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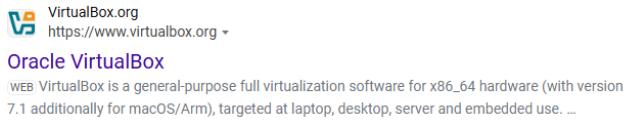
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1 Basics of Linux Environments

1.1 Virtual Machine setup

1.1.1 Download oracle VirtualBox

Search for VirtualBox in my browser and clicked on the link that says “**Oracle VirtualBox**”

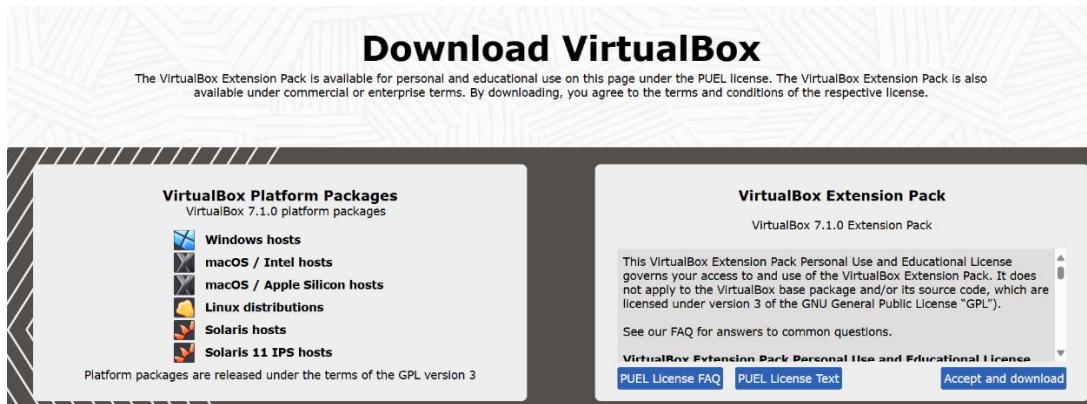


VirtualBox.org
<https://www.virtualbox.org>

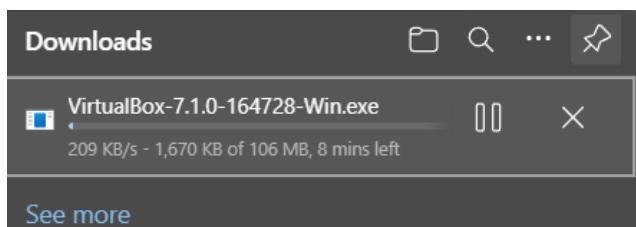
Oracle VirtualBox

WEB VirtualBox is a general-purpose full virtualization software for x86_64 hardware (with version 7.1 additionally for macOS/Arm), targeted at laptop, desktop, server and embedded use. ...

Then I clicked on **download** in the navigation bar on the top right corner of the webpage which opens the page that says “**Download virtual**” box on the right side of the page there is the extention pack which is needed for interacting with host operating system click on “**Accept and download**” to download the extention pack and on the left side of the page on the box that says “**VirtualBox Platform Packages**” click on **Windows hosts**



- Now the VirtualBox will start to download



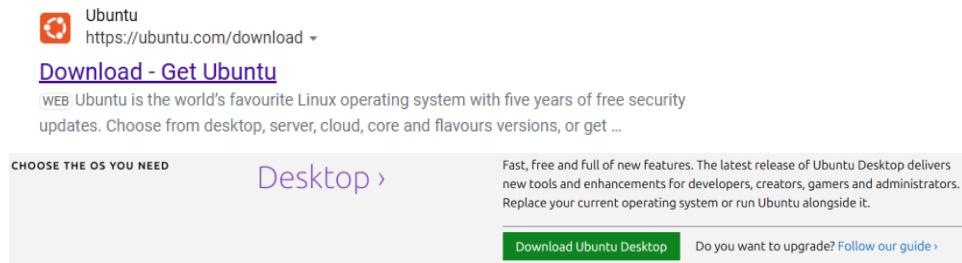
1.1.2 Installation of Oracle VirtualBox

After the download is completed, navigate to the **downloaded folder** and click on the **VirtualBox setup** then install the VirtualBox by clicking the **next** button with default specifications and by clicking on “**Finish**” to complete the installation



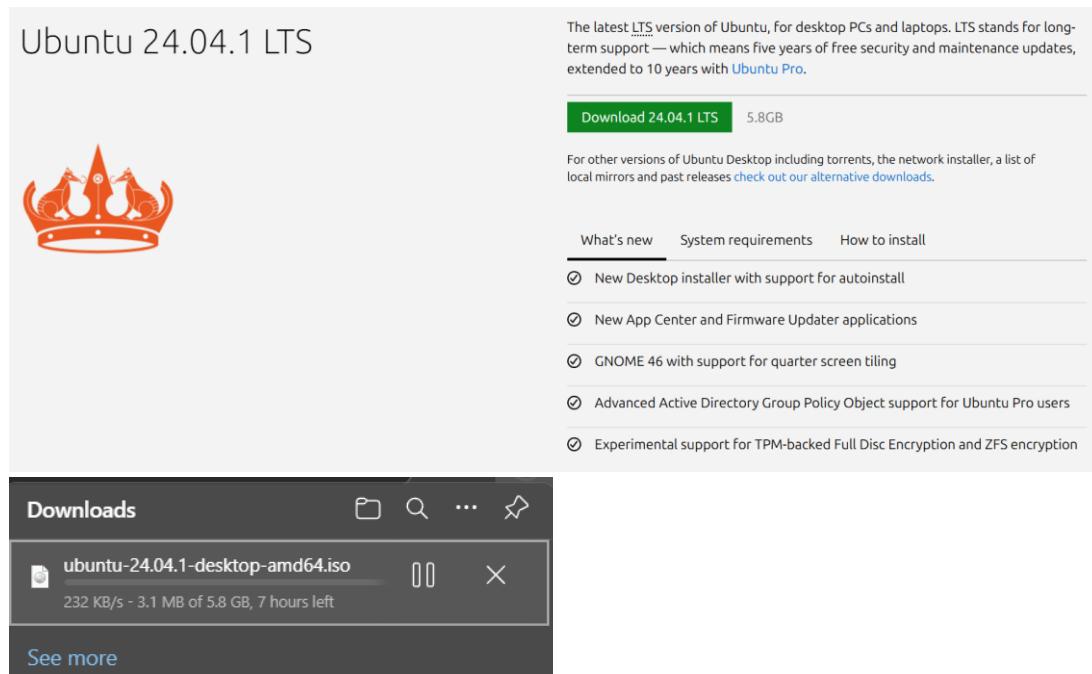
1.1.3 Downloading Ubuntu guide

search for the official ubuntu page click on the link that says “**Download-Get Ubuntu**” which directly navigated me to the download page and scroll down and clicked on the button that says “**Download Ubuntu Desktop**”



The screenshot shows the Ubuntu download page. The 'Desktop' option is selected under 'CHOOSE THE OS YOU NEED'. A description of the desktop version is provided: "Fast, Free and full of new features. The latest release of Ubuntu Desktop delivers new tools and enhancements for developers, creators, gamers and administrators. Replace your current operating system or run Ubuntu alongside it." Below this is a green 'Download Ubuntu Desktop' button and a link to 'Follow our guide'.

Then click on the button that says “**Download 24.04.1 LTS**” and the Ubuntu ISO file started to download

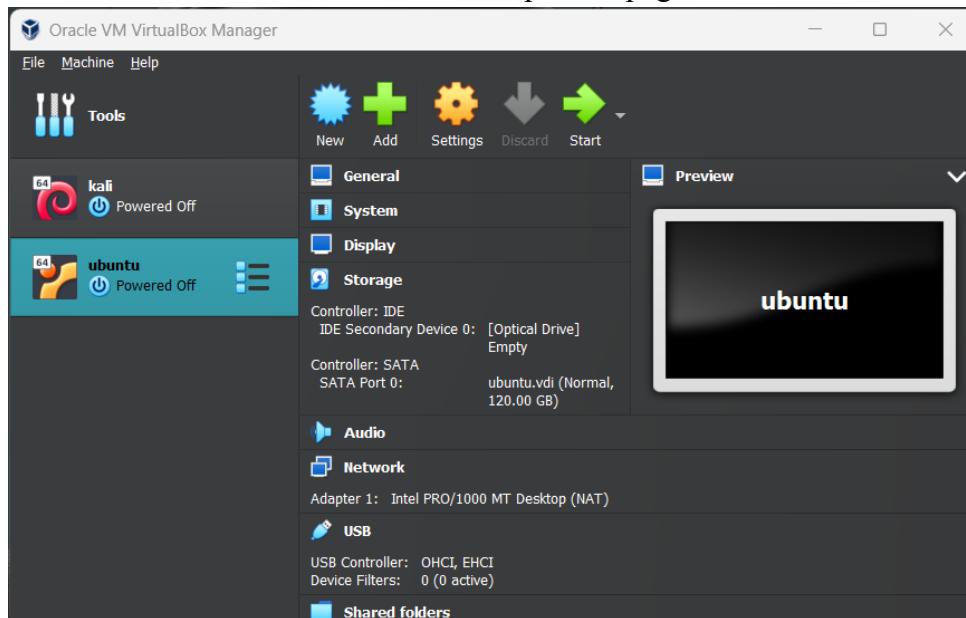


The screenshot shows the Ubuntu 24.04.1 LTS download page. It highlights the LTS version, noting five years of free security and maintenance updates, extended to 10 years with Ubuntu Pro. A large orange crown icon is displayed. Below the main content is a list of what's new, system requirements, and how to install, each with a checkbox. The 'What's new' section is underlined. The 'What's new' list includes: New Desktop installer with support for autoinstall, New App Center and Firmware Updater applications, GNOME 46 with support for quarter screen tiling, Advanced Active Directory Group Policy Object support for Ubuntu Pro users, and Experimental support for TPM-backed Full Disc Encryption and ZFS encryption.

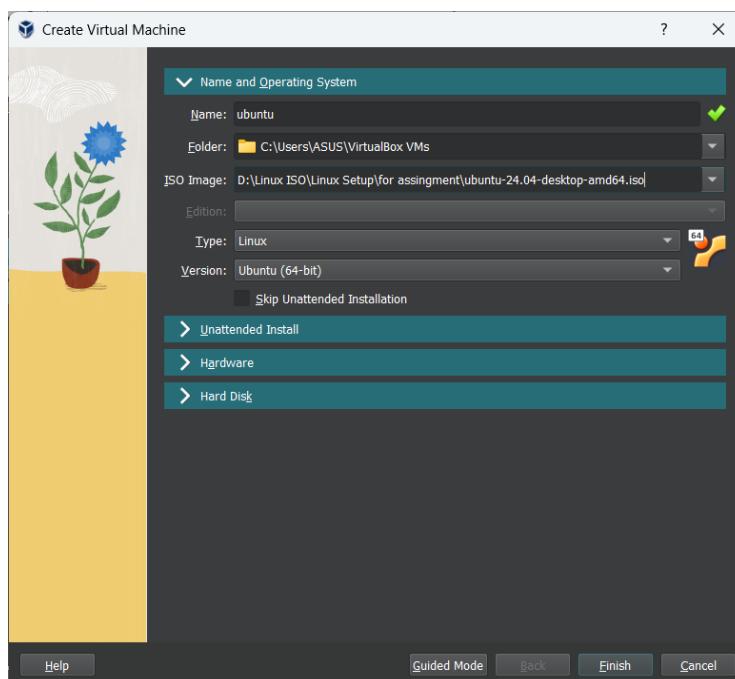
The second part of the screenshot shows a 'Downloads' window from a Linux desktop environment. It lists a single file: 'ubuntu-24.04.1-desktop-amd64.iso'. The file size is 232 KB/s - 3.1 MB of 5.8 GB, and there are 7 hours left. There are standard file operations icons (copy, search, more, close) above the list.

