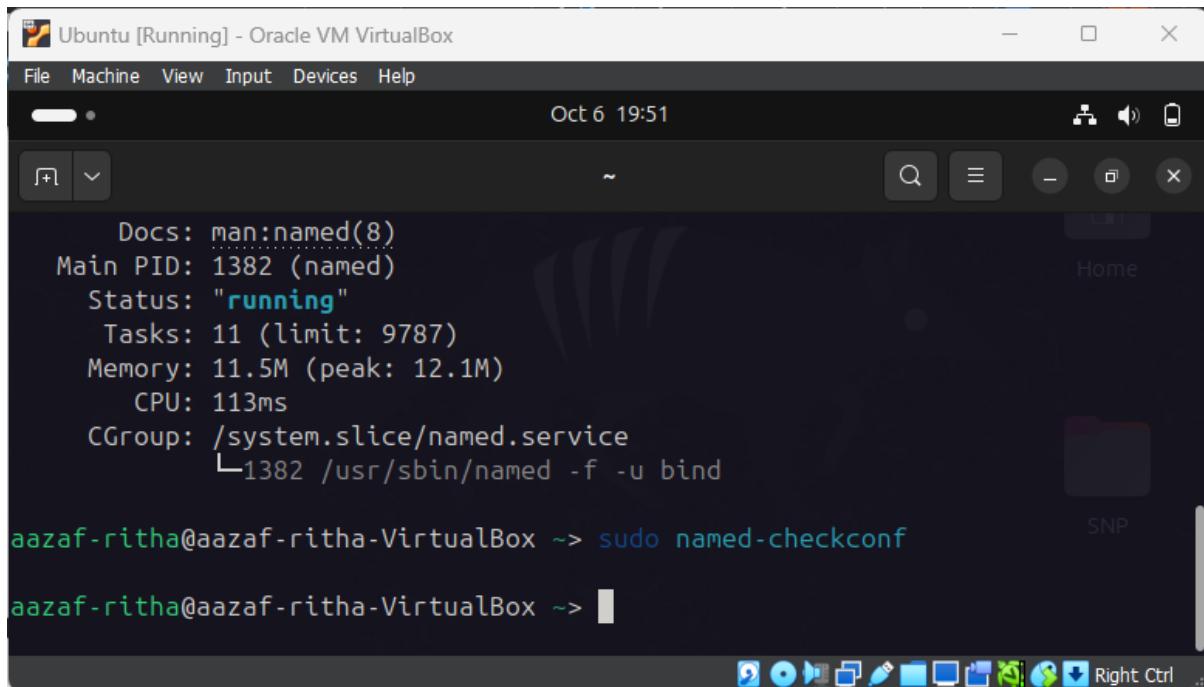


```
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind> sudo cp /etc/bind/db.local /etc/bind/db.example.com
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind> sudo nano /etc/bind/db.example.com
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind> sudo nano /etc/bind/db.example.com
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind> sudo systemctl restart bind9
```

Check and Restart BIND

I checked for any syntax errors in my BIND configuration to ensure everything was set up correctly.

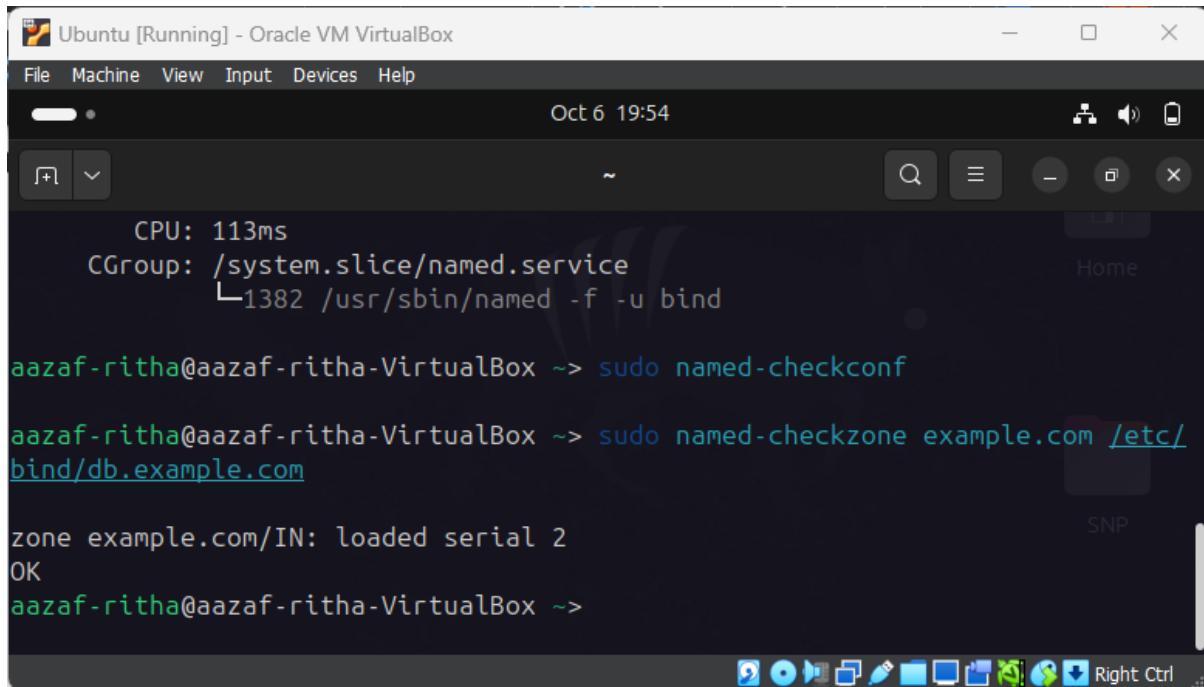
sudo named-checkconf, I used this command to check the general configuration.



```
Docs: man:named(8)
Main PID: 1382 (named)
Status: "running"
Tasks: 11 (limit: 9787)
Memory: 11.5M (peak: 12.1M)
CPU: 113ms
CGroup: /system.slice/named.service
└─1382 /usr/sbin/named -f -u bind

aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo named-checkconf
```

Then, I checked the zone file for errors



```
CPU: 113ms
CGroup: /system.slice/named.service
└─1382 /usr/sbin/named -f -u bind

aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo named-checkconf

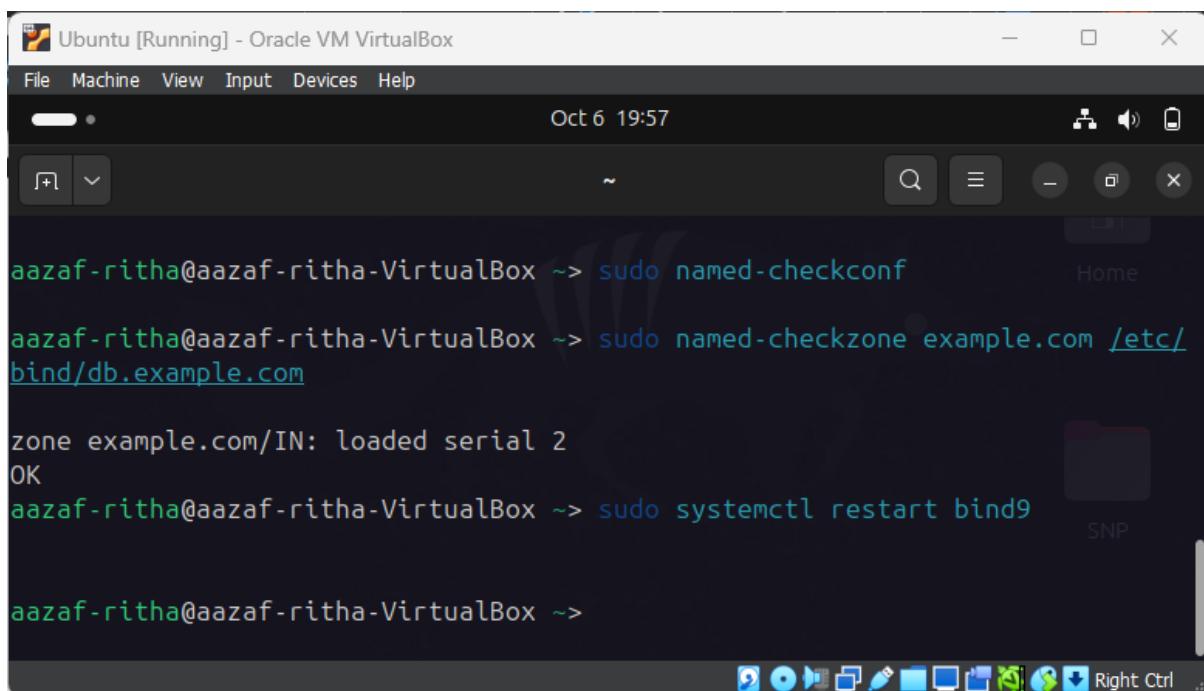
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo named-checkzone example.com /etc/
bind/db.example.com

zone example.com/IN: loaded serial 2
OK
aazaf-ritha@aazaf-ritha-VirtualBox ~>
```

Both checks returned no errors, so I was confident the configuration was correct.

The output shows that the zone **mydomain.local** is loaded successfully, indicating that the serial number in my zone file is valid.

I restarted the BIND service to apply the changes using this command **sudo systemctl restart bind9**.



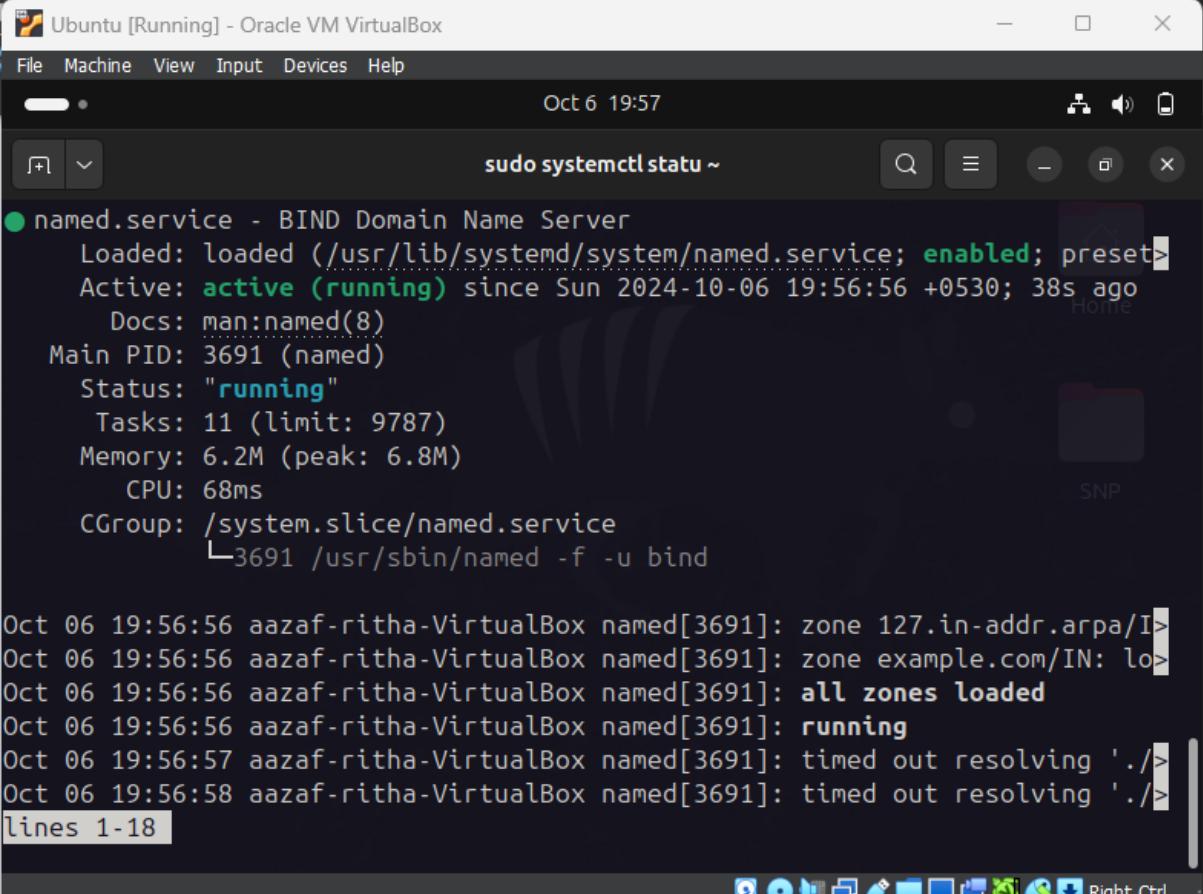
```
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo named-checkconf

aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo named-checkzone example.com /etc/
bind/db.example.com

zone example.com/IN: loaded serial 2
OK
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo systemctl restart bind9

aazaf-ritha@aazaf-ritha-VirtualBox ~>
```

I also verified the status of BIND to ensure whether it is running properly using the command **sudo systemctl status bind9**.



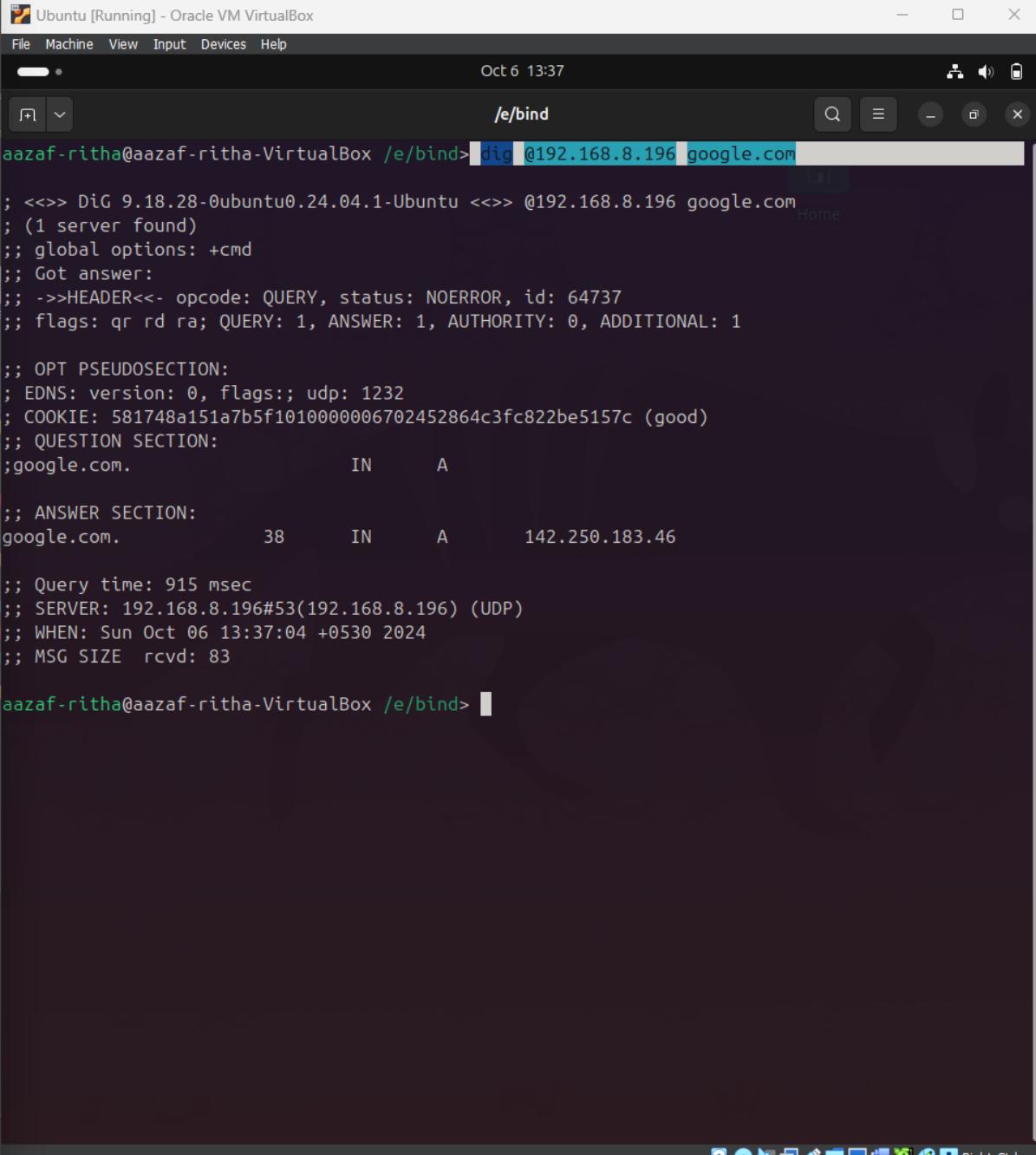
```
sudo systemctl status ~
● named.service - BIND Domain Name Server
   Loaded: loaded (/usr/lib/systemd/system/named.service; enabled; preset)
   Active: active (running) since Sun 2024-10-06 19:56:56 +0530; 38s ago
     Docs: man:named(8)
 Main PID: 3691 (named)
   Status: "running"
      Tasks: 11 (limit: 9787)
     Memory: 6.2M (peak: 6.8M)
        CPU: 68ms
      CGroup: /system.slice/named.service
              └─3691 /usr/sbin/named -f -u bind

Oct 06 19:56:56 aazaf-ritha-VirtualBox named[3691]: zone 127.in-addr.arpa/IN: loaded
Oct 06 19:56:56 aazaf-ritha-VirtualBox named[3691]: zone example.com/IN: loaded
Oct 06 19:56:56 aazaf-ritha-VirtualBox named[3691]: all zones loaded
Oct 06 19:56:56 aazaf-ritha-VirtualBox named[3691]: running
Oct 06 19:56:57 aazaf-ritha-VirtualBox named[3691]: timed out resolving '.>
Oct 06 19:56:58 aazaf-ritha-VirtualBox named[3691]: timed out resolving '.>
lines 1-18
```

1.4. Test the DNS Server

I ensured my DNS server is functioning properly, and I used the dig command to test DNS resolution

Test the DNS server's resolution by using **dig @192.168.8.196 google.com** command.



Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 13:37

/e/bind

```
aazaf-ritha@aazaf-ritha-VirtualBox /e/bind> dig @192.168.8.196 google.com

; <>> DiG 9.18.28-0ubuntu0.24.04.1-Ubuntu <>> @192.168.8.196 google.com
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 64737
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
; COOKIE: 581748a151a7b5f1010000006702452864c3fc822be5157c (good)
;; QUESTION SECTION:
;google.com.           IN      A

;; ANSWER SECTION:
google.com.        38      IN      A      142.250.183.46

;; Query time: 915 msec
;; SERVER: 192.168.8.196#53(192.168.8.196) (UDP)
;; WHEN: Sun Oct 06 13:37:04 +0530 2024
;; MSG SIZE  rcvd: 83

aazaf-ritha@aazaf-ritha-VirtualBox /e/bind>
```

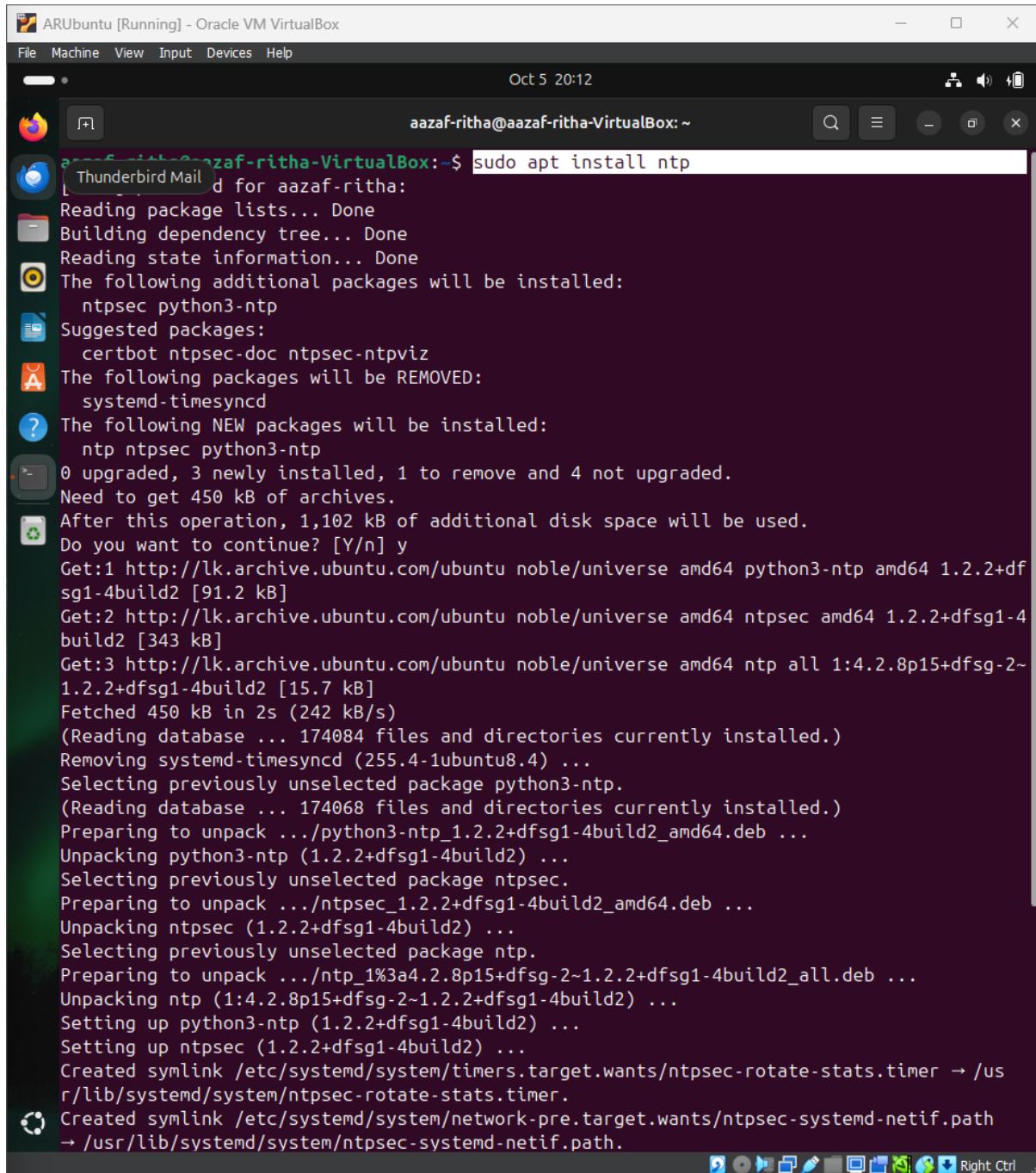
3.3. NTP (Network Time Protocol)

Updated Package List

Before installing the NTP server, I ensured that my package list was up to date. I executed the following command **sudo apt update** and **sudo apt upgrade**.

Installed NTP Server

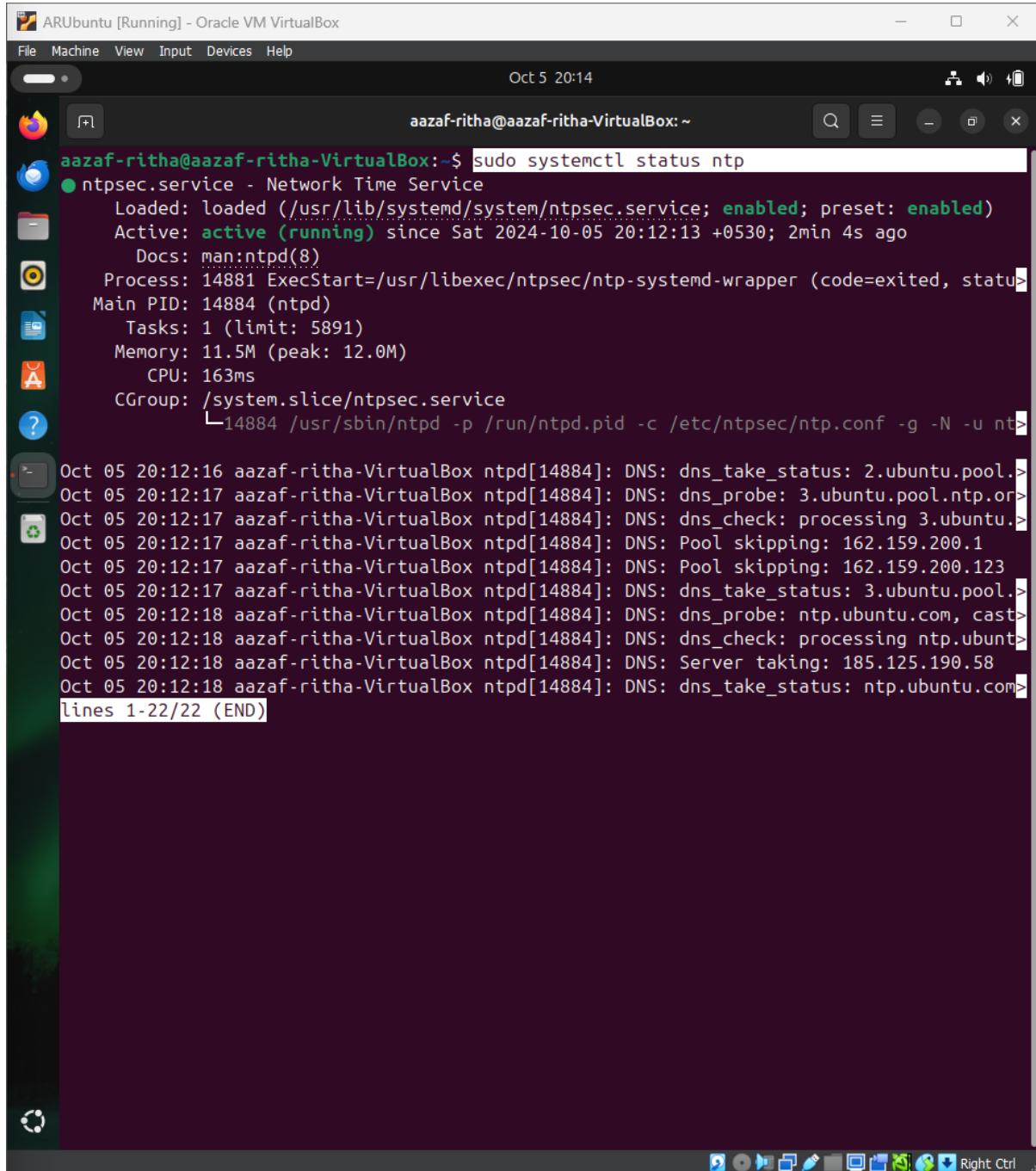
Next, I installed the NTP server using the apt package manager. I ran the following **sudo apt install ntp** command in terminal.



```
aazaf-ritha@aaazaf-ritha-VirtualBox:~$ sudo apt install ntp
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  ntpsec python3-ntp
Suggested packages:
  certbot ntpsec-doc ntpsec-ntpviz
The following packages will be REMOVED:
  systemd-timesyncd
The following NEW packages will be installed:
  ntp ntpsec python3-ntp
0 upgraded, 3 newly installed, 1 to remove and 4 not upgraded.
Need to get 450 kB of archives.
After this operation, 1,102 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://lk.archive.ubuntu.com/ubuntu noble/universe amd64 python3-ntp amd64 1.2.2+dfsg1-4build2 [91.2 kB]
Get:2 http://lk.archive.ubuntu.com/ubuntu noble/universe amd64 ntpsec amd64 1.2.2+dfsg1-4build2 [343 kB]
Get:3 http://lk.archive.ubuntu.com/ubuntu noble/universe amd64 ntp all 1:4.2.8p15+dfsg-2~1.2.2+dfsg1-4build2 [15.7 kB]
Fetched 450 kB in 2 s (242 kB/s)
(Reading database ... 174084 files and directories currently installed.)
Removing systemd-timesyncd (255.4-1ubuntu8.4) ...
Selecting previously unselected package python3-ntp.
(Reading database ... 174068 files and directories currently installed.)
Preparing to unpack .../python3-ntp_1.2.2+dfsg1-4build2_amd64.deb ...
Unpacking python3-ntp (1.2.2+dfsg1-4build2) ...
Selecting previously unselected package ntpsec.
Preparing to unpack .../ntpsec_1.2.2+dfsg1-4build2_amd64.deb ...
Unpacking ntpsec (1.2.2+dfsg1-4build2) ...
Selecting previously unselected package ntp.
Preparing to unpack .../ntp_1%3a4.2.8p15+dfsg-2~1.2.2+dfsg1-4build2_all.deb ...
Unpacking ntp (1:4.2.8p15+dfsg-2~1.2.2+dfsg1-4build2) ...
Setting up python3-ntp (1.2.2+dfsg1-4build2) ...
Setting up ntpsec (1.2.2+dfsg1-4build2) ...
Created symlink /etc/systemd/system/timers.target.wants/ntpsec-rotate-stats.timer → /usr/lib/systemd/system/ntpsec-rotate-stats.timer.
Created symlink /etc/systemd/system/network-pre.target.wants/ntpsec-systemd-netif.path → /usr/lib/systemd/system/ntpsec-systemd-netif.path.
```

Checked NTP Service Status

After the installation was completed, I checked the status of the NTP service to ensure whether it was running correctly. I used the command



```
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo systemctl status ntp
● ntpsec.service - Network Time Service
   Loaded: loaded (/usr/lib/systemd/system/ntpsec.service; enabled; preset: enabled)
   Active: active (running) since Sat 2024-10-05 20:12:13 +0530; 2min 4s ago
     Docs: man:ntpd(8)
     Process: 14881 ExecStart=/usr/libexec/ntpsec/ntp-systemd-wrapper (code=exited, statu>
    Main PID: 14884 (ntpd)
      Tasks: 1 (limit: 5891)
     Memory: 11.5M (peak: 12.0M)
        CPU: 163ms
       CGroup: /system.slice/ntpsec.service
               └─14884 /usr/sbin/ntpd -p /run/ntpd.pid -c /etc/ntpsec/ntp.conf -g -N -u nt>

Oct 05 20:12:16 aazaf-ritha-VirtualBox ntpd[14884]: DNS: dns_take_status: 2.ubuntu.pool.>
Oct 05 20:12:17 aazaf-ritha-VirtualBox ntpd[14884]: DNS: dns_probe: 3.ubuntu.pool.ntp.or>
Oct 05 20:12:17 aazaf-ritha-VirtualBox ntpd[14884]: DNS: dns_check: processing 3.ubuntu.>
Oct 05 20:12:17 aazaf-ritha-VirtualBox ntpd[14884]: DNS: Pool skipping: 162.159.200.1
Oct 05 20:12:17 aazaf-ritha-VirtualBox ntpd[14884]: DNS: Pool skipping: 162.159.200.123
Oct 05 20:12:17 aazaf-ritha-VirtualBox ntpd[14884]: DNS: dns_take_status: 3.ubuntu.pool.>
Oct 05 20:12:18 aazaf-ritha-VirtualBox ntpd[14884]: DNS: dns_probe: ntp.ubuntu.com, cast>
Oct 05 20:12:18 aazaf-ritha-VirtualBox ntpd[14884]: DNS: dns_check: processing ntp.ubuntu>
Oct 05 20:12:18 aazaf-ritha-VirtualBox ntpd[14884]: DNS: Server taking: 185.125.190.58
Oct 05 20:12:18 aazaf-ritha-VirtualBox ntpd[14884]: DNS: dns_take_status: ntp.ubuntu.com>
lines 1-22/22 (END)
```

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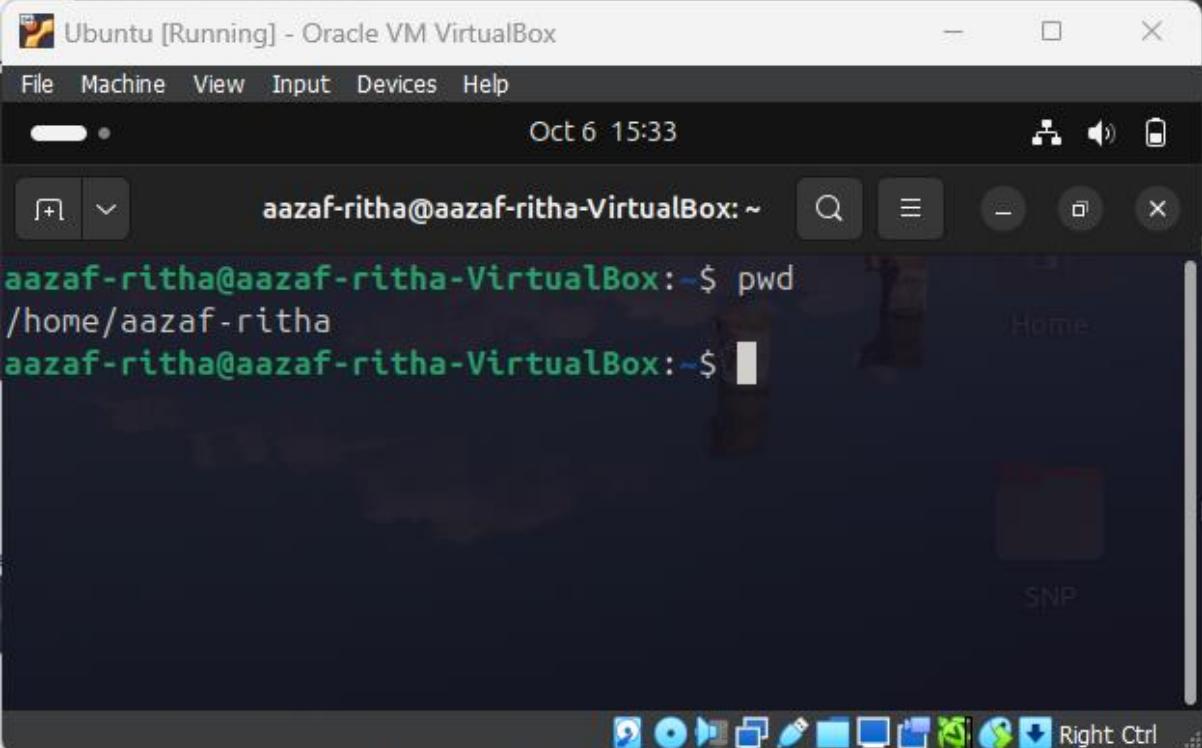
File Machine View Input Devices Help

```
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ ntpq -p
      remote                  refid      st t when poll reach   delay   offset
===== 
 0.ubuntu.pool.ntp.org        .POOL.      16 p    - 256    0  0.0000   0
 1.ubuntu.pool.ntp.org        .POOL.      16 p    - 256    0  0.0000   0
 2.ubuntu.pool.ntp.org        .POOL.      16 p    - 256    0  0.0000   0
 3.ubuntu.pool.ntp.org        .POOL.      16 p    - 256    0  0.0000   0
 *alphyn.canonical.com      132.163.96.1  2 u     8 256  377 248.4960 32
 +time.cloudflare.com       10.4.8.56   3 u   224 256  377 31.5656 17
 +time.cloudflare.com       10.4.8.56   3 u   216 256  377 26.8217 16
 time.cloudflare.com         .STEP.     16 u    - 1024   0  0.0000   0
 Help.cloudflare.com        .STEP.     16 u    - 1024   0  0.0000   0
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ timedatectl status
          Local time: Sat 2024-10-05 22:01:54 +0530
          Universal time: Sat 2024-10-05 16:31:54 UTC
                 RTC time: Sat 2024-10-05 16:31:54
                   Time zone: Asia/Colombo (+0530, +0530)
System clock synchronized: yes
          NTP service: n/a
    RTC in local TZ: no
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$
```

04. Shell Scripting and Security

4.1. Shell Scripting

I opened my linux machine terminal and checked the directory in my case my username is aazaf-ritha



A screenshot of a Linux terminal window titled "Ubuntu [Running] - Oracle VM VirtualBox". The terminal shows the command "pwd" being run by user "aazaf-ritha" at the prompt "aazaf-ritha@aazaf-ritha-VirtualBox:~\$". The output of the command is "/home/aazaf-ritha". The terminal has a dark theme with light-colored text. The window title bar includes the application name, window controls, and the date/time "Oct 6 15:33". The desktop environment visible behind the terminal window includes icons for Home, SNP, and other applications.

```
aazaf-ritha@aazaf-ritha-VirtualBox:~$ pwd
/home/aazaf-ritha
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

In the question destination directory is **/home/user/system_reports**. So, I created a folder on my user directory by **mkdir** command. And I verified it by using **ls** command.

I navigated to that folder by **cd** command.

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 15:36

aazaf-ritha@aazaf-ritha-VirtualBox: ~system_reports

```
aazaf-ritha@aazaf-ritha-VirtualBox:~$ pwd
/home/aazaf-ritha
aazaf-ritha@aazaf-ritha-VirtualBox:~$ ls
Desktop Downloads Music Public Templates
Documents msfinstall Pictures snap Videos
aazaf-ritha@aazaf-ritha-VirtualBox:~$ mkdir system_report
aazaf-ritha@aazaf-ritha-VirtualBox:~$ ls
Desktop Downloads Music Public system_report Videos
Documents msfinstall Pictures snap Templates
aazaf-ritha@aazaf-ritha-VirtualBox:~$ rmdir system_report
aazaf-ritha@aazaf-ritha-VirtualBox:~$ mkdir system_reports
aazaf-ritha@aazaf-ritha-VirtualBox:~$ ls
Desktop Downloads Music Public system_reports Videos
Documents msfinstall Pictures snap Templates
aazaf-ritha@aazaf-ritha-VirtualBox:~$ cd system_reports
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ pwd
/home/aazaf-ritha/system_reports
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$
```

Right Ctrl

next I created a new script file using nano editor.

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 15:38

aazaf-ritha@aazaf-ritha-VirtualBox: ~

```
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ cd ..
aazaf-ritha@aazaf-ritha-VirtualBox:~$ ls
Desktop Downloads Music Public system_reports Videos
Documents msfinstall Pictures snap Templates
aazaf-ritha@aazaf-ritha-VirtualBox:~$ nano system_info.sh
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

Right Ctrl

I opened and typed the script.

