

**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.**

**Create Virtual Machine**

**Virtual machine Name and Operating System**

Please choose a descriptive name and destination folder for the new virtual machine. The name you choose will be used throughout VirtualBox to identify this machine. Additionally, you can select an ISO image which may be used to install the guest operating system.

Name:

Folder:

ISO Image:

Edition:

Type:

Version:

☐ Skip Unattended Installation

No ISO image is selected, the guest OS will need to be installed manually.

Help Expert Mode Back Next Cancel

**Create Virtual Machine**

**Summary**

The following table summarizes the configuration you have chosen for the new virtual machine. When you are happy with the configuration press Finish to create the virtual machine. Alternatively you can go back and modify the configuration.

Machine Name and OS Type	
Machine Name	LubuntuB2111933
Machine Folder	F:\Máy Ảo\VirtualBox\Lubuntu\LubuntuB2111933
ISO Image	
Guest OS Type	Lubuntu (64-bit)

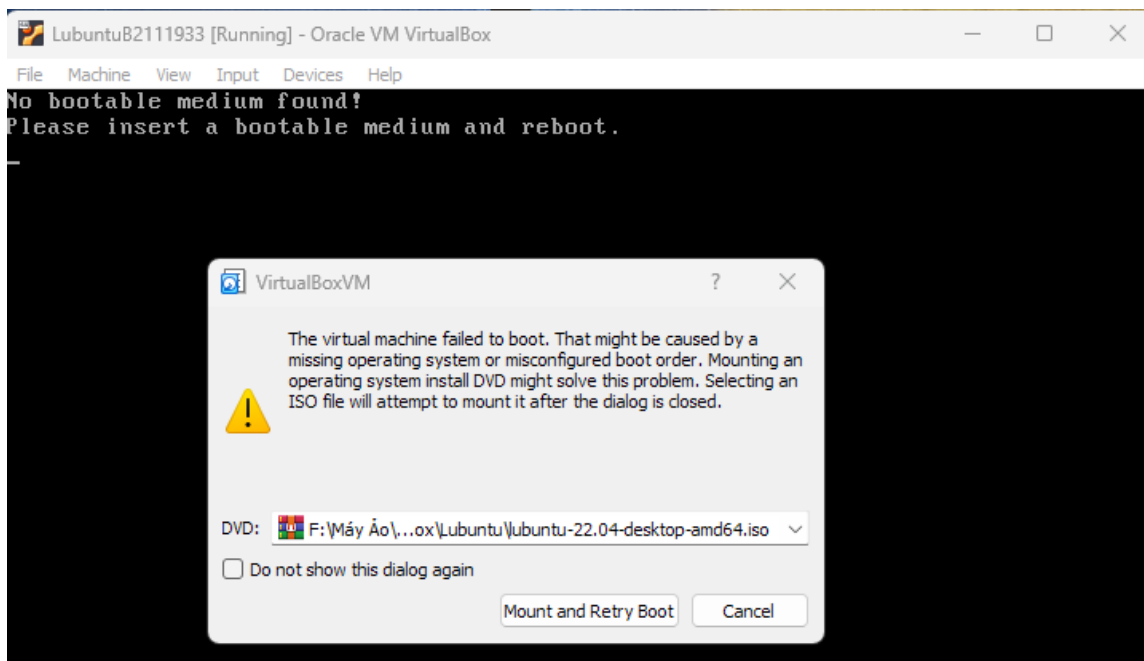
Hardware	
Base Memory	4096
Processor(s)	2
EFI Enable	false

Disk	
Disk Size	25.00 GB
Pre-allocate Full Size	false

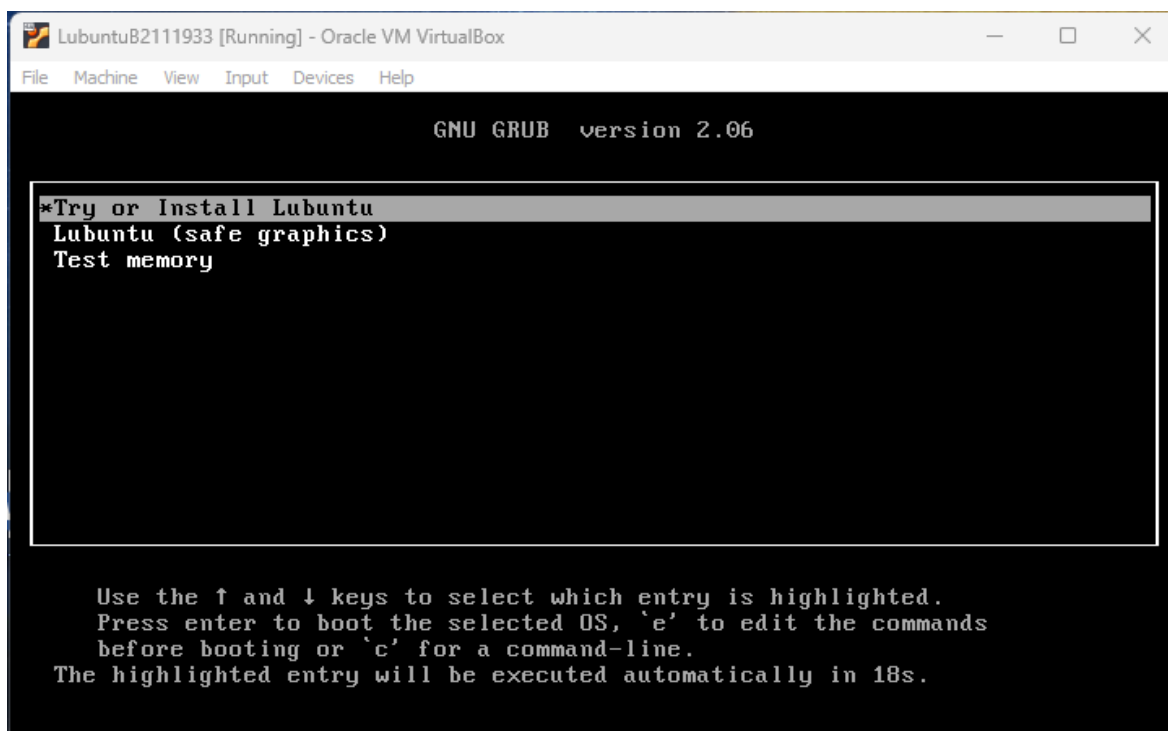
Help Back Finish Cancel

**Create a Virtual Machine**

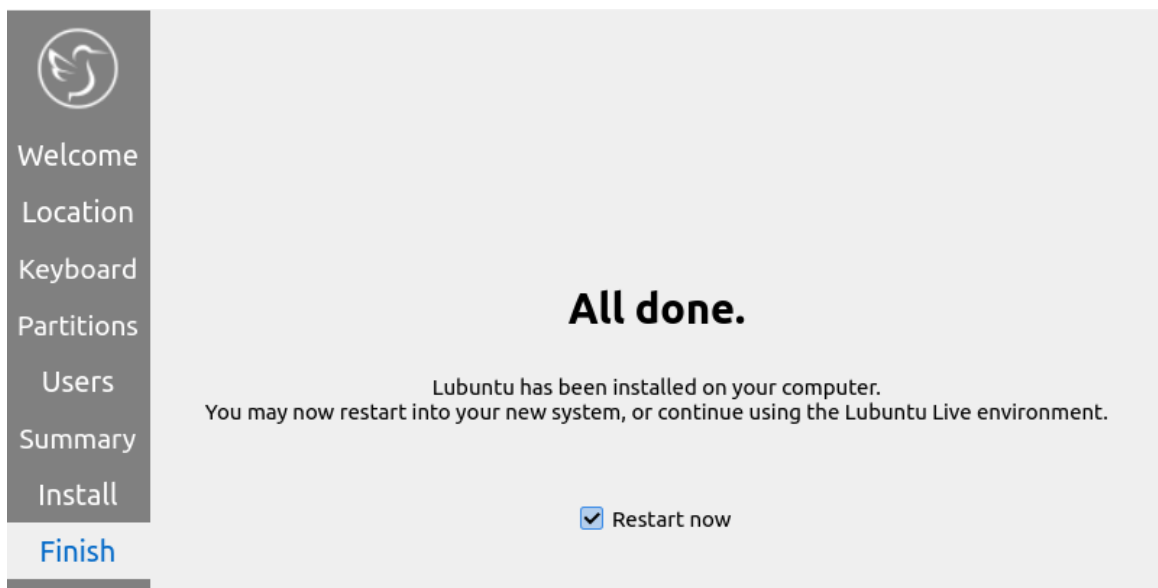
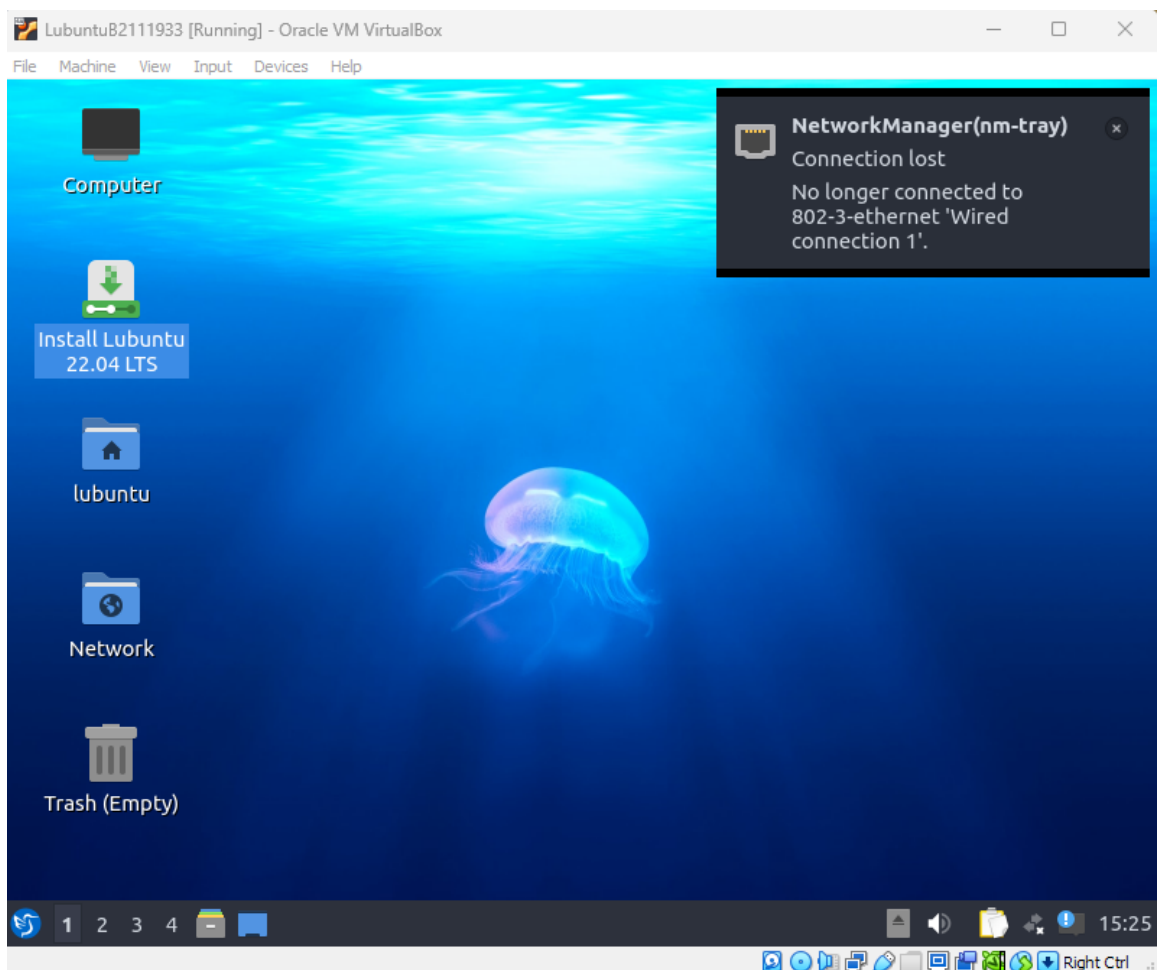
- 1.2. Install Lubuntu Desktop 22.04 LTS (or any other Linux distributions) as the OS of the VM. **(take a screenshot after finishing the installation)**  
+ Please disable networking before installing the OS.