1.1.4 Installation of ubuntu

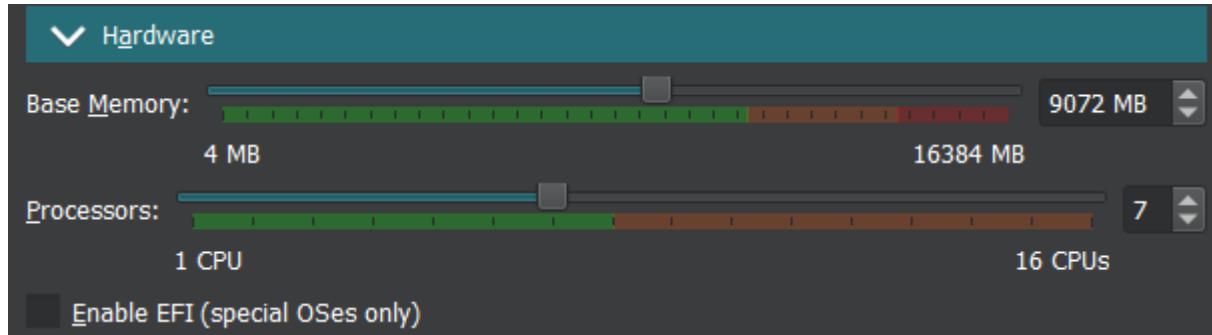
click on the shortcut created on the desktop that says “**Oracle VM VirtualBox**” after the installation of oracle VirtualBox which open the page below.



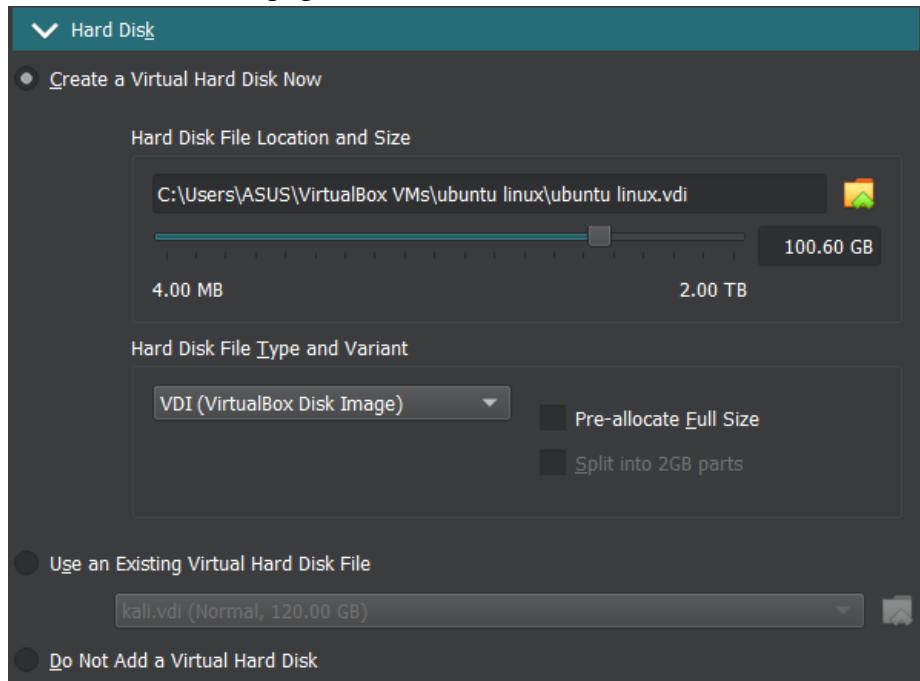
then click on the button that says “**New**” and a page appeared with multiple fields then click on “**Name and Operating Systems**” then click on the name field and type a name for my Virtual machine then click on the arrow in the “**folder**” and navigated to the place where you want to store my virtual machine and click on the arrow in the “**ISO Image**” and click on **other** Navigate to the downloaded **Ubuntu iso** file and click on “open” then on “**type**” select “**Linux**” click on “**version**” and selected “**Ubuntu (64-bit)**”



I skipped “**Unattended install**” then I clicked on “**Hardware**” and Set “**Base Memory**” to 9 gb to get a smoother performance and in “**Processors**” I allocated 7 process to make the Virtual machine smoother



Then clicked on “**Hard Disk**” and clicked on Create a Virtual Hard Disk Now and set the size to 100 GB as storage the minimum storage limit would be around 20 GB then click on “**finish**” at the bottom of the page to create the virtual machine.



click on the **created Ubuntu virtual machine** to start the virtual machine and clicked on “**Try or Install Ubuntu**” and the next step was to choose **english as language** and went to the next step which was to select keyboard layout I selected the “**English (US)**” layout and went to the next step and I chose “**Use wired connection**” since it’s a virtual machine and in the next step I clicked on **update now** for latest version and Select “**Install Ubuntu**” and select “**Interactive Installation**” and I selected the default packages and in the next step I selected “**Erase disk and install Ubuntu**” and I select “**Your Name**” and typed my name typed a password for my Virtual Machine and click on next and then I selected my location and click on ”**Next**” and clicked on “**Install**” and waited till the installation and then I clicked on the button that says “**restart**”.

Welcome to Ubuntu

Choose your language:

- Dansk
- Deutsch
- Eesti
- English**
- Español
- Esperanto
- Finskra

Ubuntu

Internet connection

Next

Select your keyboard layout

Keyboard layout

Detected

English (South Africa)

English (UK)

English (US)

Esperanto

Estonian

Select your keyboard variant: English (US)

Type here to test your keyboard

Back Next

Update available

An update is available for the installer

Update to the latest version for improved reliability and more features.

Update now

Try or install Ubuntu

Connect to the internet

A internet connection will improve your installation with compatibility check and extra software packages.

Use wired connection

No Wi-Fi devices detected

Do not connect to the internet

Back Try or install Ubuntu Next

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

Type of installation

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 Skip Next

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.

Back Next

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

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.

Back Next

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

Back Next

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

Create your account

Create your account

Your name

Your computer's name

Your username

Password Show

Confirm password

Require my password to log in

Use Active Directory

Back Next

Ready to install

Review your choices

General	Erase disk and install Ubuntu VBOX HARDDISK sda Default selection
Security & more	Disk encryption Proprietary software
Partitions	partition sda1 created partition sda2 formatted as ext4 used for /
None	

Install

Select your timezone

Location: Colombo (Western, Sri Lanka) Timezone: Asia/Colombo



Back Next

Ubuntu 24.04 LTS

Fast, free and full of new features

The latest version makes computing easier than ever.
Whether you're a developer, creator, gamer or administrator you'll find new tools to improve your productivity and enhance your experience in this release.



Installation complete



Ubuntu 24.04 LTS is installed and ready to use

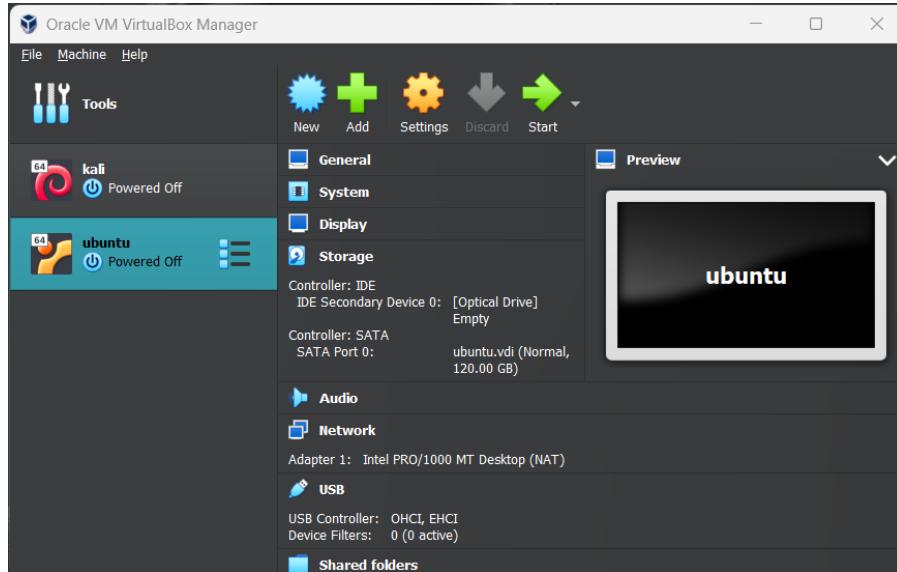
Restart to complete the installation or continue testing.
Any changes you make will not be saved.

Continue testing Restart now

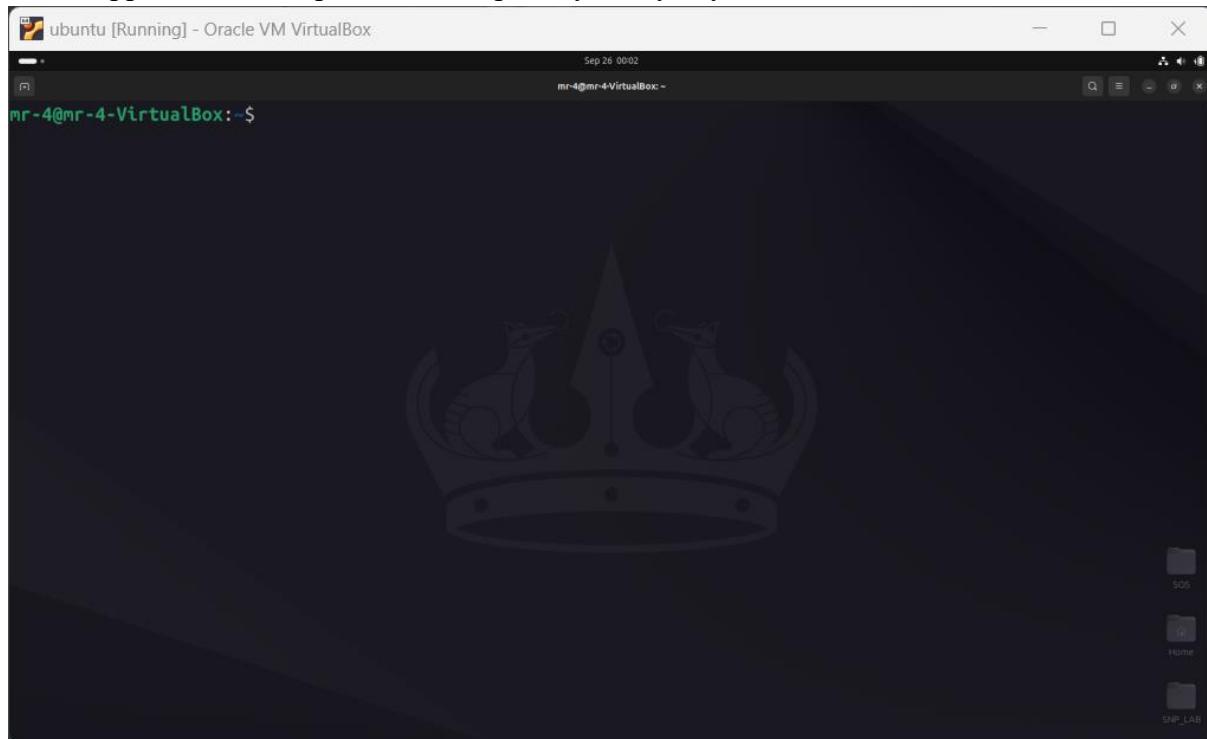
1.2 Command Line Introduction

1.2.1 Access your virtual machine

I clicked on the shortcut “**Oracle VM VirtualBox**” in my desktop and Selected the created ubuntu machine and click on “**Start**”