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 15:39

aazaf-ritha@aazaf-ritha-VirtualBox: ~

GNU nano 7.2 system_info.sh

```
#!/bin/bash

# Get current date
date=$(date +%Y-%m-%d)

# Get system information
uptime=$(uptime -p)
free_mem=$(free -m | grep Mem: | awk '{print $4}')
disk_usage=$(df -h / | grep / | awk '{print $5}')

# Create report file path
mkdir -p "/home/aazaf-ritha/system_reports"
report_file="/home/aazaf-ritha/system_reports/system_report_${date}.txt"
touch "$report_file"

# Create report header
echo "System Report - $(date)" >> "$report_file"

# Append system information
echo "Uptime: $uptime" >> "$report_file"
echo "Free Memory: $free_mem MB" >> "$report_file"
echo "Disk Usage: $disk_usage" >> "$report_file"
echo "Report generated successfully!"

^G Help      ^O Write Out ^W Where Is   ^K Cut      ^T Execute   ^C Location
^X Exit      ^R Read File ^\ Replace   ^U Paste     ^J Justify   ^/ Go To Line

```

```
#!/bin/bash

# Get current date
date=$(date +%Y-%m-%d)

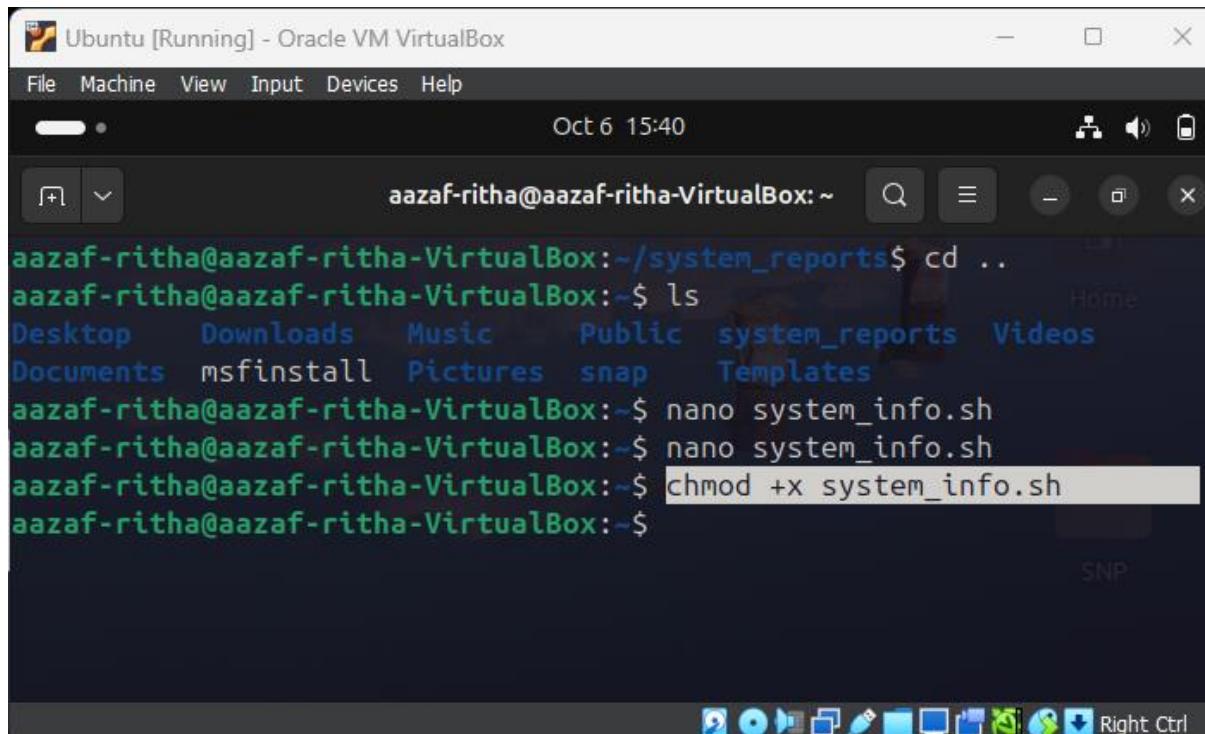
# Get system information
uptime=$(uptime -p)
free_mem=$(free -m | grep Mem: | awk '{print $4}')
disk_usage=$(df -h / | grep / | awk '{print $5}')

# Create report file path
mkdir -p "/home/aazaf-ritha/system_reports"
report_file="/home/aazaf-ritha/system_reports/system_report_${date}.txt"
touch "$report_file"

# Create report header
echo "System Report - $(date)" >> "$report_file"
```

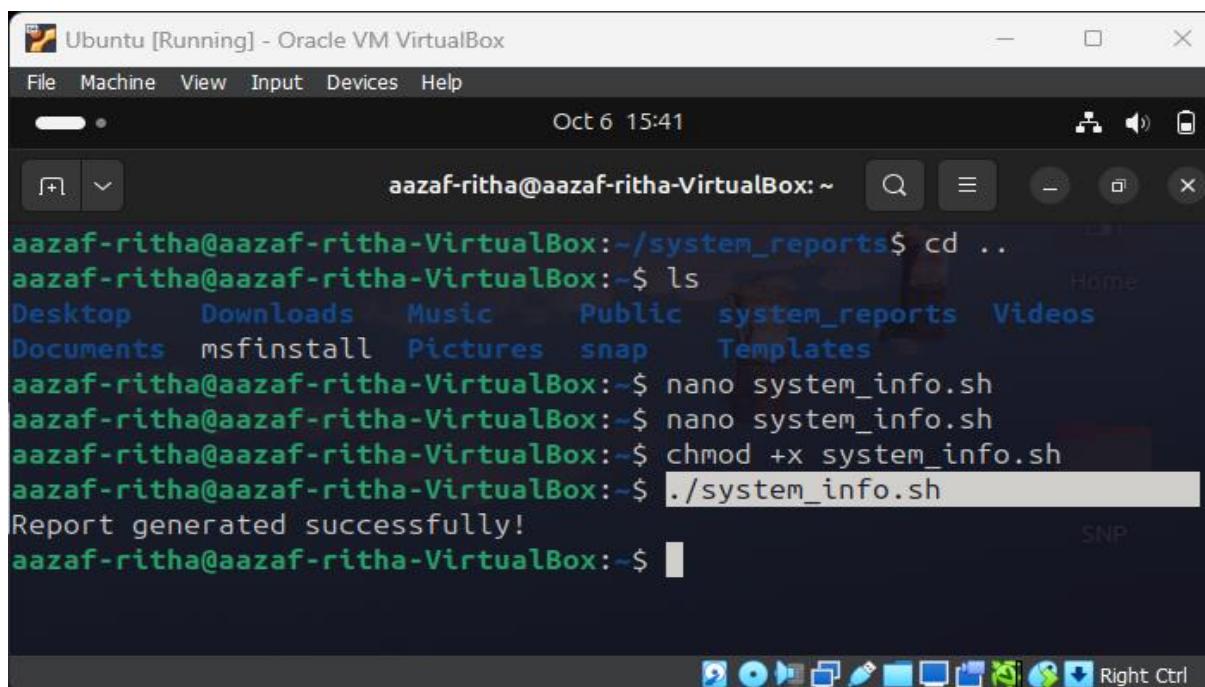
```
# Append system information
echo "Uptime: $uptime" >> "$report_file"
echo "Free Memory: $free_mem MB" >> "$report_file"
echo "Disk Usage: $disk_usage" >> "$report_file"
echo "Report generated successfully!"
```

I ran **chmod +x system_info.sh** to make them executable.



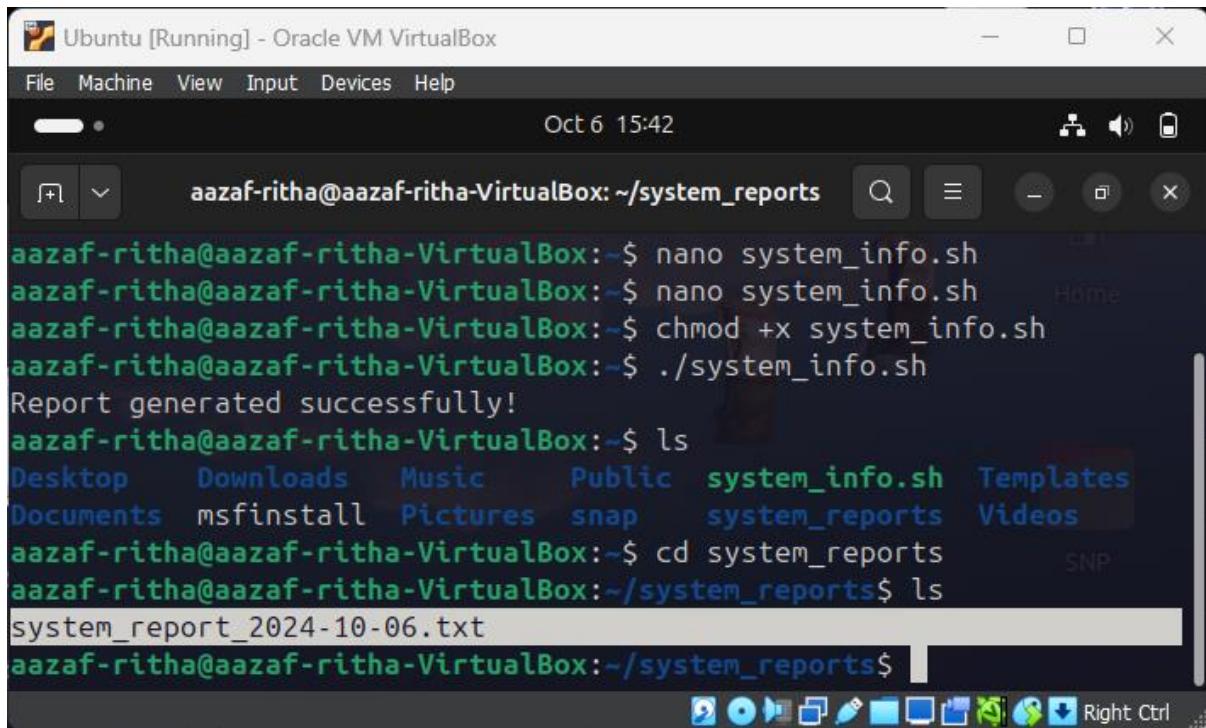
```
aazaf-ritha@aaazaf-ritha-VirtualBox:~/system_reports$ cd ..
aazaf-ritha@aaazaf-ritha-VirtualBox:~$ ls
Desktop Downloads Music Public system_reports Videos
Documents msfinstall Pictures snap Templates
aazaf-ritha@aaazaf-ritha-VirtualBox:~$ nano system_info.sh
aazaf-ritha@aaazaf-ritha-VirtualBox:~$ nano system_info.sh
aazaf-ritha@aaazaf-ritha-VirtualBox:~$ chmod +x system_info.sh
aazaf-ritha@aaazaf-ritha-VirtualBox:~$
```

Then I ran **./system_info.sh** to test the system information script.



```
aazaf-ritha@aaazaf-ritha-VirtualBox:~/system_reports$ cd ..
aazaf-ritha@aaazaf-ritha-VirtualBox:~$ ls
Desktop Downloads Music Public system_reports Videos
Documents msfinstall Pictures snap Templates
aazaf-ritha@aaazaf-ritha-VirtualBox:~$ nano system_info.sh
aazaf-ritha@aaazaf-ritha-VirtualBox:~$ nano system_info.sh
aazaf-ritha@aaazaf-ritha-VirtualBox:~$ chmod +x system_info.sh
aazaf-ritha@aaazaf-ritha-VirtualBox:~$ ./system_info.sh
Report generated successfully!
aazaf-ritha@aaazaf-ritha-VirtualBox:~$
```

Then I saw it displays system report generated and displaying it's directory.



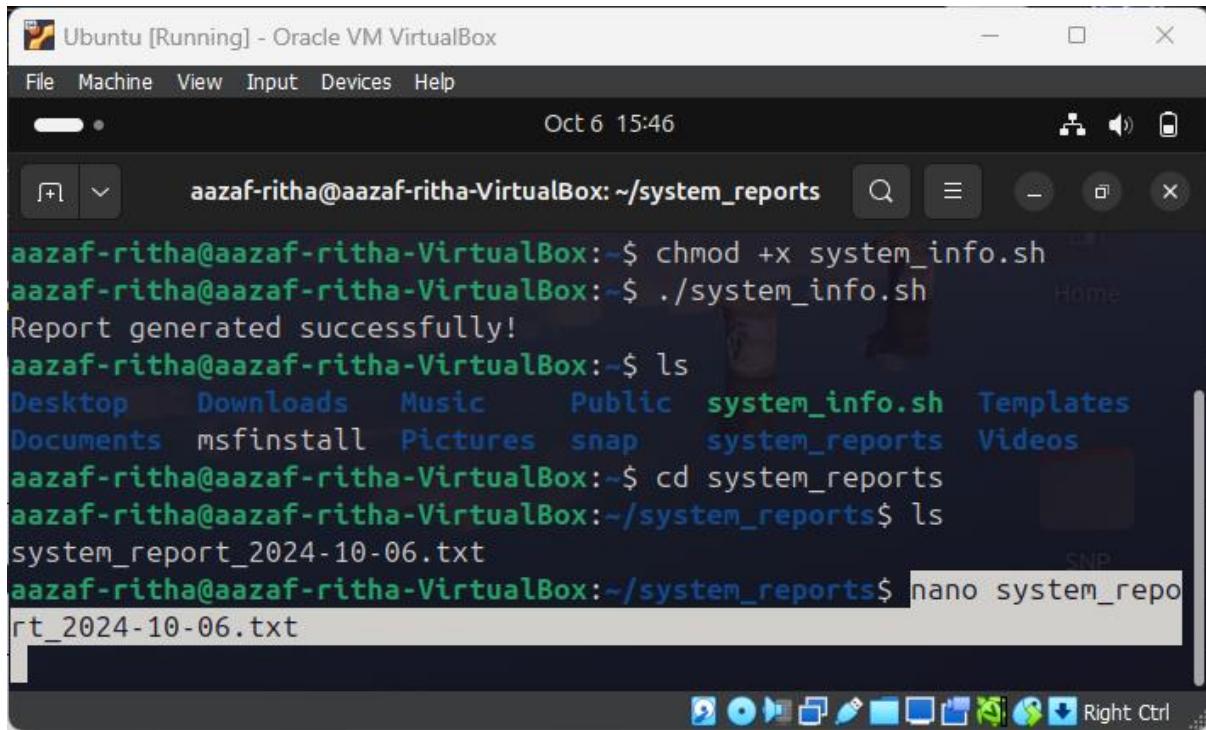
Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 15:42

```
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ nano system_info.sh
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ nano system_info.sh
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ chmod +x system_info.sh
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ ./system_info.sh
Report generated successfully!
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ ls
Desktop Downloads Music Public system_info.sh Templates
Documents msfinstall Pictures snap system_reports Videos
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ cd system_reports
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ ls
system_report_2024-10-06.txt
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$
```

And I changed the directories to that file and opened the .txt file by using ‘nano’ command.

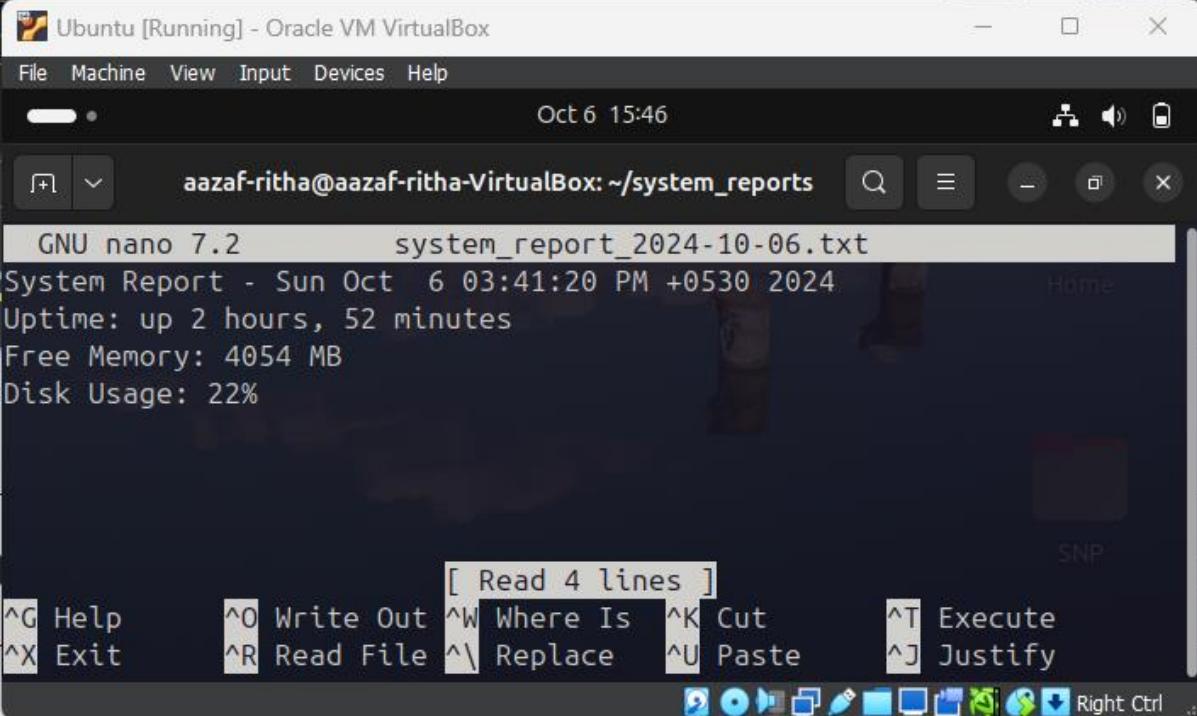


Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 15:46

```
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ chmod +x system_info.sh
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ ./system_info.sh
Report generated successfully!
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ ls
Desktop Downloads Music Public system_info.sh Templates
Documents msfinstall Pictures snap system_reports Videos
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ cd system_reports
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ ls
system_report_2024-10-06.txt
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ nano system_report_2024-10-06.txt
```



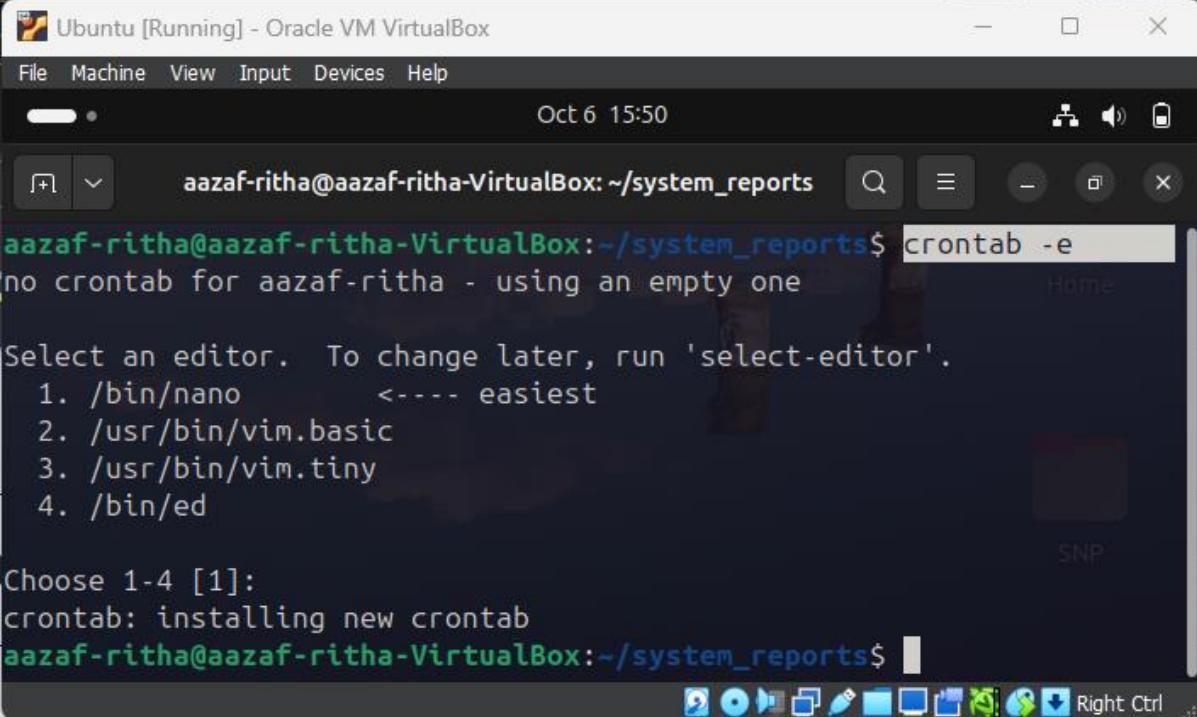
```

GNU nano 7.2          system_report_2024-10-06.txt
System Report - Sun Oct  6 03:41:20 PM +0530 2024
Uptime: up 2 hours, 52 minutes
Free Memory: 4054 MB
Disk Usage: 22%
[ Read 4 lines ]
^G Help      ^O Write Out ^W Where Is  ^K Cut      ^T Execute
^X Exit      ^R Read File ^\ Replace   ^U Paste    ^J Justify

```

Adding to Cron

To run this script run automatically, I set up a cron job. using **crontab -e** command.



```

aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ crontab -e
no crontab for aazaf-ritha - using an empty one
Home

Select an editor. To change later, run 'select-editor'.
1. /bin/nano      <---- easiest
2. /usr/bin/vim.basic
3. /usr/bin/vim.tiny
4. /bin/ed

Choose 1-4 [1]:
crontab: installing new crontab
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ 

```

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 15:49

aazaf-ritha@aazaf-ritha-VirtualBox: ~/system_reports

```
GNU nano 7.2          /tmp/crontab.r7wIzn/crontab *
# For example, you can run a backup of all your user accounts Home
# at 5 a.m every week with:
# 0 5 * * 1 tar -zcf /var/backups/home.tgz /home/
#
# For more information see the manual pages of crontab(5) and cron(8)
#
# m h dom mon dow   command
0 0 * * * /home/aazaf-ritha/system_info.sh
```

^G Help ^O Write Out ^W Where Is ^K Cut ^T Execute
 ^X Exit ^R Read File ^\ Replace ^U Paste ^J Justify

Right Ctrl

First, I changed the directories and made the backup_script.sh file in Documents directory. And created a backup_script.sh using **nano backup_script.sh** command.

