

**LAB 2**  
**LINUX BASIC - SHELL SCRIPTING**



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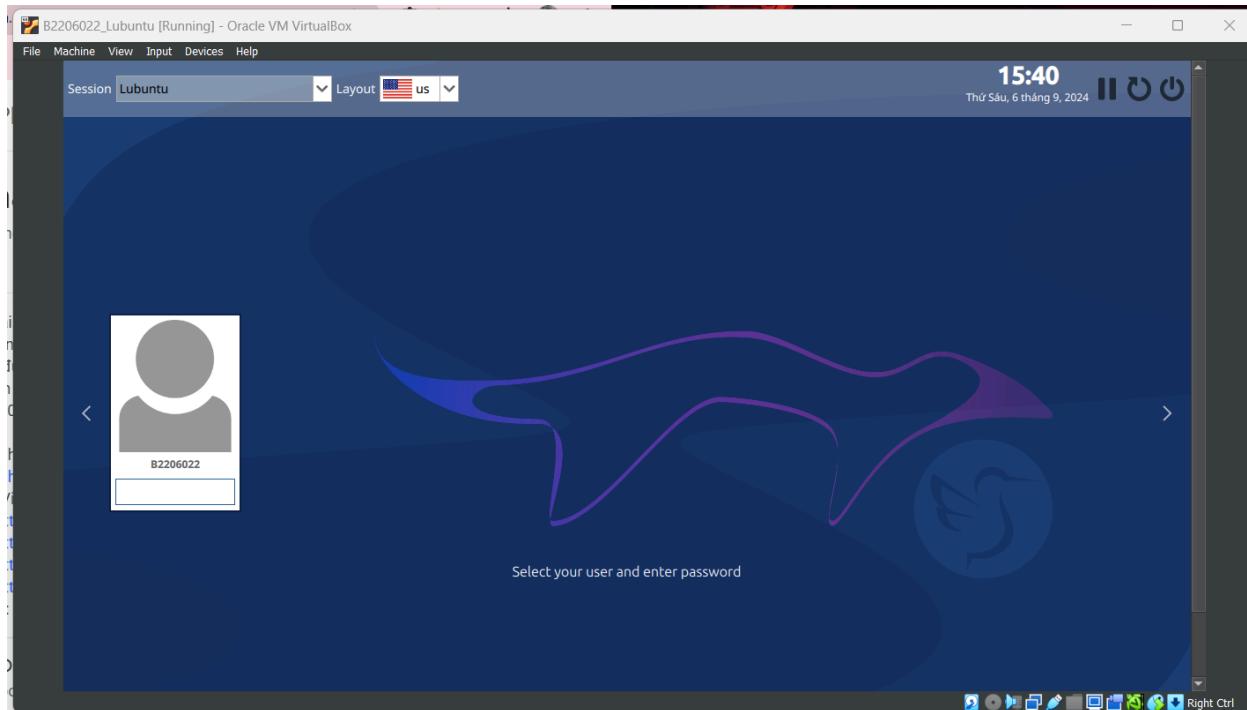
- Note: screenshots need to be clear and good-looking; submissions must be in PDF format.

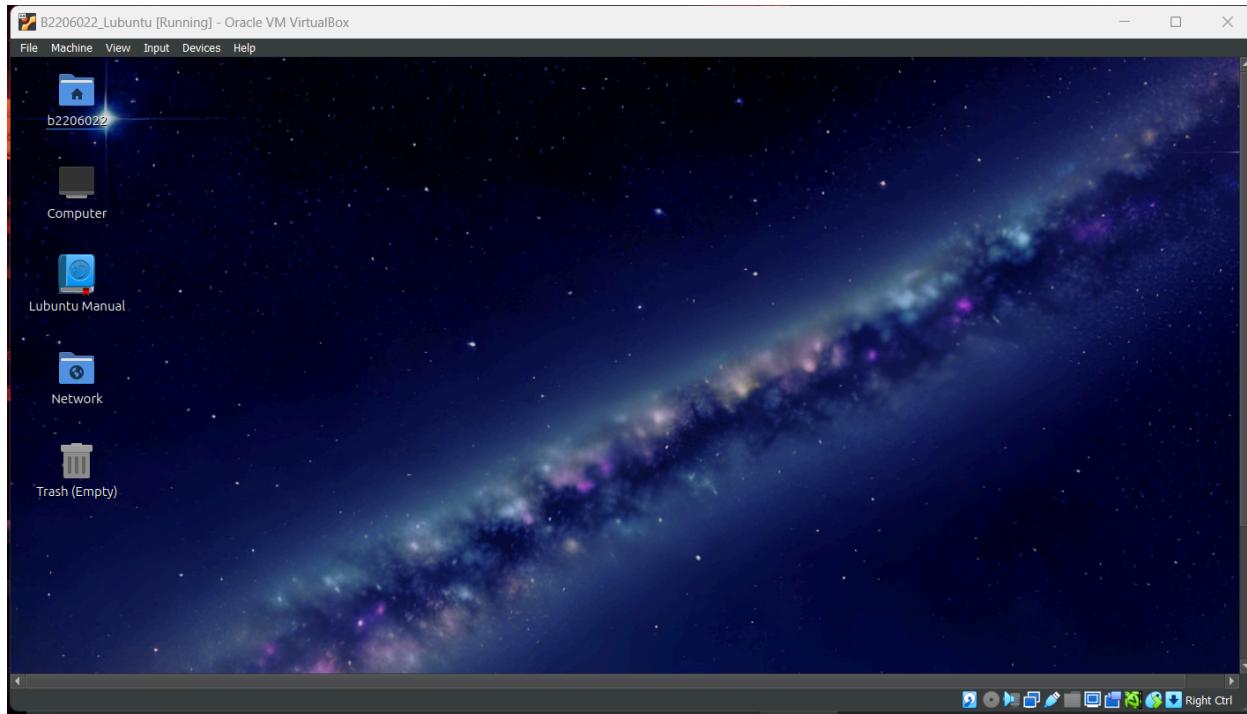
### 1. Lubuntu/Ubuntu installation

1.1. Create a virtual machine using VirtualBox/VMWare.

1.2. Install Lubuntu Desktop 24.04 LTS (or any other Linux distributions) as the OS of the VM.

During the installation process, create an account with a username being your student ID  
(take a screenshot after finishing the installation).





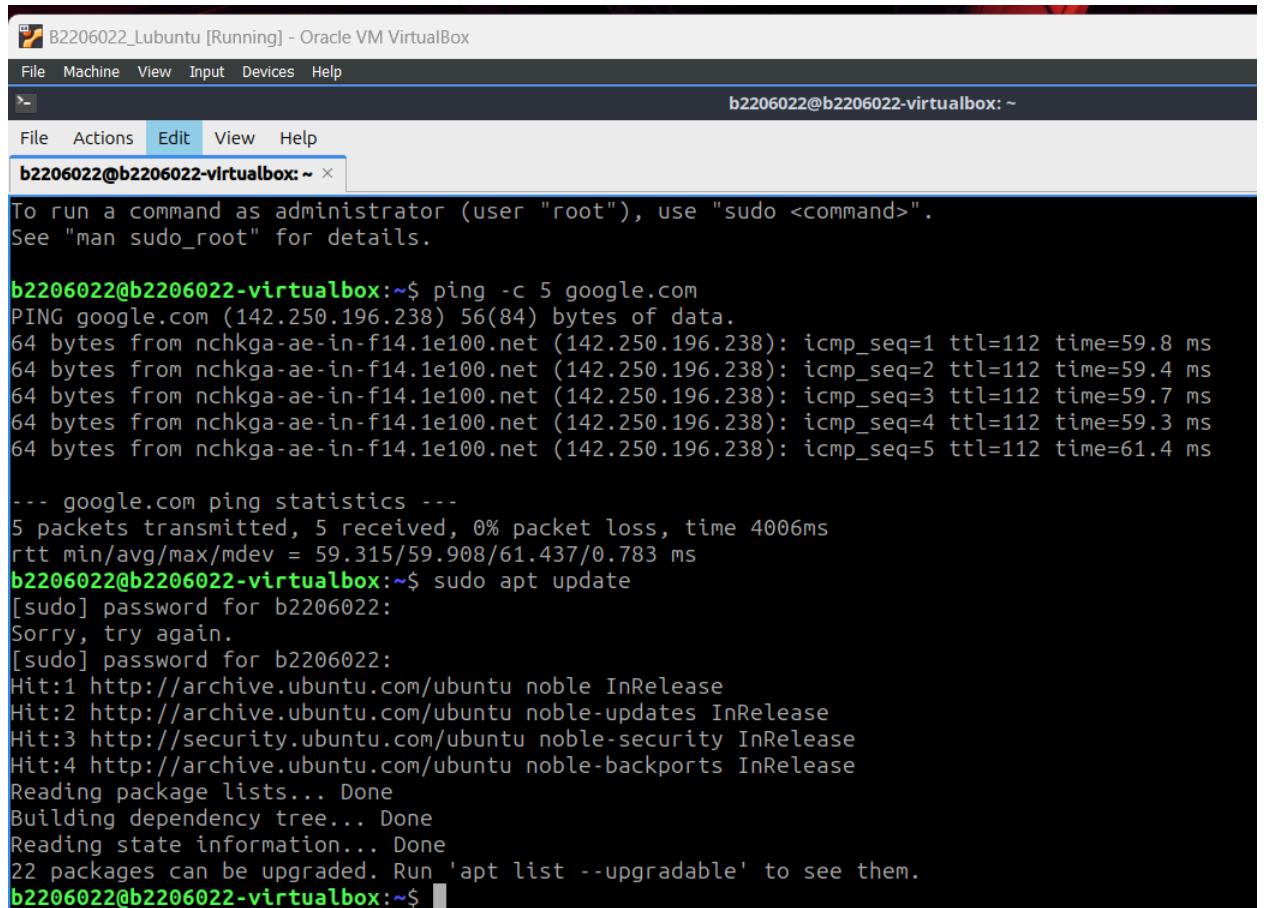
**1.3.** Configure network and proxy settings using graphical user interface (**if necessary**)

**1.4.** Setting up proxy for command line (**if necessary**)

```
$sudo featherpad /etc/environment
- Appending the below lines to the file
http_proxy="http://proxy.ctu.edu.vn:3128"
https_proxy="http://proxy.ctu.edu.vn:3128"
ftp_proxy="http://proxy.ctu.edu.vn:3128"
no_proxy=localhost,127.0.0.1
$source /etc/environment
```

**1.5.** Verifying network connections

```
$ping -c 5 google.com
$sudo apt update
```



```
b2206022@b2206022-virtualbox:~$ ping -c 5 google.com
PING google.com (142.250.196.238) 56(84) bytes of data.
64 bytes from nchkga-ae-in-f14.1e100.net (142.250.196.238): icmp_seq=1 ttl=112 time=59.8 ms
64 bytes from nchkga-ae-in-f14.1e100.net (142.250.196.238): icmp_seq=2 ttl=112 time=59.4 ms
64 bytes from nchkga-ae-in-f14.1e100.net (142.250.196.238): icmp_seq=3 ttl=112 time=59.7 ms
64 bytes from nchkga-ae-in-f14.1e100.net (142.250.196.238): icmp_seq=4 ttl=112 time=59.3 ms
64 bytes from nchkga-ae-in-f14.1e100.net (142.250.196.238): icmp_seq=5 ttl=112 time=61.4 ms

--- google.com ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4006ms
rtt min/avg/max/mdev = 59.315/59.908/61.437/0.783 ms
b2206022@b2206022-virtualbox:~$ sudo apt update
[sudo] password for b2206022:
Sorry, try again.
[sudo] password for b2206022:
Hit:1 http://archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://security.ubuntu.com/ubuntu noble-security InRelease
Hit:4 http://archive.ubuntu.com/ubuntu noble-backports InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
22 packages can be upgraded. Run 'apt list --upgradable' to see them.
b2206022@b2206022-virtualbox:~$
```