Then logged in with my **credentials** then I searched for the terminal app through the search bar which appeared when I pressed the super key in my keyboard



1.2.2 basic navigation commands

1.2.2.1 PWD: prints the current working directory the user is in

In the terminal I typed pwd and it displays the path that I'm in

```
mr-4@mr-4-VirtualBox:~$ pwd  
/home/mr-4
```

1.2.2.2 Cd Change directory or switches directories

Cd could be used in many ways to change directory and

cd . is the current directory that im in doesn't change directory

cd .. changes the directory to parent directory from the directory that I'm in

cd ~ takes me to home directory

cd - switches between previous directories that I was working in

cd /path/ takes me to the specified directory in the path

```
mr-4@mr-4-VirtualBox:~$ cd .  
mr-4@mr-4-VirtualBox:~$ cd ..  
mr-4@mr-4-VirtualBox:/home$ cd ~  
mr-4@mr-4-VirtualBox:~$ cd -  
/home  
mr-4@mr-4-VirtualBox:/home$ cd mr-4/Desktop/  
mr-4@mr-4-VirtualBox:~/Desktop$
```

1.2.2.3 ls: lists directories

ls also could be used in multiple ways

ls lists the directories and files in the directory that I'm working in.

ls /path/ lists the directories and files in the path that I specified.

ls -a lists all hidden and unhidden directories and files in the directory I'm working on

ls -l lists the directories and files in the working directory in a long format.

ls -al lists all hidden and unhidden directories and files, in a long format

ls /path/ -al lists all hidden and unhidden directories and files in the path directory in a long format

```
mr-4@mr-4-VirtualBox ~/Desktop> ls
linux.txt SNP_LAB/ SOS/
mr-4@mr-4-VirtualBox ~/Desktop> ls SOS/
lab2/ lab2.1/ student/
mr-4@mr-4-VirtualBox ~/Desktop> ls -a
./ ../ ..farhan linux.txt .readme.swp SNP_LAB/ SOS/
mr-4@mr-4-VirtualBox ~/Desktop> ls -l
total 16
-rw-rw-r-- 1 mr-4 mr-4 6356 Sep 26 00:28 linux.txt
drwxrwxr-x 4 mr-4 mr-4 4096 Aug 5 14:17 SNP_LAB/
drwxrwxr-x 5 mr-4 mr-4 4096 Aug 8 10:29 SOS/
mr-4@mr-4-VirtualBox ~/Desktop> ls -al
total 1460
drwxr-xr-x 4 mr-4 mr-4 4096 Sep 26 00:28 .
drwxr-xr-x 17 mr-4 mr-4 4096 Sep 26 00:28 ..
-rw-rw-r-- 1 mr-4 mr-4 0 Sep 26 00:09 ..farhan
-rw-rw-r-- 1 mr-4 mr-4 6356 Sep 26 00:28 linux.txt
-rw----- 1 mr-4 mr-4 1466368 Sep 26 00:25 .readme.swp
drwxrwxr-x 4 mr-4 mr-4 4096 Aug 5 14:17 SNP_LAB/
drwxrwxr-x 5 mr-4 mr-4 4096 Aug 8 10:29 SOS/
mr-4@mr-4-VirtualBox ~/Desktop>
```

```
-rw-rw-r-- 1 mr-4 mr-4 0 Sep 26 00:43 onetext.txt
drwxrwxr-x 4 mr-4 mr-4 4096 Sep 26 10:14 SNP_LAB
```

First letter specifies the file type and next 3 bits specifies user permission, and the next 3 bits specifies group permission, and the next 3 bits specifies other permission. The fist could be either a regular file (-) or a directory (d) the next 3 bits of each type of users have 8 possibilities with bits representing r, w,x and the empty permissions representing as -

- **d | rwx | rwx | r-x**
 - **d** specified for directory | – specified for regular files
 - **r** : readable
 - **w** : writable
 - **x** : executable
 - **-** : empty

1.2.2.4 tree: displays directories in hierarchy from current directory

The **tree** command can be used in two ways

tree /path/: displays directories in hierarchy from path that I have mentioned.

tree . : displays directories in hierarchy from current directory that I'm in.

```
mr-4@mr-4-VirtualBox:~/Desktop/SNP_LAB$ tree .
.
+- factorial
|   factorial.c
+- shell
|   +- 4_prac
|   |   calculator.sh
|   |   +- hi.sh
|   |   +- case.sh
|   |   +- first.sh
|   |   +- function.sh
|   |   +- logical.sh
|   |   +- loop.sh
|   |   +- operators.sh
|   |   +- rel.sh
|   |   +- variable.sh
+- test
|   test.c
+- testfolder
|   test.txt
4 directories, 15 files
mr-4@mr-4-VirtualBox:~/Desktop/SNP_LAB$ tree shell
shell
+- 4_prac
|   +- calculator.sh
|   |   +- hi.sh
|   |   +- case.sh
|   |   +- first.sh
|   |   +- function.sh
|   |   +- logical.sh
|   |   +- loop.sh
|   |   +- operators.sh
|   |   +- rel.sh
|   |   +- variable.sh
2 directories, 10 files
```

1.2.2.5 find used to search for files or directories

by using find I can find files and directories by specifying the directory that I need to search and the name after the command -name and to search a directory the -type command should be used and then I could specify the file type as “d” for directory.

```
mr-4@mr-4-VirtualBox:~/Desktop$ find . -name test.txt
./SNP_LAB/test.txt
```

find . -name filename: searches file from current directory that I'm in and searches for the filename

```
mr-4@mr-4-VirtualBox:~/Desktop$ find ./SNP_LAB -type d -name testfolder
./SNP_LAB/testfolder
```

find /path/ -type d -name filename: searches file from path the specified file name

1.2.2.6 locate: quick find files

locate find file names faster than find it uses index to locate file, to use the command simply type locate and the filename

```
mr-4@mr-4-VirtualBox:~/Desktop$ locate test.txt
/home/mr-4/.test.txt.swp
/home/mr-4/.test.txt.swp
/home/mr-4/Desktop/SNP_LAB/test.txt
/var/tmp/test.txt.swp
```

1.2.2.7 which provides path of the command

this command show the path of commands to use the command type which and the command name

```
mr-4@mr-4-VirtualBox:~/Desktop$ which vim  
/usr/bin/vim
```

1.2.2.8 whatis: provides information about command

provides information about what the command is used for.

```
mr-4@mr-4-VirtualBox:~/Desktop$ whatis vim  
vim (1) - Vi IMproved, a programmer's text editor
```

1.2.2.9 Whereis: find location of files

Finds all location of **files, binaries, source codes, manual pages** of a command. To use the command simply type whereis and the command name it will display all the files of that particular command

```
mr-4@mr-4-VirtualBox:~/Desktop$ whereis vim  
vim: /usr/bin/vim /etc/vim /usr/share/vim /usr/share/man/man1/vim.1.gz
```

1.2.3 file manipulation commands.

1.2.3.1 Touch: create empty files

Touch command create empty files there are many ways the touch command can be used

touch document_name: create one file

touch document_name{1..5}: creates multiple files with same name by numbering them

touch document_name1 document_name2 document_name3 : create multiple files with different names

```
mr-4@mr-4-VirtualBox:~/Desktop$ touch onetext.txt
mr-4@mr-4-VirtualBox:~/Desktop$ ls
onetext.txt  SNP_LAB  SOS
mr-4@mr-4-VirtualBox:~/Desktop$ touch manytext.txt{1..5}
mr-4@mr-4-VirtualBox:~/Desktop$ ls
manytext.txt1  manytext.txt2  manytext.txt3  manytext.txt4  manytext.txt5  onetext.txt  SNP_LAB  SOS
mr-4@mr-4-VirtualBox:~/Desktop$ touch textOne textTwo textThree
mr-4@mr-4-VirtualBox:~/Desktop$ ls
manytext.txt1  manytext.txt3  manytext.txt5  SNP_LAB  textOne  textTwo
manytext.txt2  manytext.txt4  onetext.txt  SOS      textThree
mr-4@mr-4-VirtualBox:~/Desktop$
```

1.2.3.2 rm: remove files

rm command removes or deletes files, rm command can be used by typing the rm command and the filename that I need to delete

```
mr-4@mr-4-VirtualBox:~/Desktop$ rm onetext.txt
mr-4@mr-4-VirtualBox:~/Desktop$ ls
manytext.txt1  manytext.txt3  manytext.txt5  SOS      textThree
manytext.txt2  manytext.txt4  SNP_LAB      textOne  textTwo
mr-4@mr-4-VirtualBox:~/Desktop$ rm manytext.txt{1..5}
mr-4@mr-4-VirtualBox:~/Desktop$ ls
SNP_LAB  SOS  textOne  textThree  textTwo
mr-4@mr-4-VirtualBox:~/Desktop$ rm textOne textThree textTwo
mr-4@mr-4-VirtualBox:~/Desktop$ ls
SNP_LAB  SOS
```

1.2.3.3 mkdir: create directory

mkdir is a command used for creating directories there multiple ways to use it

mkdir directoryName create a directory mention more directory names with space to create multiple directories

mkdir -p /newpath/ create directoris inside directories as path by specifying -p

mkdir //path/directoryName create directory inside a path by specifying the path in front of the directory specified

```
mr-4@mr-4-VirtualBox:~/Desktop$ mkdir assingment
mr-4@mr-4-VirtualBox:~/Desktop$ ls
assingment manytext.txt{0..5} manytext.txt{1..5} onetext.txt SNP_LAB SOS
mr-4@mr-4-VirtualBox:~/Desktop$ mkdir -p assingment/SNP/newfolder
mr-4@mr-4-VirtualBox:~/Desktop$ tree assingment/
assingment/
└── SNP
    └── newfolder

3 directories, 0 files
mr-4@mr-4-VirtualBox:~/Desktop$ mkdir oneDir twoDir
mr-4@mr-4-VirtualBox:~/Desktop$ ls
assingment manytext.txt{0..5} manytext.txt{1..5} oneDir onetext.txt SNP_LAB SOS twoDir
```

1.2.3.4 rmdir: remove directory

rmdir is a command used to remove directories there are two ways

rmdir directoryName: remove a directory from current directory to remove multiple directories in the same directory specify the name of the directory with space.

rmdir -p /path/: remove a path by specifying the -p command and the path which removes subdirectories in the path.

```
mr-4@mr-4-VirtualBox:~/Desktop$ rmdir onw
mr-4@mr-4-VirtualBox:~/Desktop$ ls
assingment manytext.txt{0..5} manytext.txt{1..5} one onetext.txt SNP_LAB SOS two
mr-4@mr-4-VirtualBox:~/Desktop$ rmdir one/ two/
mr-4@mr-4-VirtualBox:~/Desktop$ ls
assingment manytext.txt{0..5} manytext.txt{1..5} onetext.txt SNP_LAB SOS
mr-4@mr-4-VirtualBox:~/Desktop$ rmdir -p
assingment/ SNP_LAB/ SOS/
mr-4@mr-4-VirtualBox:~/Desktop$ rmdir -p assingment/SNP/
mr-4@mr-4-VirtualBox:~/Desktop$ ls
manytext.txt{0..5} manytext.txt{1..5} onetext.txt SNP_LAB SOS
```