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 16:06

aazaf-ritha@aazaf-ritha-VirtualBox: ~/Documents

```
aazaf-ritha@aazaf-ritha-VirtualBox:~/system_reports$ cd
aazaf-ritha@aazaf-ritha-VirtualBox:~$ ls
Desktop  Downloads  Music      Public  system_info.sh  Templates
Documents  msfinstall  Pictures  snap    system_reports  Videos
aazaf-ritha@aazaf-ritha-VirtualBox:~$ cd Documents
aazaf-ritha@aazaf-ritha-VirtualBox:~/Documents$ nano backup_scripts.sh
aazaf-ritha@aazaf-ritha-VirtualBox:~/Documents$
```

Right Ctrl

This is a script that automates the backup of the **/home/aazaf-ritha/Documents** directory to **/home/aazaf-ritha/backup/Documents**, naming the backup file with the current date,

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File Machine View Input Devices Help

Oct 6 16:06

aazaf-ritha@aazaf-ritha-VirtualBox: ~/Documents

```
GNU nano 7.2          backup_scripts.sh *
```

```
#!/bin/bash

#Source and destination directories

Source_directorie="/home/aazaf-ritha/Documents"
Destination_directorie="/home/aazaf-ritha/backup/Documents"

#Create destination directory if it doesn't exist
mkdir -p $Destination_directorie

#Backup file name with the current date
backup_file="Destination_directorie/Documents_$(date +%Y-%m-%d).tar.gz"

#Create the backup using tar
tar -czf $backup_file $Source_derectorie

#Print success message
echo "Backup Completed: $backup_file"
```

^G Help ^O Write Out ^W Where Is ^K Cut ^T Execute
 ^X Exit ^R Read File ^\ Replace ^U Paste ^J Justify

Right Ctrl

```
#!/bin/bash
```

```
#Source and destination directories
```

```
Source_directorie="/home/aazaf-ritha/Documents"
Destination_directorie="/home/aazaf-ritha/backup/Documents"
```

```
#Create destination directory if it doesn't exist
mkdir -p $Destination_directorie
```

```
#Backup file name with the current date
backup_file="Destination_directorie/Documents_$(date +%Y-%m-%d).tar.gz"
```

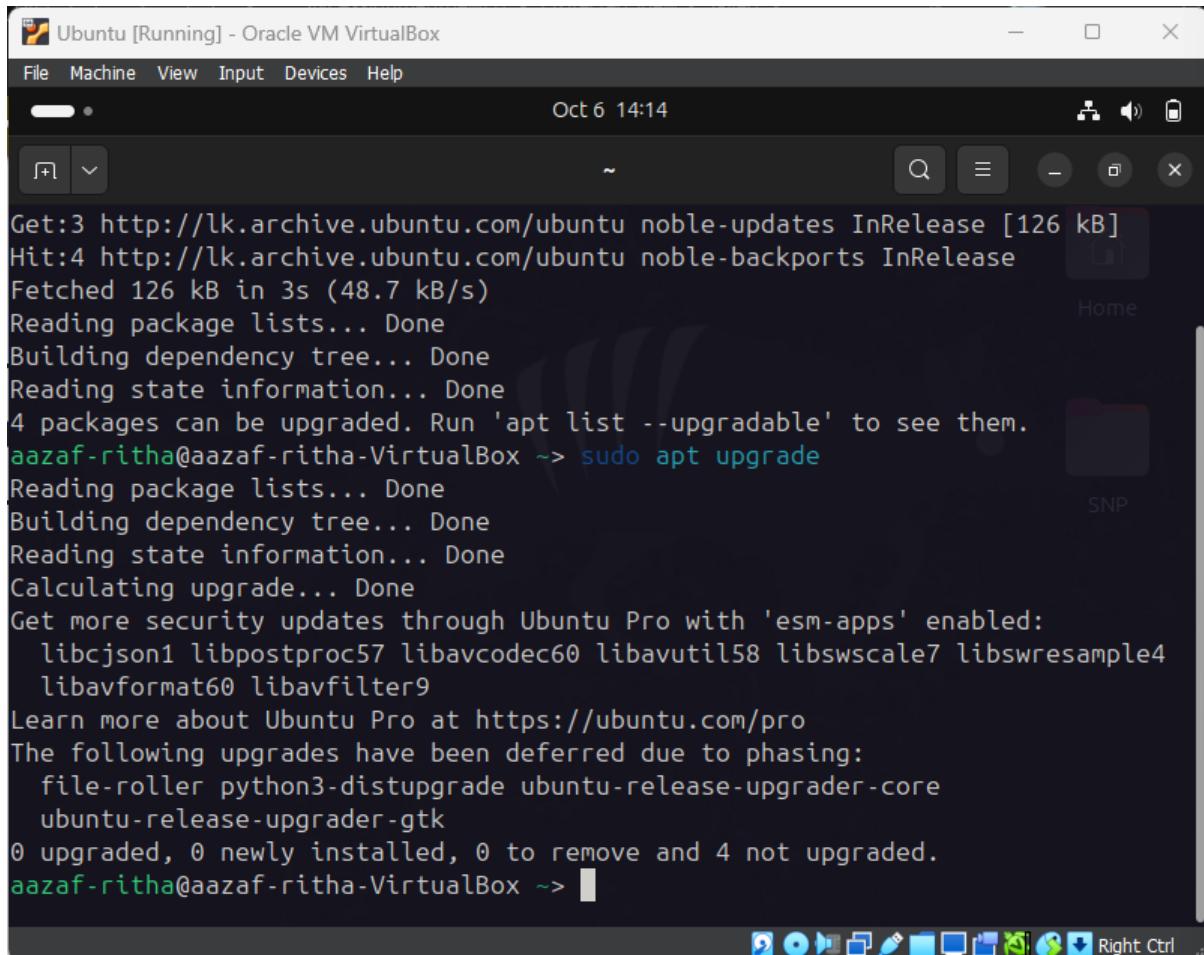
```
#Create the backup using tar
tar -czf $backup_file $Source_derectorie
```

```
#Print success massage
echo "Backup Completed: $backup_file"
```


4.2. SSH (Secure Shell):

i. System Update

The system's package list was updated using **sudo apt-get update**, and the packages were upgraded with **sudo apt-get upgrade**, ensuring compatibility and security.



```
Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 14:14
Get:3 http://lk.archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]
Hit:4 http://lk.archive.ubuntu.com/ubuntu noble-backports InRelease
Fetched 126 kB in 3s (48.7 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
4 packages can be upgraded. Run 'apt list --upgradable' to see them.
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo apt upgrade
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
Get more security updates through Ubuntu Pro with 'esm-apps' enabled:
  libcjson1 libpostproc57 libavcodec60 libavutil58 libswscale7 libswresample4
  libavformat60 libavfilter9
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following upgrades have been deferred due to phasing:
  file-roller python3-distupgrade ubuntu-release-upgrader-core
  ubuntu-release-upgrader-gtk
0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded.
aazaf-ritha@aazaf-ritha-VirtualBox ~>
```

ii. SSH server Installation

The OpenSSH server was installed using **sudo apt-get install openssh-server**, setting up the SSH daemon on the Linux machine.

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 14:15

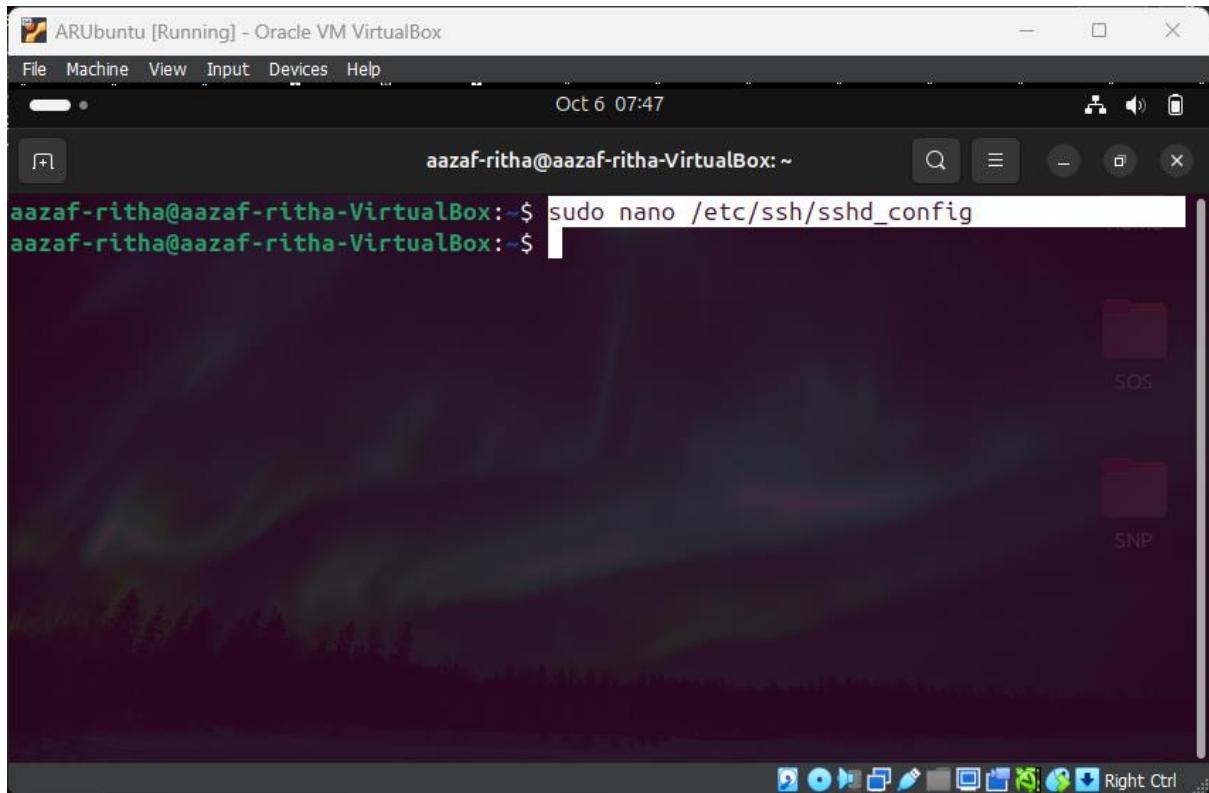
```
aazaf-ritha@aazaf-ritha-VirtualBox ~ > sudo apt-get install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  ncurses-term openssh-sftp-server ssh-import-id
Suggested packages:
  molly-guard monkeysphere ssh-askpass
The following NEW packages will be installed:
  ncurses-term openssh-server openssh-sftp-server ssh-import-id
0 upgraded, 4 newly installed, 0 to remove and 4 not upgraded.
Need to get 832 kB of archives.
After this operation, 6,747 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://lk.archive.ubuntu.com/ubuntu noble-updates/main amd64 openssh-sftp-server amd64 1:9.6p1-3ubuntu13.5 [37.3 kB]
Get:2 http://lk.archive.ubuntu.com/ubuntu noble-updates/main amd64 openssh-server amd64 1:9.6p1-3ubuntu13.5 [509 kB]
Get:3 http://lk.archive.ubuntu.com/ubuntu noble/main amd64 ncurses-term all 6.4+20240113-1ubuntu2 [275 kB]
Get:4 http://lk.archive.ubuntu.com/ubuntu noble/main amd64 ssh-import-id all 5.11-0ubuntu2 [10.0 kB]
Fetched 832 kB in 5s (181 kB/s)
Preconfiguring packages ...
Selecting previously unselected package openssh-sftp-server.
(Reading database ... 215192 files and directories currently installed.)
Preparing to unpack .../openssh-sftp-server_1%3a9.6p1-3ubuntu13.5_amd64.deb ...
Unpacking openssh-sftp-server (1:9.6p1-3ubuntu13.5) ...
Selecting previously unselected package openssh-server.
Preparing to unpack .../openssh-server_1%3a9.6p1-3ubuntu13.5_amd64.deb ...
Unpacking openssh-server (1:9.6p1-3ubuntu13.5) ...
Selecting previously unselected package ncurses-term.
Preparing to unpack .../ncurses-term_6.4+20240113-1ubuntu2_all.deb ...
Unpacking ncurses-term (6.4+20240113-1ubuntu2) ...
Selecting previously unselected package ssh-import-id.
Preparing to unpack .../ssh-import-id_5.11-0ubuntu2_all.deb ...
Unpacking ssh-import-id (5.11-0ubuntu2) ...
Setting up openssh-sftp-server (1:9.6p1-3ubuntu13.5) ...
Setting up openssh-server (1:9.6p1-3ubuntu13.5) ...

Creating config file /etc/ssh/sshd_config with new version
Created symlink /etc/systemd/system/sockets.target.wants/ssh.socket → /usr/lib/systemd/system/

```

iii. Configuration of SSH server

The SSH configuration file (**/etc/ssh/sshd_config**) was opened and edited using a text editor like **nano**.



Root Login Disabled: Remote login as the root user was disabled to enhance system security. And enable the port 22.

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 14:17

sudo nano /etc/ssh/sshd_config *

GNU nano 7.2 /etc/ssh/sshd_config *

```
# This is the sshd server system-wide configuration file. See
# sshd_config(5) for more information.

# This sshd was compiled with PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/b>

# The strategy used for options in the default sshd_config shipped with
# OpenSSH is to specify options with their default value where
# possible, but leave them commented. Uncommented options override the
# default value.

Include /etc/ssh/sshd_config.d/*.conf

Port 22
#AddressFamily any
#ListenAddress 0.0.0.0
#ListenAddress ::

#HostKey /etc/ssh/ssh_host_rsa_key
#HostKey /etc/ssh/ssh_host_ecdsa_key
#HostKey /etc/ssh/ssh_host_ed25519_key

# Ciphers and keying
#RekeyLimit default none

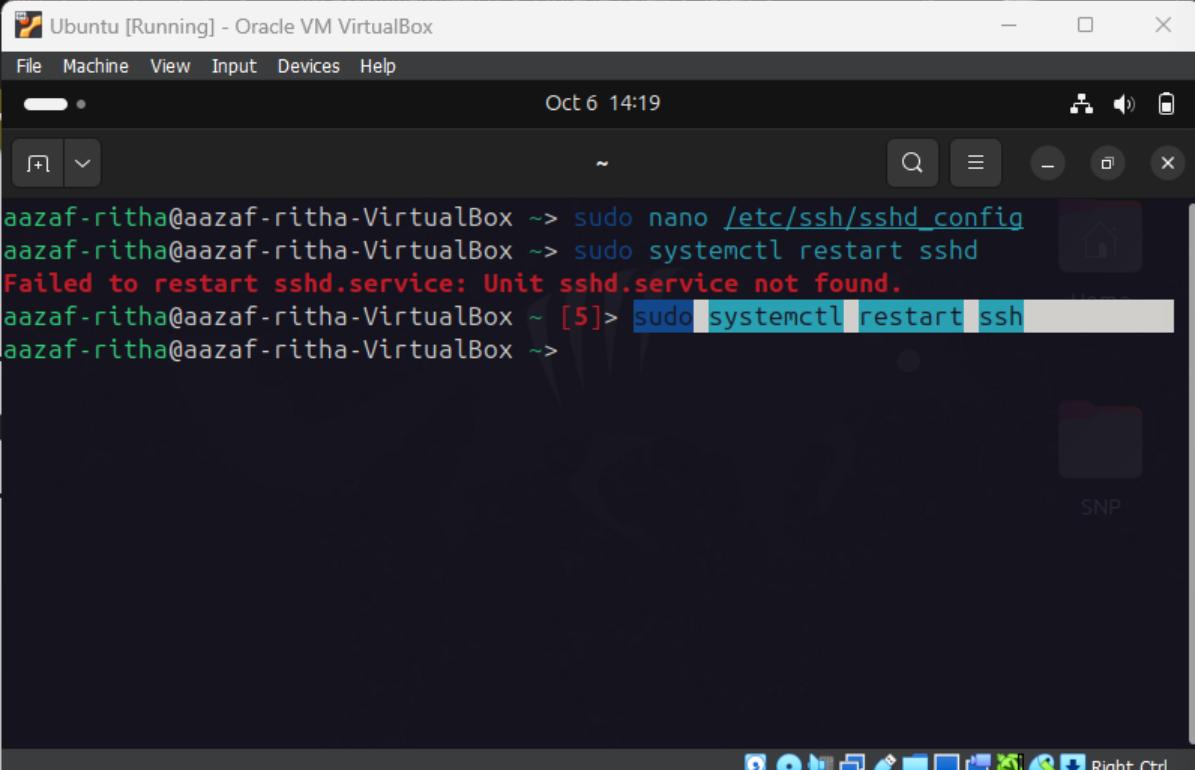
# Logging
#SyslogFacility AUTH
#LogLevel INFO

# Authentication:

#LoginGraceTime 2m
PermitRootLogin no
#StrictModes yes
#MaxAuthTries 6
#MaxSessions 10

^G Help      ^O Write Out   ^W Where Is   ^K Cut        ^T Execute   ^C Location
^X Exit      ^R Read File   ^\ Replace    ^U Paste     ^J Justify   ^/ Go To Line
                                         Right Ctrl
```

To restart the ssh



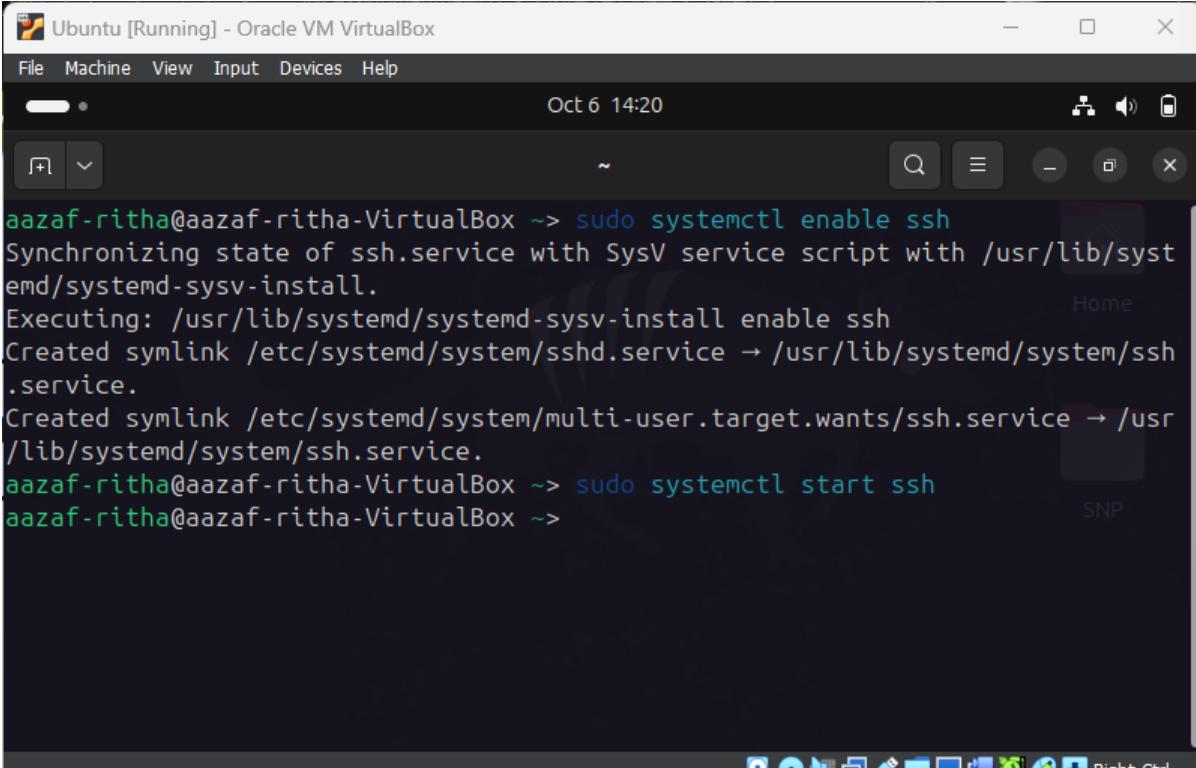
Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 14:19

```
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo nano /etc/ssh/sshd_config
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo systemctl restart sshd
Failed to restart sshd.service: Unit sshd.service not found.
aazaf-ritha@aazaf-ritha-VirtualBox ~ [5]> sudo systemctl restart ssh
aazaf-ritha@aazaf-ritha-VirtualBox ~>
```

iv. Enable the ssh and start the ssh.