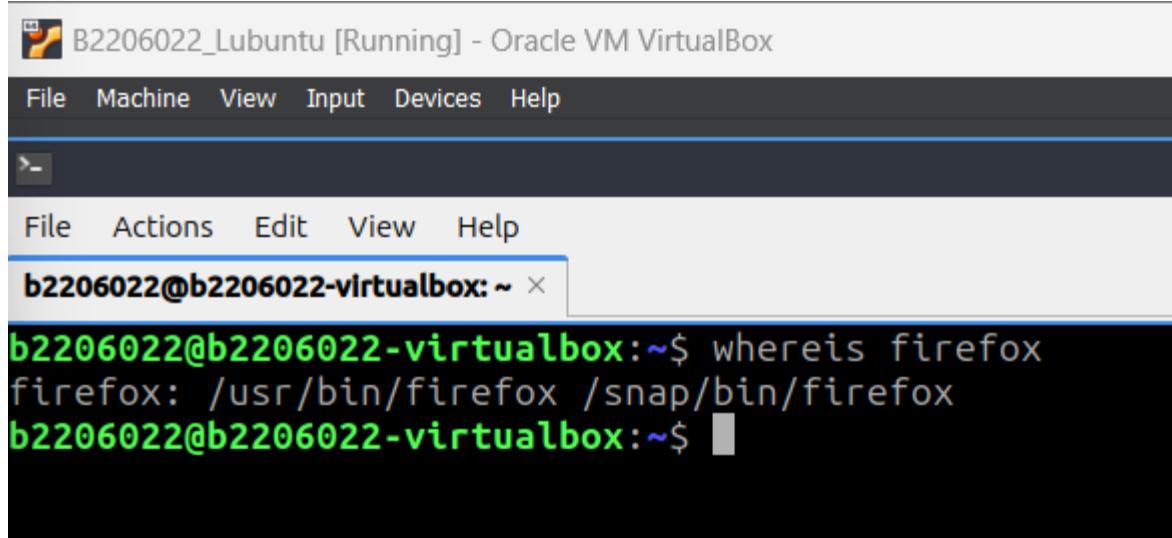
(take a screenshot of the login screen)

## 2. Basic operations

### 2.1. Accessing Directories

- Locate the application titled "firefox" using **whereis** command.

```
$whereis firefox
```



```
b2206022@b2206022-virtualbox:~$ whereis firefox
firefox: /usr/bin/firefox /snap/bin/firefox
b2206022@b2206022-virtualbox:~$
```

- Display the present working directory.

```
$pwd
```

- Change the current working directory to **/usr/bin** directory.

```
$cd /usr/bin
```

- Change the current working directory to **\$HOME** directory.

```
$cd ~
```

- Move to the parent directory.

```
$cd ..
```

- Go to the previous directory by the shortcut method, i.e., using '-' operator.

```
$cd -
```

- Display the present working directory.

```
$pwd
```

- Display the filesystem tree of the current directory

```
$tree
```

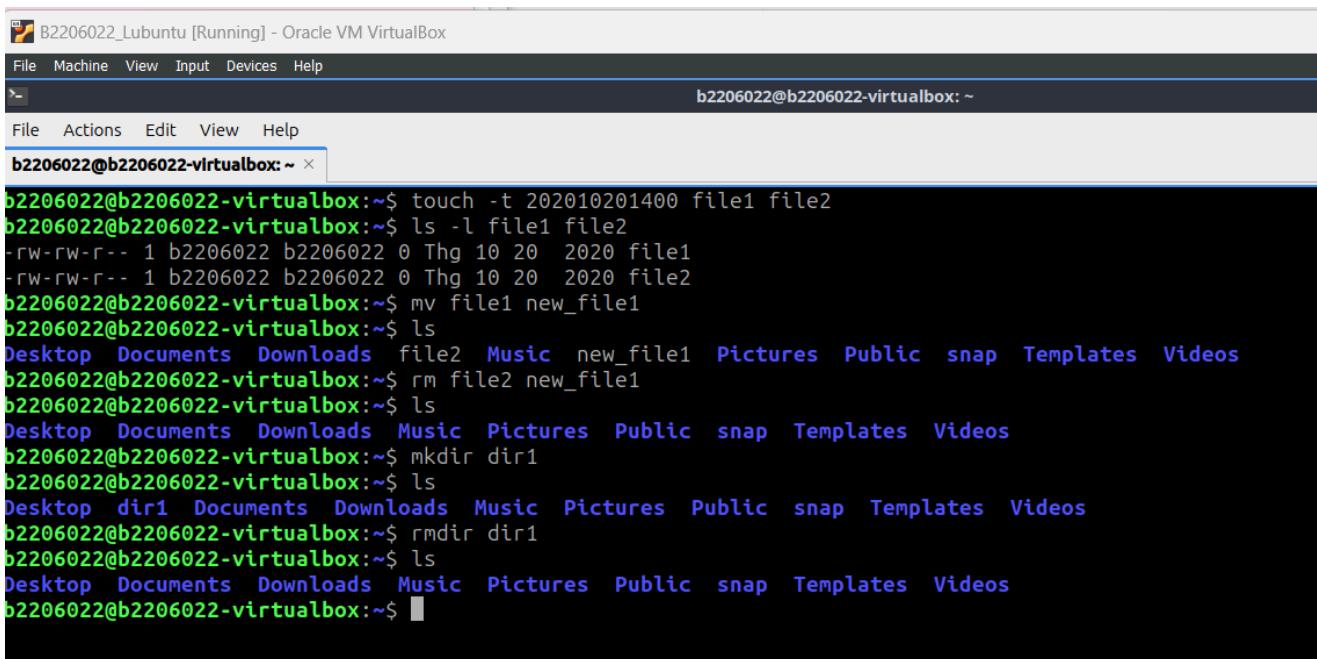
The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The terminal window has a dark theme with white text. It displays the following command-line session:

```
b2206022@b2206022-virtualbox:~$ whereis firefox
firefox: /usr/bin/firefox /snap/bin/firefox
b2206022@b2206022-virtualbox:~$ pwd
/home/b2206022
b2206022@b2206022-virtualbox:~$ cd /usr/bin
b2206022@b2206022-virtualbox:/usr/bin$ cd ~
b2206022@b2206022-virtualbox:~$ cd ..
b2206022@b2206022-virtualbox:/home$ cd -
/home/b2206022
b2206022@b2206022-virtualbox:~$ pwd
/home/b2206022
b2206022@b2206022-virtualbox:~$ tree
.
+- Desktop
  +- computer.desktop
  +- lubuntu-manual.desktop
  +- network.desktop
  +- trash-can.desktop
  +- user-home.desktop
+- Documents
+- Downloads
+- Music
+- Pictures
+- Public
+- snap
  +- firefox
    +- 4793
    +- common
    +- current -> 4793
+- Templates
+- Videos

14 directories, 5 files
b2206022@b2206022-virtualbox:~$
```

## 2.2. Working With Files and Directories

- Using **touch**, create **file1** and **file2** (two empty files) with timestamp: 20 October 2020 2:00 PM.  
    \$touch -t 202010201400 file1 file2
- Check for the existence of **file1** and **file2** using **ls -l**.  
    \$ls -l file1 file2
- Rename **file1** to **new\_file1** using **mv**.  
    \$mv file1 new\_file1
- Remove **file2** and **new\_file1** using **rm** without any options.  
    \$rm file2 new\_file1
- Create a directory named **dir1**, using **mkdir**.  
    \$mkdir dir1
- Remove **dir1** using **rmdir** without any options  
    \$rmdir dir1



The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The terminal prompt is "b2206022@b2206022-virtualbox: ~". The user has run the following commands:

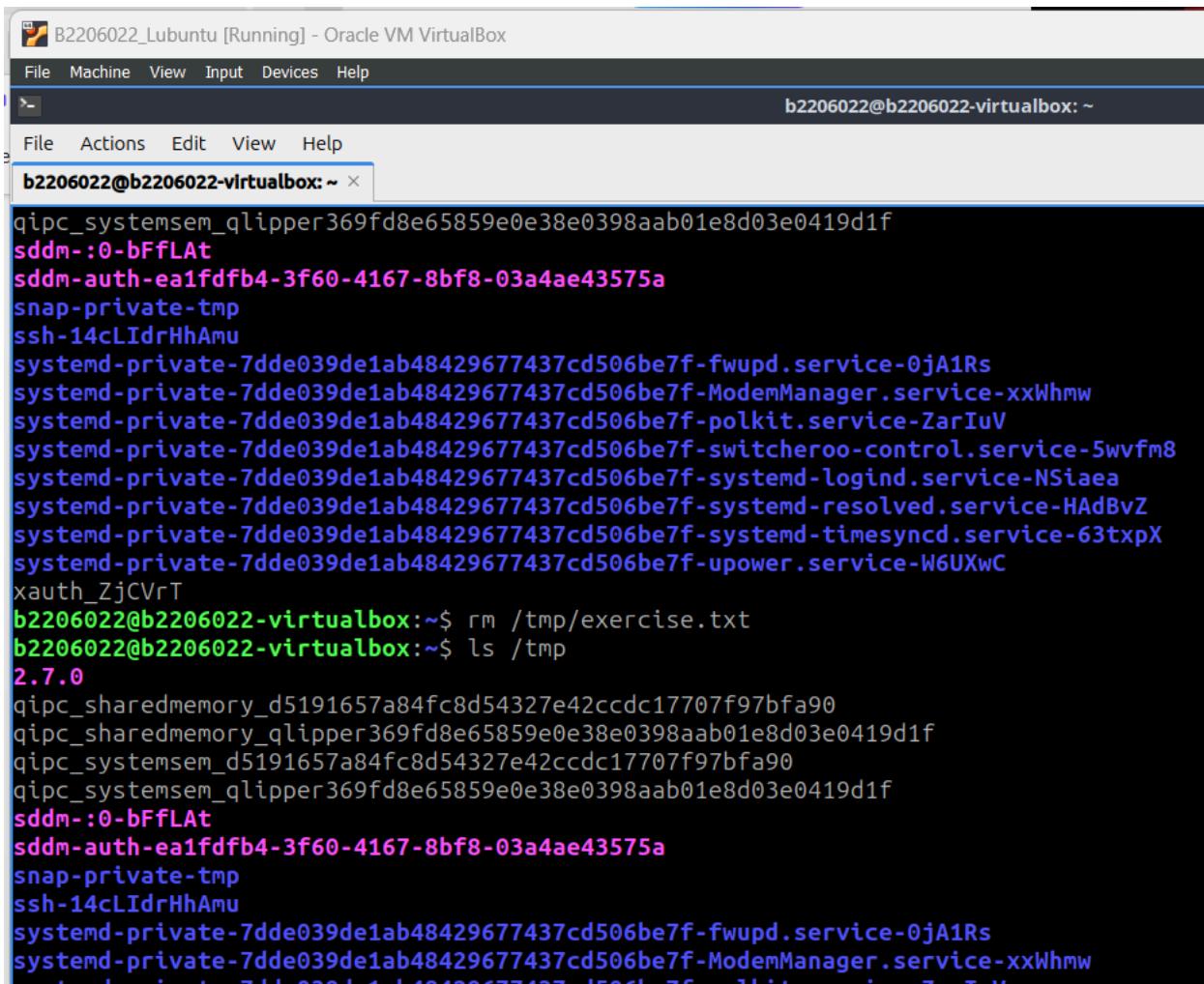
```
b2206022@b2206022-virtualbox:~$ touch -t 202010201400 file1 file2
b2206022@b2206022-virtualbox:~$ ls -l file1 file2
-rw-rw-r-- 1 b2206022 b2206022 0 Thg 10 20 2020 file1
-rw-rw-r-- 1 b2206022 b2206022 0 Thg 10 20 2020 file2
b2206022@b2206022-virtualbox:~$ mv file1 new_file1
b2206022@b2206022-virtualbox:~$ ls
Desktop Documents Downloads file2 Music new_file1 Pictures Public snap Templates Videos
b2206022@b2206022-virtualbox:~$ rm file2 new_file1
b2206022@b2206022-virtualbox:~$ ls
Desktop Documents Downloads Music Pictures Public snap Templates Videos
b2206022@b2206022-virtualbox:~$ mkdir dir1
b2206022@b2206022-virtualbox:~$ ls
Desktop dir1 Documents Downloads Music Pictures Public snap Templates Videos
b2206022@b2206022-virtualbox:~$ rmdir dir1
b2206022@b2206022-virtualbox:~$ ls
Desktop Documents Downloads Music Pictures Public snap Templates Videos
b2206022@b2206022-virtualbox:~$
```

- Create an empty file named **exercise.txt** and move it to **/tmp** using relative pathname.  
Then delete this file using an absolute pathname

```
$touch exercise.txt  
$mv ./exercise.txt /tmp  
$rm /tmp/exercise.txt
```