1.2.3.5 cp: copy files or directories

cp command is used to copy files or directories to another path or a directory cp can be used in many ways

cp originalFile duplicateFile: command used to copy one document

cp originalFile /path/: command to copy document to another directory

cp directory duplicateName -r: this command is used to copy directory by specifying the -r command

```
mr-4@mr-4-VirtualBox:~/Desktop$ cp onetext.txt new.txt
mr-4@mr-4-VirtualBox:~/Desktop$ ls
manytext.txt{0..5} manytext.txt{1..5} new.txt onetext.txt.snp SNP_LAB SOS
mr-4@mr-4-VirtualBox:~/Desktop$ cp new.txt.snp/
mr-4@mr-4-VirtualBox:~/Desktop$ tree.snp/
└── new.txt

1 directory, 1 file
mr-4@mr-4-VirtualBox:~/Desktop$ cp.snp/ new -r
mr-4@mr-4-VirtualBox:~/Desktop$ ls
manytext.txt{0..5} manytext.txt{1..5} new new.txt onetext.txt.snp SNP_LAB SOS
```

1.2.3.6 mv move files

mv command used to move files or directories and rename files, this command can be used in multiple ways

mv file newname rename a file by moving the file to another name

mv file /path/ move a file to another directory by specifying the path

mv directory /path/ move a directory to another directory by specifying the directory name and the path of the directory you need to move it

```
mr-4@mr-4-VirtualBox:~/Desktop$ mv new.txt rename
mr-4@mr-4-VirtualBox:~/Desktop$ ls
manytext.txt{0..5} manytext.txt{1..5} new onetext.txt rename.snp SNP_LAB SOS
mr-4@mr-4-VirtualBox:~/Desktop$ mv rename new/
mr-4@mr-4-VirtualBox:~/Desktop$ ls
manytext.txt{0..5} manytext.txt{1..5} new onetext.txt.snp SNP_LAB SOS
mr-4@mr-4-VirtualBox:~/Desktop$ mv.snp/ new/
mr-4@mr-4-VirtualBox:~/Desktop$ ls
manytext.txt{0..5} manytext.txt{1..5} new onetext.txt SNP_LAB SOS
mr-4@mr-4-VirtualBox:~/Desktop$ ls new/
rename.snp
```

1.2.3.7 cat displays file content

cat command displays the full content in a file in a text-based format

cat filename prints the file in text

cat /path/to/file prints another directories file in text

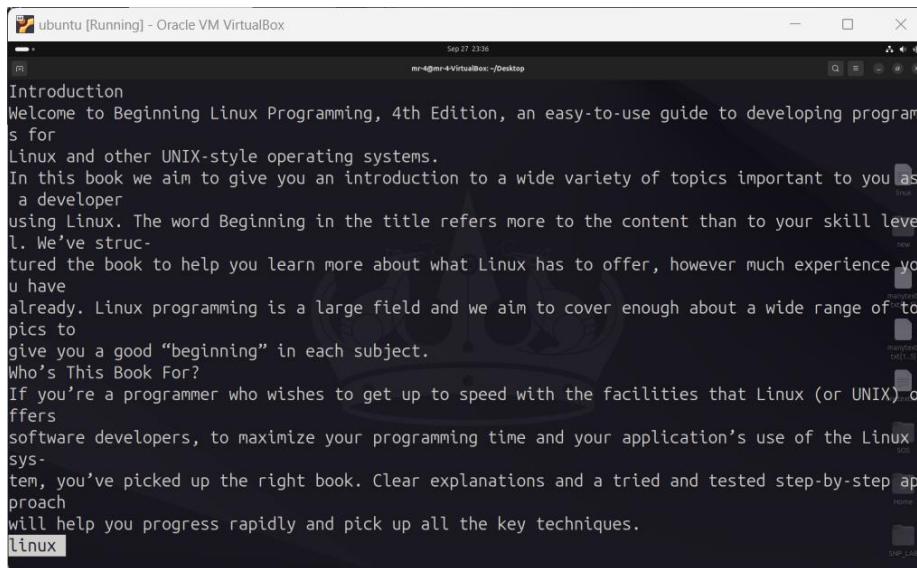
```
mr-4@mr-4-VirtualBox:~/Desktop$ cat onetext.txt
this is the first line of my text file
```

1.2.3.8 less displays content

less command displays file content one page at a time

less filename: shows text one page at a time of the specified file

```
mr-4@mr-4-VirtualBox:~/Desktop$ less linux
```



```

ubuntu [Running] - Oracle VM VirtualBox
Sep 27 23:16
mr-4@mr-4-VirtualBox:~/Desktop

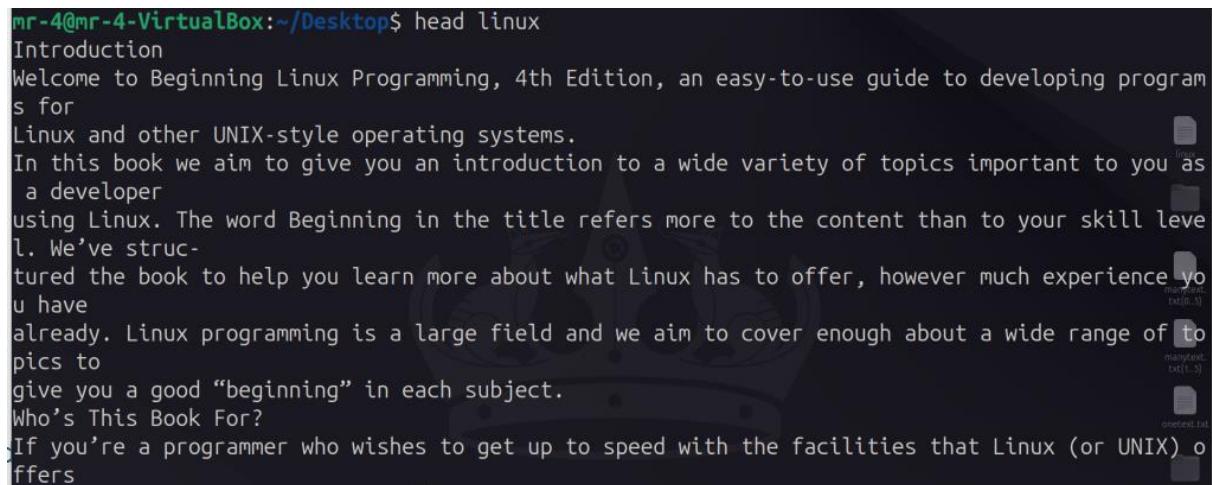
Introduction
Welcome to Beginning Linux Programming, 4th Edition, an easy-to-use guide to developing programs for
Linux and other UNIX-style operating systems.
In this book we aim to give you an introduction to a wide variety of topics important to you as
a developer
using Linux. The word Beginning in the title refers more to the content than to your skill level. We've structured
the book to help you learn more about what Linux has to offer, however much experience you
have
already. Linux programming is a large field and we aim to cover enough about a wide range of topics to
give you a good "beginning" in each subject.
Who's This Book For?
If you're a programmer who wishes to get up to speed with the facilities that Linux (or UNIX) offers
software developers, to maximize your programming time and your application's use of the Linux system,
you've picked up the right book. Clear explanations and a tried and tested step-by-step approach
will help you progress rapidly and pick up all the key techniques.
linux

```

1.2.3.9 head displays file content

displays top few contents of a file in text

head filename shows first few lines of the file in text without printing the whole file



```

mr-4@mr-4-VirtualBox:~/Desktop$ head linux
Introduction
Welcome to Beginning Linux Programming, 4th Edition, an easy-to-use guide to developing programs for
Linux and other UNIX-style operating systems.
In this book we aim to give you an introduction to a wide variety of topics important to you as
a developer
using Linux. The word Beginning in the title refers more to the content than to your skill level. We've structured
the book to help you learn more about what Linux has to offer, however much experience you
have
already. Linux programming is a large field and we aim to cover enough about a wide range of topics to
give you a good "beginning" in each subject.
Who's This Book For?
If you're a programmer who wishes to get up to speed with the facilities that Linux (or UNIX) offers

```

1.2.3.10 tail displays file content

displays bottom few contents of a file in text

tail filename this command shows last few contents of the file in text

```
mr-4@mr-4-VirtualBox:~/Desktop$ tail linux
As you work through the examples in this book, you may choose either to type in all the code ma
nually or
to use the source code files that accompany the book. All of the source code used in this book
is available
for download at http://www.wrox.com. Once at the site, simply locate the book's title (either b
y using
the Search box or by using one of the title lists) and click the Download Code link on the book
's detail
page to obtain all the source code for the book.
Because many books have similar titles, you may find it easiest to search by ISBN; this book's
ISBN is
978-0-470-14762-7.
Once you download the code, just decompress it with your favorite compression tool. Alternative
ly, you can
go to the main Wrox code download page at http://www.wrox.com/dynamic/books/download.aspx to
see the code available for this book and all other Wrox books.
mr-4@mr-4-VirtualBox:~/Desktop$
```

1.2.3.11 vim/vi text editor

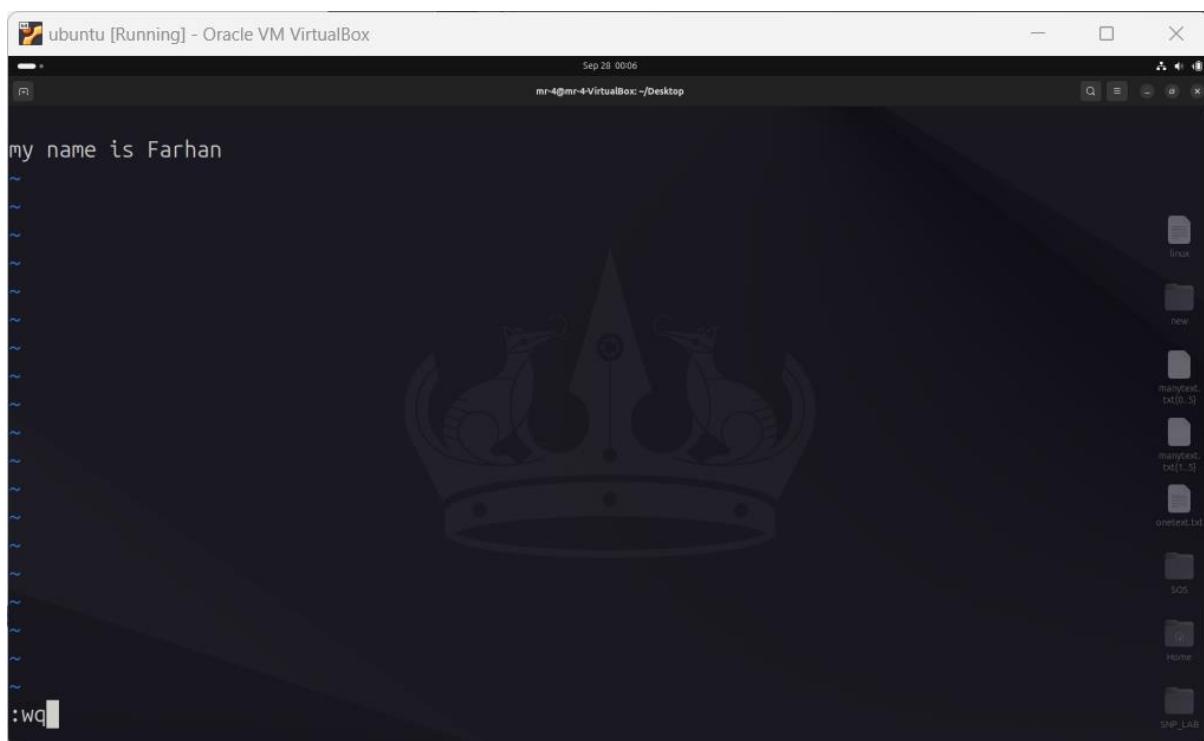
vim is a text editor for files to start editing text

vim filename click “**enter**” file name can be an existing file or a file name that isn’t created,
if the file name isn’t created then the file will be created by the vim editor

```
mr-4@mr-4-VirtualBox:~/Desktop$ vim name
```

When entered the vim editor use following commands to start editing.