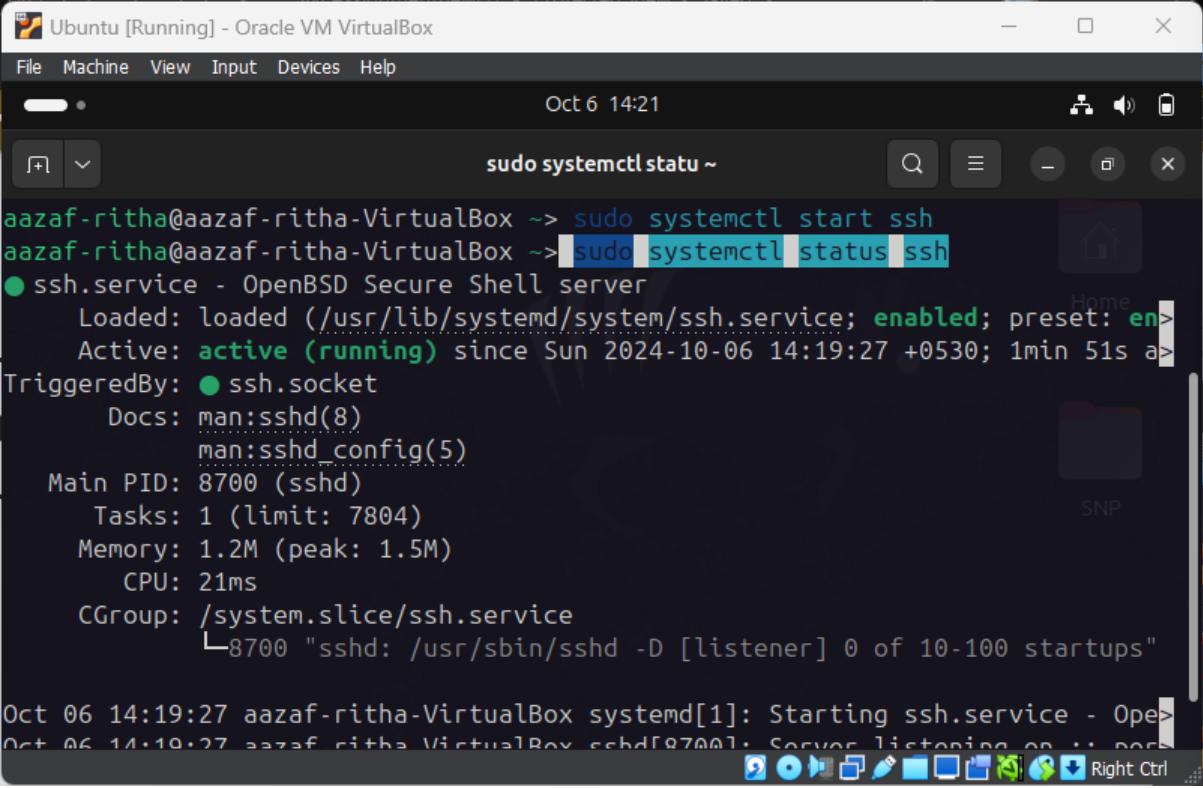
Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 14:20

```
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo systemctl enable ssh
Synchronizing state of ssh.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable ssh
Created symlink /etc/systemd/system/multi-user.target.wants/ssh.service → /usr/lib/systemd/system/ssh.service.
Created symlink /etc/systemd/system/multi-user.target.wants/ssh.service → /usr/lib/systemd/system/ssh.service.
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo systemctl start ssh
aazaf-ritha@aazaf-ritha-VirtualBox ~>
```

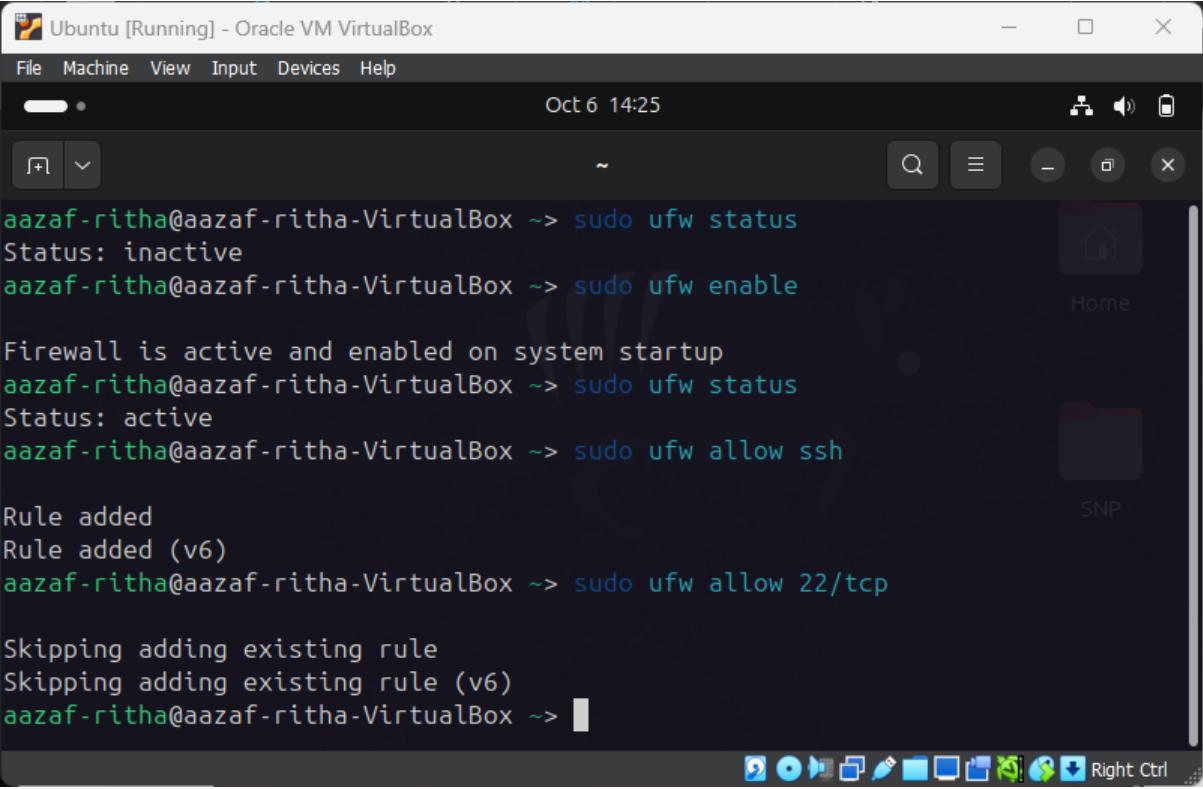
v. Check the status of the ssh.



```
Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 14:21
sudo systemctl status ~
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo systemctl start ssh
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo systemctl status ssh
● ssh.service - OpenBSD Secure Shell server
    Loaded: loaded (/usr/lib/systemd/system/ssh.service; enabled; preset: en>
    Active: active (running) since Sun 2024-10-06 14:19:27 +0530; 1min 51s a>
TriggeredBy: ● ssh.socket
    Docs: man:sshd(8)
          man:sshd_config(5)
  Main PID: 8700 (sshd)
    Tasks: 1 (limit: 7804)
   Memory: 1.2M (peak: 1.5M)
      CPU: 21ms
     CGroup: /system.slice/ssh.service
             └─8700 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Oct 06 14:19:27 aazaf-ritha-VirtualBox systemd[1]: Starting ssh.service - Open>
Oct 06 14:19:27 aazaf-ritha-VirtualBox sshd[8700]: Server listening on :: port 22<
```

This step is to allow ssh through my firewall with which it can listen for incoming requests.

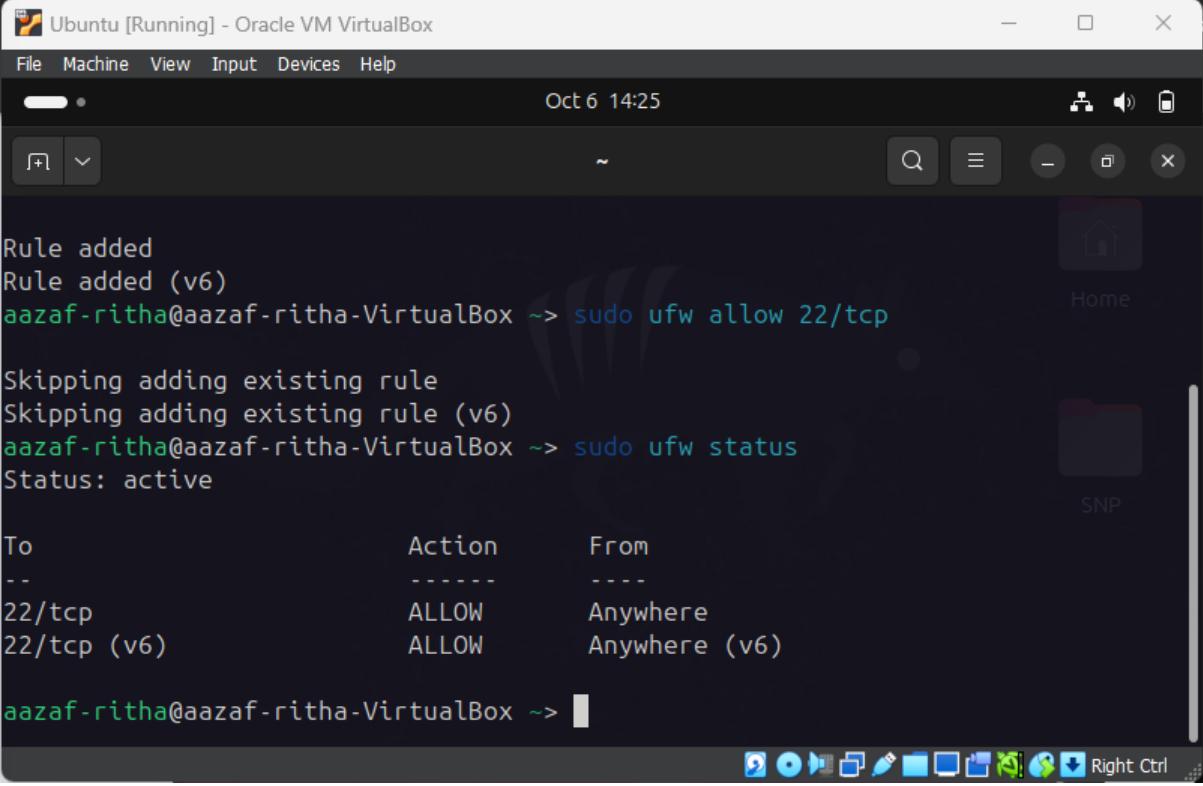


```
Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 14:25
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo ufw status
Status: inactive
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo ufw enable

Firewall is active and enabled on system startup
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo ufw status
Status: active
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo ufw allow ssh

Rule added
Rule added (v6)
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo ufw allow 22/tcp

Skipping adding existing rule
Skipping adding existing rule (v6)
aazaf-ritha@aazaf-ritha-VirtualBox ~>
```



```

Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 14:25
Home
SNP

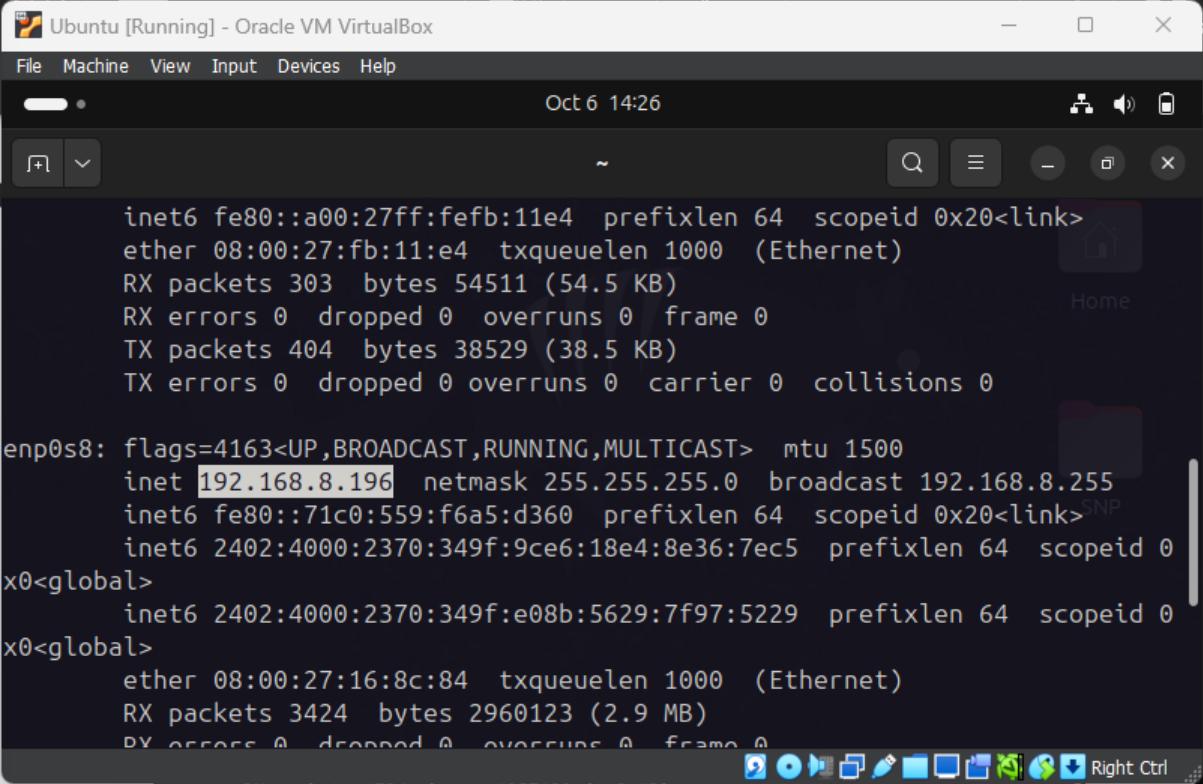
Rule added
Rule added (v6)
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo ufw allow 22/tcp

Skipping adding existing rule
Skipping adding existing rule (v6)
aazaf-ritha@aazaf-ritha-VirtualBox ~> sudo ufw status
Status: active

To           Action      From
--          ----       ---
22/tcp        ALLOW      Anywhere
22/tcp (v6)   ALLOW      Anywhere (v6)

aazaf-ritha@aazaf-ritha-VirtualBox ~>
    
```

Port 22/tcp is the default TCP port for SSH. The next step is to find the server computer's IP address, so the client can connect. Several tools can help with this, including the **ifconfig** command.



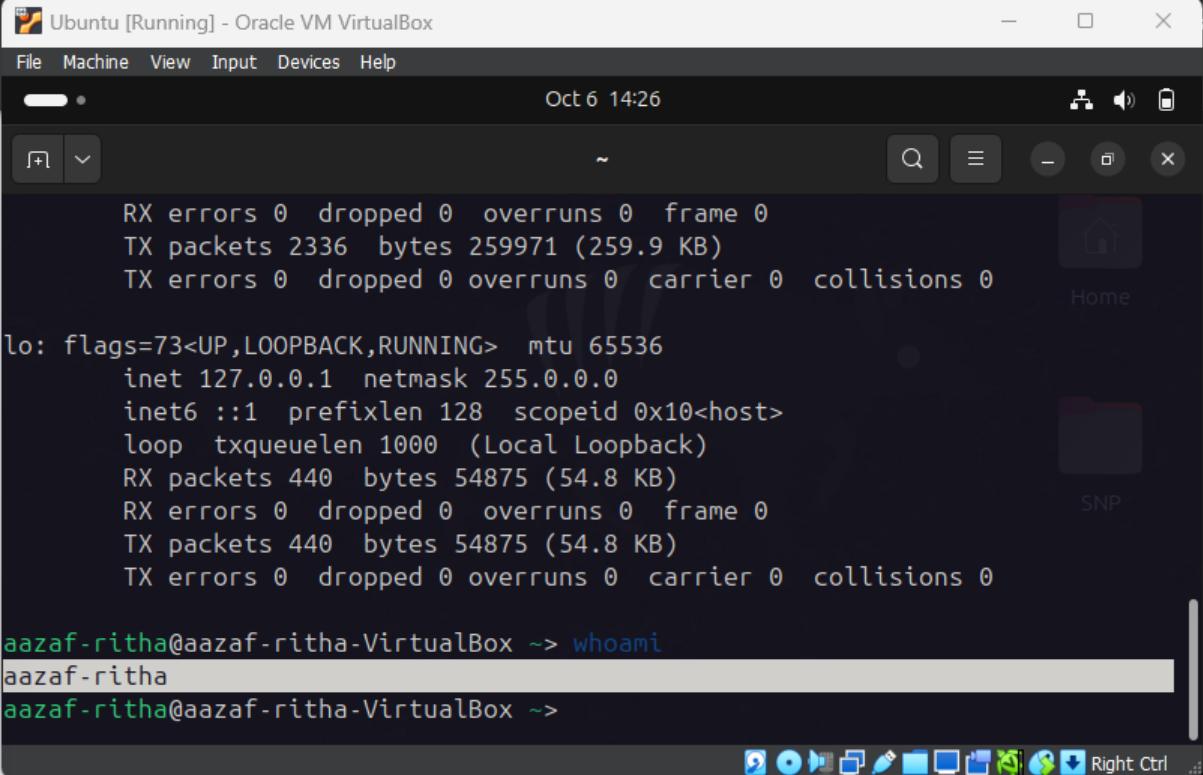
```

Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 14:26
Home
SNP

inet6 fe80::a00:27ff:febf:11e4  prefixlen 64  scopeid 0x20<link>
ether 08:00:27:fb:11:e4  txqueuelen 1000  (Ethernet)
RX packets 303  bytes 54511 (54.5 KB)
RX errors 0  dropped 0  overruns 0  frame 0
TX packets 404  bytes 38529 (38.5 KB)
TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
inet 192.168.8.196  netmask 255.255.255.0  broadcast 192.168.8.255
inet6 fe80::71c0:559:f6a5:d360  prefixlen 64  scopeid 0x20<link>
inet6 2402:4000:2370:349f:9ce6:18e4:8e36:7ec5  prefixlen 64  scopeid 0
x0<global>
inet6 2402:4000:2370:349f:e08b:5629:7f97:5229  prefixlen 64  scopeid 0
x0<global>
ether 08:00:27:16:8c:84  txqueuelen 1000  (Ethernet)
RX packets 3424  bytes 2960123 (2.9 MB)
RX errors 0  dropped 0  overruns 0  frame 0
    
```

Checking the username.



```

Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 14:26
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 2336 bytes 259971 (259.9 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
inet 127.0.0.1 netmask 255.0.0.0
inet6 ::1 prefixlen 128 scopeid 0x10<host>
loop txqueuelen 1000 (Local Loopback)
RX packets 440 bytes 54875 (54.8 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 440 bytes 54875 (54.8 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

aazaf-ritha@aazaf-ritha-VirtualBox ~> whoami
aazaf-ritha
aazaf-ritha@aazaf-ritha-VirtualBox ~>