The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The terminal prompt is "b2206022@b2206022-virtualbox: ~". The user has run the following commands:

```
b2206022@b2206022-virtualbox:~$ touch exercise.txt  
b2206022@b2206022-virtualbox:~$ ls  
Desktop Documents Downloads exercise.txt Music Pictures Public snap Templates Videos  
b2206022@b2206022-virtualbox:~$ mv ./exercise.txt /tmp  
b2206022@b2206022-virtualbox:~$ ls /tmp  
2.7.0  
exercise.txt  
qipc_sharedmemory_d5191657a84fc8d54327e42ccdc17707f97bfa90  
qipc_sharedmemory_qlipper369fd8e65859e0e38e0398aab01e8d03e0419d1f  
qipc_systemsem_d5191657a84fc8d54327e42ccdc17707f97bfa90  
qipc_systemsem_qlipper369fd8e65859e0e38e0398aab01e8d03e0419d1f  
sddm-:0-bFfLAT  
sddm-auth-ea1fdb4-3f60-4167-8bf8-03a4ae43575a  
snap-private-tmp  
ssh-14cLIdrHhAmu  
systemd-private-7dde039de1ab48429677437cd506be7f-fwupd.service-0jA1Rs  
systemd-private-7dde039de1ab48429677437cd506be7f-ModemManager.service-xxWhmw  
systemd-private-7dde039de1ab48429677437cd506be7f-polkit.service-ZarIuV  
systemd-private-7dde039de1ab48429677437cd506be7f-switcheroo-control.service-5wvfm8  
systemd-private-7dde039de1ab48429677437cd506be7f-systemd-logind.service-NSiaeae  
systemd-private-7dde039de1ab48429677437cd506be7f-systemd-resolved.service-HAdBvZ  
systemd-private-7dde039de1ab48429677437cd506be7f-systemd-timesyncd.service-63txpX  
systemd-private-7dde039de1ab48429677437cd506be7f-upower.service-W6UXwC  
xauth_ZjCVrT
```



```

B2206022_Lubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
b2206022@b2206022-virtualbox: ~
File Actions Edit View Help
b2206022@b2206022-virtualbox: ~ ×
qipc_systemsem_qlipper369fd8e65859e0e38e0398aab01e8d03e0419d1f
sddm--0-bFfLAT
sddm-auth-ea1fdfb4-3f60-4167-8bf8-03a4ae43575a
snap-private-tmp
ssh-14cLIdrHhAmu
systemd-private-7dde039de1ab48429677437cd506be7f-fwupd.service-0jA1Rs
systemd-private-7dde039de1ab48429677437cd506be7f-ModemManager.service-xxWhmw
systemd-private-7dde039de1ab48429677437cd506be7f-polkit.service-ZarIuV
systemd-private-7dde039de1ab48429677437cd506be7f-switcheroo-control.service-5wvfm8
systemd-private-7dde039de1ab48429677437cd506be7f-systemd-logind.service-NSiaeaa
systemd-private-7dde039de1ab48429677437cd506be7f-systemd-resolved.service-HAdBvZ
systemd-private-7dde039de1ab48429677437cd506be7f-systemd-timesyncd.service-63txpX
systemd-private-7dde039de1ab48429677437cd506be7f-upower.service-W6UXwC
xauth_ZjCVrT
b2206022@b2206022-virtualbox:~$ rm /tmp/exercise.txt
b2206022@b2206022-virtualbox:~$ ls /tmp
2.7.0
qipc_sharedmemory_d5191657a84fc8d54327e42ccdc17707f97bfa90
qipc_sharedmemory_qlipper369fd8e65859e0e38e0398aab01e8d03e0419d1f
qipc_systemsem_d5191657a84fc8d54327e42ccdc17707f97bfa90
qipc_systemsem_qlipper369fd8e65859e0e38e0398aab01e8d03e0419d1f
sddm--0-bFfLAT
sddm-auth-ea1fdfb4-3f60-4167-8bf8-03a4ae43575a
snap-private-tmp
ssh-14cLIdrHhAmu
systemd-private-7dde039de1ab48429677437cd506be7f-fwupd.service-0jA1Rs
systemd-private-7dde039de1ab48429677437cd506be7f-ModemManager.service-xxWhmw
systemd-private-7dde039de1ab48429677437cd506be7f-polkit.service-ZarIuV

```

- Create a file **Autumn\_Leaves** with its content as below using **nano** tool.

```

$ nano Autumn_Leaves
#Content of Autumn_Leaves file
The falling leaves drift by my window
The falling leaves of red and gold
I see your lips the summer kisses
The sunburned hands I used to hold
Since you went away the days grow long
And soon I will hear old winter's song
But I miss you most of all my darling
When autumn leaves start to fall
...
# Ctrl o: Save file
# Ctrl x: Quit nano

```

- Search for the string “**falling**” in the file **Autumn\_Leaves**

- ```
$grep "falling" Autumn_Leaves
- Display the first 2 lines of the file Autumn_Leaves
$head -n 2 Autumn_Leaves
- Display the last 3 lines of the file Autumn_Leaves
$tail -n 3 Autumn_Leaves
```

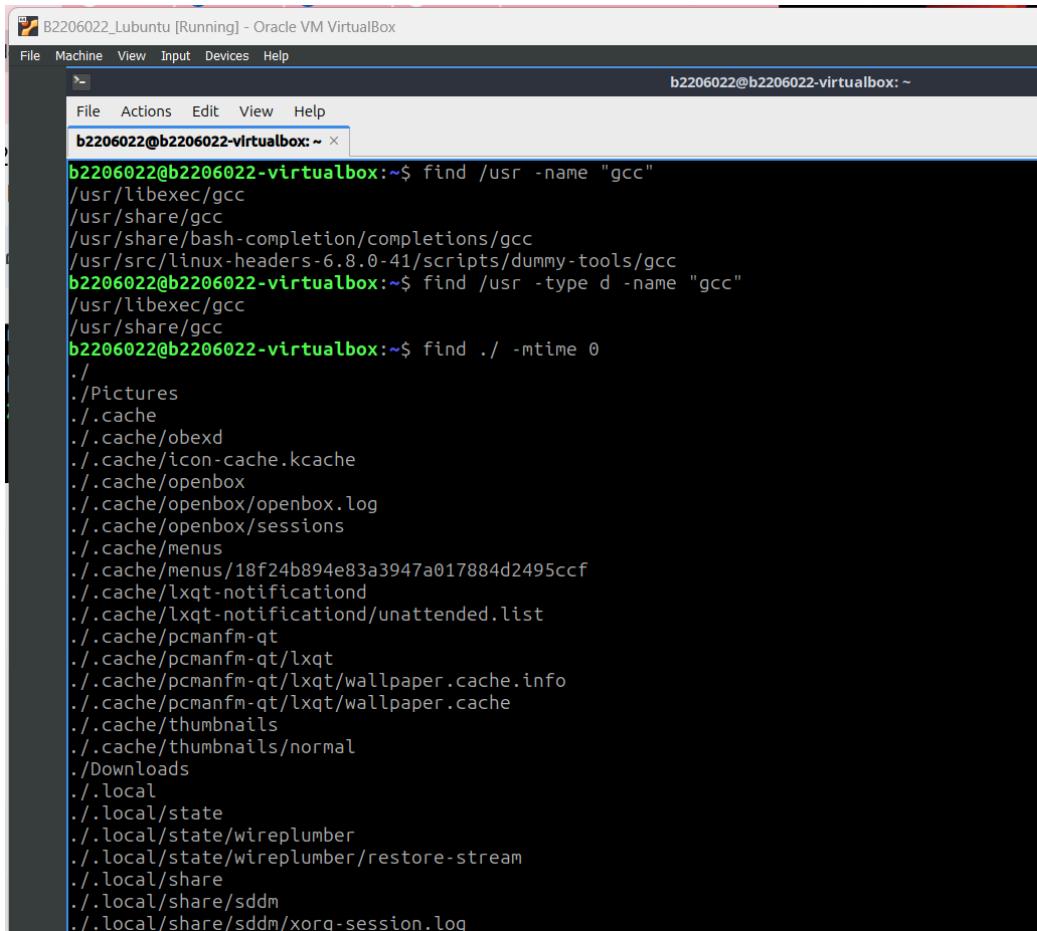
The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The terminal interface includes a menu bar with "File", "Machine", "View", "Input", "Devices", "Help" and a user name "b2206022@b2206022". Below the menu is a toolbar with "File", "Actions", "Edit", "View", "Help". The command line prompt is "b2206022@b2206022-virtualbox: ~ >". The terminal displays the following text:

```
b2206022@b2206022-virtualbox:~$ nano Autumn_Leaves
b2206022@b2206022-virtualbox:~$ cat Autumn_Leaves
#Content of Autumn_Leaves file
The falling leaves drift by my window
The falling leaves of red and gold
I see your lips the summer kisses
The sunburned hands I used to hold
Since you went away the days grow long
And soon I will hear old winter's song
But I miss you most of all my darling
When autumn leaves start to fall
b2206022@b2206022-virtualbox:~$ grep "falling" Autumn_Leaves
The falling leaves drift by my window
The falling leaves of red and gold
b2206022@b2206022-virtualbox:~$ head -n 2 Autumn_Leaves
#Content of Autumn_Leaves file
The falling leaves drift by my window
b2206022@b2206022-virtualbox:~$ tail -n 3 Autumn_Leaves
And soon I will hear old winter's song
But I miss you most of all my darling
When autumn leaves start to fall
b2206022@b2206022-virtualbox:~$
```

(take a screenshot of the console)

### 2.3. Finding files in a directory

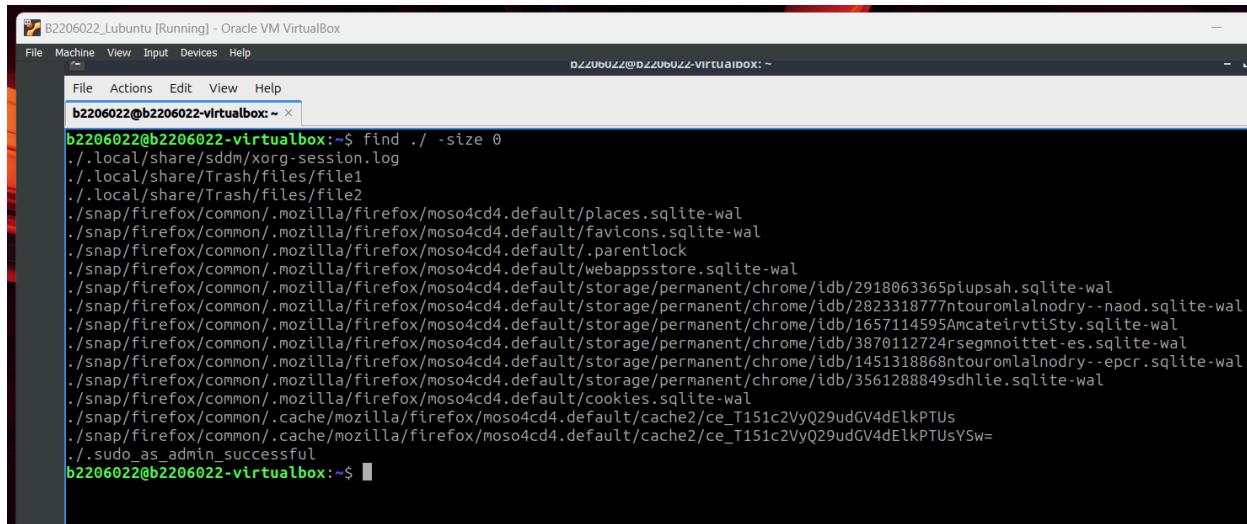
- Search for a file with the name **gcc** in the **/usr** folder using **find** command.  
    \$find /usr -name "gcc"
- Search for a directory with the name **gcc**, in the **/usr** folder using **find** command.  
    \$find /usr -type d -name "gcc"
- Search for files in the current directory that were modified today.  
    \$find ./ -mtime 0



```
b2206022@b2206022-virtualbox:~$ find /usr -name "gcc"
/usr/libexec/gcc
/usr/share/gcc
/usr/share/bash-completion/completions/gcc
/usr/src/linux-headers-6.8.0-41/scripts/dummy-tools/gcc
b2206022@b2206022-virtualbox:~$ find /usr -type d -name "gcc"
/usr/libexec/gcc
/usr/share/gcc
b2206022@b2206022-virtualbox:~$ find ./ -mtime 0
./
./Pictures
./.cache
./.cache/obexd
./.cache/icon-cache.kcache
./.cache/openbox
./.cache/openbox/openbox.log
./.cache/openbox/sessions
./.cache/menus
./.cache/menus/18f24b894e83a3947a017884d2495ccf
./.cache/lxqt-notificationd
./.cache/lxqt-notificationd/unattended.list
./.cache/pcmanfm-qt
./.cache/pcmanfm-qt/lxqt
./.cache/pcmanfm-qt/lxqt/wallpaper.cache.info
./.cache/pcmanfm-qt/lxqt/wallpaper.cache
./.cache/thumbnails
./.cache/thumbnails/normal
./Downloads
./.local
./.local/state
./.local/state/wireplumber
./.local/state/wireplumber/restore-stream
./.local/share
./.local/share/sddm
./.local/share/sddm/xorg-session.log
```