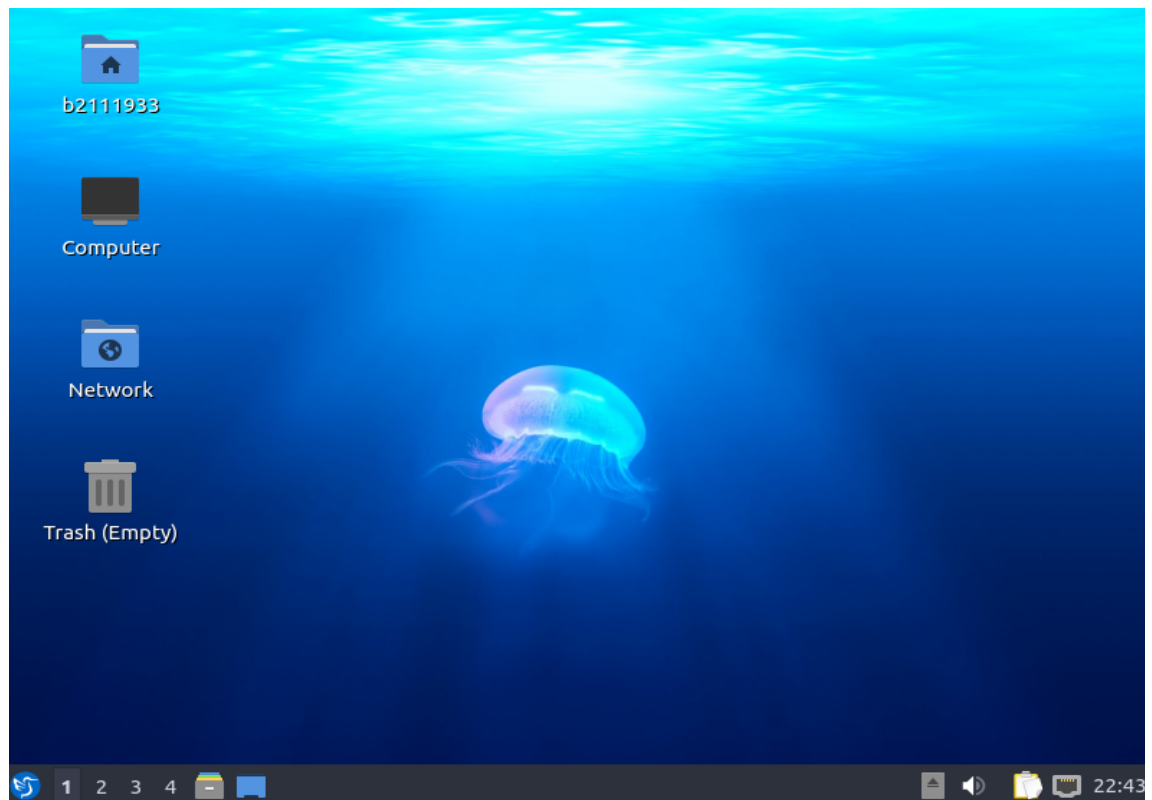
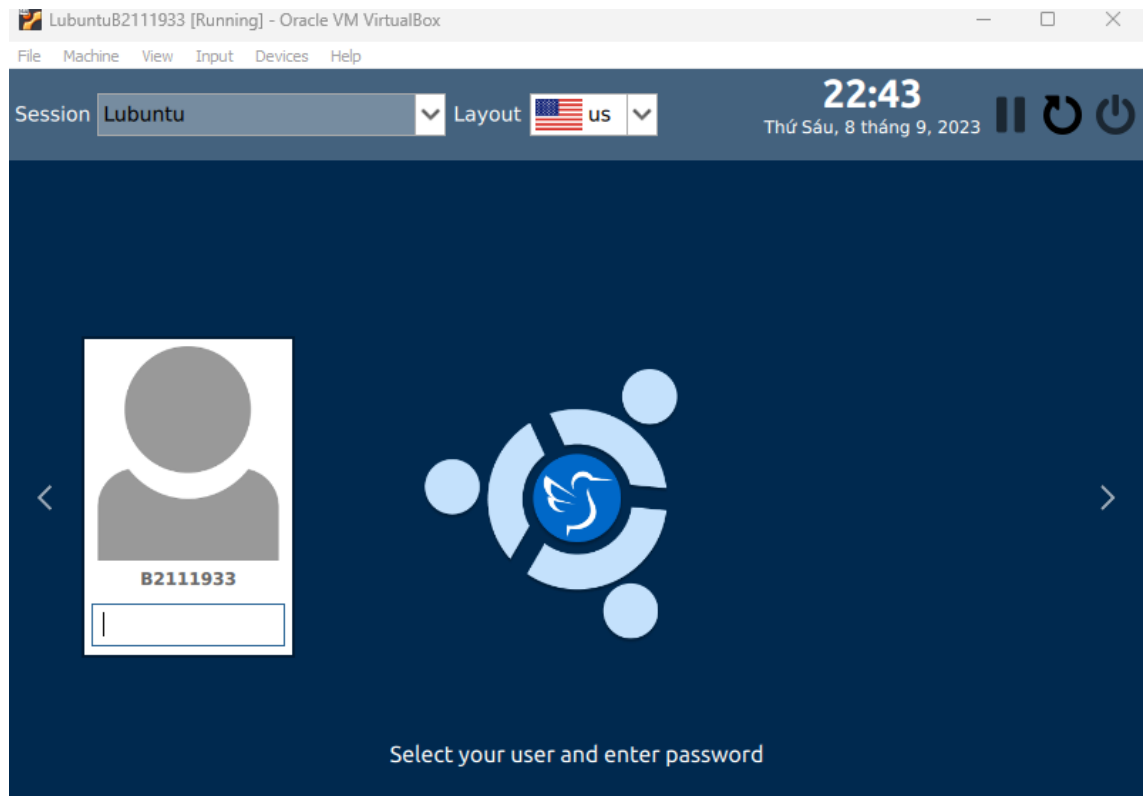
Choose a disk for the **VM**



Start the created **VM**



Restart **Lubuntu** to complete the installation



**Lubuntu** is installed

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

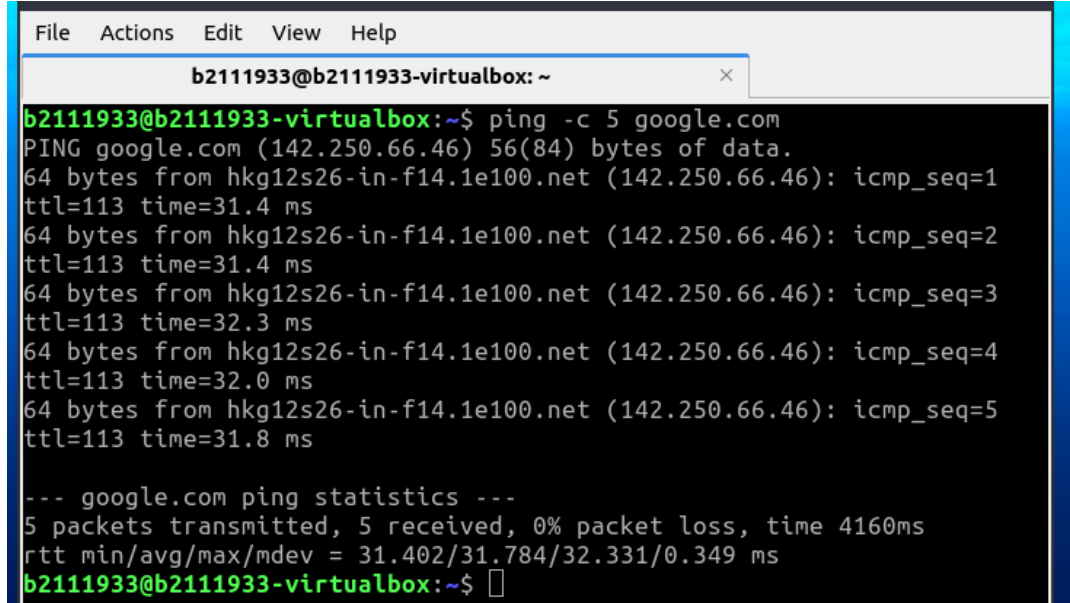
**1.4.** Setting up proxy for command line (if necessary)

```
$sudo featherpad /etc/environment
- Appending 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
```

### Skip 1.3 & 1.4

**1.5.** Verifying network connections

```
$ping -c 5 google.com
```

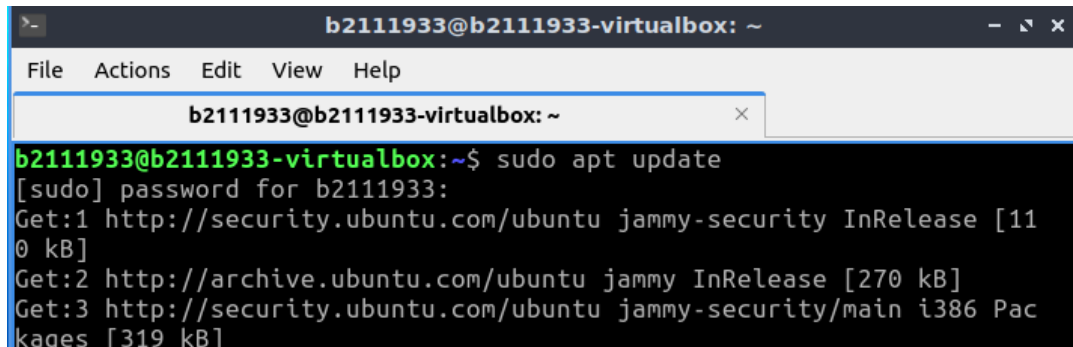
A screenshot of a terminal window titled "b2111933@b2111933-virtualbox: ~". The terminal shows the command "ping -c 5 google.com" being executed. The output displays five successful ping requests to google.com (142.250.66.46) with varying response times between 31.4ms and 32.3ms. A summary line indicates "5 packets transmitted, 5 received, 0% packet loss, time 4160ms" and "rtt min/avg/max/mdev = 31.402/31.784/32.331/0.349 ms". The prompt returns to the user.

```
b2111933@b2111933-virtualbox: ~$ ping -c 5 google.com
PING google.com (142.250.66.46) 56(84) bytes of data.
64 bytes from hkg12s26-in-f14.1e100.net (142.250.66.46): icmp_seq=1
ttl=113 time=31.4 ms
64 bytes from hkg12s26-in-f14.1e100.net (142.250.66.46): icmp_seq=2
ttl=113 time=31.4 ms
64 bytes from hkg12s26-in-f14.1e100.net (142.250.66.46): icmp_seq=3
ttl=113 time=32.3 ms
64 bytes from hkg12s26-in-f14.1e100.net (142.250.66.46): icmp_seq=4
ttl=113 time=32.0 ms
64 bytes from hkg12s26-in-f14.1e100.net (142.250.66.46): icmp_seq=5
ttl=113 time=31.8 ms

--- google.com ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4160ms
rtt min/avg/max/mdev = 31.402/31.784/32.331/0.349 ms
b2111933@b2111933-virtualbox: ~$
```