- press “**I**” to start writing
- “**Esc + :wq**” to write and quit
- “**Esc + :q!**” quit without saving



```
ubuntu [Running] - Oracle VM VirtualBox
Sep 28 00:06
mr-4@mr-4-VirtualBox: ~/Desktop

my name is Farhan

:wq
```

1.2.3.12 Chmod change permission

chmod command used to change file permission to another user (u), group(g), others(o).

To use the command first type the command chmod and specify the user type and use the + sing to add permission and use the -sing to remove permission and specify the permission you need to add or remove

chmod ugo+rwx filwname

- u** user
- g** group
- o** other
- + add permission
- remove permission
- r** read
- w** write
- x** executable

```
mr-4@mr-4-VirtualBox:~/Desktop$ chmod ugo+rwx onetext.txt
mr-4@mr-4-VirtualBox:~/Desktop$ ls -alps
total 1476
4 drwxr-xr-x 5 mr-4 mr-4 4096 Sep 28 00:14 .
4 drwxr-x--- 17 mr-4 mr-4 4096 Sep 28 00:22 ..
0 -rw-rw-r-- 1 mr-4 mr-4 0 Sep 26 00:09 ..farhan
12 -rw-rw-r-- 1 mr-4 mr-4 9225 Sep 27 23:33 linux
0 -rw-rw-r-- 1 mr-4 mr-4 0 Sep 26 00:44 manytext.txt{0..5}
0 -rw-rw-r-- 1 mr-4 mr-4 0 Sep 26 00:43 manytext.txt{1..5}
4 -rw-rw-r-- 1 mr-4 mr-4 19 Sep 28 00:06 name
4 drwxrwxr-x 3 mr-4 mr-4 4096 Sep 27 22:17 new/
4 -rwxrwxrwx 1 mr-4 mr-4 42 Sep 27 22:22 onetext.txt
1436 -rw----- 1 mr-4 mr-4 1466368 Sep 26 00:25 .readme.swp
4 drwxrwxr-x 4 mr-4 mr-4 4096 Sep 27 22:01 SNP_LAB/
4 drwxrwxr-x 5 mr-4 mr-4 4096 Sep 26 00:43 SOS/
mr-4@mr-4-VirtualBox:~/Desktop$
```

1.2.3.13 Chown change owner

Chown command changes file ownership to another user. To use this command, write sudo to get superuser access and type chown to change ownership then the user who you want to change the ownership to and then the file name

sudo chown username file

```
mr-4@mr-4-VirtualBox:~/Desktop$ sudo chown sara linux
mr-4@mr-4-VirtualBox:~/Desktop$ ls -al
total 1476
drwxr-xr-x  5 mr-4 mr-4      4096 Sep 28 00:14 .
drwxr-x--- 17 mr-4 mr-4      4096 Sep 28 00:22 ..
-rw-rw-r--  1 mr-4 mr-4       0 Sep 26 00:09 ..farhan
-rw-rw-r--  1 sara  mr-4     9225 Sep 27 23:33 linux
-rw-rw-r--  1 mr-4 mr-4       0 Sep 26 00:44 manytext.txt{0..5}
-rw-rw-r--  1 mr-4 mr-4       0 Sep 26 00:43 manytext.txt{1..5}
-rw-rw-r--  1 mr-4 mr-4      19 Sep 28 00:06 name
drwxrwxr-x  3 mr-4 mr-4      4096 Sep 27 22:17 new
-rwxrwxrwx  1 mr-4 mr-4      42 Sep 27 22:22 onetext.txt
-rw-----  1 mr-4 mr-4 1466368 Sep 26 00:25 .readme.swp
drwxrwxr-x  4 mr-4 mr-4      4096 Sep 27 22:01 SNP_LAB
drwxrwxr-x  5 mr-4 mr-4      4096 Sep 26 00:43 SOS
```

1.2.3.14 Chgrp change group

to change file group to another user use the command **chgrp** type sudo to get superuser access and then type the command **chgrp** and the username then the file which you want the specified user to be a group in

sudo chgroup username file

```
mr-4@mr-4-VirtualBox:~/Desktop$ sudo chgrp sara onetext.txt
mr-4@mr-4-VirtualBox:~/Desktop$ ls -alps
total 1476
 4 drwxr-xr-x  5 mr-4 mr-4      4096 Sep 28 00:14 .
 4 drwxr-x--- 17 mr-4 mr-4      4096 Sep 28 00:22 ..
 0 -rw-rw-r--  1 mr-4 mr-4       0 Sep 26 00:09 ..farhan
12 -rw-rw-r--  1 sara  mr-4     9225 Sep 27 23:33 linux
 0 -rw-rw-r--  1 mr-4 mr-4       0 Sep 26 00:44 manytext.txt{0..5}
 0 -rw-rw-r--  1 mr-4 mr-4       0 Sep 26 00:43 manytext.txt{1..5}
 4 -rw-rw-r--  1 mr-4 mr-4      19 Sep 28 00:06 name
 4 drwxrwxr-x  3 mr-4 mr-4      4096 Sep 27 22:17 new/
 4 -rwxrwxrwx  1 mr-4 sara      42 Sep 27 22:22 onetext.txt
1436 -rw-----  1 mr-4 mr-4 1466368 Sep 26 00:25 .readme.swp
 4 drwxrwxr-x  4 mr-4 mr-4      4096 Sep 27 22:01 SNP_LAB/
 4 drwxrwxr-x  5 mr-4 mr-4      4096 Sep 26 00:43 SOS/
```

1.2.3.15 File display file type

File command displays the file type of a file to use the command simply type file and the filename

file filename

```
mr-4@mr-4-VirtualBox:~/Desktop$ file name
name: ASCII text
```

1.2.3.16 Grep highlights text

Grep command highlights text and prints the line the text is in, to use the command type grep the text that should be highlighted and the file name

grep highlightText filename

```
mr-4@mr-4-VirtualBox:~/Desktop$ grep Farhan name.txt
my name is Farhan
```

1.2.3.17 zip/unzip

zip/ unzip command is used to compresses file and decompresses files

compress files: type zip and compressed filename and the file you want to compress

zip file.zip filename

decompress files: type unzip command and the file name that was compressed

unzip file.zip

```
mr-4@mr-4-VirtualBox:~/Desktop$ ls
linux manytext.txt{0..5} manytext.txt{1..5} name.txt new onetext.txt SNP_LAB SOS
mr-4@mr-4-VirtualBox:~/Desktop$ zip new.zip new/
adding: new/ (stored 0%)
mr-4@mr-4-VirtualBox:~/Desktop$ ls
linux manytext.txt{1..5} new onetext.txt SOS
manytext.txt{0..5} name.txt new.zip SNP_LAB
mr-4@mr-4-VirtualBox:~/Desktop$ 
mr-4@mr-4-VirtualBox:~/Desktop$ ls
linux manytext.txt{0..5} manytext.txt{1..5} name.txt new.zip onetext.txt SNP_LAB SOS
mr-4@mr-4-VirtualBox:~/Desktop$ unzip new.zip
Archive: new.zip
  creating: new/
mr-4@mr-4-VirtualBox:~/Desktop$ ls
linux manytext.txt{1..5} new onetext.txt SOS
manytext.txt{0..5} name.txt new.zip SNP_LAB
mr-4@mr-4-VirtualBox:~/Desktop$
```

1.3 System Information and User Management

1.3.1 System information

1.3.1.1 Uname displays OS information

Uname command displays operating system information and uname -a displays all information about the operating system

```
mr-4@mr-4-VirtualBox:~$ uname
Linux
mr-4@mr-4-VirtualBox:~$ uname -a
Linux mr-4-VirtualBox 6.8.0-45-generic #45-Ubuntu SMP PREEMPT_DYNAMIC Fri Aug 30 12:02:04 UTC 2
024 x86_64 x86_64 x86_64 GNU/Linux
```

1.3.1.2 Df displays disk space

df command displays the disk space available and the disk space used by system to use the command simply type **df**

```
mr-4@mr-4-VirtualBox:~/Desktop$ df
Filesystem      1K-blocks    Used Available Use% Mounted on
tmpfs            793644     1556    792088   1% /run
/dev/sda2       123265600 13567908 103390008 12% /
tmpfs            3968200      0    3968200   0% /dev/shm
tmpfs             5120       8     5112   1% /run/lock
tmpfs            793640     116    793524   1% /run/user/1000
mr-4@mr-4-VirtualBox:~/Desktop$
```

1.3.1.3 Free

Free command displays the free memory space available to use the command simply type **free**

```
mr-4@mr-4-VirtualBox:~/Desktop$ free
              total        used        free      shared  buff/cache   available
Mem:      7936404     1129680     6185308          0      43096     904044     6806724
Swap:     4194300          0     4194300          0          0          0          0
```

1.3.2 User management

1.3.2.1 Id

Displays user and user group information of current user, to use the command simply type **id** and specify another username to display information of another user.

```
mr-4@mr-4-VirtualBox:~$ id
uid=1000(mr-4) gid=1000(mr-4) groups=1000(mr-4),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),1
00(users),114(lpadmin)
```

1.3.2.2 Whoami

Whoami command prints the uername of the current user

```
mr-4@mr-4-VirtualBox:~$ whoami
mr-4
```

1.3.2.3 Passwd

Passwd command is used to change user's password to change password of another user type **passwd** and the other username

passwd: change current users' password

passwd username: change other users' password

```
mr-4@mr-4-VirtualBox:~$ passwd
Changing password for mr-4.
Current password:
New password:
```

1.3.2.4 Useradd

User add command used to add users to use the command type **sudo** to get access from superuser and type **useradd** and specify the **username**

```
mr-4@mr-4-VirtualBox:~$ sudo useradd reshvi
mr-4@mr-4-VirtualBox:~$ sudo id reshvi
uid=1002(reshvi) gid=1002(reshvi) groups=1002(reshvi)
```

1.3.2.5 Su

Su command is used to switch user simply type su and the username that you want to move to

```
mr-4@mr-4-VirtualBox:~$ sudo su reshvi
[sudo] password for mr-4:
$ whoami
reshvi
$ su sara
Password:
sara@mr-4-VirtualBox:/home/mr-4$ whoami
sara
```

1.3.2.6 Userdel

Userdel command used to delete user to use the command type **sudo** to get superuser access and type **userdel** and the **username** that you want to delete.