- Search for files with size **0 bytes**

```
$ find ./ -size 0
```



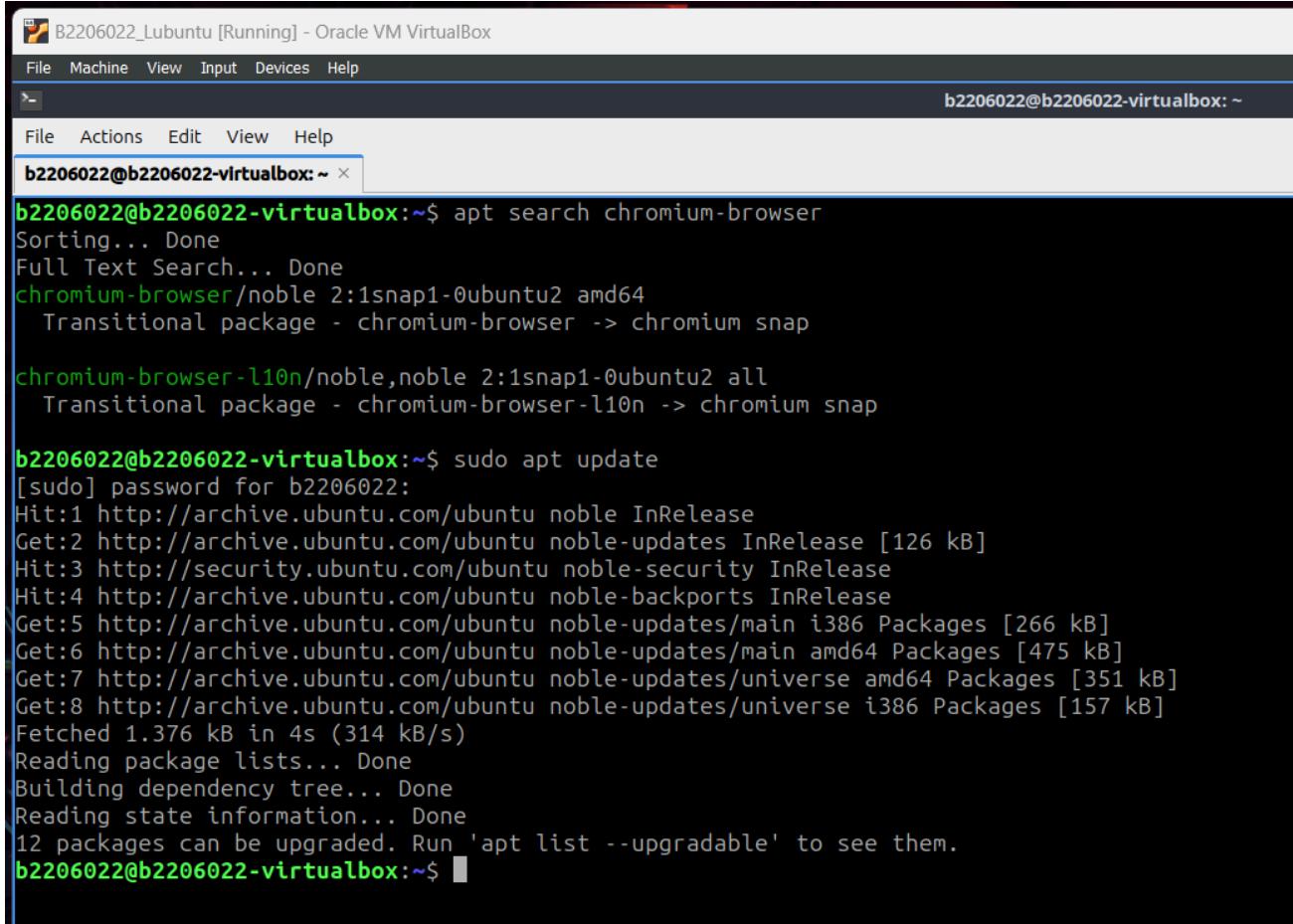
```
b2206022@b2206022-virtualbox:~$ find ./ -size 0
./.local/share/sddm/xorg-session.log
./.local/share/Trash/files/file1
./.local/share/Trash/files/file2
./snap/firefox/common/.mozilla/firefox/moso4cd4.default/places.sqlite-wal
./snap/firefox/common/.mozilla/firefox/moso4cd4.default/favicons.sqlite-wal
./snap/firefox/common/.mozilla/firefox/moso4cd4.default/.parentlock
./snap/firefox/common/.mozilla/firefox/moso4cd4.default/webappsstore.sqlite-wal
./snap/firefox/common/.mozilla/firefox/moso4cd4.default/storage/permanent/chrome/idb/2918063365piupsah.sqlite-wal
./snap/firefox/common/.mozilla/firefox/moso4cd4.default/storage/permanent/chrome/idb/3870112724rsegmnottet-es.sqlite-wal
./snap/firefox/common/.mozilla/firefox/moso4cd4.default/storage/permanent/chrome/idb/1451318868ntouromlalnodry--naod.sqlite-wal
./snap/firefox/common/.mozilla/firefox/moso4cd4.default/storage/permanent/chrome/idb/1657114595AmcateirvtiSty.sqlite-wal
./snap/firefox/common/.mozilla/firefox/moso4cd4.default/storage/permanent/chrome/idb/3561288849sdhlies.sqlite-wal
./snap/firefox/common/.mozilla/firefox/moso4cd4.default/storage/cookies.sqlite-wal
./snap/firefox/common/.cache/.mozilla/firefox/moso4cd4.default/cache2/ce_T151c2VyQ29udGV4dElkPTUsYSw=
./.sudo_as_admin_successful
b2206022@b2206022-virtualbox:~$
```

(take a screenshot of the console)

### 3. Installing and Removing software packages

#### 3.1. Install from default repositories

- Using apt tool, find the **chromium-browser** package.  
\$apt search chromium-browser
- If it is not installed, install it; otherwise, remove it, and then re-install it.  
\$sudo apt update

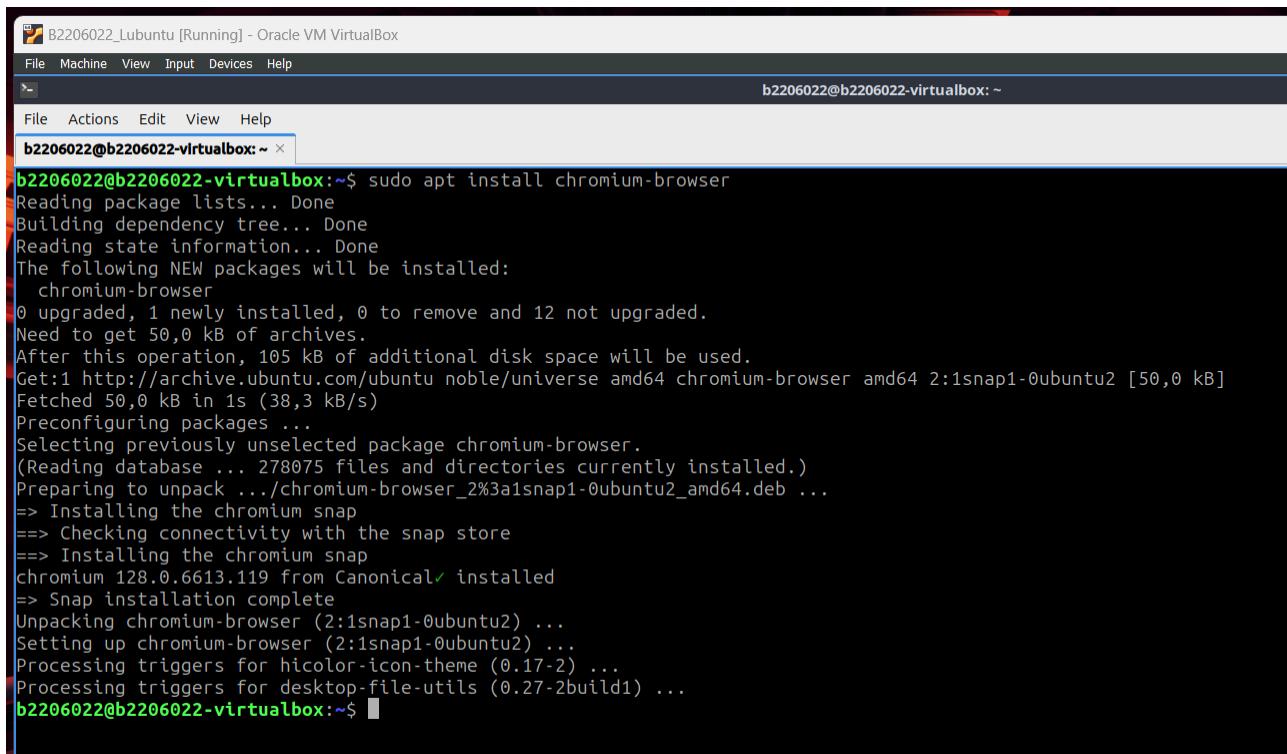


```
B2206022_Lubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
File Actions Edit View Help
b2206022@b2206022-virtualbox: ~ ×
b2206022@b2206022-virtualbox:~$ apt search chromium-browser
Sorting... Done
Full Text Search... Done
chromium-browser/noble 2:1snap1-0ubuntu2 amd64
    Transitional package - chromium-browser -> chromium snap

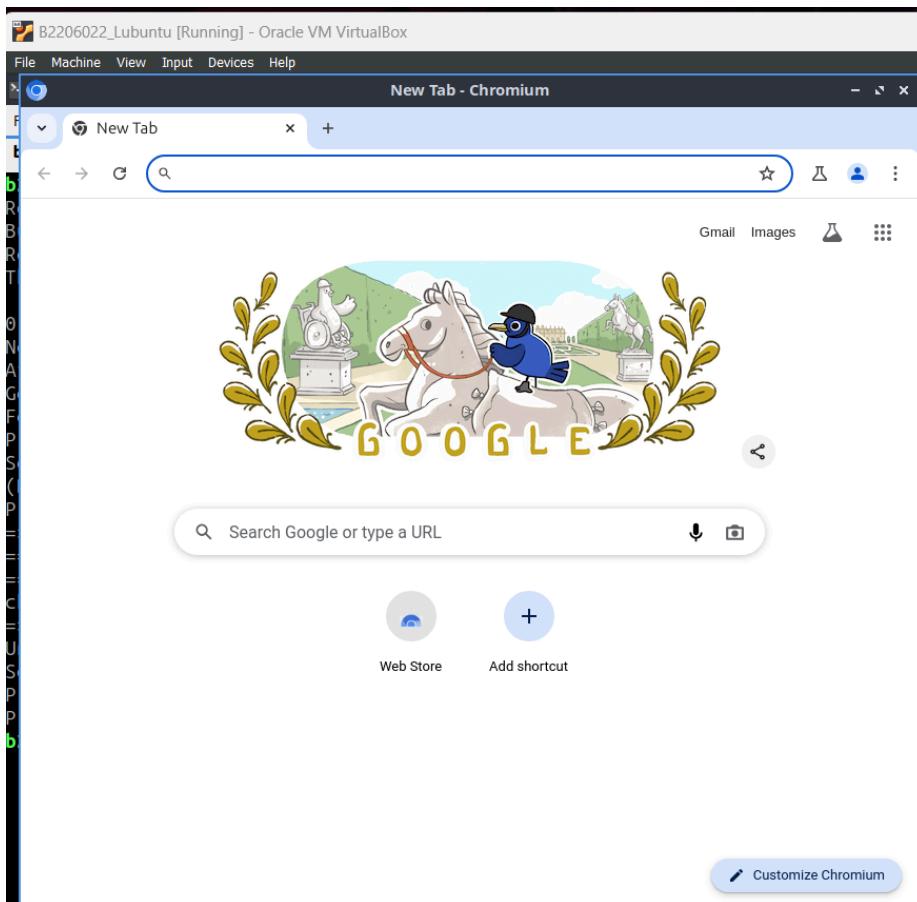
chromium-browser-l10n/noble,noble 2:1snap1-0ubuntu2 all
    Transitional package - chromium-browser-l10n -> chromium snap

b2206022@b2206022-virtualbox:~$ sudo apt update
[sudo] password for b2206022:
Hit:1 http://archive.ubuntu.com/ubuntu noble InRelease
Get:2 http://archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]
Hit:3 http://security.ubuntu.com/ubuntu noble-security InRelease
Hit:4 http://archive.ubuntu.com/ubuntu noble-backports InRelease
Get:5 http://archive.ubuntu.com/ubuntu noble-updates/main i386 Packages [266 kB]
Get:6 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 Packages [475 kB]
Get:7 http://archive.ubuntu.com/ubuntu noble-updates/universe amd64 Packages [351 kB]
Get:8 http://archive.ubuntu.com/ubuntu noble-updates/universe i386 Packages [157 kB]
Fetched 1.376 kB in 4s (314 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
12 packages can be upgraded. Run 'apt list --upgradable' to see them.
b2206022@b2206022-virtualbox:~$
```