The VM can connect to **Google**

```
$sudo apt update
```

A screenshot of a terminal window titled "b2111933@b2111933-virtualbox: ~". The terminal shows the command "sudo apt update" being executed. The output displays the progress of updating the package lists from various sources, including security.ubuntu.com and archive.ubuntu.com. The terminal shows the download of security updates and the main package list.

```
b2111933@b2111933-virtualbox: ~$ sudo apt update
[sudo] password for b2111933:
Get:1 http://security.ubuntu.com/ubuntu jammy-security InRelease [11
0 kB]
Get:2 http://archive.ubuntu.com/ubuntu jammy InRelease [270 kB]
Get:3 http://security.ubuntu.com/ubuntu jammy-security/main i386 Pac
kages [319 kB]
```

```
-11 48x48 Icons [15,7 kB]
Get:89 http://archive.ubuntu.com/ubuntu jammy-backports/universe DEP
-11 64x64 Icons [25,6 kB]
Get:90 http://archive.ubuntu.com/ubuntu jammy-backports/universe DEP
-11 64x64@2 Icons [29 B]
Get:91 http://archive.ubuntu.com/ubuntu jammy-backports/universe DEP
-11 128x128 Icons [49,6 kB]
Get:92 http://archive.ubuntu.com/ubuntu jammy-backports/universe and
64 c-n-f Metadata [640 B]
Get:93 http://archive.ubuntu.com/ubuntu jammy-backports/multiverse a
md64 c-n-f Metadata [116 B]
Fetched 44,4 MB in 11s (4.045 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
439 packages can be upgraded. Run 'apt list --upgradable' to see the
m.
b2111933@b2111933-virtualbox:~$
```

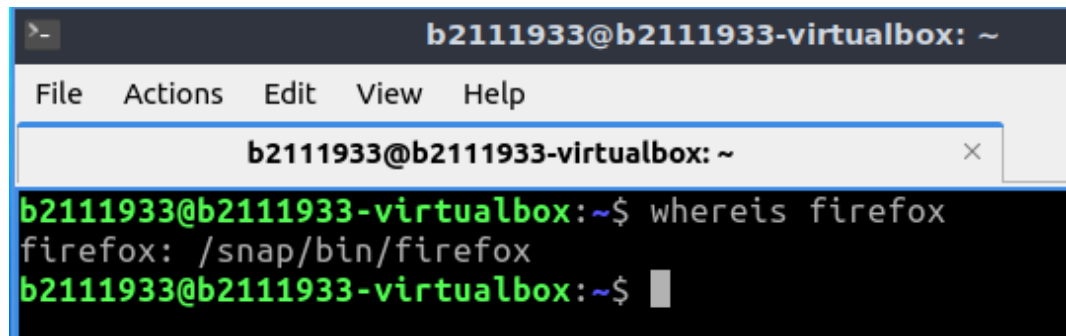
Updated successfully

## 2. Basic operations

### 2.1. Accessing Directories

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

```
$whereis firefox
```

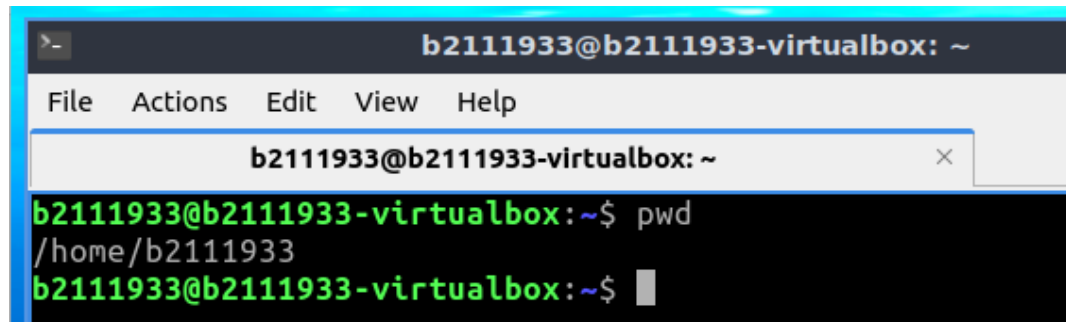


The screenshot shows a terminal window titled "b2111933@b2111933-virtualbox: ~". The terminal has a menu bar with "File", "Actions", "Edit", "View", and "Help". Below the menu bar is a tab labeled "b2111933@b2111933-virtualbox: ~". The terminal content shows the command `whereis firefox` being executed, resulting in the output `firefox: /snap/bin/firefox`. The prompt `b2111933@b2111933-virtualbox:~$` is visible at the bottom.

Located "**firefox**" application

- Display the present working directory.

```
$pwd
```

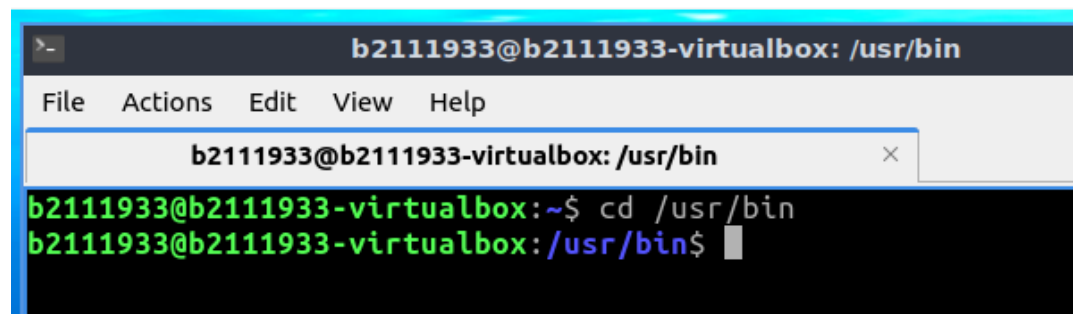


The screenshot shows a terminal window titled "b2111933@b2111933-virtualbox: ~". The terminal has a menu bar with "File", "Actions", "Edit", "View", and "Help". Below the menu bar is a tab labeled "b2111933@b2111933-virtualbox: ~". The terminal content shows the command `pwd` being executed, resulting in the output `/home/b2111933`. The prompt `b2111933@b2111933-virtualbox:~$` is visible at the bottom.

The present working directory is: `/home/b2111933`

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

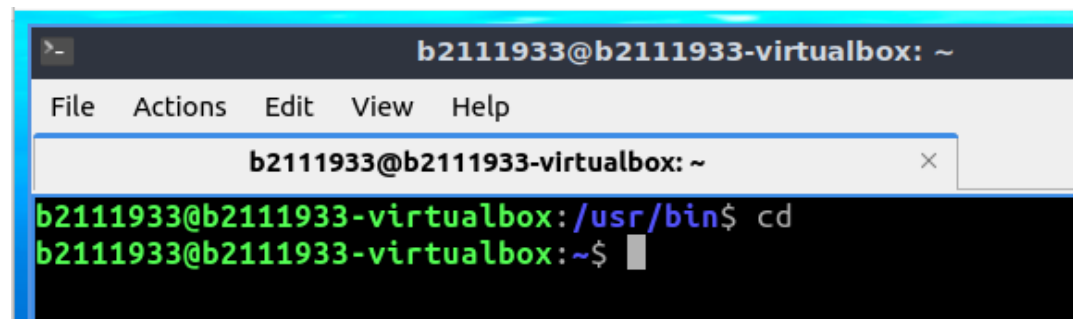
```
$cd /usr/bin
```

A terminal window titled 'b2111933@b2111933-virtualbox: /usr/bin'. The window has a menu bar with 'File', 'Actions', 'Edit', 'View', and 'Help'. Below the menu bar is a tab labeled 'b2111933@b2111933-virtualbox: /usr/bin'. The terminal shows the command 'cd /usr/bin' being entered and executed, with the prompt changing from '~\$' to '/usr/bin\$'.

Now the **current directory** is **/usr/bin**

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

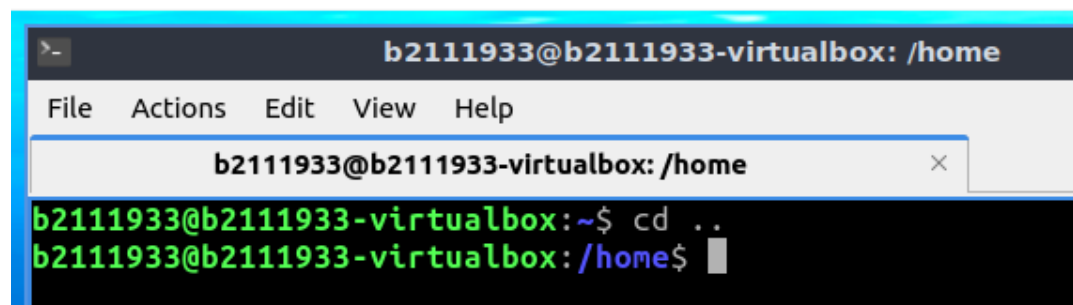
```
$cd ~
```

A terminal window titled 'b2111933@b2111933-virtualbox: ~'. The window has a menu bar with 'File', 'Actions', 'Edit', 'View', and 'Help'. Below the menu bar is a tab labeled 'b2111933@b2111933-virtualbox: ~'. The terminal shows the command 'cd' being entered and executed, with the prompt changing from '/usr/bin\$' to '~\$'.

The **current working directory** returned to **\$HOME** directory (/home/b2111933)

- Move to the parent directory.

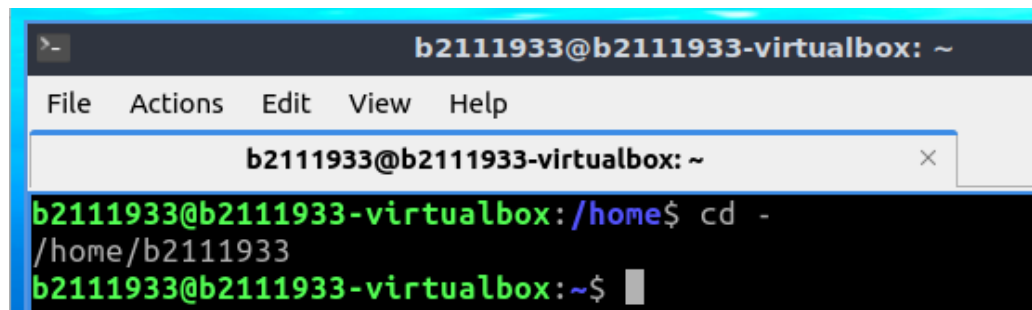
```
$cd ..
```

A terminal window titled 'b2111933@b2111933-virtualbox: /home'. The window has a menu bar with 'File', 'Actions', 'Edit', 'View', and 'Help'. Below the menu bar is a tab labeled 'b2111933@b2111933-virtualbox: /home'. The terminal shows the command 'cd ..' being entered and executed, with the prompt changing from '~\$' to '/home\$'.