```

Using Windows Command Prompt, I connected to my Ubuntu 24.04.1 LTS server via SSH by executing `ssh aazaf-ritha@192.168.8.196`. Upon first connection, I verified and accepted the server's fingerprint. After logging in with my password, I accessed the server where the prompt displayed the Ubuntu version and my username (**aazaf-ritha**). The terminal output indicated that no updates were immediately necessary, though eight security updates were available through ESM Apps. I verified my current directory with `pwd`, listed directory contents with `ls`, and confirmed the system architecture using `uname`, ensuring full operational access to the server.

```
aazaf-ritha@aazaf-ritha-V ~ + - X
Microsoft Windows [Version 10.0.22631.4249]
(c) Microsoft Corporation. All rights reserved.

C:\Users\aaazaf>aaazaf-ritha@192.168.8.196
'aaazaf-ritha@192.168.8.196' is not recognized as an internal or external command,
operable program or batch file.

C:\Users\aaazaf>ssh aaazaf-ritha@192.168.8.196
The authenticity of host '192.168.8.196 (192.168.8.196)' can't be established.
ED25519 key fingerprint is SHA256:lxOMEtaEn6Rj8GOpdZoBPOWdRarTuxsS/f6ekDEI09k.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.8.196' (ED25519) to the list of known hosts.
aaazaf-ritha@192.168.8.196's password:
Welcome to Ubuntu 24.04.1 LTS (GNU/Linux 6.8.0-45-generic x86_64)

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

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

8 additional security updates can be applied with ESM Apps.
Learn more about enabling ESM Apps service at https://ubuntu.com/esm

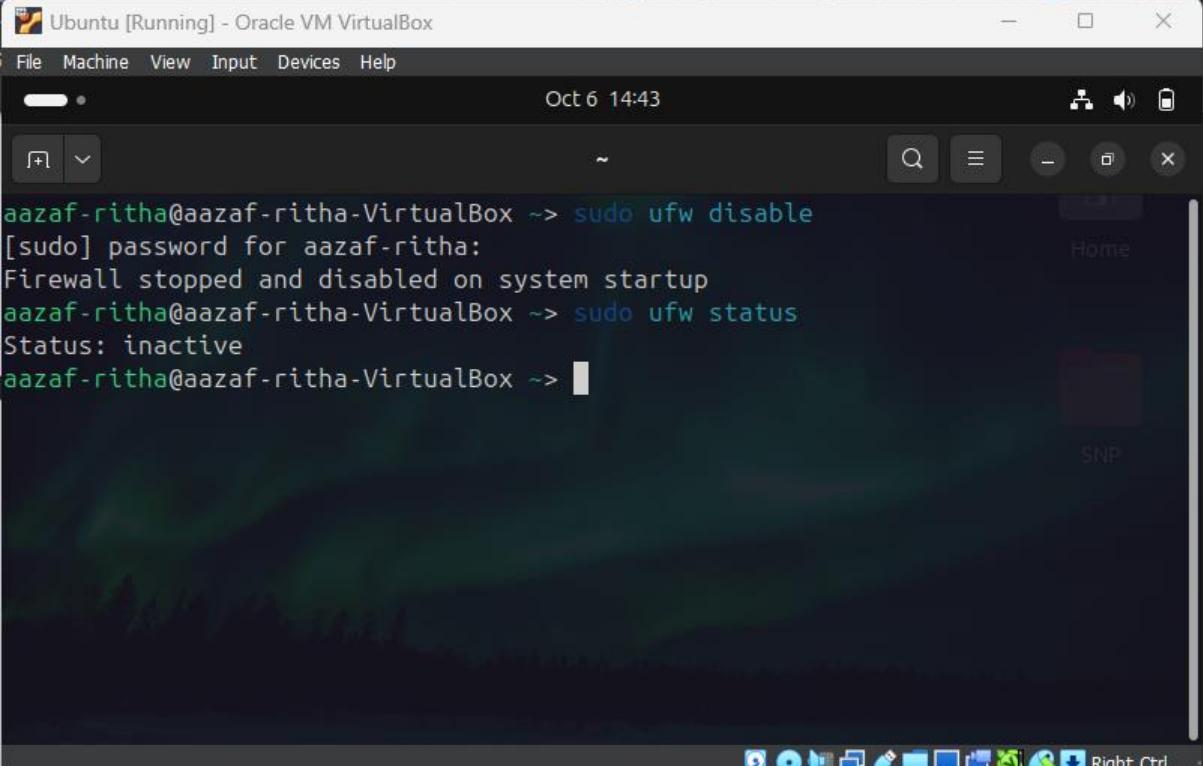
The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

aaazaf-ritha@aazaf-ritha-VirtualBox:~$ whoami
aaazaf-ritha
aaazaf-ritha@aazaf-ritha-VirtualBox:~$ pwd
/home/aaazaf-ritha
aaazaf-ritha@aazaf-ritha-VirtualBox:~$ ls
Desktop   Downloads  Music   Public  Templates
Documents msfinstall Pictures snap   Videos
aaazaf-ritha@aazaf-ritha-VirtualBox:~$ uname
Linux
aaazaf-ritha@aazaf-ritha-VirtualBox:~$
```

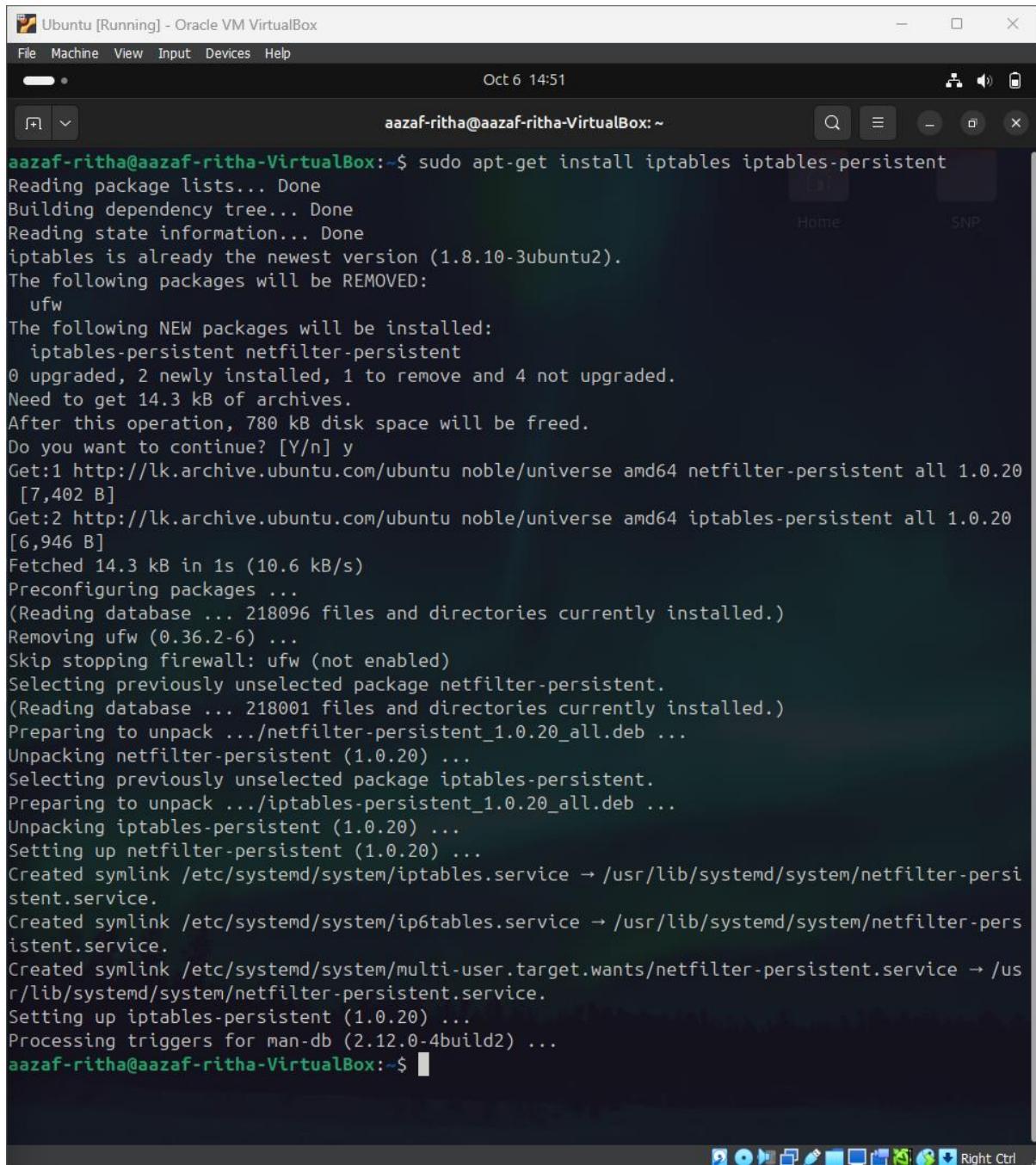
4.3. iptables and ACLs

Iptables serves as a firewall and is available on all Linux operating systems. Notably, many distributions come pre-installed with "**ufw**," which often acts as the default firewall interface. Initially, I disabled '**ufw**' to install and configure iptables directly.



```
Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 14:43
azaf-ritha@azaf-ritha-VirtualBox ~> sudo ufw disable
[sudo] password for azaf-ritha:
Firewall stopped and disabled on system startup
azaf-ritha@azaf-ritha-VirtualBox ~> sudo ufw status
Status: inactive
azaf-ritha@azaf-ritha-VirtualBox ~>
```

Then Install iptables using '**sudo apt install iptables**'



```
aazaf-rita@aaazaf-rita-VirtualBox:~$ sudo apt-get install iptables iptables-persistent
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
iptables is already the newest version (1.8.10-3ubuntu2).
The following packages will be REMOVED:
  ufw
The following NEW packages will be installed:
  iptables-persistent netfilter-persistent
0 upgraded, 2 newly installed, 1 to remove and 4 not upgraded.
Need to get 14.3 kB of archives.
After this operation, 780 kB disk space will be freed.
Do you want to continue? [Y/n] y
Get:1 http://lk.archive.ubuntu.com/ubuntu noble/universe amd64 netfilter-persistent all 1.0.20
[7,402 B]
Get:2 http://lk.archive.ubuntu.com/ubuntu noble/universe amd64 iptables-persistent all 1.0.20
[6,946 B]
Fetched 14.3 kB in 1s (10.6 kB/s)
Preconfiguring packages ...
(Reading database ... 218096 files and directories currently installed.)
Removing ufw (0.36.2-6) ...
Skip stopping firewall: ufw (not enabled)
Selecting previously unselected package netfilter-persistent.
(Reading database ... 218001 files and directories currently installed.)
Preparing to unpack .../netfilter-persistent_1.0.20_all.deb ...
Unpacking netfilter-persistent (1.0.20) ...
Selecting previously unselected package iptables-persistent.
Preparing to unpack .../iptables-persistent_1.0.20_all.deb ...
Unpacking iptables-persistent (1.0.20) ...
Setting up netfilter-persistent (1.0.20) ...
Created symlink /etc/systemd/system/iptables.service → /usr/lib/systemd/system/netfilter-persistent.service.
Created symlink /etc/systemd/system/ip6tables.service → /usr/lib/systemd/system/netfilter-persistent.service.
Created symlink /etc/systemd/system/multi-user.target.wants/netfilter-persistent.service → /usr/lib/systemd/system/netfilter-persistent.service.
Setting up iptables-persistent (1.0.20) ...
Processing triggers for man-db (2.12.0-4build2) ...
aazaf-rita@aaazaf-rita-VirtualBox:~$
```

I started by setting default policies to drop all incoming connections and allow all outgoing connections

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 14:53

aazaf-ritha@aazaf-ritha-VirtualBox: ~

```
Unpacking netfilter-persistent (1.0.20) ...
Selecting previously unselected package iptables-persistent.
Preparing to unpack .../iptables-persistent_1.0.20_all.deb ...
Unpacking iptables-persistent (1.0.20) ...
Setting up netfilter-persistent (1.0.20) ...
Created symlink /etc/systemd/system/iptables.service → /usr/lib/systemd/system
/netfilter-persistent.service.
Created symlink /etc/systemd/system/ip6tables.service → /usr/lib/systemd/system
/netfilter-persistent.service.
Created symlink /etc/systemd/system/multi-user.target.wants/netfilter-persistent
.service → /usr/lib/systemd/system/netfilter-persistent.service.
Setting up iptables-persistent (1.0.20) ...
Processing triggers for man-db (2.12.0-4build2) ...
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo iptables -P INPUT DROP
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo iptables -P OUTPUT ACCEPT
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

Home

SNP

Right Ctrl

i. Web Server Security

Allowed HTTP and HTTPS

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 14:58

aazaf-ritha@aazaf-ritha-VirtualBox: ~

```
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo iptables -A INPUT -p tcp --dport 80
-j ACCEPT
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo iptables -A INPUT -p tcp --dport 44
3 -j ACCEPT
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

Home

SNP

Right Ctrl

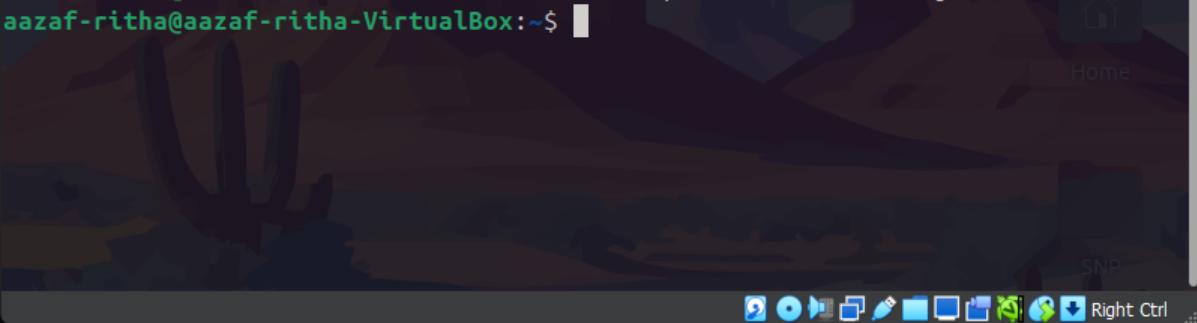
Then I blocked all other incoming traffic

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 15:07

aazaf-ritha@aazaf-ritha-VirtualBox:~\$ sudo iptables -A INPUT -j DROP
 aazaf-ritha@aazaf-ritha-VirtualBox:~\$



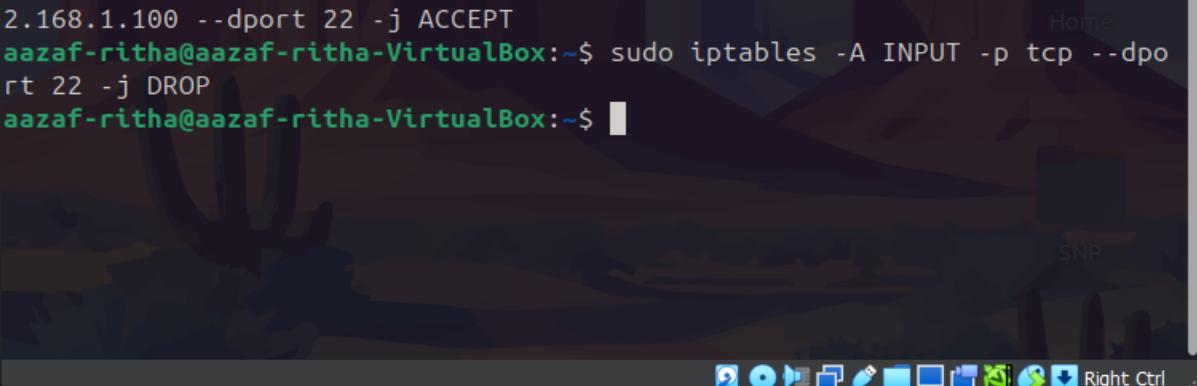
ii. Remote Administration Access

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Oct 6 15:14

aazaf-ritha@aazaf-ritha-VirtualBox:~\$ sudo iptables -A INPUT -p tcp -s 192.168.1.100 --dport 22 -j ACCEPT
 aazaf-ritha@aazaf-ritha-VirtualBox:~\$ sudo iptables -A INPUT -p tcp --dport 22 -j DROP
 aazaf-ritha@aazaf-ritha-VirtualBox:~\$



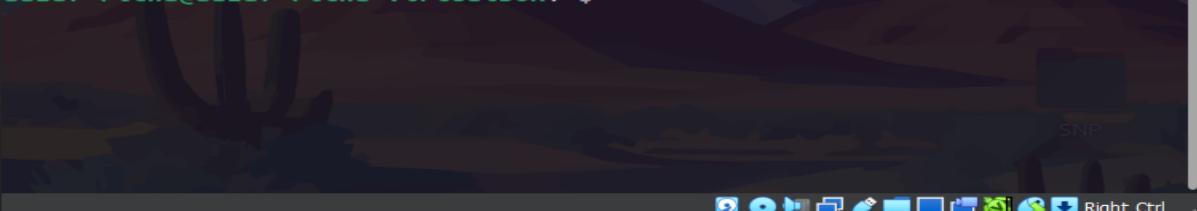
iii. Allow Specific Applications

Ubuntu [Running] - Oracle VM VirtualBox

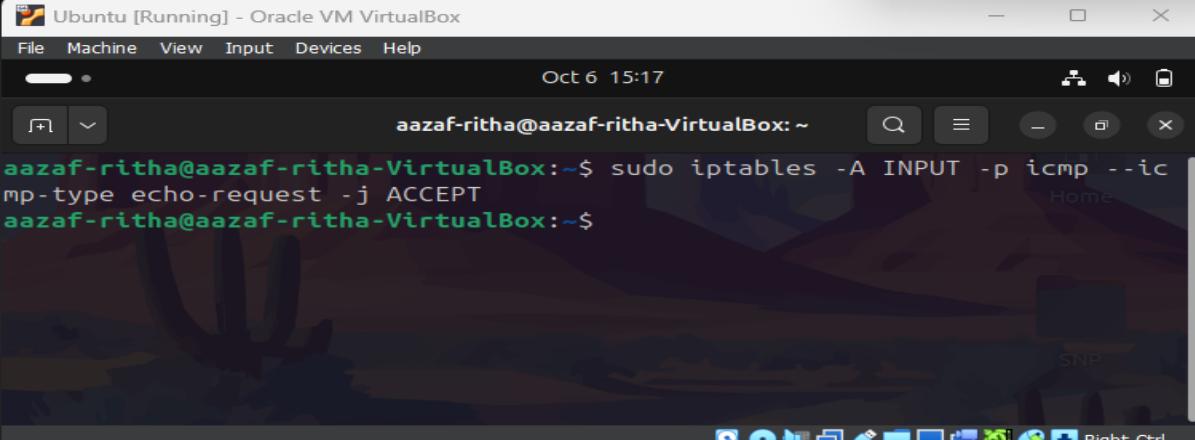
File Machine View Input Devices Help

Oct 6 15:16

aazaf-ritha@aazaf-ritha-VirtualBox:~\$ sudo iptables -A INPUT -p tcp --dport 443 -j ACCEPT
 aazaf-ritha@aazaf-ritha-VirtualBox:~\$

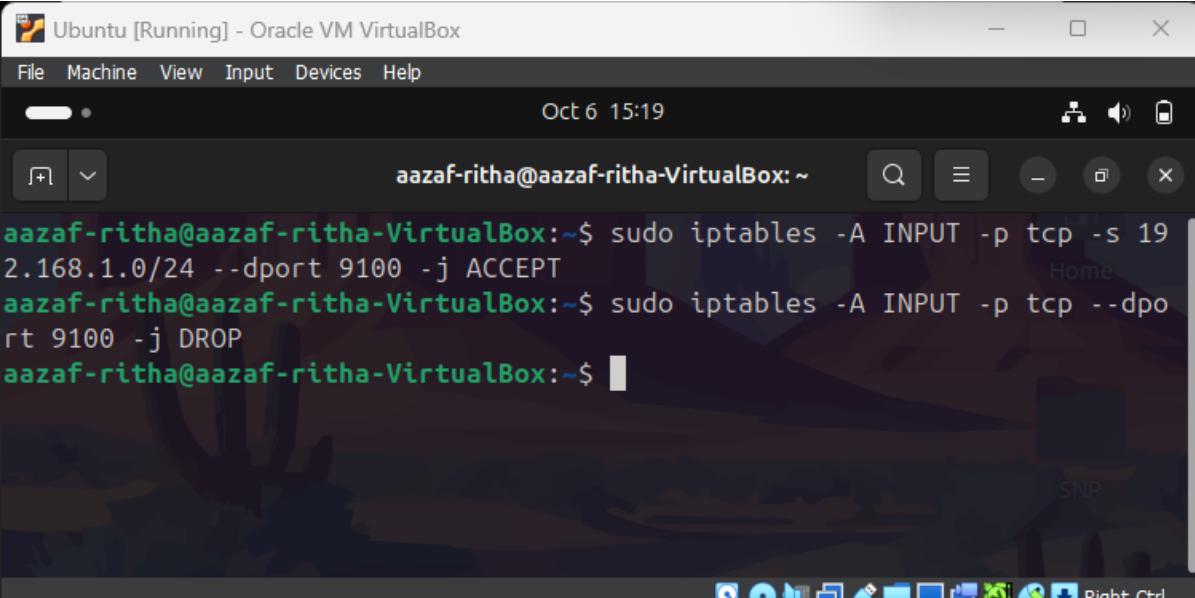


iv. Allow Pings (ICMP Echo Request)



```
Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 15:17
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo iptables -A INPUT -p icmp --icmp-type echo-request -j ACCEPT
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

v. Printer Server Access:



```
Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 15:19
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo iptables -A INPUT -p tcp -s 192.168.1.0/24 --dport 9100 -j ACCEPT
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo iptables -A INPUT -p tcp --dport 9100 -j DROP
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

After configuring the iptables, I typed the command **sudo iptables -L** to see if the permissions are successful.