\$sudo apt install chromium-browser



```
B2206022_Lubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
File Actions Edit View Help
b2206022@b2206022-virtualbox: ~
b2206022@b2206022-virtualbox:~$ sudo apt install chromium-browser
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
chromium-browser
0 upgraded, 1 newly installed, 0 to remove and 12 not upgraded.
Need to get 50,0 kB of archives.
After this operation, 105 kB of additional disk space will be used.
Get:1 http://archive.ubuntu.com/ubuntu noble/universe amd64 chromium-browser amd64 2:1snap1-0ubuntu2 [50,0 kB]
Fetched 50,0 kB in 1s (38,3 kB/s)
Preconfiguring packages ...
Selecting previously unselected package chromium-browser.
(Reading database ... 278075 files and directories currently installed.)
Preparing to unpack .../chromium-browser_2%3a1snap1-0ubuntu2_amd64.deb ...
=> Installing the chromium snap
==> Checking connectivity with the snap store
==> Installing the chromium snap
chromium 128.0.6613.119 from Canonical✓ installed
=> Snap installation complete
Unpacking chromium-browser (2:1snap1-0ubuntu2) ...
Setting up chromium-browser (2:1snap1-0ubuntu2) ...
Processing triggers for hicolor-icon-theme (0.17-2) ...
Processing triggers for desktop-file-utils (0.27-2build1) ...
b2206022@b2206022-virtualbox:~$
```



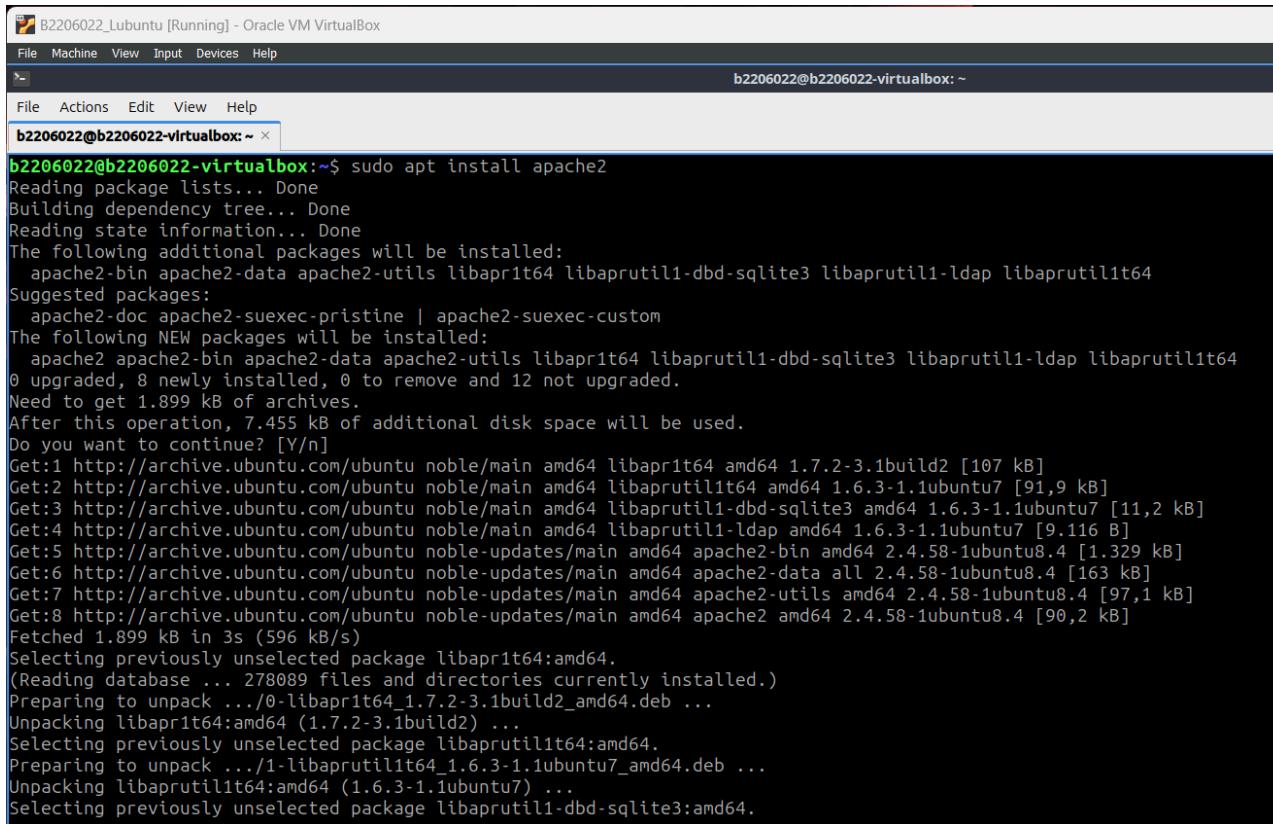
```
#  
$sudo apt remove chromium-browser  
$sudo apt install chromium-browser
```

The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The terminal interface includes a menu bar with "File", "Machine", "View", "Input", "Devices", and "Help". The title bar shows the session name "b2206022@b2206022-vir". The main area of the terminal displays the following command and its execution:

```
b2206022@b2206022-virtualbox:~$ sudo apt remove chromium-browser  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
The following packages will be REMOVED:  
  chromium-browser  
0 upgraded, 0 newly installed, 1 to remove and 12 not upgraded.  
After this operation, 105 kB disk space will be freed.  
Do you want to continue? [Y/n]  
(Reading database ... 278089 files and directories currently installed.)  
Removing chromium-browser (2:1snap1-0ubuntu2) ...  
Processing triggers for hicolor-icon-theme (0.17-2) ...  
Processing triggers for desktop-file-utils (0.27-2build1) ...  
b2206022@b2206022-virtualbox:~$ █
```

- Install **apache2** package using apt tool

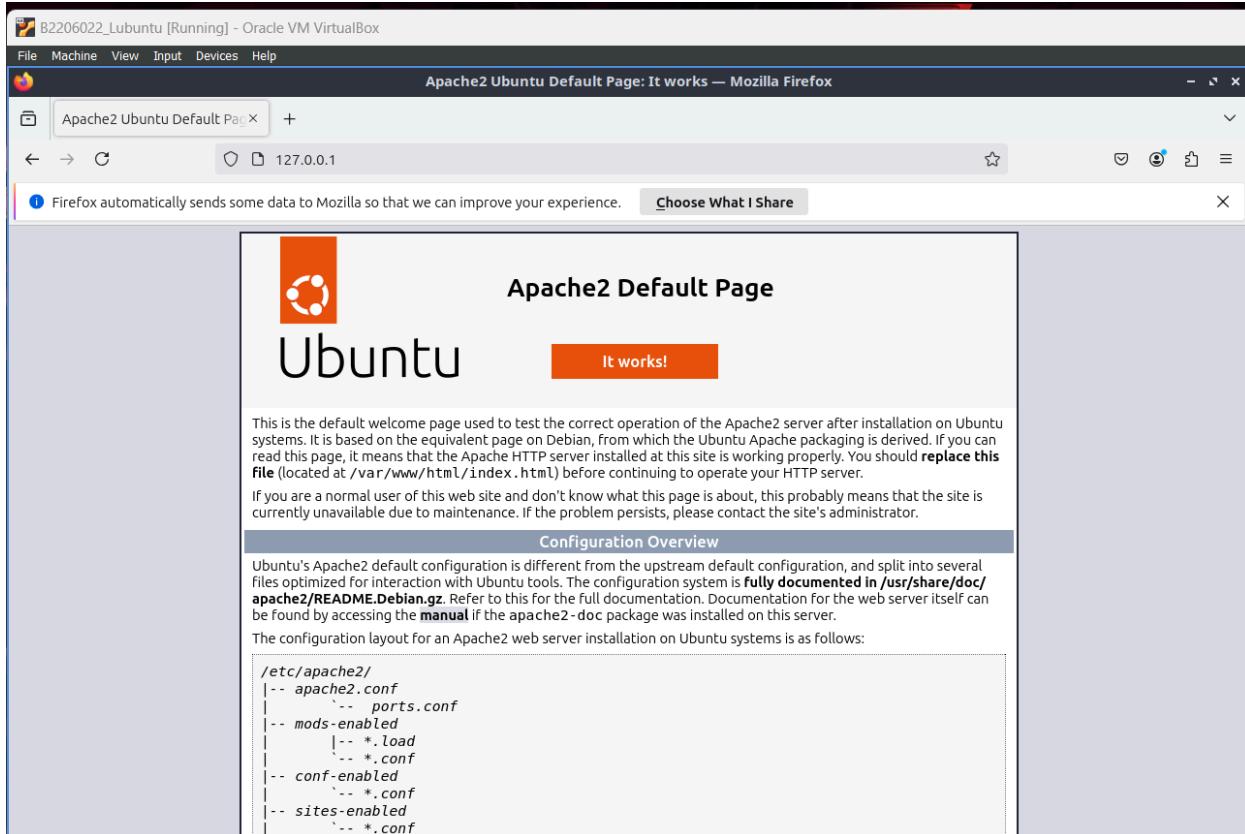
```
$sudo apt update  
$sudo apt install apache2
```



```

B2206022_Lubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
b2206022@b2206022-virtualbox: ~
File Actions Edit View Help
b2206022@b2206022-virtualbox: ~ x
b2206022@b2206022-virtualbox:~$ sudo apt install apache2
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  apache2-bin apache2-data apache2-utils libaprutil1-dbd-sqlite3 libaprutil1-ldap libaprutil1t64
Suggested packages:
  apache2-doc apache2-suexec-pristine | apache2-suexec-custom
The following NEW packages will be installed:
  apache2 apache2-bin apache2-data apache2-utils libaprutil1-dbd-sqlite3 libaprutil1-ldap libaprutil1t64
0 upgraded, 8 newly installed, 0 to remove and 12 not upgraded.
Need to get 1.899 kB of archives.
After this operation, 7.455 kB of additional disk space will be used.
Do you want to continue? [Y/n]
Get:1 http://archive.ubuntu.com/ubuntu noble/main amd64 libaprutil1-dbd-sqlite3 amd64 1.7.2-3.1build2 [107 kB]
Get:2 http://archive.ubuntu.com/ubuntu noble/main amd64 libaprutil1-ldap amd64 1.6.3-1.1ubuntu7 [91,9 kB]
Get:3 http://archive.ubuntu.com/ubuntu noble/main amd64 libaprutil1-dbd-sqlite3 amd64 1.6.3-1.1ubuntu7 [11,2 kB]
Get:4 http://archive.ubuntu.com/ubuntu noble/main amd64 libaprutil1-ldap amd64 1.6.3-1.1ubuntu7 [9.116 B]
Get:5 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2-bin amd64 2.4.58-1ubuntu8.4 [1.329 kB]
Get:6 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2-data all 2.4.58-1ubuntu8.4 [163 kB]
Get:7 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2-utils amd64 2.4.58-1ubuntu8.4 [97,1 kB]
Get:8 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2 amd64 2.4.58-1ubuntu8.4 [90,2 kB]
Fetched 1.899 kB in 3s (596 kB/s)
Selecting previously unselected package libaprutil1t64:amd64.
(Reading database ... 278089 files and directories currently installed.)
Preparing to unpack .../0-libaprutil1t64_1.7.2-3.1build2_amd64.deb ...
Unpacking libaprutil1t64:amd64 (1.7.2-3.1build2) ...
Selecting previously unselected package libaprutil1-ldap:amd64.
Preparing to unpack .../1-libaprutil1-ldap_1.6.3-1.1ubuntu7_amd64.deb ...
Unpacking libaprutil1-ldap:amd64 (1.6.3-1.1ubuntu7) ...
Selecting previously unselected package libaprutil1-dbd-sqlite3:amd64.

```



Apache2 Ubuntu Default Page: It works — Mozilla Firefox

Apache2 Ubuntu Default Page

Ubuntu

It works!

This is the default welcome page used to test the correct operation of the Apache2 server after installation on Ubuntu systems. It is based on the equivalent page on Debian, from which the Ubuntu Apache packaging is derived. If you can read this page, it means that the Apache HTTP server installed at this site is working properly. You should [replace this file](#) (located at `/var/www/html/index.html`) before continuing to operate your HTTP server.

If you are a normal user of this web site and don't know what this page is about, this probably means that the site is currently unavailable due to maintenance. If the problem persists, please contact the site's administrator.

**Configuration Overview**

Ubuntu's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Ubuntu tools. The configuration system is [fully documented in /usr/share/doc/apache2/README.Debian.gz](#). Refer to this for the full documentation. Documentation for the web server itself can be found by accessing the [manual](#) if the `apache2-doc` package was installed on this server.