Move to the parent directory of **/home/b2111933** directory

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

\$cd -

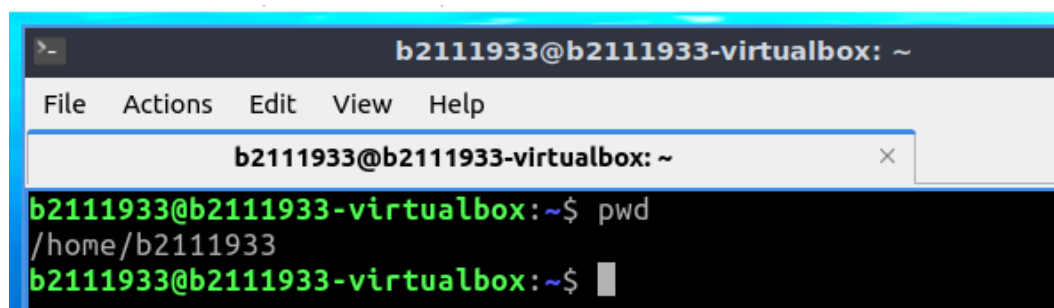


```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox: /home$ cd -  
/home/b2111933  
b2111933@b2111933-virtualbox: ~$
```

Get back to the **previous directory** (\$HOME) by the **shortcut method** ( - )

- Display the present working directory.

\$pwd

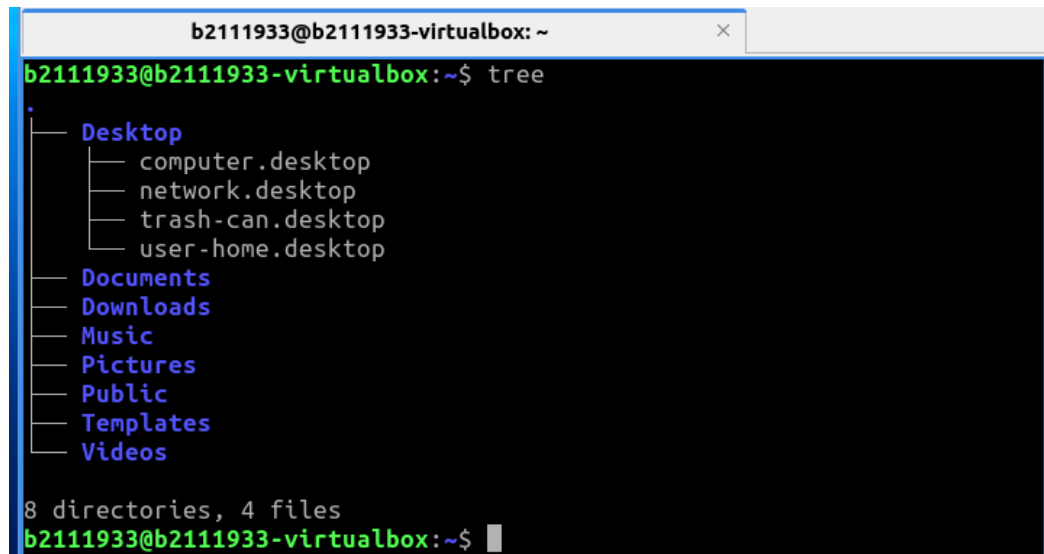


```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox: ~$ pwd  
/home/b2111933  
b2111933@b2111933-virtualbox: ~$
```

The present working directory is: **/home/b2111933**

- Display filesystem tree of current directory

\$tree



```
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox: ~$ tree  
.  
├── Desktop  
│   ├── computer.desktop  
│   ├── network.desktop  
│   ├── trash-can.desktop  
│   └── user-home.desktop  
├── Documents  
├── Downloads  
├── Music  
├── Pictures  
├── Public  
├── Templates  
└── Videos  
  
8 directories, 4 files  
b2111933@b2111933-virtualbox: ~$
```

Display **filesystem tree** of \$HOME directory

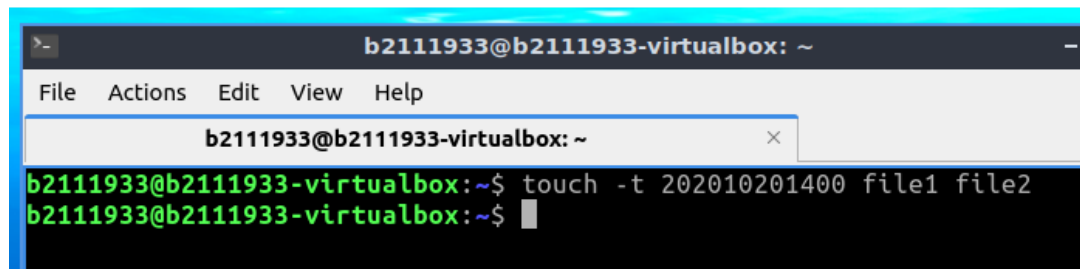
(take a screenshot of the console)



## 2.2. Working With Files and Directories

- Using **touch**, create **file1** and **file2** (two empty files) with timestamp: 20 October 2020 2:00 PM.

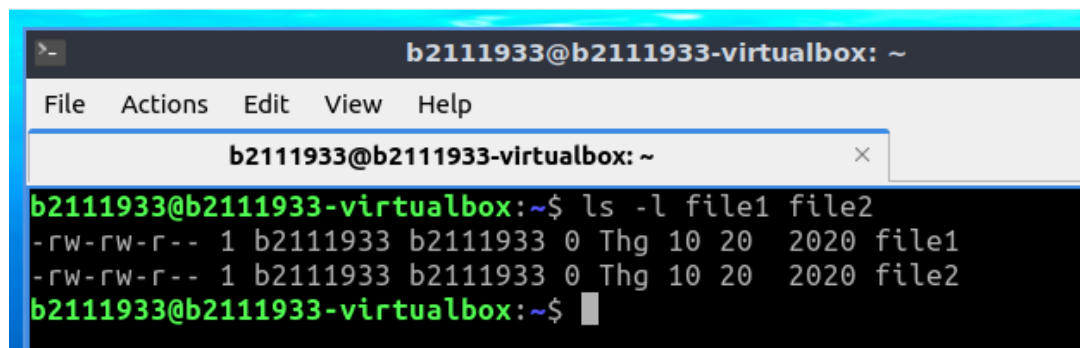
```
$touch -t 202010201400 file1 file2
```

A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'touch -t 202010201400 file1 file2' being executed, followed by a prompt 'b2111933@b2111933-virtualbox:~\$' and a cursor.

Command **touch -t** will create files with timestamp

- Check for the existence of **file1** and **file2** using **ls -l**.

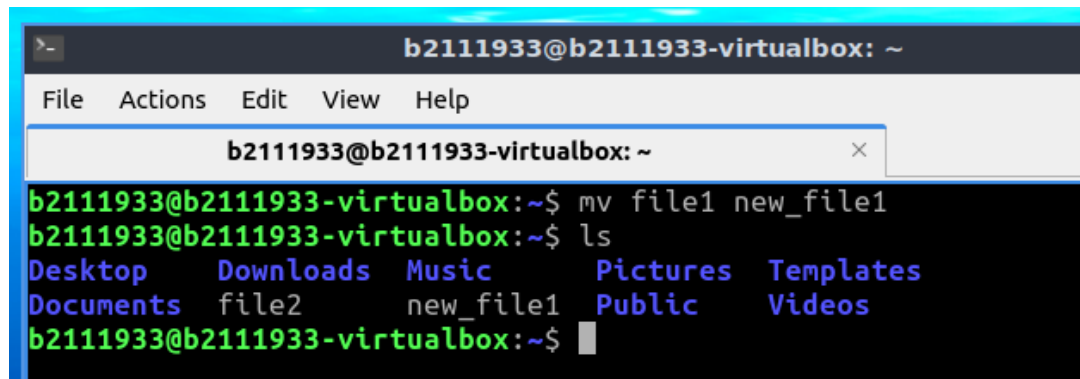
```
$ls -l file1 file2
```

A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'ls -l file1 file2' being executed. The output is: '-rw-rw-r-- 1 b2111933 b2111933 0 Thg 10 20 2020 file1' and '-rw-rw-r-- 1 b2111933 b2111933 0 Thg 10 20 2020 file2'. The prompt is 'b2111933@b2111933-virtualbox:~\$' with a cursor.

List **file1** & **file2** with full details

- Rename **file1** to **new\_file1** using **mv**.

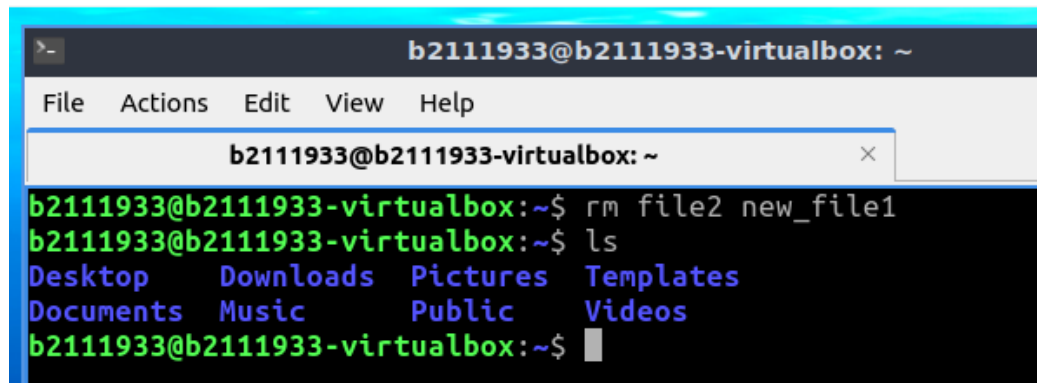
```
$mv file1 new_file1
```

A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'mv file1 new\_file1' being executed, followed by 'ls'. The output of 'ls' is: 'Desktop Downloads Music Pictures Templates Documents file2 new\_file1 Public Videos'. The prompt is 'b2111933@b2111933-virtualbox:~\$' with a cursor.