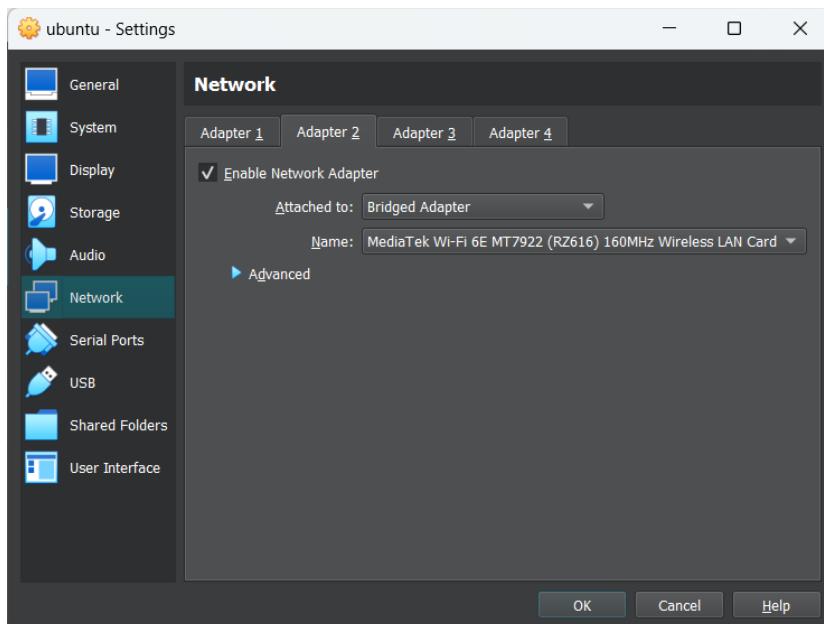
Sudo userdel username

```
mr-4@mr-4-VirtualBox:~$ su reshvi
Password:
$ whoami
reshvi
$ exit
mr-4@mr-4-VirtualBox:~$ sudo userdel reshvi
[sudo] password for mr-4:
mr-4@mr-4-VirtualBox:~$ su reshvi
su: user reshvi does not exist or the user entry does not contain all the required fields
```

2 DHCP, DNS and NTP Services

2.1 DHCP (Dynamic Host Configuration Protocol)

First shutdown virtual machine and right click on your virtual machine and click the “**settings**” And click then I clicked then “**network**” option and enabled second adapter as “**Bridged Adapter**” then click on “**ok**”



Then I started my virtual machine and opened my terminal and updated my repository by typing

Sudo apt update

```
mr-4@mr-4-VirtualBox:~$ sudo apt update
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://downloads.metasploit.com/data/releases/metasploit-framework/apt lucid InRelease
Hit:5 http://lk.archive.ubuntu.com/ubuntu noble-backports InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
47 packages can be upgraded. Run 'apt list --upgradable' to see them.
```

After updating the repository I started to install the dhcp server by entering the command “**sudo apt install isc-dhcp-server**”

```
mr-4@mr-4-VirtualBox:~$ sudo apt install isc-dhcp-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  isc-dhcp-common
Suggested packages:
  isc-dhcp-server-ldap policycoreutils
The following NEW packages will be installed:
  isc-dhcp-common isc-dhcp-server
0 upgraded, 2 newly installed, 0 to remove and 47 not upgraded.
Need to get 1,281 kB of archives.
After this operation, 4,281 kB of additional disk space will be used.
Do you want to continue? [Y/n]
```

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

```
mr-4@mr-4-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.
mr-4@mr-4-VirtualBox:~$
```

Then I searched for my network interface by entering the command **ifconfig** in my case the network interface is “**ens0p8**”

```
mr-4@mr-4-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:fe00:151%enp0s3 prefixlen 64 scopeid 0x20<link>
      ether 08:00:27:f8:46:cf txqueuelen 1000 (Ethernet)
        RX packets 15420 bytes 20902938 (20.9 MB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 4696 bytes 338944 (338.9 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
  inet 192.168.8.107 netmask 255.255.255.0 broadcast 192.168.8.255
    inet6 2402:4000:2180:ba56:355a:4c24:3202:a151 prefixlen 64 scopeid 0x0<global>
    inet6 fe80::33f2:a13:2de3:6019 prefixlen 64 scopeid 0x20<link>
    inet6 2402:4000:2180:ba56:dc09:4c69:93f3:4 prefixlen 128 scopeid 0x0<global>
    inet6 2402:4000:2180:ba56:6fec:91ad:c872:8ffd prefixlen 64 scopeid 0x0<global>
      ether 08:00:27:28:83:b9 txqueuelen 1000 (Ethernet)
        RX packets 3291 bytes 344496 (344.4 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 3079 bytes 408352 (408.3 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 1962 bytes 249384 (249.3 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 1962 bytes 249384 (249.3 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

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

```
INTERFACESv4="enp0s8"
```

```
mr-4@mr-4-VirtualBox ~> sudo vim /etc/default/isc-dhcp-server
INTERFACESv4="enp0s8"
INTERFACESv6=""
~
```

Then i navigated to the config file from the command “**dhcpd**” and then I edited the config file. And I added a subnet a subnetmask and a rage where the ip can be assinged to others and options for routers and broadcast address and I gave googles domain name server

```
mr-4@mr-4-VirtualBox ~> sudo vim /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;
}
```

then I enableed the dhcp server by running the command “**sudo systemctl enable isc-dhcp-server**”

```
mr-4@mr-4-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
```

then I typed the command “**sudo systemctl start isc-dhcp-server**” to start the server

```
mr-4@mr-4-VirtualBox ~> sudo systemctl start isc-dhcp-server
mr-4@mr-4-VirtualBox ~>
```

And then I typed the command “**sudo systemctl status isc-dhcp-server**” to see wether the server is active or inactive

```
mr-4@mr-4-VirtualBox ~$ sudo systemctl status isc-dhcp-server
● isc-dhcp-server.service - ISC DHCP IPv4 server
   Loaded: loaded (/usr/lib/systemd/system/isc-dhcp-server.service; enabled; preset: enabled)
   Active: active (running) since Sat 2024-10-05 02:19:36 +0530; 12h ago
     Docs: man:dhcpd(8)
 Main PID: 10012 (dhcpd)
   Tasks: 1 (limit: 9729)
  Memory: 3.8M (peak: 4.6M)
    CPU: 127ms
   CGroup: /system.slice/isc-dhcp-server.service
           └─10012 dhcpd -user dhcpd -group dhcpd -f -4 -pf /run/dhcp-server/dhcpd.pid -cf /etc/dhcp/dhcpd.conf enp0s8

Oct 05 14:42:23 mr-4-VirtualBox dhcpd[10012]: DHCPREQUEST for 192.168.8.101 from 08:00:27:97:7a:c5 (mr-4-VirtualBox) via enp0s8
Oct 05 14:42:23 mr-4-VirtualBox dhcpd[10012]: DHCPCACK on 192.168.8.101 to 08:00:27:97:7a:c5 (mr-4-VirtualBox) via enp0s8
Oct 05 14:46:56 mr-4-VirtualBox dhcpd[10012]: DHCPREQUEST for 192.168.8.100 from 08:00:27:59:36:27 (parrot) via enp0s8
Oct 05 14:46:56 mr-4-VirtualBox dhcpd[10012]: DHCPCACK on 192.168.8.100 to 08:00:27:59:36:27 (parrot) via enp0s8
Oct 05 14:47:23 mr-4-VirtualBox dhcpd[10012]: DHCPREQUEST for 192.168.8.101 from 08:00:27:97:7a:c5 (mr-4-VirtualBox) via enp0s8
Oct 05 14:47:23 mr-4-VirtualBox dhcpd[10012]: DHCPCACK on 192.168.8.101 to 08:00:27:97:7a:c5 (mr-4-VirtualBox) via enp0s8
Oct 05 14:51:56 mr-4-VirtualBox dhcpd[10012]: DHCPREQUEST for 192.168.8.100 from 08:00:27:59:36:27 (parrot) via enp0s8
Oct 05 14:52:26 mr-4-VirtualBox dhcpd[10012]: DHCPCACK on 192.168.8.100 to 08:00:27:59:36:27 (parrot) via enp0s8
Oct 05 14:52:26 mr-4-VirtualBox dhcpd[10012]: DHCPREQUEST for 192.168.8.101 from 08:00:27:97:7a:c5 (mr-4-VirtualBox) via enp0s8
Oct 05 14:52:26 mr-4-VirtualBox dhcpd[10012]: DHCPCACK on 192.168.8.101 to 08:00:27:97:7a:c5 (mr-4-VirtualBox) via enp0s8
mr-4@mr-4-VirtualBox ~>
```

After the server was active I created two more virtual machines to see whether the server assigns the IP address to clients. After creating the machines and connecting them to the internet And I switched to my virtual machine which runs the DHCP server and typed the following command “**dhclient-lease-list**” to check whether the clients have been assigned IP address by the server

```
mr-4@mr-4-VirtualBox ~$ dhclient-lease-list
To get manufacturer names please download http://standards-out.ieee.org/oui.txt to /usr/local/etc/oui.txt
Reading leases from /var/lib/dhcp/dhcpd.leases
MAC          IP          hostname      valid until      manufacturer
=====
08:00:27:59:36:27  192.168.8.100  parrot        2024-10-05 09:26:56 -NA-
08:00:27:97:7a:c5  192.168.8.101  mr-4-VirtualBo 2024-10-05 09:27:23 -NA-
```

2.2 DNS (Domain Name System)

To install DNS server first I started by updating my repository and then I installed the DNS server by typing the command “**sudo apt install bind9 bind9utils bind9-doc**” this command installs all the thing needed to setup and configure the DNS server

```
mr-4@mr-4-VirtualBox:~$ sudo apt install bind9 bind9utils bind9-doc
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
bind9 is already the newest version (1:9.18.28-0ubuntu0.24.04.1).
bind9utils is already the newest version (1:9.18.28-0ubuntu0.24.04.1).
bind9-doc is already the newest version (1:9.18.28-0ubuntu0.24.04.1).
0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded.
mr-4@mr-4-VirtualBox:~$
```

After the installation I started by editing my config file by typing the command “**sudo nano /etc/bind/named.conf.options**” and then I provided my password so that I can use super user privileges. Then I removed the comments in “**forwarders**” and included google servers so that any domain name not in my server will be forwarded to the googles server and exit the configuration file

```
mr-4@mr-4-VirtualBox ~> sudo nano /etc/bind/named.conf.options
[sudo] password for mr-4: *****

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-v6 { any; };
    listen-on { 192.168.8.107; };
};
```

Then I copied the file “**db.local**” file and renamed it as “**db.example.com**” then I typed the command “**sudo nano /etc/bind/db.example.com**” to alter the file I added the domain name and my Ip address to id.

```
mr-4@mr-4-VirtualBox ~> sudo nano /etc/bind/db.example.com
;
; BIND data file for local domain example.com
;
$TTL    604800
@       IN      SOA     ns1.example.com. admin.example.com. (
                            2           ; Serial
                            604800      ; Refresh
                            86400       ; Retry
                           2419200     ; Expire
                           604800 )     ; Negative Cache TTL
;
@       IN      NS      ns1.example.com.
ns1    IN      A       192.168.8.107 ;
@       IN      A       192.168.8.107 ;
www   IN      A       192.168.8.108 ;
```

Then I copied the file “**db.127**” file and renamed it as “**db.192.168.8**” then i typed the command “**sudo nano /etc/bind/db.192.168.8**” to alter the file I added the domain name and my Ip address to id.