The configuration layout for an Apache2 web server installation on Ubuntu systems is as follows:

```

/etc/apache2/
|-- apache2.conf
|   |-- ports.conf
|   |-- mods-enabled
|       |-- *.load
|       |-- *.conf
|-- conf-enabled
|   '-- *.conf
|-- sites-enabled
    '-- *.conf

```

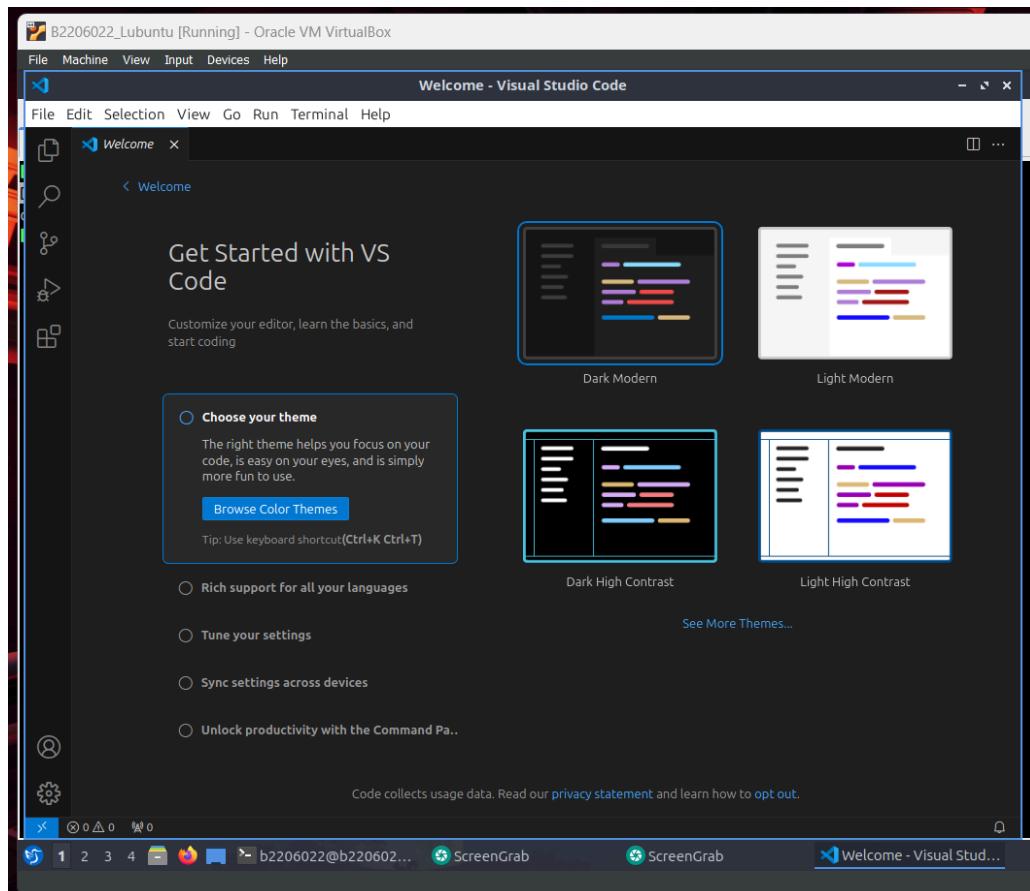
(take a screenshot of the console)

### 3.2. Install using snap

- Install VScode using snap tool

```
$sudo snap install --classic code
```

The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The command \$sudo snap install --classic code is entered, followed by the output: "Download snap \"code\" (168) from channel \"stable\"", "code 4849ca9b from Visual Studio Code (vscode) installed", and the prompt "b2206022@b2206022-virtualbox:~\$". The status bar at the bottom right indicates "38% 5.83MB/s 34.7".



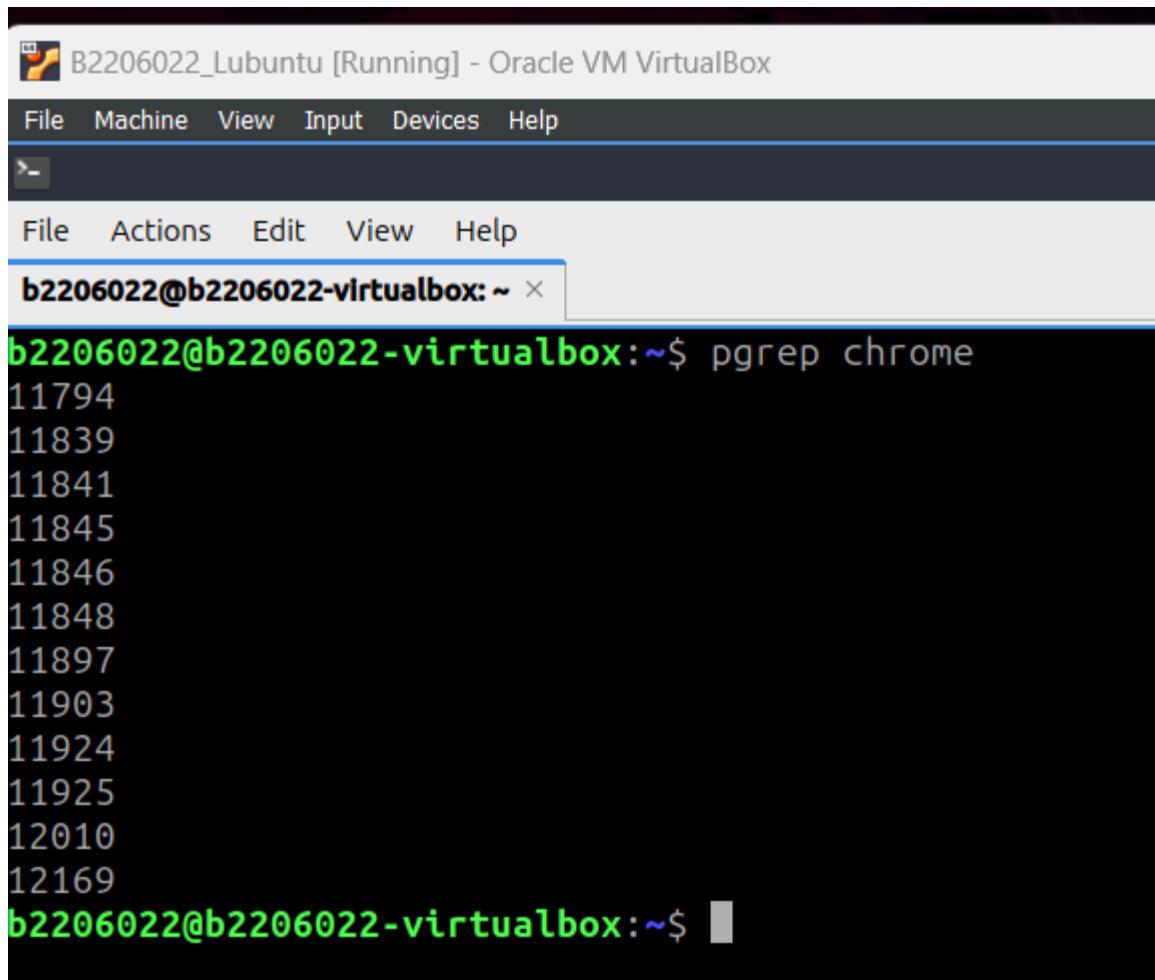
(take a screenshot of the console)

## 4. Process and daemons (services)

- Launch **chromium-browser** application; then find its PID using **pgrep** command

```
$chromium
```

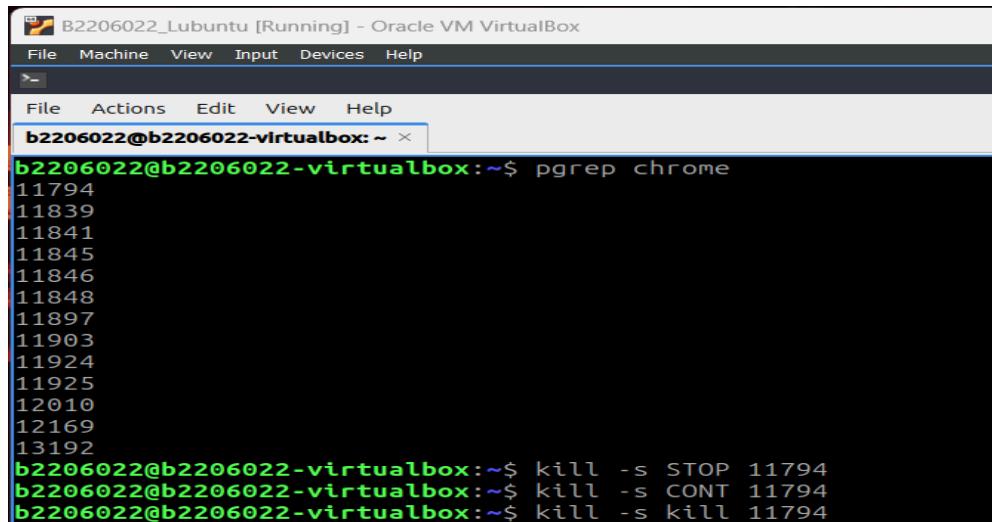
```
$pgrep chrome
```



```
b2206022@b2206022-virtualbox:~$ pgrep chrome
11794
11839
11841
11845
11846
11848
11897
11903
11924
11925
12010
12169
b2206022@b2206022-virtualbox:~$
```

- Stop/continue/terminate **chromium-browser** application using **kill** command

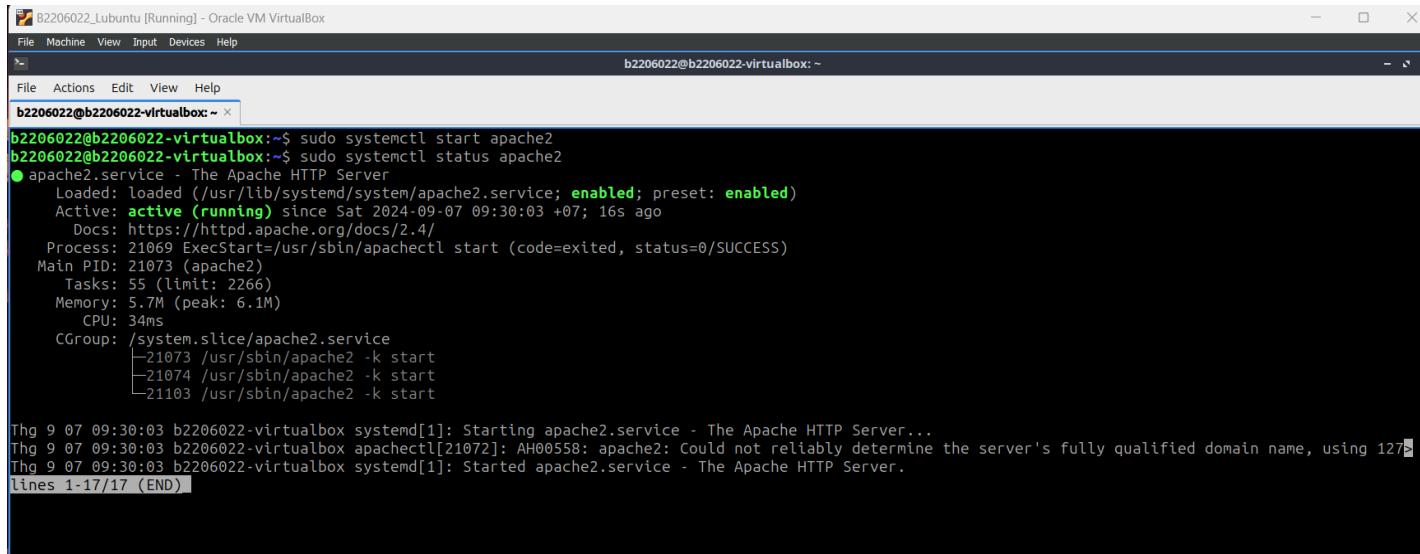
```
$kill -s STOP <PID>
$kill -s CONT <PID>
$kill -s KILL <PID>
```



```
b2206022@b2206022-virtualbox:~$ pgrep chrome
11794
11839
11841
11845
11846
11848
11897
11903
11924
11925
12010
12169
13192
b2206022@b2206022-virtualbox:~$ kill -s STOP 11794
b2206022@b2206022-virtualbox:~$ kill -s CONT 11794
b2206022@b2206022-virtualbox:~$ kill -s KILL 11794
```

- Start and then display the status of **apache2** web server using **systemctl** command