Rename **file1** to **new\_file1** using **mv**

- Remove **file2** and **new\_file1** using **rm** without any options.

```
$rm file2 new_file1
```

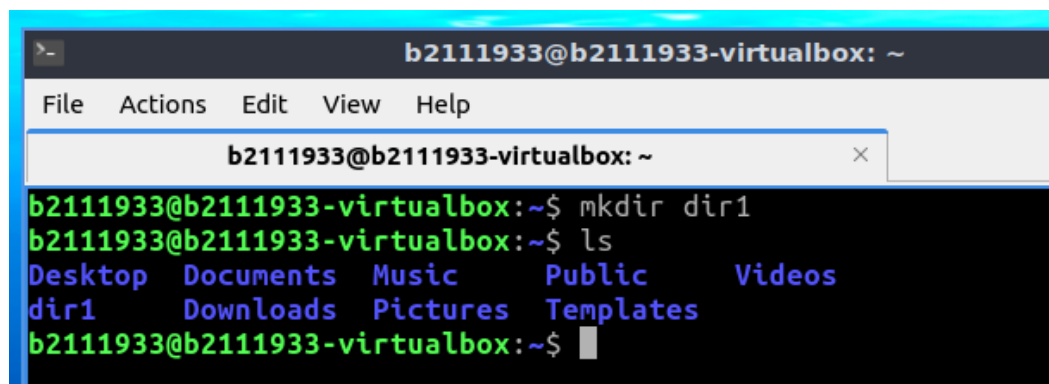
A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the execution of 'rm file2 new\_file1' and 'ls', which lists standard Linux directories: Desktop, Downloads, Pictures, Templates, Documents, Music, Public, and Videos.

```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox:~$ rm file2 new_file1  
b2111933@b2111933-virtualbox:~$ ls  
Desktop Downloads Pictures Templates  
Documents Music Public Videos  
b2111933@b2111933-virtualbox:~$
```

Removed **file2** & **new\_file1** successfully

- Create a directory named **dir1**, using **mkdir**.

```
$mkdir dir1
```

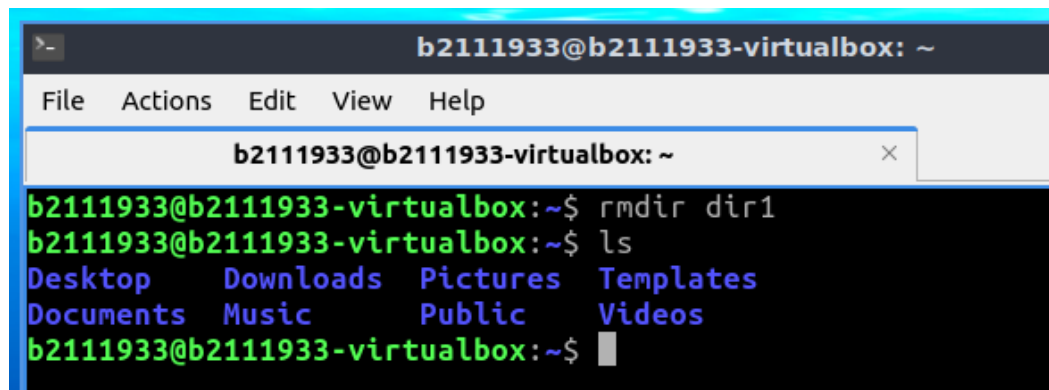
A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the execution of 'mkdir dir1' and 'ls', which now includes 'dir1' in the list of directories.

```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox:~$ mkdir dir1  
b2111933@b2111933-virtualbox:~$ ls  
Desktop Documents Music Public Videos  
dir1 Downloads Pictures Templates  
b2111933@b2111933-virtualbox:~$
```

Created a directory named **dir1**

- Remove **dir1** using **rmdir** without any options

```
$rmdir dir1
```

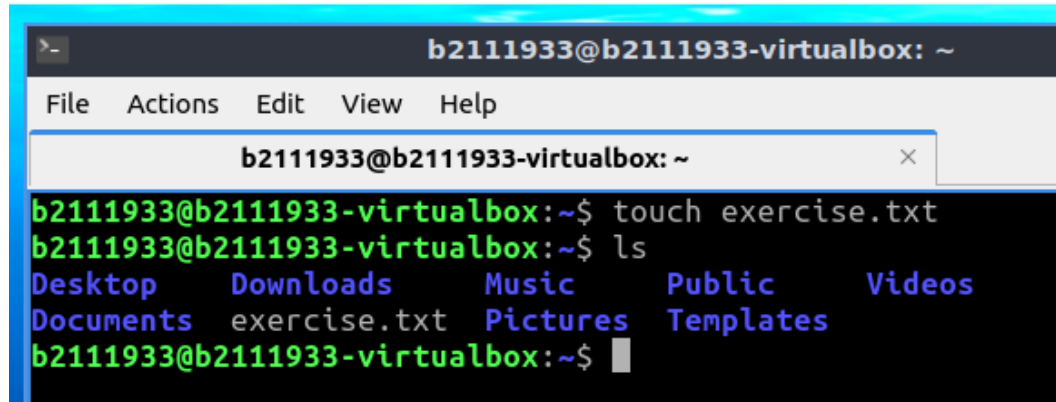
A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the execution of 'rmdir dir1' and 'ls', which no longer includes 'dir1' in the list of directories.

```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox:~$ rmdir dir1  
b2111933@b2111933-virtualbox:~$ ls  
Desktop Downloads Pictures Templates  
Documents Music Public Videos  
b2111933@b2111933-virtualbox:~$
```

Removed **dir1** using **rmdir**

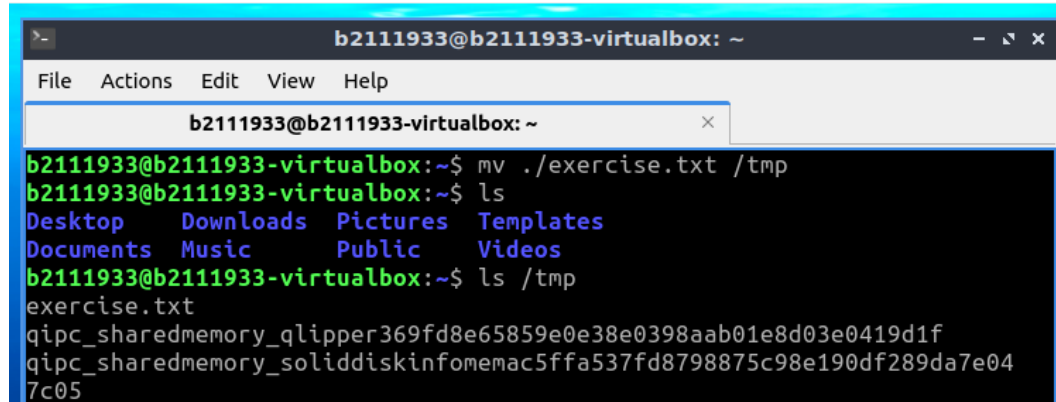
- Create an empty file named **exercise.txt** and move it to **/tmp** using relative pathname. Then delete this file using an absolute pathname

```
$touch exercise.txt
```

A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'touch exercise.txt' being executed, followed by 'ls' which lists the contents of the home directory: Desktop, Downloads, Music, Public, Videos, Documents, exercise.txt, Pictures, and Templates. The prompt is then '\$'.

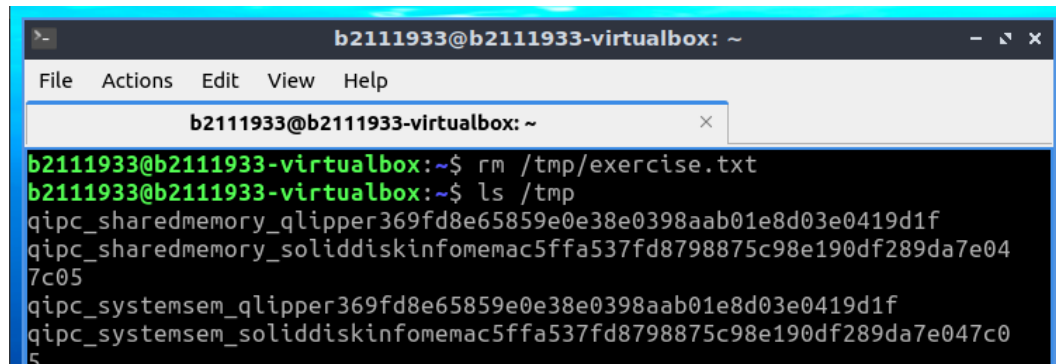
Created an empty file named **exercise.txt**

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

A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'mv ./exercise.txt /tmp' being executed, followed by 'ls' which lists the home directory contents. Then 'ls /tmp' is executed, showing 'exercise.txt' and two large system files: 'qipc\_sharedmemory\_qlipper369fd8e65859e0e38e0398aab01e8d03e0419d1f' and 'qipc\_sharedmemory\_soliddiskinfomemac5ffa537fd8798875c98e190df289da7e047c05'. The prompt is then '\$'.

Moved file named **exercise.txt** to **/tmp** using relative pathname

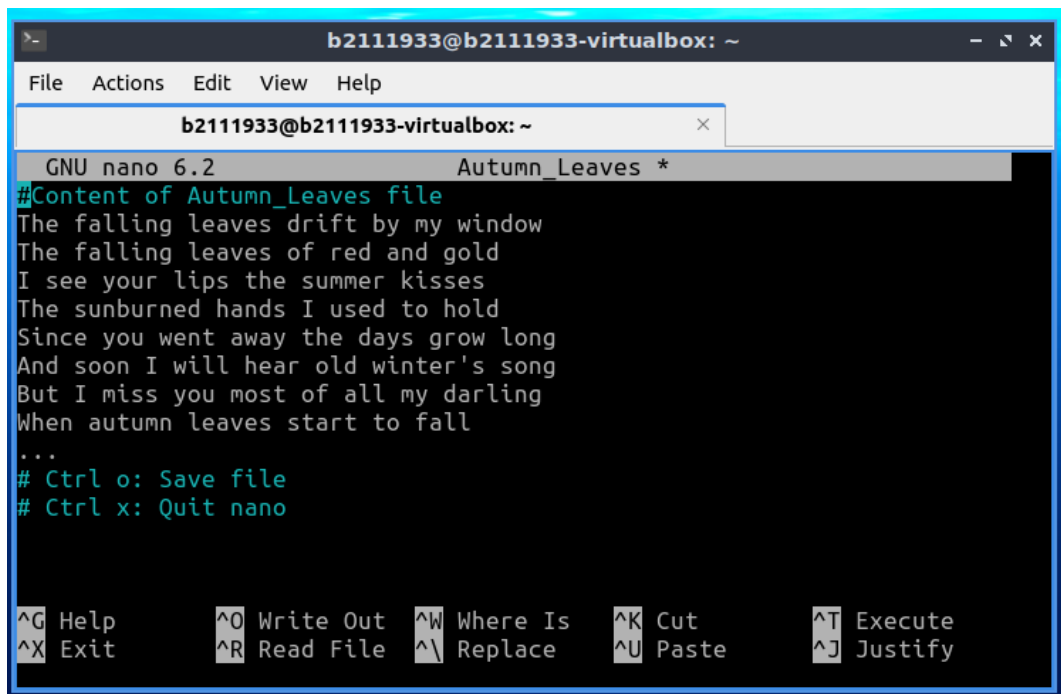
```
$rm /tmp/exercise.txt
```

A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'rm /tmp/exercise.txt' being executed, followed by 'ls /tmp' which lists the same two large system files as before, but 'exercise.txt' is no longer present. The prompt is then '\$'.