Ubuntu [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help Oct 6 15:28 aazaf-rita@aazaf-rita-VirtualBox: ~

```
aazaf-rita@aazaf-rita-VirtualBox:~$ sudo iptable 0L
sudo: iptable: command not found
aazaf-rita@aazaf-rita-VirtualBox:~$ sudo iptable -L

sudo: iptable: command not found
aazaf-rita@aazaf-rita-VirtualBox:~$ sudo iptables -L
Chain INPUT (policy DROP)
target  prot opt source          destination
ufw-before-logging-input  all  --  anywhere        anywhere
ufw-before-input  all  --  anywhere        anywhere
ufw-after-input  all  --  anywhere        anywhere
ufw-after-logging-input  all  --  anywhere        anywhere
ufw-reject-input  all  --  anywhere        anywhere
ufw-track-input  all  --  anywhere        anywhere
ACCEPT   tcp  --  anywhere      anywhere          tcp dpt:http
ACCEPT   tcp  --  anywhere      anywhere          tcp dpt:https
DROP     all  --  anywhere      anywhere
ACCEPT   tcp  --  192.168.1.100  anywhere          tcp dpt:ssh
DROP     tcp  --  anywhere      anywhere          tcp dpt:ssh
ACCEPT   tcp  --  anywhere      anywhere          tcp dpt:https
ACCEPT   icmp --  anywhere     anywhere          icmp echo-request
ACCEPT   tcp  --  192.168.1.0/24  anywhere          tcp dpt:9100
DROP     tcp  --  anywhere      anywhere          tcp dpt:9100

Chain FORWARD (policy ACCEPT)
target  prot opt source          destination
ufw-before-logging-forward  all  --  anywhere        anywhere
ufw-before-forward  all  --  anywhere        anywhere
ufw-after-forward  all  --  anywhere        anywhere
ufw-after-logging-forward  all  --  anywhere        anywhere
ufw-reject-forward  all  --  anywhere        anywhere
ufw-track-forward  all  --  anywhere        anywhere

Chain OUTPUT (policy ACCEPT)
target  prot opt source          destination
ufw-before-logging-output  all  --  anywhere        anywhere
ufw-before-output  all  --  anywhere        anywhere
ufw-after-output  all  --  anywhere        anywhere
ufw-after-logging-output  all  --  anywhere        anywhere
ufw-reject-output  all  --  anywhere        anywhere
ufw-track-output  all  --  anywhere        anywhere
```

05. Best Practices for Linux Network Security

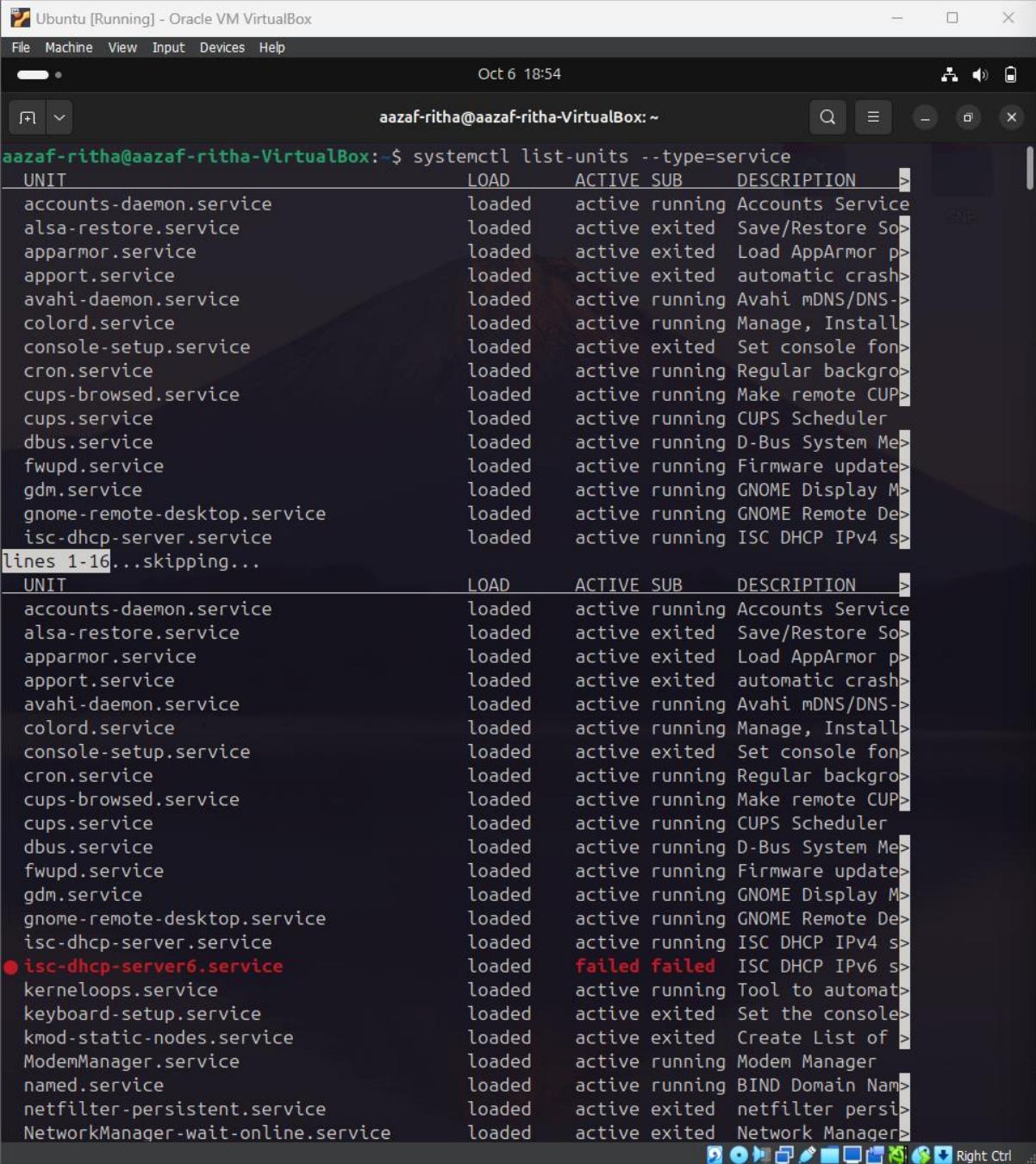
5.1. Disable Unused Network Services

I aimed to reduce the system's attack surface by disabling services that were not in use.

Identified active services.

I opened the terminal and ran the following command to list all the active services.

```
systemctl list-units --type=service
```



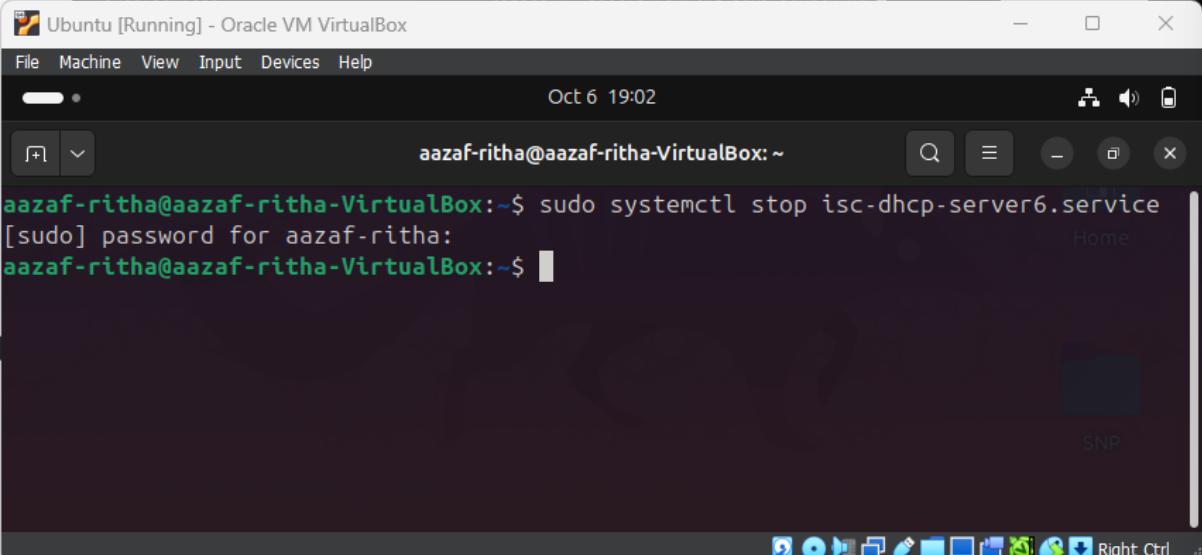
```
aazaf-ritha@aazaf-ritha-VirtualBox:~$ systemctl list-units --type=service
UNIT                                     LOAD   ACTIVE SUB   DESCRIPTION
accounts-daemon.service                  loaded  active  running Accounts Service
alsa-restore.service                    loaded  active  exited   Save/Restore So>
apparmor.service                        loaded  active  exited   Load AppArmor p>
apport.service                          loaded  active  exited   automatic crash>
avahi-daemon.service                   loaded  active  running Avahi mDNS/DNS->
colord.service                          loaded  active  running Manage, Install>
console-setup.service                  loaded  active  exited   Set console fon>
cron.service                            loaded  active  running Regular backgro>
cups-browsed.service                   loaded  active  running Make remote CUP>
cups.service                           loaded  active  running CUPS Scheduler
dbus.service                            loaded  active  running D-Bus System Me>
fwupd.service                           loaded  active  running Firmware update>
gdm.service                            loaded  active  running GNOME Display M>
gnome-remote-desktop.service          loaded  active  running GNOME Remote De>
isc-dhcp-server.service                loaded  active  running ISC DHCP IPv4 s>
lines 1-16...skipping...
UNIT                                     LOAD   ACTIVE SUB   DESCRIPTION
accounts-daemon.service                  loaded  active  running Accounts Service
alsa-restore.service                    loaded  active  exited   Save/Restore So>
apparmor.service                        loaded  active  exited   Load AppArmor p>
apport.service                          loaded  active  exited   automatic crash>
avahi-daemon.service                   loaded  active  running Avahi mDNS/DNS->
colord.service                          loaded  active  running Manage, Install>
console-setup.service                  loaded  active  exited   Set console fon>
cron.service                            loaded  active  running Regular backgro>
cups-browsed.service                   loaded  active  running Make remote CUP>
cups.service                           loaded  active  running CUPS Scheduler
dbus.service                            loaded  active  running D-Bus System Me>
fwupd.service                           loaded  active  running Firmware update>
gdm.service                            loaded  active  running GNOME Display M>
gnome-remote-desktop.service          loaded  active  running GNOME Remote De>
isc-dhcp-server6.service               loaded  failed  failed  ISC DHCP IPv6 s>
kerneloops.service                     loaded  active  running Tool to automat>
keyboard-setup.service                 loaded  active  exited   Set the console>
kmod-static-nodes.service              loaded  active  exited   Create List of >
ModemManager.service                   loaded  active  running Modem Manager
named.service                           loaded  active  running BIND Domain Nam>
netfilter-persistent.service           loaded  active  exited   netfilter persis>
NetworkManager-wait-online.service    loaded  active  exited   Network Manager
```

I reviewed the list to identify unnecessary services.

Stop the service if it's currently running.

If a service is currently running and I want to stop it immediately, I used the following command:

```
sudo systemctl stop <service_name>
```

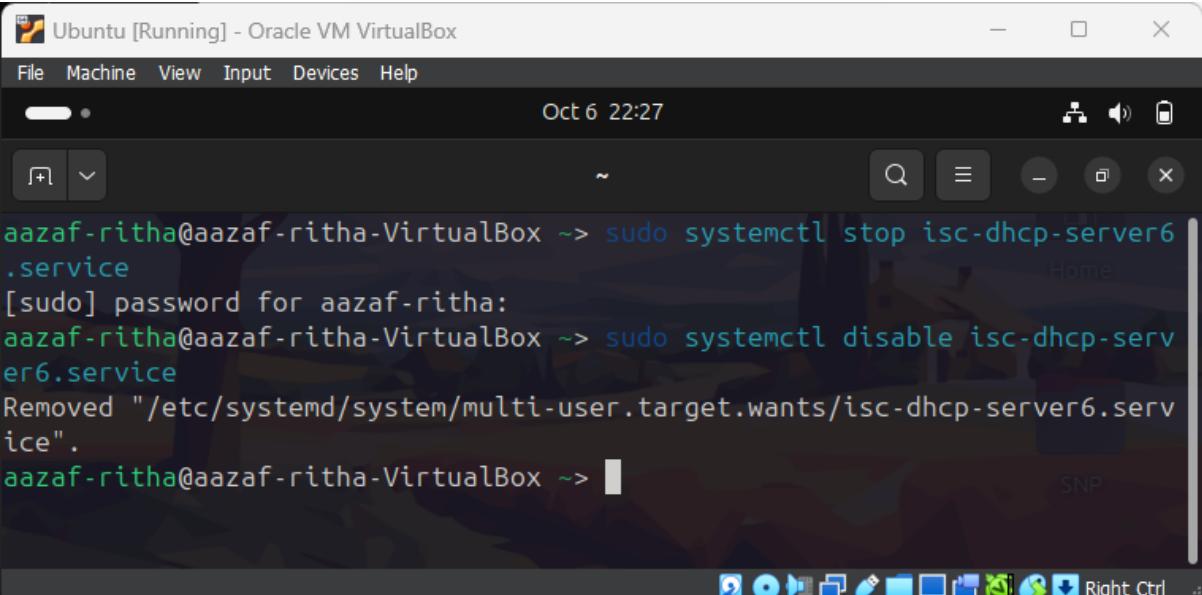


The screenshot shows a terminal window titled "Ubuntu [Running] - Oracle VM VirtualBox". The terminal prompt is "aaazaf-ritha@aaazaf-ritha-VirtualBox:~\$". The user runs the command "sudo systemctl stop isc-dhcp-server6.service". A password prompt follows: "[sudo] password for aaazaf-ritha:". The terminal then displays the command again: "aaazaf-ritha@aaazaf-ritha-VirtualBox:~\$".

Disabled unnecessary services.

For each service that was not needed, I disabled it to prevent it from starting at boot.

```
sudo systemctl disable <service_name>
```



The screenshot shows a terminal window titled "Ubuntu [Running] - Oracle VM VirtualBox". The terminal prompt is "aaazaf-ritha@aaazaf-ritha-VirtualBox ~>". The user runs the command "sudo systemctl stop isc-dhcp-server6.service". A password prompt follows: "[sudo] password for aaazaf-ritha:". The user then runs the command "sudo systemctl disable isc-dhcp-server6.service". The terminal displays the message "Removed '/etc/systemd/system/multi-user.target.wants/isc-dhcp-server6.service'." The terminal prompt ends with "aaazaf-ritha@aaazaf-ritha-VirtualBox ~>".

5.2. Configuring Firewall Rules Using iptables

I configured the firewall to control network traffic and protected the system from unauthorized access.

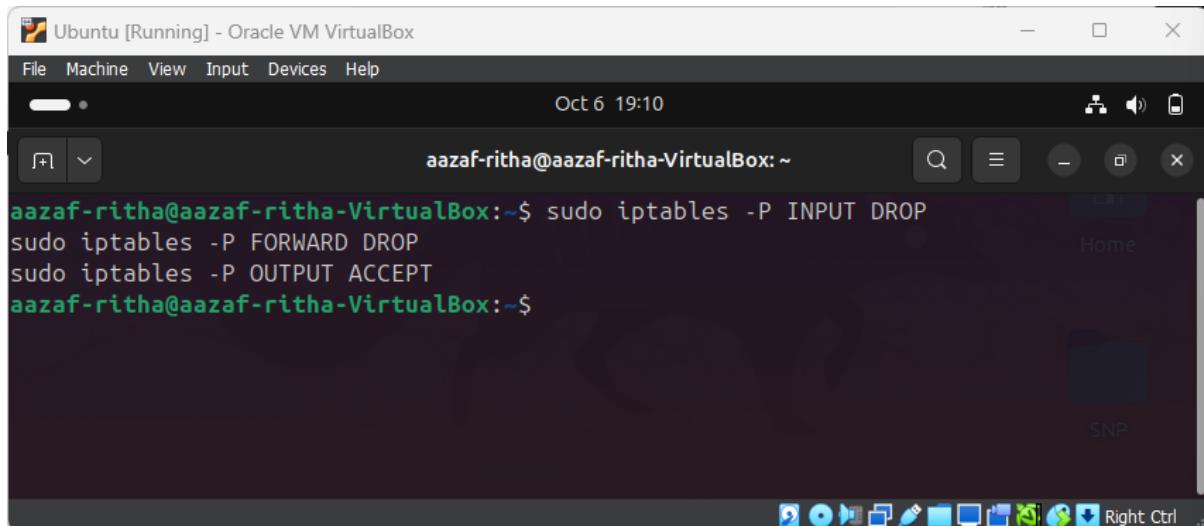
5.2.1. Set Default Policies

I set up the default policy to block all inbound and forwarding traffic

```
sudo iptables -P INPUT DROP
```

```
sudo iptables -P FORWARD DROP
```

```
sudo iptables -P OUTPUT ACCEPT
```

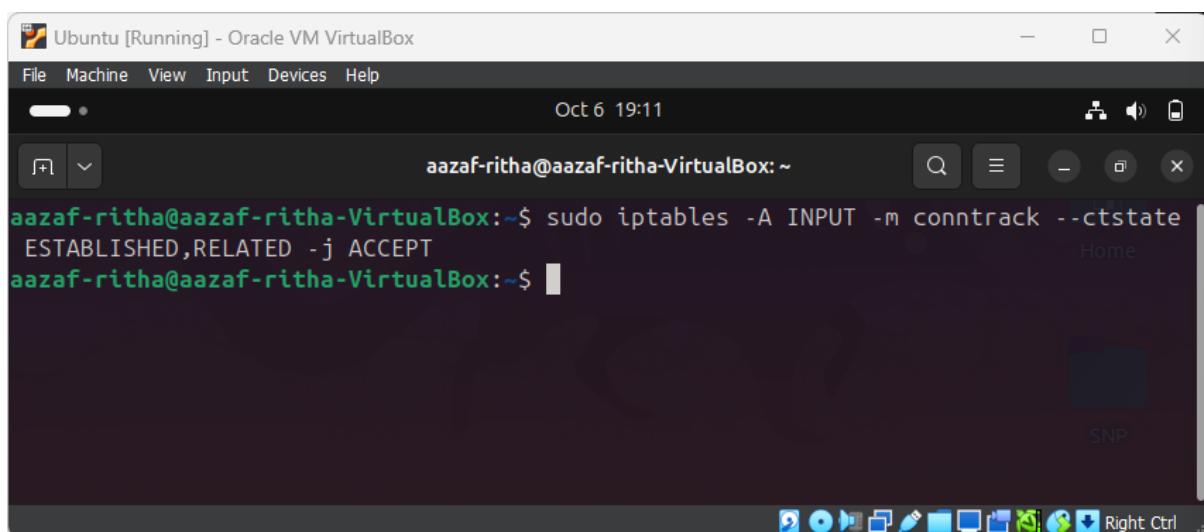


The screenshot shows a terminal window titled "Ubuntu [Running] - Oracle VM VirtualBox". The terminal prompt is "aazaf-ritha@aazaf-ritha-VirtualBox:~\$". The user has run three commands:
`sudo iptables -P INPUT DROP`
`sudo iptables -P FORWARD DROP`
`sudo iptables -P OUTPUT ACCEPT`