```
mr-4@mr-4-VirtualBox ~> sudo nano /etc/bind/db.192.168.8
;
; BIND reverse data file for local 192.168.8.0/24 subnet
;
$TTL    604800
@       IN      SOA     ns1.example.com. admin.example.com. (
                            2           ; Serial
                            604800      ; Refresh
                            86400       ; Retry
                           2419200     ; Expire
                           604800 )     ; Negative Cache TTL
;
@       IN      NS      ns1.example.com.
107    IN      PTR     ns1.example.com.
108    IN      PTR     www.example.com.
```

Then I added the files to the “**name.conf.local**” file by typing the following command

```
mr-4@mr-4-VirtualBox ~> sudo nano /etc/bind/named.conf.local
zone "example.com" {
    type master;
    file "/etc/bind/db.example.com";
};

zone "8.168.192.in-addr.arpa" {
    type master;
    file "/etc/bind/db.192.168.8";
};
```

After the configuration of the server I restart the server by typing the command “**sudo systemctl restart bind9**” and then I typed the command “**sudo systemctl status bind9**” to check the status of the server

```
mr-4@mr-4-VirtualBox ~> sudo systemctl restart bind9
mr-4@mr-4-VirtualBox ~>
```

```
mr-4@mr-4-VirtualBox ~> sudo systemctl status bind9
● named.service - BIND Domain Name Server
  Loaded: loaded (/usr/lib/systemd/system/named.service; enabled; preset: enabled)
  Active: active (running) since Thu 2024-10-03 21:50:57 +0530; 27s ago
    Docs: man:named(8)
   Main PID: 6270 (named)
     Status: "running"
       Tasks: 23 (limit: 9217)
      Memory: 8.2M (peak: 9.6M)
        CPU: 164ms
       CGroup: /system.slice/named.service
               └─6270 /usr/sbin/named -f -u bind

Oct 03 21:50:57 mr-4-VirtualBox named[6270]: network unreachable resolving './NS/IN': 2001:dc3>
Oct 03 21:50:57 mr-4-VirtualBox named[6270]: network unreachable resolving './NS/IN': 2001:500>
Oct 03 21:50:57 mr-4-VirtualBox named[6270]: network unreachable resolving './NS/IN': 2001:500>
Oct 03 21:50:57 mr-4-VirtualBox named[6270]: network unreachable resolving './NS/IN': 2001:500>
Oct 03 21:50:57 mr-4-VirtualBox named[6270]: network unreachable resolving './NS/IN': 2001:503>
Oct 03 21:50:57 mr-4-VirtualBox named[6270]: network unreachable resolving './NS/IN': 2001:500>
Oct 03 21:50:57 mr-4-VirtualBox named[6270]: network unreachable resolving './NS/IN': 2001:500>
Oct 03 21:50:57 mr-4-VirtualBox named[6270]: network unreachable resolving './NS/IN': 2001:7fd>
Oct 03 21:50:57 mr-4-VirtualBox named[6270]: managed-keys-zone: Key 20326 for zone . is now tr>
```

Then I checked if my dns server was responding through some commands like **nslookup** and **ping**

```
mr-4@mr-4-VirtualBox ~> nslookup example.com 192.168.8.107
Server:      192.168.8.107
Address:     192.168.8.107#53

Name:   example.com
Address: 192.168.8.107

mr-4@mr-4-VirtualBox ~> ping example.com
PING example.com (93.184.215.14) 56(84) bytes of data.
64 bytes from 93.184.215.14: icmp_seq=1 ttl=53 time=236 ms
64 bytes from 93.184.215.14: icmp_seq=2 ttl=53 time=253 ms
64 bytes from 93.184.215.14: icmp_seq=3 ttl=53 time=488 ms
64 bytes from 93.184.215.14: icmp_seq=4 ttl=53 time=262 ms
```

2.3 NTP (Network Time Protocol)

First, I updated my repositories and then I installed the NTP server by typing the command “**sudo apt install ntp**”

```
mr-4@mr-4-VirtualBox ~> sudo apt install ntp
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
ntp is already the newest version (1:4.2.8p15+dfsg-2~1.2.2+dfsg1-4build2).
0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded.
```

After the installation I navigated to the configuration file here the server is setup by default to the ubuntu servers

```
mr-4@mr-4-VirtualBox ~> sudo nano /etc/ntpsec/ntp.conf
# Use servers from the NTP Pool Project. Approved by Ubuntu Technical Board
# on 2011-02-08 (LP: #104525). See https://www.pool.ntp.org/join.html for
# more information.
pool 0.ubuntu.pool.ntp.org iburst
pool 1.ubuntu.pool.ntp.org iburst
pool 2.ubuntu.pool.ntp.org iburst
pool 3.ubuntu.pool.ntp.org iburst

# Use Ubuntu's ntp server as a fallback.
server ntp.ubuntu.com
```

Then restart the ntp server by typing the command by “**sudo systemctl restart ntp**” and then I checked whether the server is running by typing the commands “**sudo systemctl status ntp**” “**ntpq -p**”

```
mr-4@mr-4-VirtualBox ~> sudo systemctl restart ntp
mr-4@mr-4-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 Fri 2024-10-04 14:43:55 +0530; 27s ago
    Docs: man:ntpd(8)
   Process: 6097 ExecStart=/usr/libexec/ntpsec/ntp-systemd-wrapper (code=exited, status=0/SUCCESS)
 Main PID: 6101 (ntpd)
    Tasks: 1 (limit: 9217)
   Memory: 10.5M (peak: 11.3M)
      CPU: 74ms
     CGroup: /system.slice/ntpsec.service
             └─6101 /usr/sbin/ntpd -p /run/ntpd.pid -c /etc/ntpsec/ntp.conf -g -N -u ntpsec:ntpsec

Oct 04 14:43:58 mr-4-VirtualBox ntpd[6101]: DNS: dns_take_status: 2.ubuntu.pool.ntp.org=>good, 8
Oct 04 14:43:59 mr-4-VirtualBox ntpd[6101]: DNS: dns_probe: 3.ubuntu.pool.ntp.org, cast_flags:8, flags:101
Oct 04 14:43:59 mr-4-VirtualBox ntpd[6101]: DNS: dns_check: processing 3.ubuntu.pool.ntp.org, 8, 101
Oct 04 14:43:59 mr-4-VirtualBox ntpd[6101]: DNS: Pool skipping: 162.159.200.123
Oct 04 14:43:59 mr-4-VirtualBox ntpd[6101]: DNS: Pool skipping: 162.159.200.1
Oct 04 14:43:59 mr-4-VirtualBox ntpd[6101]: DNS: dns_take_status: 3.ubuntu.pool.ntp.org=>good, 8
Oct 04 14:44:00 mr-4-VirtualBox ntpd[6101]: DNS: dns_probe: ntp.ubuntu.com, cast_flags:1, flags:20801
Oct 04 14:44:00 mr-4-VirtualBox ntpd[6101]: DNS: dns_check: processing ntp.ubuntu.com, 1, 20801
Oct 04 14:44:00 mr-4-VirtualBox ntpd[6101]: DNS: Server taking: 185.125.190.57
Oct 04 14:44:00 mr-4-VirtualBox ntpd[6101]: DNS: dns_take_status: ntp.ubuntu.com=>good, 0
```

```
mr-4@mr-4-VirtualBox ~> ntpq -p
      remote           refid      st t when poll reach   delay    offset  jitter
=====
0.ubuntu.pool.ntp.org .POOL.        16 p  -  256    0  0.0000  0.0000  0.0001
1.ubuntu.pool.ntp.org .POOL.        16 p  -  256    0  0.0000  0.0000  0.0001
2.ubuntu.pool.ntp.org .POOL.        16 p  -  256    0  0.0000  0.0000  0.0001
3.ubuntu.pool.ntp.org .POOL.        16 p  -  256    0  0.0000  0.0000  0.0001
prod-ntp-5.ntp1.ps5.canonical. 201.68.88.106  2 u  30 128    7 163.2907 -0.2403 18.6334
LOCAL(0)             .LOCL.        5 l  30  64   17  0.0000  0.0000  0.0000
+time.cloudflare.com 10.4.8.56   3 u   71 128    7 33.2624 -9.0238 97.1043
+time.cloudflare.com 10.4.8.56   3 u  125 128    5 32.9867 -10.2605 81.3515
time.cloudflare.com .STEP.        16 u  -  512    0  0.0000  0.0000  0.0001
time.cloudflare.com .STEP.        16 u  -  512    0  0.0000  0.0000  0.0001
mr-4@mr-4-VirtualBox ~>
```

3 Shell Scripting and Security

3.1 Shell Scripting

3.1.1 script to automate a report

first, I created a path as requested and I added a directory to store my report source file “**report.sh**” then I created and edited the file “**report.sh**”

```
mr-4@mr-4-VirtualBox ~> mkdir -p /home/mr-4/system_reports/reportsource/  
mr-4@mr-4-VirtualBox ~> nano /home/mr-4/system_reports/reportsource/report.sh
```

Then I typed the following code to store the date and time and the time the system has been awake and free memory space and the disk usage space to the requested path.

```
#!/bin/bash

mkdir -p /home/mr-4/system_reports

DATE=$(date '+%Y-%m-%d')

REPORT_FILE="/home/mr-4/system_reports/$DATE.txt"

echo -e "System Report - $DATE \n \n" > $REPORT_FILE
echo -e "Date and Time: $(date) \n \n" >> $REPORT_FILE
echo -e "Uptime: $(uptime -p) \n \n" >> $REPORT_FILE
echo -e "Free Memory: $(free -h) \n \n" >> $REPORT_FILE
echo -e "Disk Usage: $(df -h) \n" >> $REPORT_FILE

echo "System report saved to $REPORT_FILE"
```

```

#!/bin/bash

mkdir -p /home/mr-4/system_reports

DATE=$(date '+%Y-%m-%d')

REPORT_FILE="/home/mr-4/system_reports/$DATE.txt"

echo -e "System Report - $DATE \n \n " > $REPORT_FILE
echo -e "Date and Time: $(date) \n \n " >> $REPORT_FILE
echo -e "Uptime: $(uptime -p) \n \n " >> $REPORT_FILE
echo -e "Free Memory: $(free -h) \n \n " >> $REPORT_FILE
echo -e "Disk Usage: $(df -h) \n " >> $REPORT_FILE

echo "System report saved to $REPORT_FILE"

```

After saving the code I scheduled a cron job by typing the command “**crontab -e**” and specifying the time and the path to the file this automates the job by creating a file and executing the “**report.sh**” at the time specified and storing the values created in the new file inside the “**home/mr-4/system_reports**”

```

mr-4@mr-4-VirtualBox ~> crontab -e
#
# m h dom mon dow   command
0 0 * * * /home/mr-4/system_reports/reportsource/report.sh

```

3.1.2 script to automate the backup

first, I created a path as requested and I added a directory to store my back up source file “bakup.sh” then I created and edited the file “backup.sh”

```
mr-4@mr-4-VirtualBox ~> mkdir -p /home/mr-4/backup/documents/bckupcode/  
mr-4@mr-4-VirtualBox ~> nano /home/mr-4/backup/documents/bckupcode/backup.sh
```

Then I typed the following code to back up the document directory into the requested path by compressing it.

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

```
mkdir -p /home/mr-4/backup/documents
```

```
DATE=$(date '+%Y-%m-%d')
```

```
SOURCE_DIR="/home/mr-4/documents"
```

```
DEST_DIR="/home/mr-4/backup/documents/backup-$DATE.tar.gz"
```

```
tar -czf $DEST_DIR $SOURCE_DIR
```

```
echo "Backup of $SOURCE_DIR completed and saved to $DEST_DIR"
```

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

```
mkdir -p /home/mr-4/backup/documents
```

```
DATE=$(date '+%Y-%m-%d')
```

```
SOURCE_DIR="/home/mr-4/documents"
```

```
DEST_DIR="/home/mr-4/backup/documents/backup-$DATE.tar.gz"
```

```
tar -czf $DEST_DIR $SOURCE_DIR
```

```
echo "Backup of $SOURCE_DIR completed and saved to $DEST_DIR"
```

After saving the code I scheduled a cron job by typing the command “**crontab -e**” and specifying the time and the path to the file this automates the job by creating a file and executing the “**backup.sh**” at the time specified and storing the backup files in the “**/home/mr-4/backup/documents**” directory.