Deleted file **exercise.txt** using absolute pathname **/tmp/exercise.txt**

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

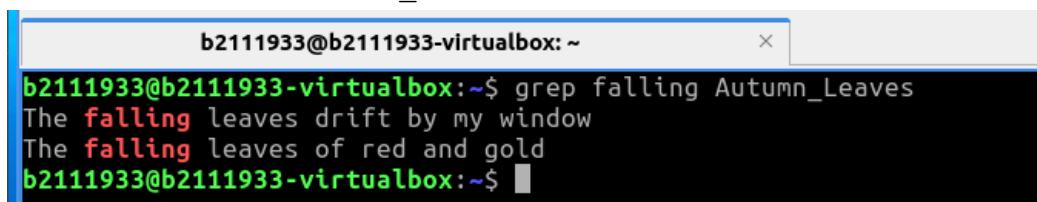
```
$nano Autumn_Leaves
#Content of Autumn_Leaves file
The falling leaves drift by my window
The falling leaves of red and gold
I see your lips the summer kisses
The sunburned hands I used to hold
Since you went away the days grow long
And soon I will hear old winter's song
But I miss you most of all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



Create a file **Autumn\_Leaves** with its content using **nano** tool

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

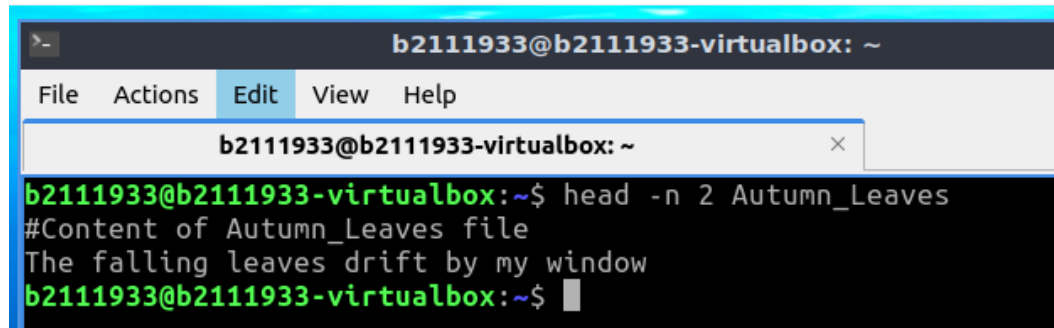
```
$grep "falling" Autumn_Leaves
```



There are 2 strings “**falling**” in the file **Autumn\_Leaves**

- Display the first 2 lines of the file **Autumn\_Leaves**

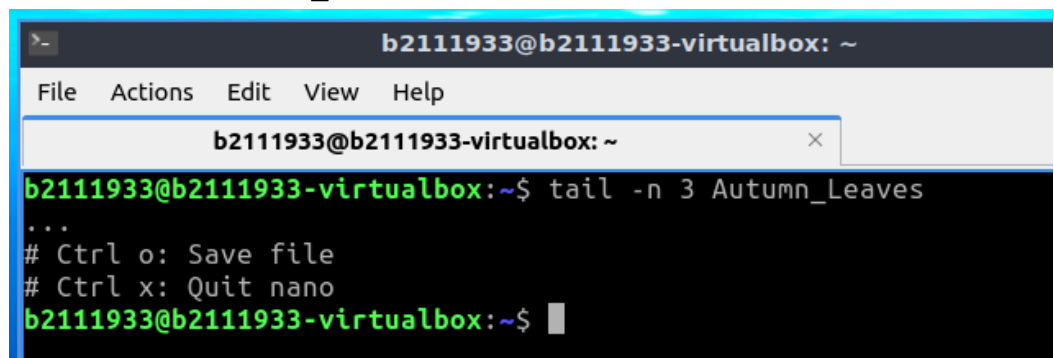
```
$head -n 2 Autumn_Leaves
```

A screenshot of a terminal window titled "b2111933@b2111933-virtualbox: ~". The window has a menu bar with "File", "Actions", "Edit", "View", and "Help". Below the menu bar is a tab labeled "b2111933@b2111933-virtualbox: ~". The terminal shows the command "head -n 2 Autumn\_Leaves" being executed. The output is: "#Content of Autumn\_Leaves file" and "The falling leaves drift by my window". The prompt "b2111933@b2111933-virtualbox:~\$" is visible at the bottom.

Displayed the first 2 lines of the file **Autumn\_Leaves**

- Display the last 3 lines of the file **Autumn\_Leaves**

```
$tail -n 3 Autumn_Leaves
```

A screenshot of a terminal window titled "b2111933@b2111933-virtualbox: ~". The window has a menu bar with "File", "Actions", "Edit", "View", and "Help". Below the menu bar is a tab labeled "b2111933@b2111933-virtualbox: ~". The terminal shows the command "tail -n 3 Autumn\_Leaves" being executed. The output is: "...", "# Ctrl o: Save file", and "# Ctrl x: Quit nano". The prompt "b2111933@b2111933-virtualbox:~\$" is visible at the bottom.

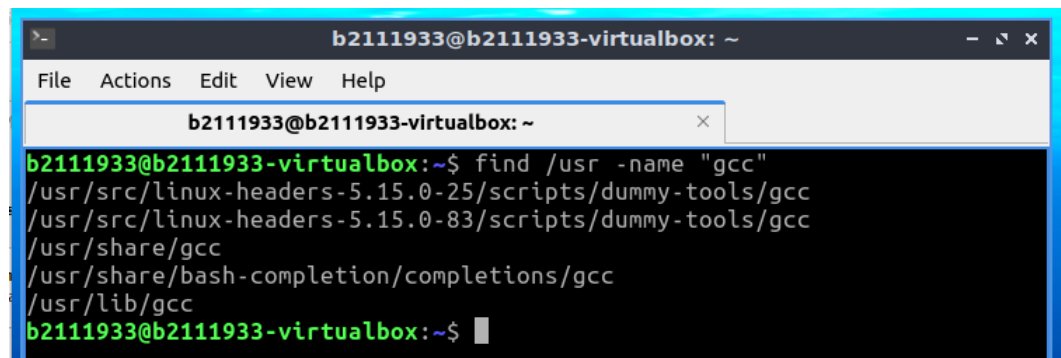
Displayed the last 3 lines of the file **Autumn\_Leaves**

(take a screenshot of the console)

## 2.3. Finding files in a directory

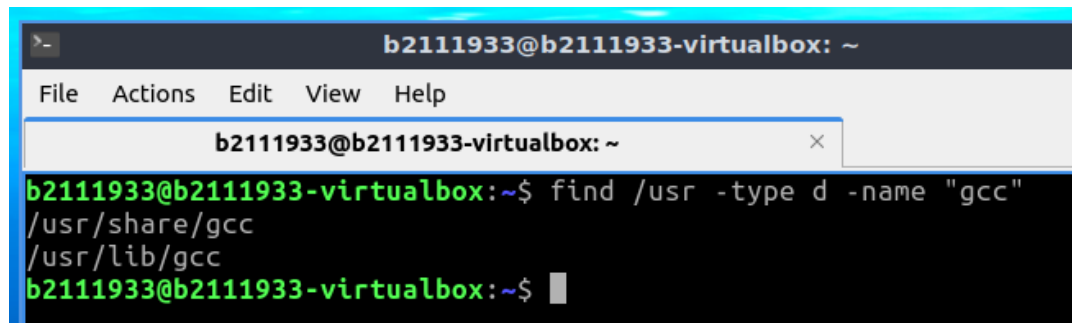
- Search for a file with the name **gcc** in the **/usr** folder using **find** command.

```
$find /usr -name "gcc"
```

A screenshot of a terminal window titled "b2111933@b2111933-virtualbox: ~". The window has a menu bar with "File", "Actions", "Edit", "View", and "Help". Below the menu bar is a tab labeled "b2111933@b2111933-virtualbox: ~". The terminal shows the command "find /usr -name 'gcc'" being executed. The output is: "/usr/src/linux-headers-5.15.0-25/scripts/dummy-tools/gcc", "/usr/src/linux-headers-5.15.0-83/scripts/dummy-tools/gcc", "/usr/share/gcc", "/usr/share/bash-completion/completions/gcc", and "/usr/lib/gcc". The prompt "b2111933@b2111933-virtualbox:~\$" is visible at the bottom.

Searched for files with the name "**gcc**" in the **/usr** folder using **find** command

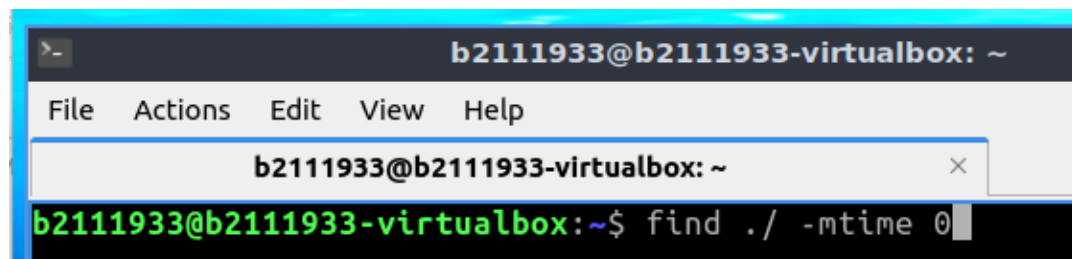
- Search for a directory with the name **gcc**, in the **/usr** folder using **find** command.  
`$find /usr -type d -name "gcc"`



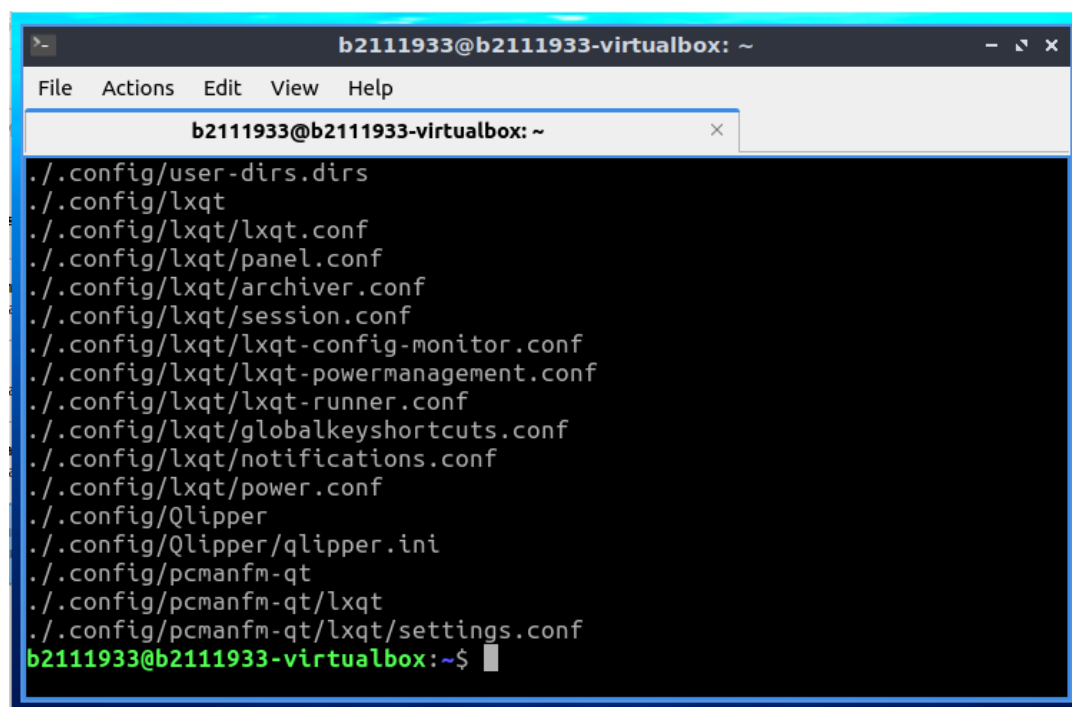
```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox:~$ find /usr -type d -name "gcc"  
/usr/share/gcc  
/usr/lib/gcc  
b2111933@b2111933-virtualbox:~$
```

Searched for directories with the name **gcc**, in the **/usr** folder using **find** command

- Search for files in the current directory which were modified today.  
`$find ./ -mtime 0`