5.2.2. Allowed Established Connections

I allowed incoming traffic for established and related connections

```
sudo iptables -A INPUT -m conntrack --ctstate ESTABLISHED,RELATED -j  
ACCEPT
```

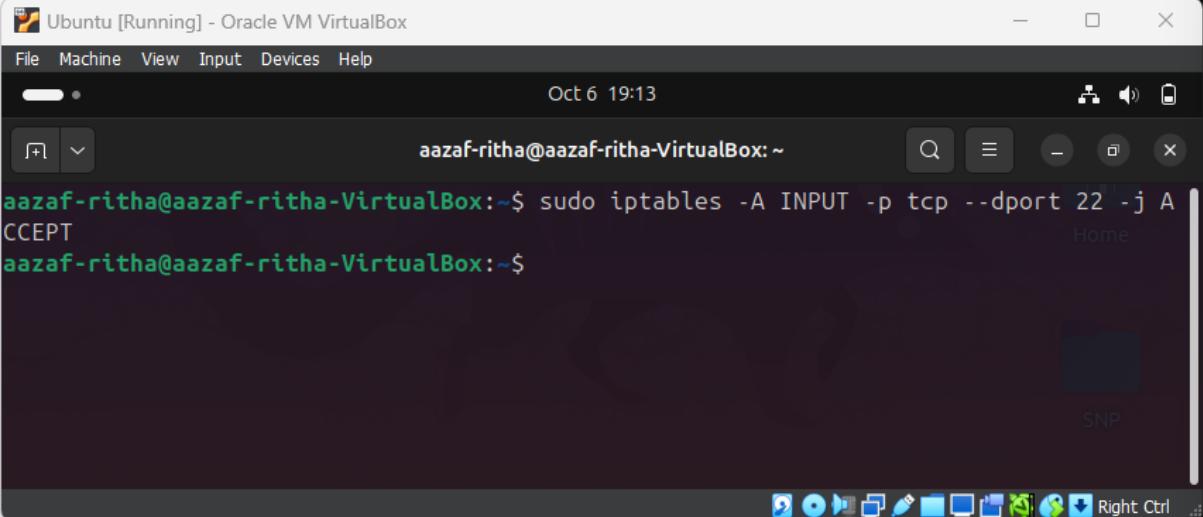


The screenshot shows a terminal window titled "Ubuntu [Running] - Oracle VM VirtualBox". The terminal prompt is "aazaf-ritha@aazaf-ritha-VirtualBox:~\$". The user has run one command:
`sudo iptables -A INPUT -m conntrack --ctstate ESTABLISHED,RELATED -j ACCEPT`

5.2.3. Enabled SSH Access

I allowed SSH access by enabling incoming traffic on port 22

```
sudo iptables -A INPUT -p tcp --dport 22 -j ACCEPT
```

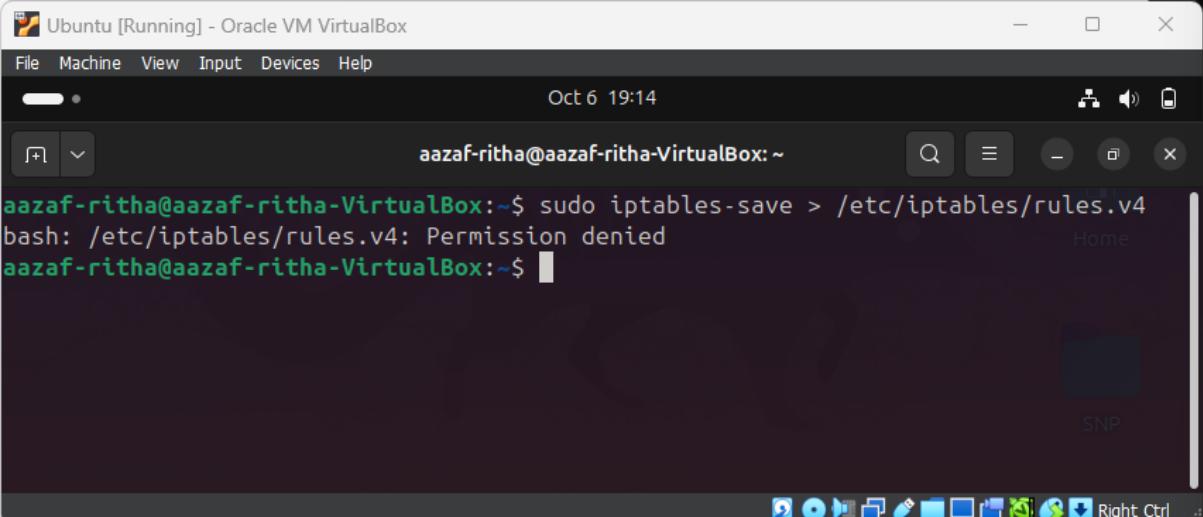


```
Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 19:13
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo iptables -A INPUT -p tcp --dport 22 -j ACCEPT
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

5.2.4. Saved Firewall Configuration

I saved the firewall rules to ensure they continue after reboot

```
sudo iptables-save > /etc/iptables/rules.v4
```



```
Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 6 19:14
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo iptables-save > /etc/iptables/rules.v4
bash: /etc/iptables/rules.v4: Permission denied
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

5.3. Securing SSH Access

I enhanced security for remote SSH access to prevent unauthorized entry.

5.3.1. Modified SSH Configuration

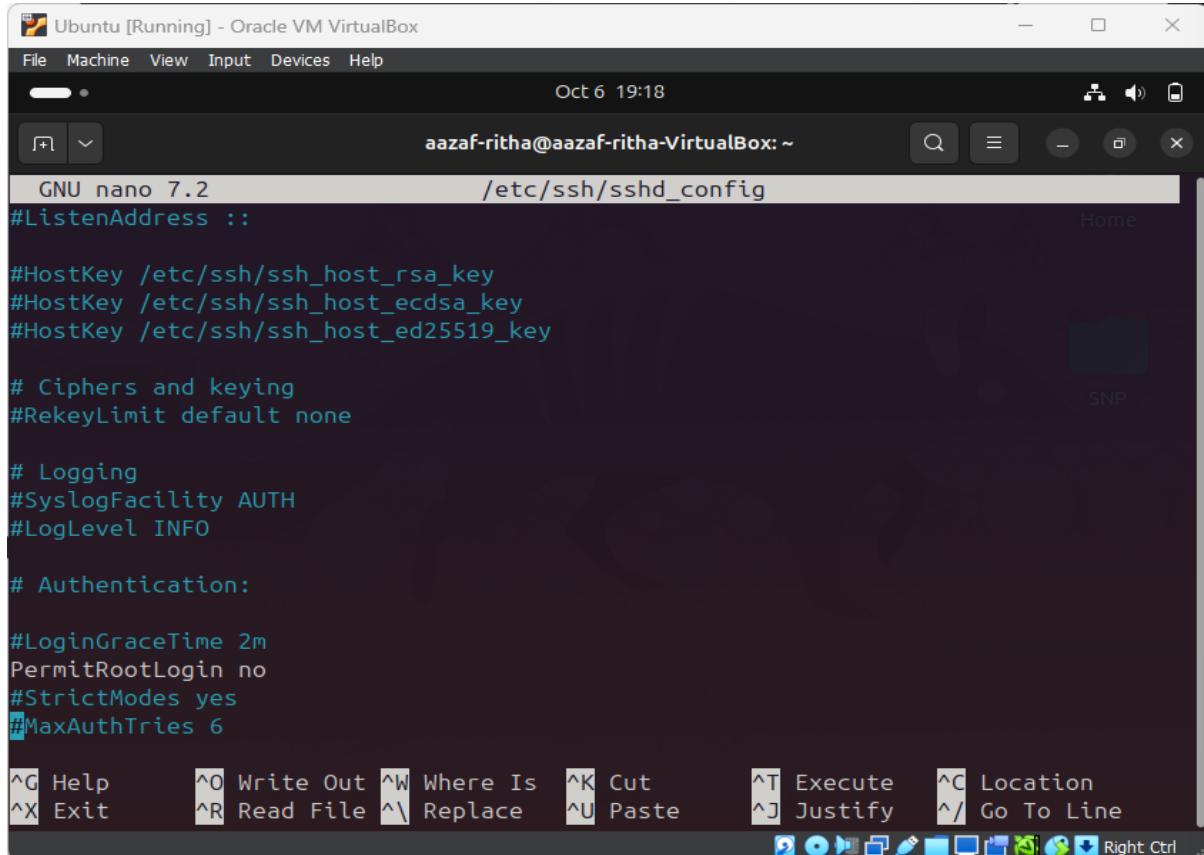
I edited the SSH configuration file with the following changes:

- Disabled root login: **PermitRootLogin no**

- Enabled key-based authentication: **PasswordAuthentication no**
- Prohibited empty passwords: **PermitEmptyPasswords no**

I used the following command to edit the file

```
sudo nano /etc/ssh/sshd_config
```



```
GNU nano 7.2          /etc/ssh/sshd_config
#ListenAddress ::

#HostKey /etc/ssh/ssh_host_rsa_key
#HostKey /etc/ssh/ssh_host_ecdsa_key
#HostKey /etc/ssh/ssh_host_ed25519_key

# Ciphers and keying
#RekeyLimit default none

# Logging
#SyslogFacility AUTH
#LogLevel INFO

# Authentication:

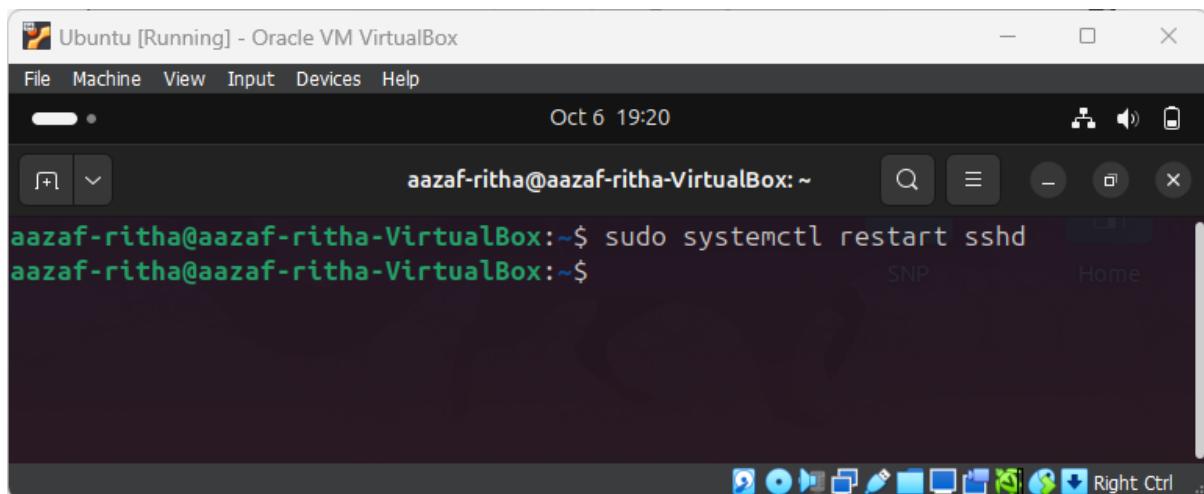
#LoginGraceTime 2m
PermitRootLogin no
#StrictModes yes
#MaxAuthTries 6

^G Help      ^O Write Out  ^W Where Is  ^K Cut      ^T Execute  ^C Location
^X Exit      ^R Read File  ^\ Replace   ^U Paste    ^J Justify  ^/ Go To Line
                                         Right Ctrl
```

5.3.2. Restarted SSH Service

After making the changes, I restarted the SSH service to apply the new settings

```
sudo systemctl restart sshd
```



```
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo systemctl restart sshd
aazaf-ritha@aazaf-ritha-VirtualBox:~$
```

5.4. Regular Updates and Security Patches

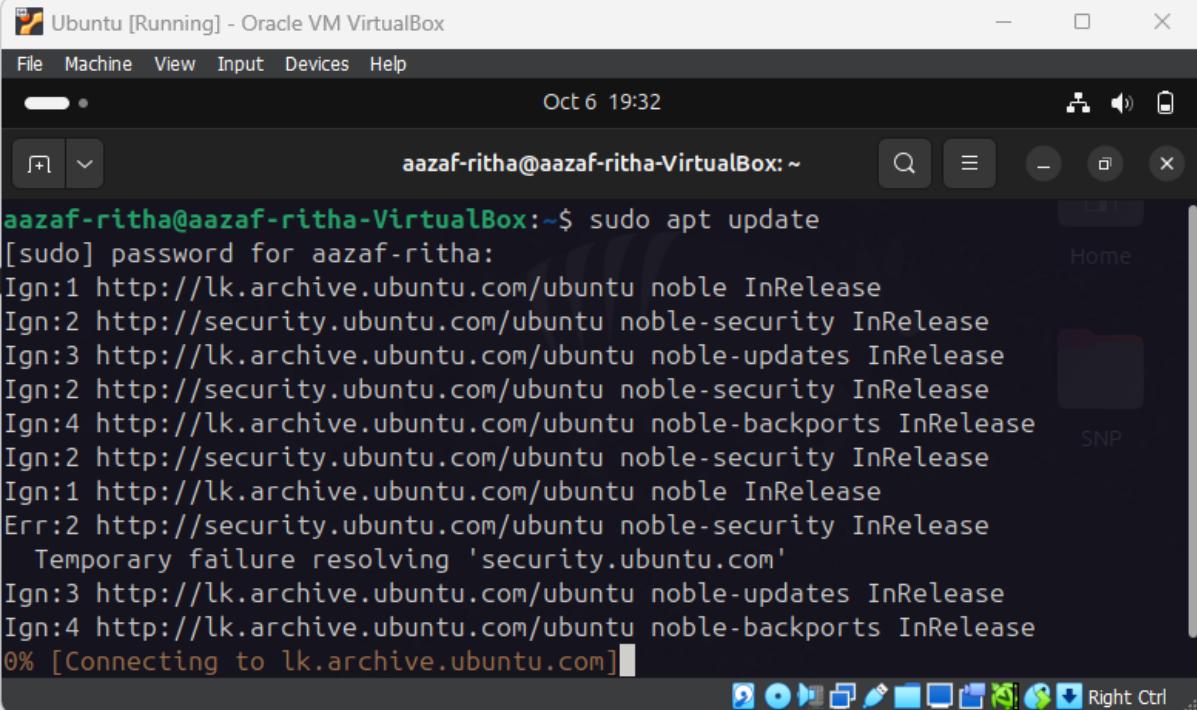
I ensured the system remained secure by regularly applying updates and patches.

5.4.1. Updated Software Packages

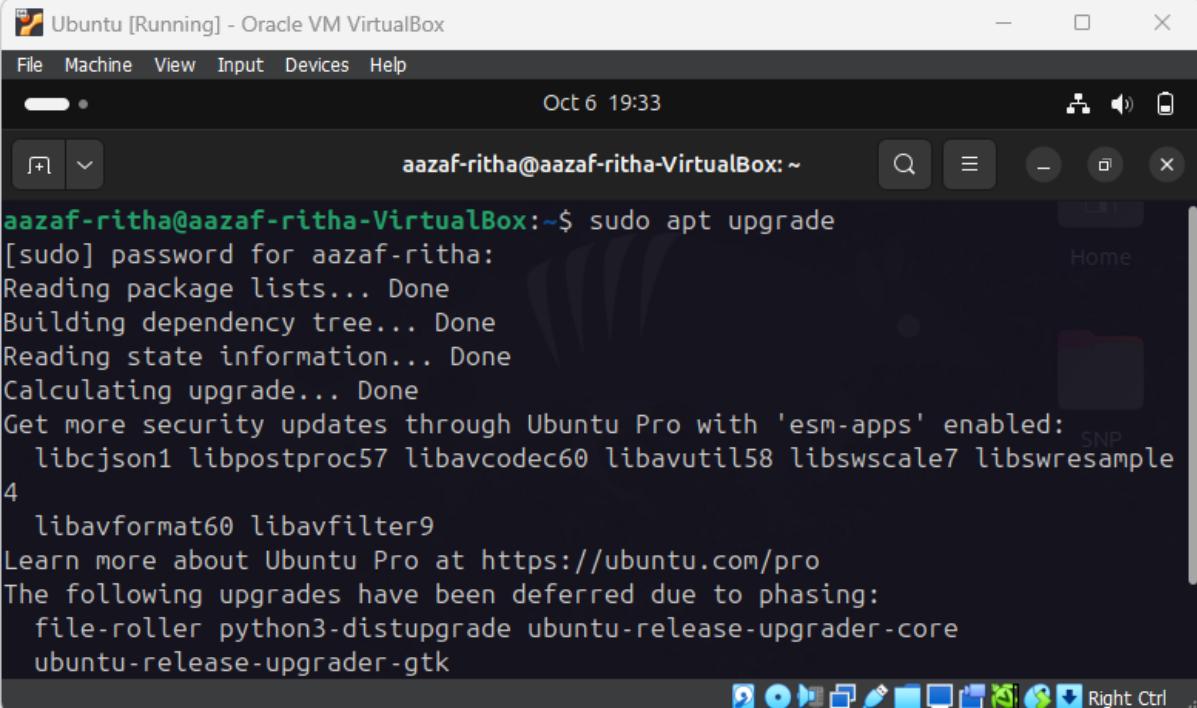
I used the following commands to update the system and install the latest security patches

```
sudo apt update
```

```
sudo apt upgrade
```



```
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo apt update
[sudo] password for aazaf-ritha:
Ign:1 http://lk.archive.ubuntu.com/ubuntu noble InRelease
Ign:2 http://security.ubuntu.com/ubuntu noble-security InRelease
Ign:3 http://lk.archive.ubuntu.com/ubuntu noble-updates InRelease
Ign:2 http://security.ubuntu.com/ubuntu noble-security InRelease
Ign:4 http://lk.archive.ubuntu.com/ubuntu noble-backports InRelease
Ign:2 http://security.ubuntu.com/ubuntu noble-security InRelease
Ign:1 http://lk.archive.ubuntu.com/ubuntu noble InRelease
Err:2 http://security.ubuntu.com/ubuntu noble-security InRelease
      Temporary failure resolving 'security.ubuntu.com'
Ign:3 http://lk.archive.ubuntu.com/ubuntu noble-updates InRelease
Ign:4 http://lk.archive.ubuntu.com/ubuntu noble-backports InRelease
0% [Connecting to lk.archive.ubuntu.com]
```



```
aazaf-ritha@aazaf-ritha-VirtualBox:~$ sudo apt upgrade
[sudo] password for aazaf-ritha:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
Get more security updates through Ubuntu Pro with 'esm-apps' enabled:
  libcjson1 libpostproc57 libavcodec60 libavutil58 libswscale7 libswresample
4
  libavformat60 libavfilter9
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following upgrades have been deferred due to phasing:
  file-roller python3-distupgrade ubuntu-release-upgrader-core
  ubuntu-release-upgrader-gtk
```

5.5. Network Interface Configuration Security

I secured the network interfaces by disabling unused protocols and preventing unauthorized network activity.

5.5.1. Disabled IPv6

Since IPv6 was not needed, I disabled it by editing the sysctl configuration file

```
sudo nano /etc/sysctl.conf
```

I added the following lines

```
net.ipv6.conf.all.disable_ipv6 = 1
```

```
net.ipv6.conf.default.disable_ipv6 = 1
```

I then applied the changes

```
sudo sysctl -p
```

5.5.2. Secured ARP Tables

I added static ARP entries for known devices to prevent ARP spoofing

```
sudo arp -s <ip_address> <mac_address>
```