```
mr-4@mr-4-VirtualBox ~> crontab -e
# m h dom mon dow   command
0 0 * * * /home/mr-4/system_reports/reportsource/report.sh
0 0 * * * /home/mr-4/backup/documents/bckupcode/backup.sh
```

3.2 SSH (Secure Shell)

Firt I updated my repository and then I installed the ssh server by typing the command “**sudo apt install openssh-server**”

```
mr-4@mr-4-VirtualBox ~> sudo apt install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openssh-server is already the newest version (1:9.6p1-3ubuntu13.5).
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
```

Then I enabled and started the server by typing the commands “**sudo systemctl enable ssh**” and “**sudo systemctl start ssh**”

```
mr-4@mr-4-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
mr-4@mr-4-VirtualBox ~> sudo systemctl start ssh
```

Then I edited the config file by typing the command “**sudo nano /etc/ssh/sshd_config**”

And I change some permissions such as **no root access** by ssh and use port **2220**

```
mr-4@mr-4-VirtualBox ~> sudo nano /etc/ssh/sshd_config
PermitRootLogin no          Port 2220
```

Then I restarted the server and checked the status of the server by typing the command “**sudo systemctl restart ssh**” and “**sudo systemctl status ssh**”

```
mr-4@mr-4-VirtualBox ~> sudo systemctl restart ssh
mr-4@mr-4-VirtualBox ~> sudo systemctl status ssh
● ssh.service - OpenBSD Secure Shell server
  Loaded: loaded (/usr/lib/systemd/system/ssh.service; enabled; preset: enabled)
  Active: active (running) since Sat 2024-10-05 22:53:48 +0530; 2s ago
    TriggeredBy: ● ssh.socket
    Docs: man:sshd(8)
           man:sshd_config(5)
   Process: 5326 ExecStartPre=/usr/sbin/sshd -t (code=exited, status=0/SUCCESS)
   Main PID: 5328 (sshd)
     Tasks: 1 (limit: 9729)
    Memory: 1.2M (peak: 1.5M)
      CPU: 25ms
     CGroup: /system.slice/ssh.service
             └─5328 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Oct 05 22:53:48 mr-4-VirtualBox systemd[1]: Starting ssh.service - OpenBSD Secure Shell server...
Oct 05 22:53:48 mr-4-VirtualBox sshd[5328]: Server listening on :: port 2220.
Oct 05 22:53:48 mr-4-VirtualBox systemd[1]: Started ssh.service - OpenBSD Secure Shell server.
```

Then I went to my windows and searched for command prompt and typed the command “**ssh mr4@192.168.8.107 -p 2220**” then I entered my password and I had access to my Linux machine then I typed “**whoami**” to see if its my user account and the I typed “**uname**” to se what is my OS using

```
C:\Users\ASUS>ssh mr-4@192.168.8.107 -p 2220
mr-4@192.168.8.107'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.

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

Last login: Sat Oct  5 22:40:45 2024 from 192.168.8.102
mr-4@mr-4-VirtualBox:~$ whoami
mr-4
mr-4@mr-4-VirtualBox:~$ uname
Linux
```

3.3 iptables and ACLs

first I checked if I have any iptables rules active by typing the command “**sudo iptables -L**”

```
mr-4@mr-4-VirtualBox ~> sudo iptables -L
Chain INPUT (policy ACCEPT)
target     prot opt source               destination
Chain FORWARD (policy ACCEPT)
target     prot opt source               destination
Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
```

then I started to create Ip table rules

3.3.1 web security

I allowed traffic only in port 80 and port 443 and remove all other ports from being accessed

```
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p tcp --dport 80 -j ACCEPT
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p tcp --dport 443 -j ACCEPT
mr-4@mr-4-VirtualBox ~> sudo iptables -P INPUT DROP
```

3.3.2 Remote Administration Access

I allowed SSH access to port 22 only from the IP addresses in “**192.168.8.100**” of my machines. This restricts remote access attempts to authorized sources.

```
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p tcp --dport 22 -s 192.168.1.100 -j ACCEPT
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p tcp --dport 22 -j DROP
```

3.3.3 Allow Specific Applications

I allow traffic for specific applications to use port 443

```
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p tcp --dport 443 -j ACCEPT
```

3.3.4 Allow Pings (ICMP Echo Request)

I allowed ping requests for network trouble shooting

```
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p icmp --icmp-type echo-request -j ACCEPT
```

3.3.5 Printer Server Access

I allowed to access port **9100** for printing traffic only from local Ip addresses “**192.168.8.0/24**”

```
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p tcp --dport 9100 -s 192.168.1.0/24 -j ACCEPT
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p tcp --dport 9100 -j DROP
```

After allowing the requests once again I typed the command “**sudo iptables -L**” to see if the permissions are successful

```
mr-4@mr-4-VirtualBox ~ [4]> sudo iptables -L
Chain INPUT (policy DROP)
target     prot opt source          destination
ACCEPT    tcp  --  anywhere        anywhere        tcp dpt:http
ACCEPT    tcp  --  anywhere        anywhere        tcp dpt:https
ACCEPT    tcp  --  192.168.1.100   anywhere        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        anywhere        tcp dpt:9100
DROP      tcp  --  anywhere        anywhere        tcp dpt:9100

Chain FORWARD (policy ACCEPT)
target     prot opt source          destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source          destination
mr-4@mr-4-VirtualBox ~> █
```

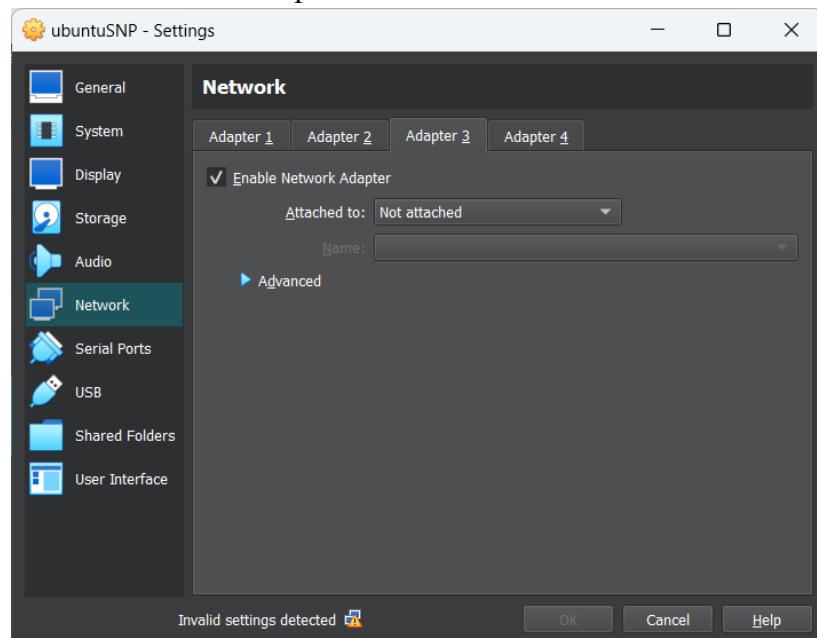
4 Best practices

4.1 Disable unused network interfaces

After installing Linux, it is important to make sure that only the required network interfaces are active. By typing the command “`ip link show`” in my case I have 3 network interfaces

```
mr-4@mr-4-VirtualBox ~> ip link show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP mode DEFAULT group default qlen 1000
    link/ether 08:00:27:f8:46:cf brd ff:ff:ff:ff:ff:ff
3: enp0s8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP mode DEFAULT group default qlen 1000
    link/ether 08:00:27:28:83:b9 brd ff:ff:ff:ff:ff:ff
4: enp0s9: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP mode DEFAULT group default qlen 1000
    link/ether 08:00:27:d0:f0:6e brd ff:ff:ff:ff:ff:ff
```

To remove an interface in virtual machine I can remove the interface by going to the virtual machine settings and clicking on network and removing an adapter by unchecking the option “Enable Network Adapter”



4.2 Use firewalls to control network traffic

Using firewall rules to control network traffic in my virtual machine by allowing only necessary traffic my machines running and remove other ports from being accessed,

I allowed traffic only in port 80 and port 443 and remove all other ports from being accessed

```
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p tcp --dport 80 -j ACCEPT
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p tcp --dport 443 -j ACCEPT
mr-4@mr-4-VirtualBox ~> sudo iptables -P INPUT DROP
```

Here I can also use ufw commands to control network traffic

```
mr-4@mr-4-VirtualBox ~ [1]> sudo ufw allow ssh
Skipping adding existing rule
Skipping adding existing rule (v6)
mr-4@mr-4-VirtualBox ~> sudo ufw allow http
Rule added
Rule added (v6)
mr-4@mr-4-VirtualBox ~> sudo ufw allow https
Rule added
Rule added (v6)
mr-4@mr-4-VirtualBox ~>
```

4.3 Enable strong encryption for remote access

After setting up ssh it is best to disable root login access and restrict ssh access to specific ip addresses

I altered the ssh config file by removing the access to root through ssh

```
PermitRootLogin no
```

I allowed SSH access to port 22 only from the IP addresses in “**192.168.8.100**” of my machines. This restricts remote access attempts to authorized sources.

```
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p tcp --dport 22 -s 192.168.1.100 -j ACCEPT
mr-4@mr-4-VirtualBox ~> sudo iptables -A INPUT -p tcp --dport 22 -j DROP
```

4.4 Disable IP forwarding

Ip forwarding allows linux machines to act as an router forwarding network traffic from one network to another this can make your system vulnerable

First i checked whether my ip forwarding is enabled by typing the command “**sysctl net.ipv4.ip_forward**” here in my case it is already disabled if the result is **0** then it is disabled and if the result is **1** then the forwarding is enabled

```
mr-4@mr-4-VirtualBox ~> sysctl net.ipv4.ip_forward
net.ipv4.ip_forward = 0
```

If the forwarding was enabled and if I need to disable the forwarding I can disable the forwarding altering the file “**/etc/sysctl.conf**” and adding the code “**net.ipv4.ip_forward=0**” and save and exit and apply the changes by typing “**sudo sysctl -p**”

4.5 Regularly update and upgrade system

Regular updates make sure that there aren’t any unpatched software’s, unpatched software’s can be vulnerable and can be exploited

To make sure that I have no unattended updates I run the command “**sudo apt update && sudo apt upgrade**” every time I login, this makes suer that all my software’s are UpToDate

```
mr-4@mr-4-VirtualBox ~> sudo apt update && sudo apt upgrade
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
3 packages can be upgraded. Run 'apt list --upgradable' to see them.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following upgrades have been deferred due to phasing:
  python3-distupgrade ubuntu-release-upgrader-core ubuntu-release-upgrader-gtk
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
mr-4@mr-4-VirtualBox ~>
```