```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox:~$ find ./ -mtime 0
```

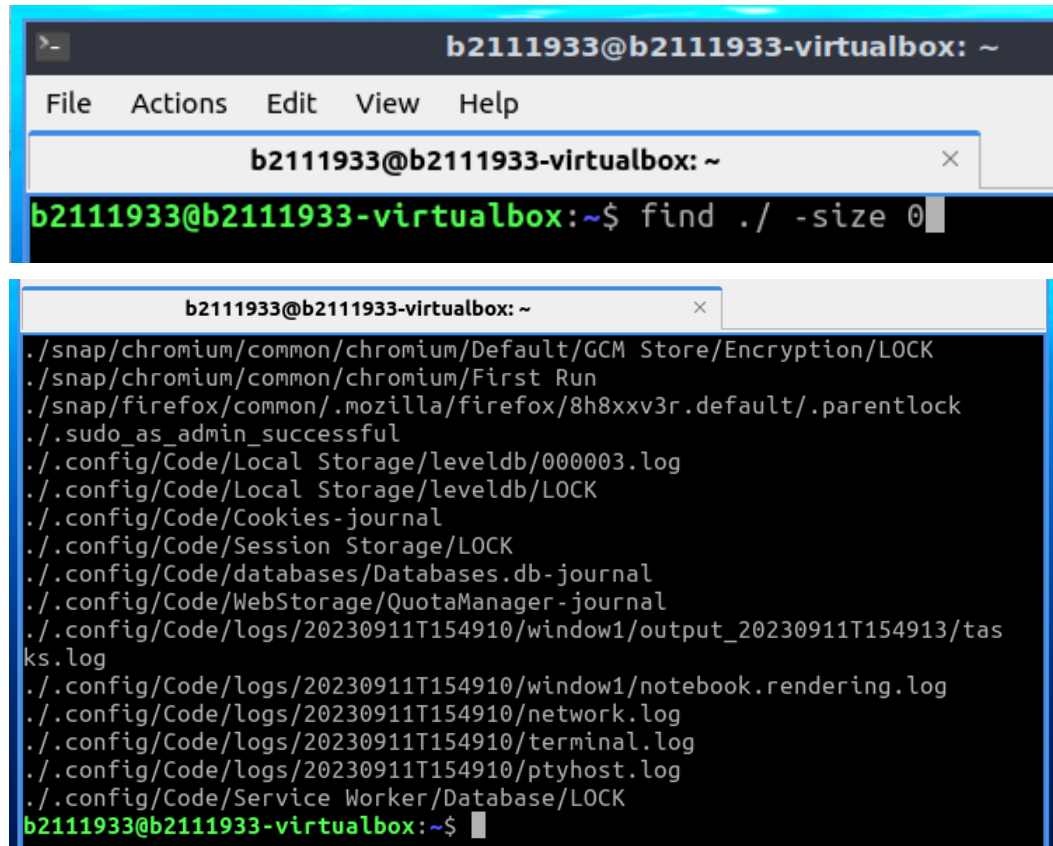


```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
./config/user-dirs.dirs  
./config/lxqt  
./config/lxqt/lxqt.conf  
./config/lxqt/panel.conf  
./config/lxqt/archiver.conf  
./config/lxqt/session.conf  
./config/lxqt/lxqt-config-monitor.conf  
./config/lxqt/lxqt-powermanagement.conf  
./config/lxqt/lxqt-runner.conf  
./config/lxqt/globalkeyshortcuts.conf  
./config/lxqt/notifications.conf  
./config/lxqt/power.conf  
./config/Qlipper  
./config/Qlipper/qlipper.ini  
./config/pcmanfm-qt  
./config/pcmanfm-qt/lxqt  
./config/pcmanfm-qt/lxqt/settings.conf  
b2111933@b2111933-virtualbox:~$
```

There are a lot of **files** in the **current directory** which were **modified today**

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

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



```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox:~$ find ./ -size 0  
./snap/chromium/common/chromium/Default/GCM Store/Encryption/LOCK  
./snap/chromium/common/chromium/First Run  
./snap/firefox/common/.mozilla/firefox/8h8xxv3r.default/.parentlock  
./sudo_as_admin_successful  
./config/Code/Local Storage/leveldb/000003.log  
./config/Code/Local Storage/leveldb/LOCK  
./config/Code/Cookies-journal  
./config/Code/Session Storage/LOCK  
./config/Code/databases/Databases.db-journal  
./config/Code/WebStorage/QuotaManager-journal  
./config/Code/logs/20230911T154910/window1/output_20230911T154913/tas  
ks.log  
./config/Code/logs/20230911T154910/window1/notebook.rendering.log  
./config/Code/logs/20230911T154910/network.log  
./config/Code/logs/20230911T154910/terminal.log  
./config/Code/logs/20230911T154910/ptyhost.log  
./config/Code/Service Worker/Database/LOCK  
b2111933@b2111933-virtualbox:~$
```

There's many files with size that is around **0 bytes**

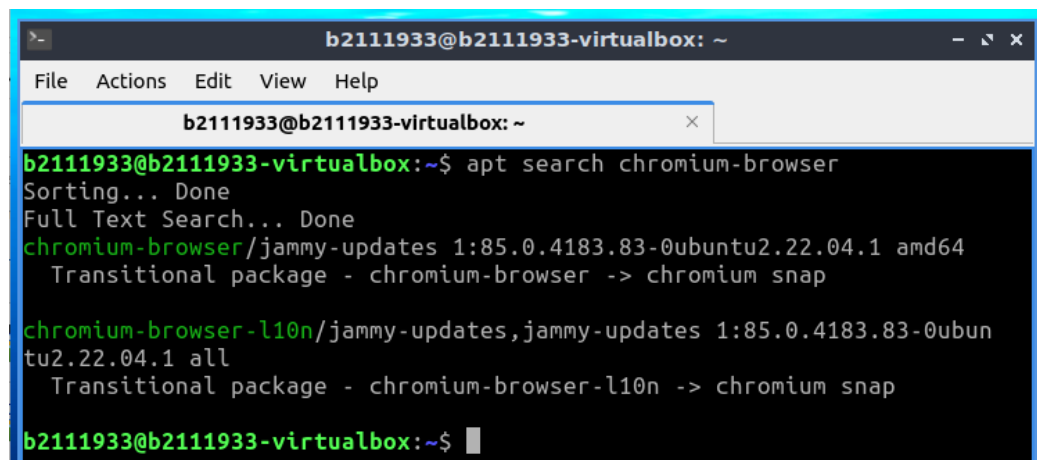
(take a screenshot of the console)

### 3. Installing and Removing software packages

#### 3.1. Install from default repositories

- Using apt tool, find the **chromium-browser** package.

```
$apt search chromium-browser
```

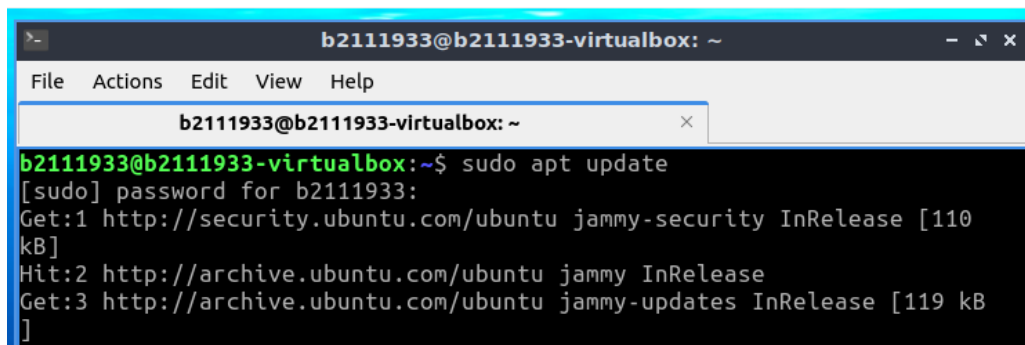


```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox:~$ apt search chromium-browser  
Sorting... Done  
Full Text Search... Done  
chromium-browser/jammy-updates 1:85.0.4183.83-0ubuntu2.22.04.1 amd64  
Transitional package - chromium-browser -> chromium snap  
chromium-browser-l10n/jammy-updates,jammy-updates 1:85.0.4183.83-0ubun  
tu2.22.04.1 all  
Transitional package - chromium-browser-l10n -> chromium snap  
b2111933@b2111933-virtualbox:~$
```

Found **chromium-browser** package

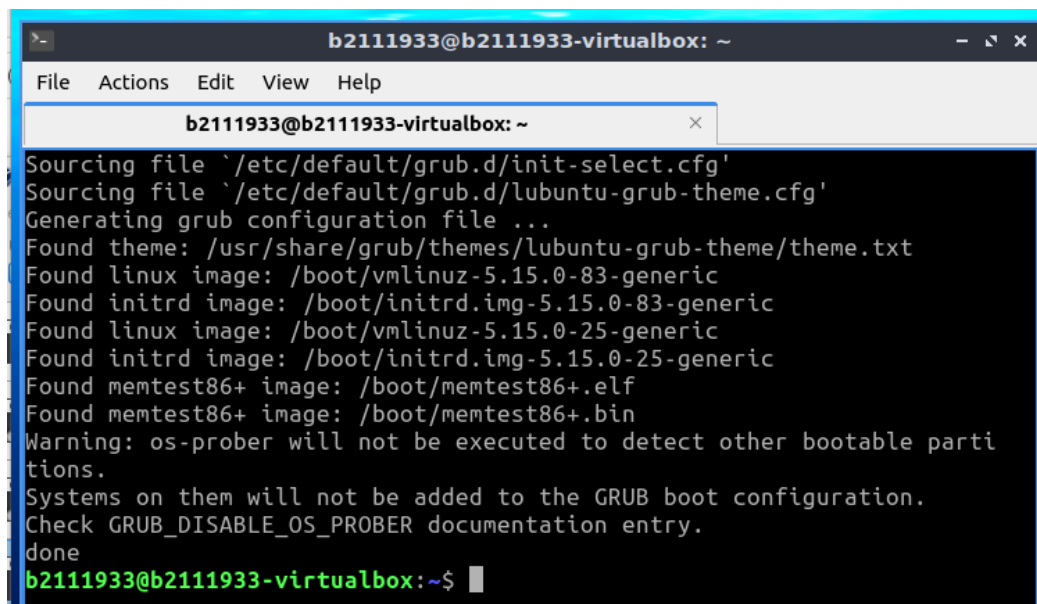


```
$sudo apt update
```

A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'sudo apt update' being executed. The output includes the password prompt, and then download progress for 'jammy-security InRelease' (110 kB), 'jammy InRelease' (119 kB), and 'jammy-updates InRelease' (119 kB).