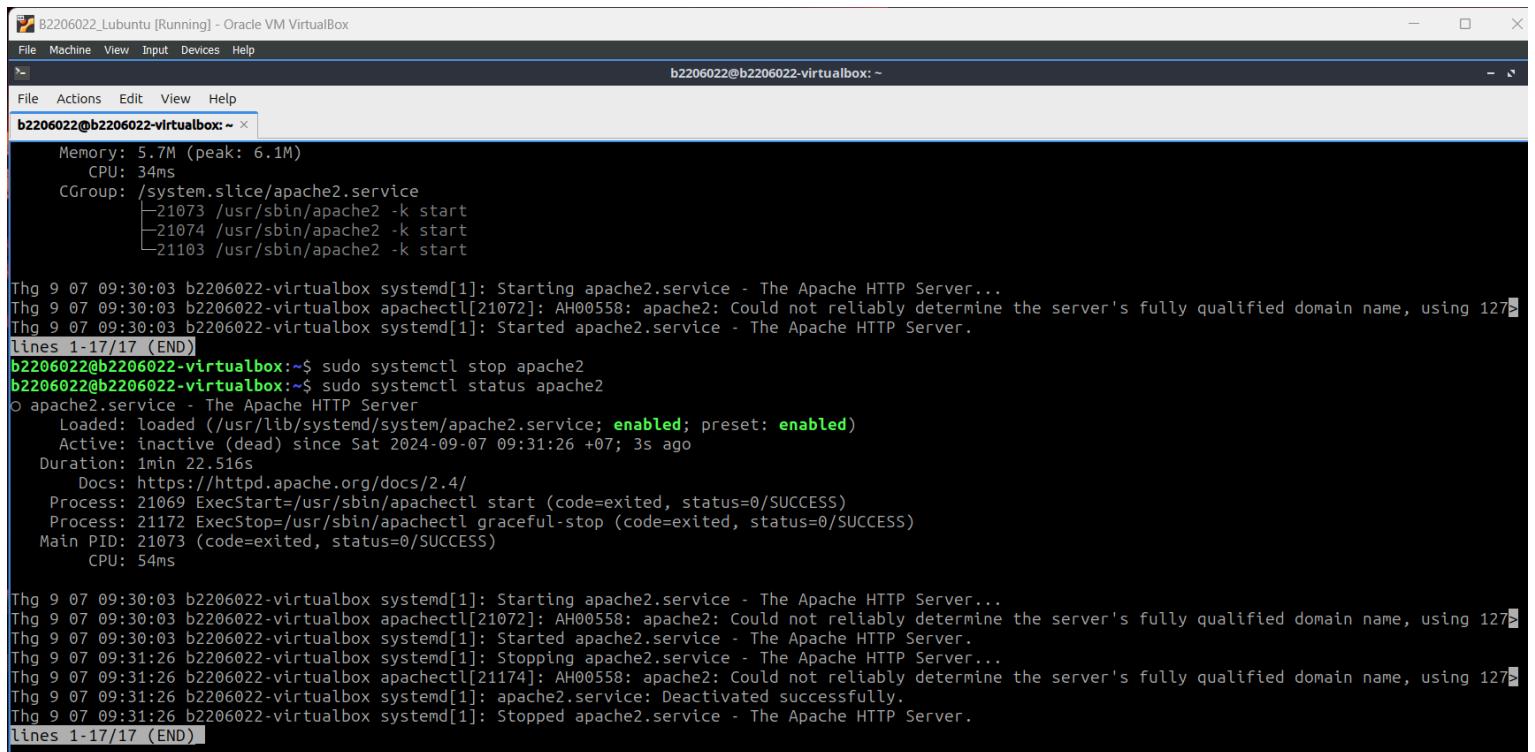
```
$sudo systemctl start apache2
$sudo systemctl status apache2
```



The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The terminal prompt is "b2206022@b2206022-virtualbox:~". The user runs the command "\$ sudo systemctl start apache2" followed by "\$ sudo systemctl status apache2". The output shows the Apache2 service is active (running) since Saturday, 09:30:03. It provides detailed resource usage information including memory, CPU, and CGroup details. The terminal then shows log entries for the start and status of the service.

```
b2206022@b2206022-virtualbox:~$ sudo systemctl start apache2
b2206022@b2206022-virtualbox:~$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/usr/lib/systemd/system/apache2.service; enabled; preset: enabled)
   Active: active (running) since Sat 2024-09-07 09:30:03 +07; 16s ago
     Docs: https://httpd.apache.org/docs/2.4/
  Process: 21069 ExecStart=/usr/sbin/apachectl start (code=exited, status=0/SUCCESS)
 Main PID: 21073 (apache2)
    Tasks: 55 (limit: 2266)
   Memory: 5.7M (peak: 6.1M)
      CPU: 34ms
     CGroup: /system.slice/apache2.service
             ├─21073 /usr/sbin/apache2 -k start
             ├─21074 /usr/sbin/apache2 -k start
             └─21103 /usr/sbin/apache2 -k start

Thg 9 07 09:30:03 b2206022-virtualbox systemd[1]: Starting apache2.service - The Apache HTTP Server...
Thg 9 07 09:30:03 b2206022-virtualbox apachectl[21072]: AH00558: apache2: Could not reliably determine the server's fully qualified domain name, using 127.0.0.1
Thg 9 07 09:30:03 b2206022-virtualbox systemd[1]: Started apache2.service - The Apache HTTP Server.
lines 1-17/17 (END)
```



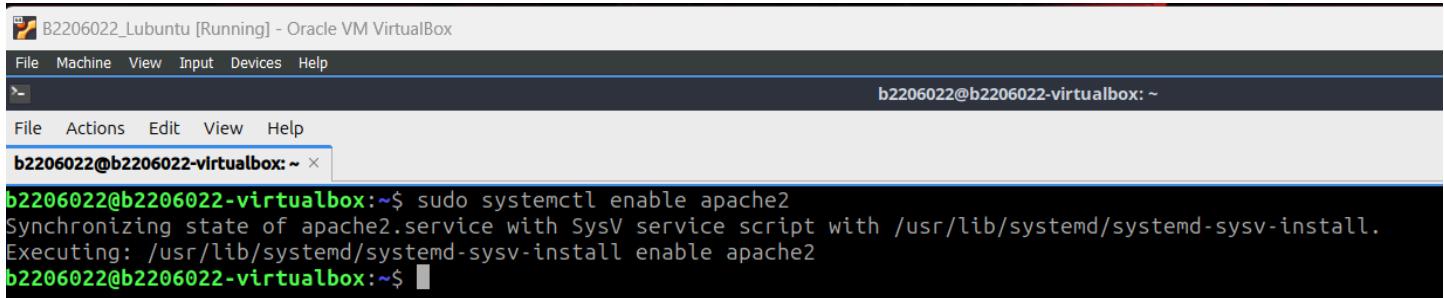
The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The terminal prompt is "b2206022@b2206022-virtualbox:~". The user runs the command "\$ sudo systemctl stop apache2" followed by "\$ sudo systemctl status apache2". The output shows the Apache2 service is inactive (dead). It provides detailed resource usage information including memory, CPU, and CGroup details. The terminal then shows log entries for the stop and status of the service.

```
b2206022@b2206022-virtualbox:~$ sudo systemctl stop apache2
b2206022@b2206022-virtualbox:~$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/usr/lib/systemd/system/apache2.service; enabled; preset: enabled)
   Active: inactive (dead) since Sat 2024-09-07 09:31:26 +07; 3s ago
     Duration: 1min 22.516s
       Docs: https://httpd.apache.org/docs/2.4/
  Process: 21069 ExecStart=/usr/sbin/apachectl start (code=exited, status=0/SUCCESS)
  Process: 21172 ExecStop=/usr/sbin/apachectl graceful-stop (code=exited, status=0/SUCCESS)
 Main PID: 21073 (code=exited, status=0/SUCCESS)
    CPU: 54ms

Thg 9 07 09:30:03 b2206022-virtualbox systemd[1]: Starting apache2.service - The Apache HTTP Server...
Thg 9 07 09:30:03 b2206022-virtualbox apachectl[21072]: AH00558: apache2: Could not reliably determine the server's fully qualified domain name, using 127.0.0.1
Thg 9 07 09:30:03 b2206022-virtualbox systemd[1]: Started apache2.service - The Apache HTTP Server.
lines 1-17/17 (END)
```

- Enable **apache2** web server starting on booting time

```
$sudo systemctl enable apache2
```



```
b2206022@b2206022-virtualbox:~$ sudo systemctl enable apache2
Synchronizing state of apache2.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable apache2
b2206022@b2206022-virtualbox:~$
```

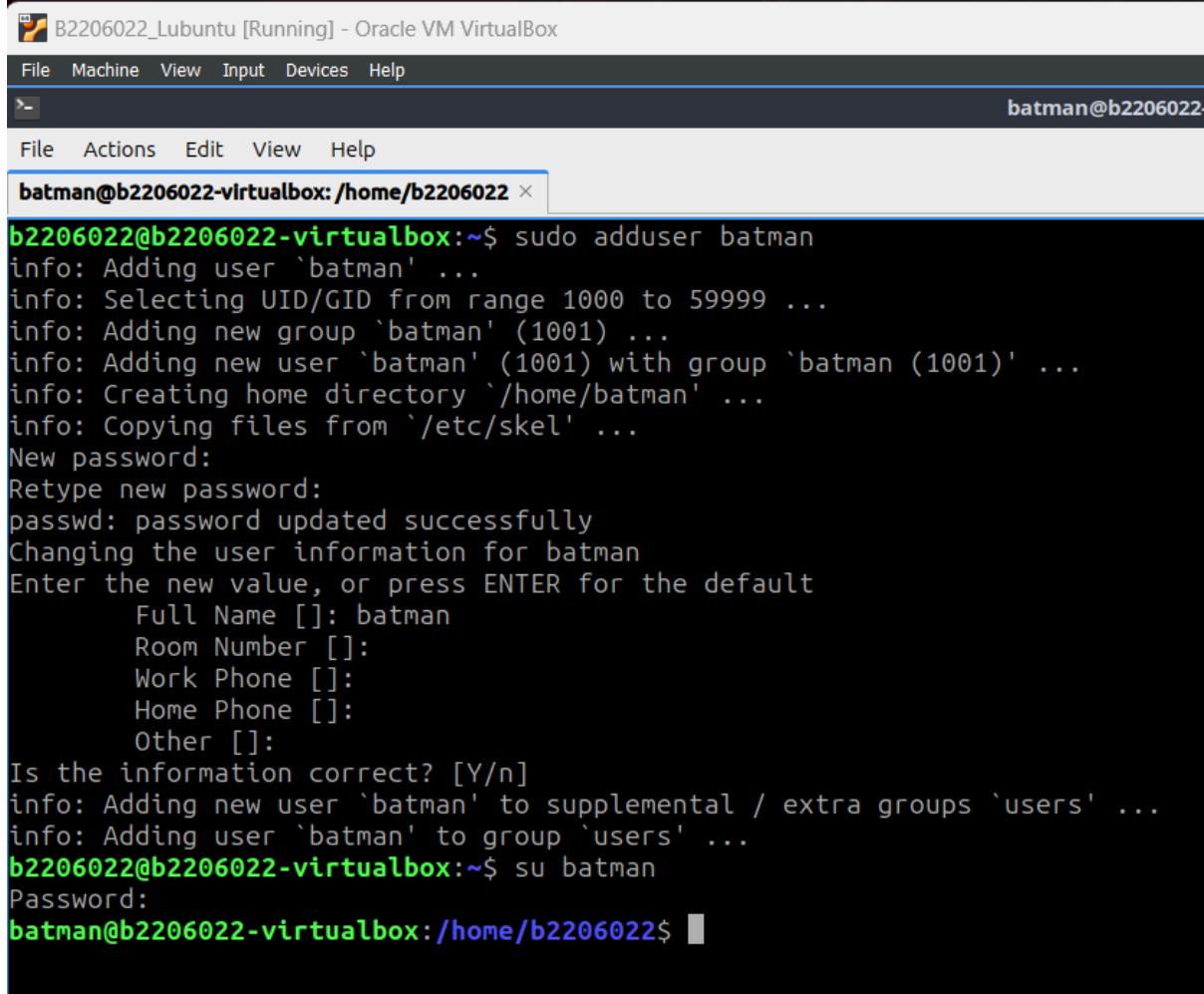
(take a screenshot of the console)

## 5. Local Security Principles

### 5.1. Create a new user and sudo

- Create a new user (batman), using **adduser**, and give the user an initial password with **passwd**.

```
$sudo adduser batman
$sudo passwd batman
```



```
b2206022@b2206022-virtualbox:~$ sudo adduser batman
info: Adding user `batman' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `batman' (1001) ...
info: Adding new user `batman' (1001) with group `batman (1001)' ...
info: Creating home directory `/home/batman' ...
info: Copying files from `/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for batman
Enter the new value, or press ENTER for the default
      Full Name []: batman
      Room Number []:
      Work Phone []:
      Home Phone []:
      Other []:
Is the information correct? [Y/n]
info: Adding new user `batman' to supplemental / extra groups `users' ...
info: Adding user `batman' to group `users' ...
b2206022@b2206022-virtualbox:~$ su batman
Password:
batman@b2206022-virtualbox:/home/b2206022$
```

- Configure this user to be able to use **sudo** command

```
$sudo usermod -aG sudo batman
```

- Login as or switch to this new user and make sure you can execute a command (cat /etc/shadow) that requires root privilege.

```
$su batman  
$sudo cat /etc/shadow
```

The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The terminal interface includes a menu bar with File, Machine, View, Input, Devices, Help, and a status bar showing "batman@b2206022". The main window has a title bar "batman@b2206022-virtualbox: /home/b2206022" and a command line area. The command line shows the user running "sudo usermod -aG sudo batman" and then switching to the "batman" user with "su batman". A password prompt follows. The user then runs "sudo cat /etc/shadow" and lists the contents of the shadow password file, which includes entries for root, daemon, bin, sys, sync, games, man, lp, mail, news, uucp, proxy, www-data, backup, list, irc, apt, nobody, and several system services like systemd-network, systemd-timesync, dhcpcd, messagebus, and syslog. Each entry consists of a colon-separated list of fields representing user information.

```
b2206022@b2206022-virtualbox:~$ sudo usermod -aG sudo batman  
b2206022@b2206022-virtualbox:~$ su batman  
Password:  
To run a command as administrator (user "root"), use "sudo <command>".  
See "man sudo_root" for details.  
  
batman@b2206022-virtualbox:/home/b2206022$ sudo cat /etc/shadow  
[sudo] password for batman:  
root:!:19972:0:99999:7:::  
daemon:*:19962:0:99999:7:::  
bin:*:19962:0:99999:7:::  
sys:*:19962:0:99999:7:::  
sync:*:19962:0:99999:7:::  
games:*:19962:0:99999:7:::  
man:*:19962:0:99999:7:::  
lp:*:19962:0:99999:7:::  
mail:*:19962:0:99999:7:::  
news:*:19962:0:99999:7:::  
uucp:*:19962:0:99999:7:::  
proxy:*:19962:0:99999:7:::  
www-data:*:19962:0:99999:7:::  
backup:*:19962:0:99999:7:::  
list:*:19962:0:99999:7:::  
irc:*:19962:0:99999:7:::  
apt:*:19962:0:99999:7:::  
nobody:*:19962:0:99999:7:::  
systemd-network:!*:19962:::::::  
systemd-timesync:!*:19962:::::::  
dhcpcd:!:19962:::::::  
messagebus:!:19962:::::::  
syslog:!:19962:::::::
```

(take a screenshot of the console)

## 5.2. Password aging

- With the newly created user from 5.1, look at the password aging for the user.

```
$sudo chage -l batman
```

- Modify the expiration date for the user, setting it to something that has passed, and check to see what has changed.

```
$sudo chage -E 2020/12/31 batman  
$su batman
```

```
b2206022@b2206022-virtualbox:~$ sudo chage -l batman  
Last password change : Thg 9 07, 2024  
Password expires : never  
Password inactive : never  
Account expires : Thg 12 31, 2020  
Minimum number of days between password change : 0  
Maximum number of days between password change : 99999  
Number of days of warning before password expires : 7  
b2206022@b2206022-virtualbox:~$ sudo chage -E 2020/12/31 batman  
b2206022@b2206022-virtualbox:~$ sudo chage -l batman  
Last password change : Thg 9 07, 2024  
Password expires : never  
Password inactive : never  
Account expires : Thg 12 31, 2020  
Minimum number of days between password change : 0  
Maximum number of days between password change : 99999  
Number of days of warning before password expires : 7  
b2206022@b2206022-virtualbox:~$ su batman  
Password:  
Your account has expired; please contact your system administrator.  
su: Authentication failure  
b2206022@b2206022-virtualbox:~$
```

(take a screenshot of the console)

### 5.3. Log files

- Display the time when the user in 5.1 created

```
$cat /var/log/auth.log | grep "new user"
```

- Find the time of the last log in to the system

```
$last
```

(take a screenshot of the console)

```
b2206022@b2206022-virtualbox:~$ cat /var/log/auth.log | grep "new user"
2024-09-06T16:43:05.703913+07:00 b2206022-virtualbox useradd[14926]: new user: name=vboxadd, UID=997, GID=1, home=/var/run/vboxadd, shell=/bin/false, from=/dev/pts/1
2024-09-07T09:06:37.475268+07:00 b2206022-virtualbox useradd[3703]: new user: name=snapd-range-524288-root, UID=524288, GID=524288, home=/nonexistent, shell=/usr/bin/false, from=none
2024-09-07T09:06:37.535371+07:00 b2206022-virtualbox useradd[3716]: new user: name=snap_daemon, UID=584788, GID=584788, home=/nonexistent, shell=/usr/bin/false, from=none
2024-09-07T09:34:43.874931+07:00 b2206022-virtualbox useradd[21443]: new user: name=batman, UID=1001, GID=1001, home=/home/batman, shell=/bin/bash, from=/dev/pts/1
b2206022@b2206022-virtualbox:~$ last
b2206022 tty2 :0 Fri Sep 6 16:45 gone - no logout
reboot system boot 6.8.0-41-generic Fri Sep 6 16:43 still running
b2206022 tty2 :0 Fri Sep 6 15:40 - down (01:03)
reboot system boot 6.8.0-41-generic Fri Sep 6 15:36 - 16:43 (01:07)

wtmp begins Fri Sep 6 15:36:20 2024
b2206022@b2206022-virtualbox:~$
```

## 6. File permissions

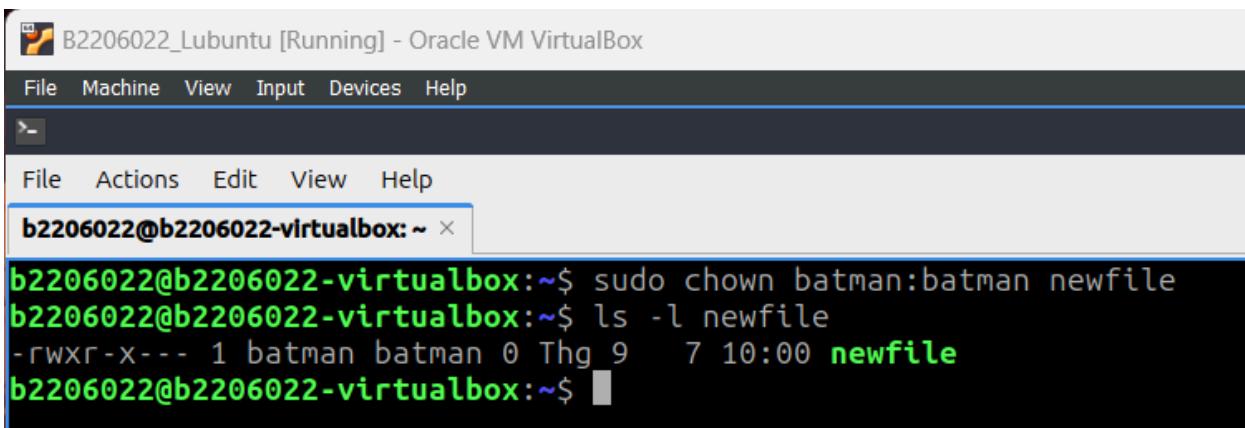
- Create a new file **newfile**; then change its permissions to **rwxr-x---**

```
$ touch newfile
$ chmod 750 newfile
```

```
b2206022@b2206022-virtualbox:~$ touch newfile
b2206022@b2206022-virtualbox:~$ ls -l newfile
-rw-r-- 1 b2206022 b2206022 0 Thg 9 7 10:00 newfile
b2206022@b2206022-virtualbox:~$ chmod 750 newfile
b2206022@b2206022-virtualbox:~$ ls -l newfile
-rwxr-x--- 1 b2206022 b2206022 0 Thg 9 7 10:00 newfile
b2206022@b2206022-virtualbox:~$
```

- Change the user and group ownership of **newfile** to the user 5.1

```
$ sudo chown batman:batman newfile
```



The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The terminal menu bar includes "File", "Machine", "View", "Input", "Devices", and "Help". Below the menu is another menu bar with "File", "Actions", "Edit", "View", and "Help". The command line prompt is "b2206022@b2206022-virtualbox: ~ >". The user runs the command "sudo chown batman:batman newfile" followed by "ls -l newfile", which lists a file named "newfile" with permissions "-rwxr-x---". The file was created by batman at 07:10:00.

(take a screenshot of the console)

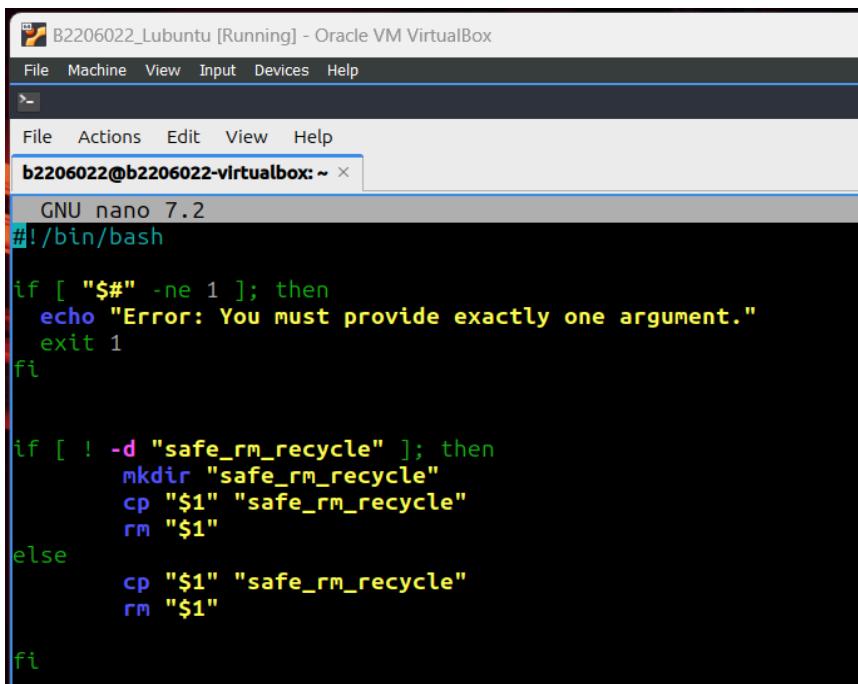
## 7. Shell scripting

The default rm command will not confirm before it deletes any regular files. Write a short script called *safe\_rm.sh*, such that it will make a copy before deleting a single file (that is, we do not use wildcard expressions for this problem) by doing the following:

- Take one and only one argument at the command line (hint: search for an expression representing the number of arguments in the shell scripts). Print out an error message if no argument or more than one argument is provided (hint: use echo).
- Create a directory "safe\_rm\_recycle" in the current one if it is not already created. Copy the file indicated by the first argument to this "safe\_rm\_recycle" folder. Remove this file from the current working directory.

Run the script, then take screenshots to show that you finish this exercise. Please also take screenshots of your code.

### Code



The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The terminal menu bar includes "File", "Machine", "View", "Input", "Devices", and "Help". Below the menu is another menu bar with "File", "Actions", "Edit", "View", and "Help". The command line prompt is "b2206022@b2206022-virtualbox: ~ >". The user is in a nano editor with the file content:

```
GNU nano 7.2
#!/bin/bash

if [ "$#" -ne 1 ]; then
    echo "Error: You must provide exactly one argument."
    exit 1
fi

if [ ! -d "safe_rm_recycle" ]; then
    mkdir "safe_rm_recycle"
    cp "$1" "safe_rm_recycle"
    rm "$1"
else
    cp "$1" "safe_rm_recycle"
    rm "$1"
fi
```

## Testing

The screenshot shows a terminal window titled "B2206022\_Lubuntu [Running] - Oracle VM VirtualBox". The terminal interface includes a menu bar with "File", "Machine", "View", "Input", "Devices", and "Help". Below the menu is a toolbar with "File", "Actions", "Edit", "View", and "Help". The main area is a terminal window with the following command history:

```
b2206022@b2206022-virtualbox: ~
b2206022@b2206022-virtualbox:~$ nano safe_rm.sh
b2206022@b2206022-virtualbox:~$ ./safe_rm.sh
Error: You must provide exactly one argument.
b2206022@b2206022-virtualbox:~$ ./safe_rm.sh text text
Error: You must provide exactly one argument.
b2206022@b2206022-virtualbox:~$ touch text
b2206022@b2206022-virtualbox:~$ ls
Autumn_Leaves Desktop Documents Downloads Music newfile Pictures Public safe_rm.sh snap Templates text Videos
b2206022@b2206022-virtualbox:~$ ./safe_rm.sh text
b2206022@b2206022-virtualbox:~$ ls
Autumn_Leaves Desktop Documents Downloads Music newfile Pictures Public safe_rm_recycle safe_rm.sh snap Templates Videos
b2206022@b2206022-virtualbox:~$ ls ./safe_rm_recycle
text
b2206022@b2206022-virtualbox:~$
```

---END---