```
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox:~$ sudo apt update  
[sudo] password for b2111933:  
Get:1 http://security.ubuntu.com/ubuntu jammy-security InRelease [110  
kB]  
Hit:2 http://archive.ubuntu.com/ubuntu jammy InRelease  
Get:3 http://archive.ubuntu.com/ubuntu jammy-updates InRelease [119 kB]  
]
```

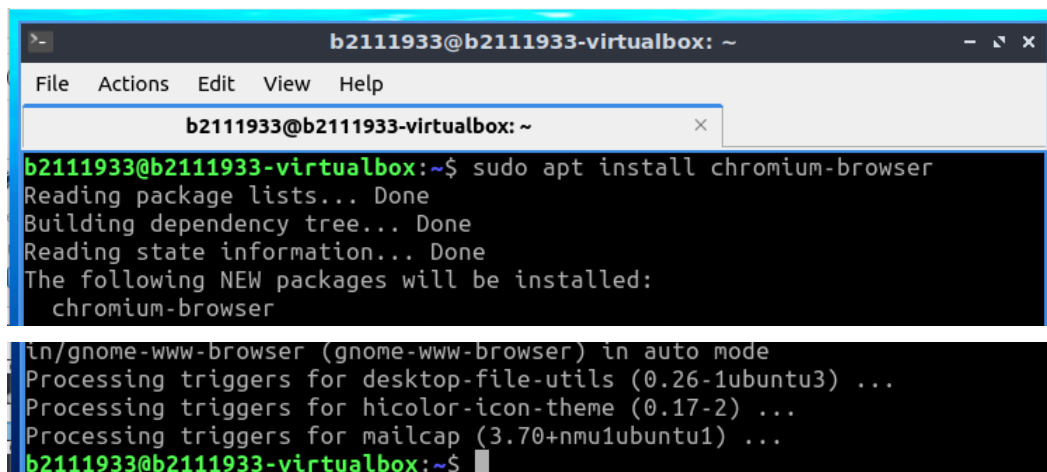
```
$sudo apt upgrade
```

A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'sudo apt upgrade' being executed. The output shows the process of sourcing GRUB configuration files, generating a new GRUB configuration, and finding various boot images. It ends with a warning about os-prober and a confirmation that the upgrade is done.

```
b2111933@b2111933-virtualbox: ~  
Sourcing file `/etc/default/grub.d/init-select.cfg'  
Sourcing file `/etc/default/grub.d/lubuntu-grub-theme.cfg'  
Generating grub configuration file ...  
Found theme: /usr/share/grub/themes/lubuntu-grub-theme/theme.txt  
Found linux image: /boot/vmlinuz-5.15.0-83-generic  
Found initrd image: /boot/initrd.img-5.15.0-83-generic  
Found linux image: /boot/vmlinuz-5.15.0-25-generic  
Found initrd image: /boot/initrd.img-5.15.0-25-generic  
Found memtest86+ image: /boot/memtest86+.elf  
Found memtest86+ image: /boot/memtest86+.bin  
Warning: os-prober will not be executed to detect other bootable parti  
tions.  
Systems on them will not be added to the GRUB boot configuration.  
Check GRUB_DISABLE_OS_PROBER documentation entry.  
done  
b2111933@b2111933-virtualbox:~$
```

Upgraded **Lubuntu** successfully

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

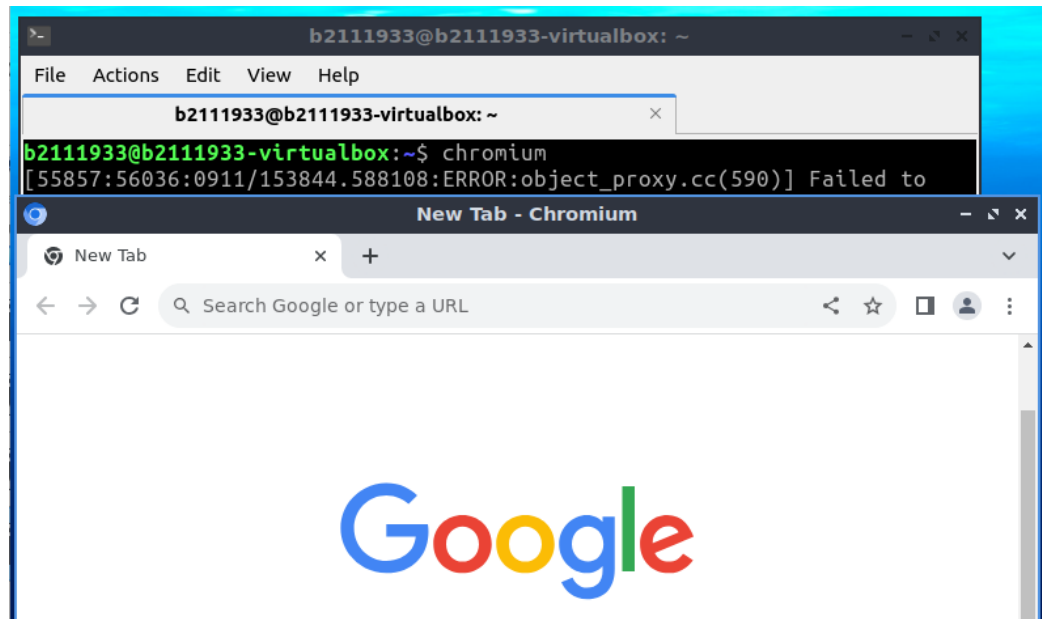
A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'sudo apt install chromium-browser' being executed. The output shows the package lists being read, the dependency tree being built, and the state information being read. It then lists the new packages to be installed: 'chromium-browser'. The installation process is shown in progress, including processing triggers for 'desktop-file-utils', 'hicolor-icon-theme', and 'mailcap'.

```
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-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  
  
in/gnome-www-browser (gnome-www-browser) in auto mode  
Processing triggers for desktop-file-utils (0.26-1ubuntu3) ...  
Processing triggers for hicolor-icon-theme (0.17-2) ...  
Processing triggers for mailcap (3.70+nm1ubuntu1) ...  
b2111933@b2111933-virtualbox:~$
```

Installed **chromium** successfully



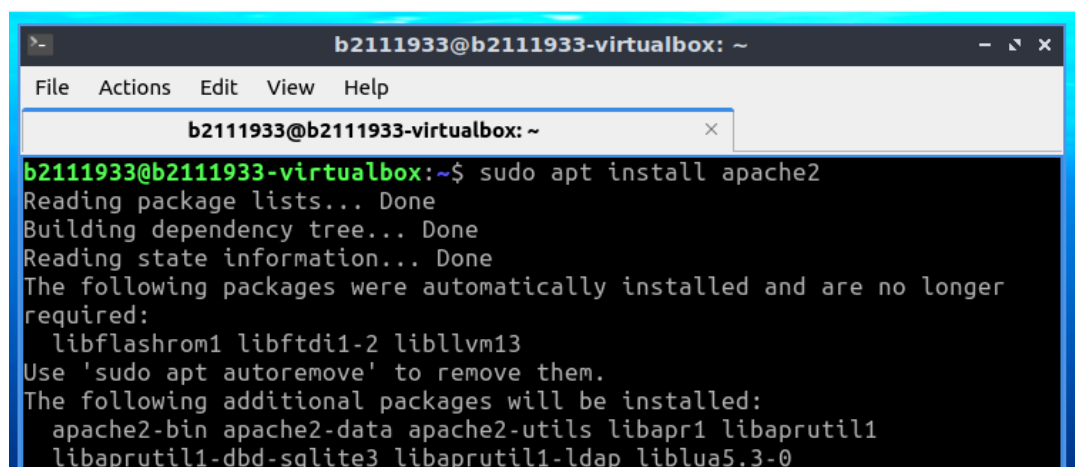
```
#  
$sudo apt remove chromium-browser  
$sudo apt install chromium-browser  
(Skip those steps)
```



Result

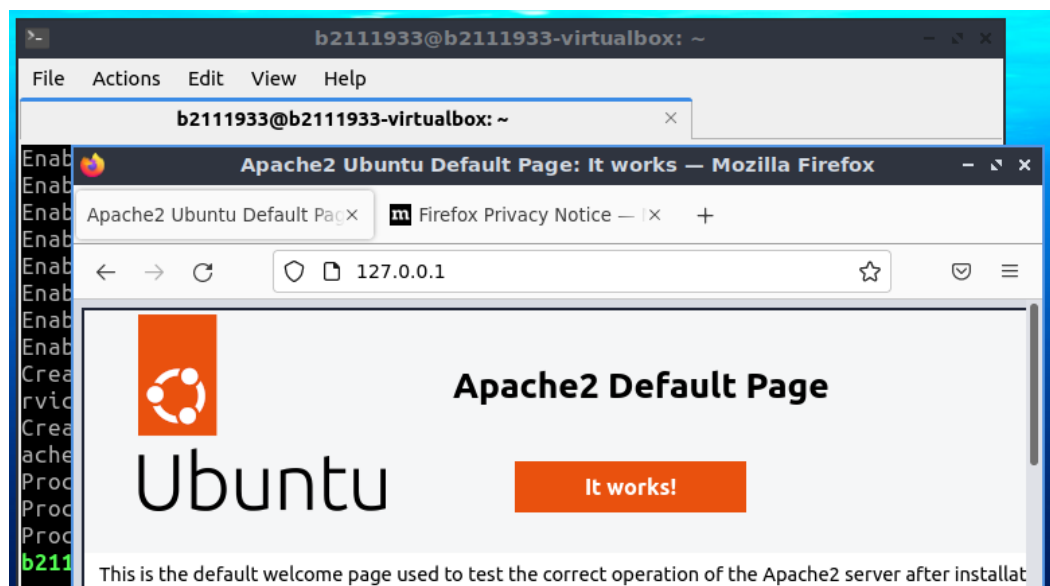
- Install **apache2** package using apt tool

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



```
Created symlink /etc/systemd/system/multi-user.target.wants/apache2.service → /lib/systemd/system/apache2.service.  
Created symlink /etc/systemd/system/multi-user.target.wants/apache-htcacheclean.service → /lib/systemd/system/apache-htcacheclean.service.  
Processing triggers for ufw (0.36.1-4ubuntu0.1) ...  
Processing triggers for man-db (2.10.2-1) ...  
Processing triggers for libc-bin (2.35-0ubuntu3.1) ...  
b2111933@b2111933-virtualbox:~$
```

Installed **apache2** successfully

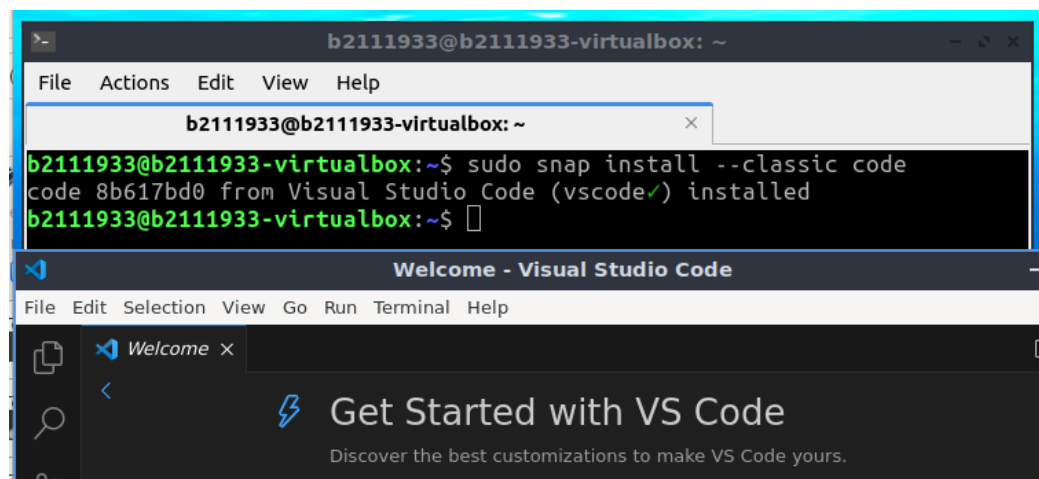


Result

### 3.2. Install using snap

- Install VScode using snap tool

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

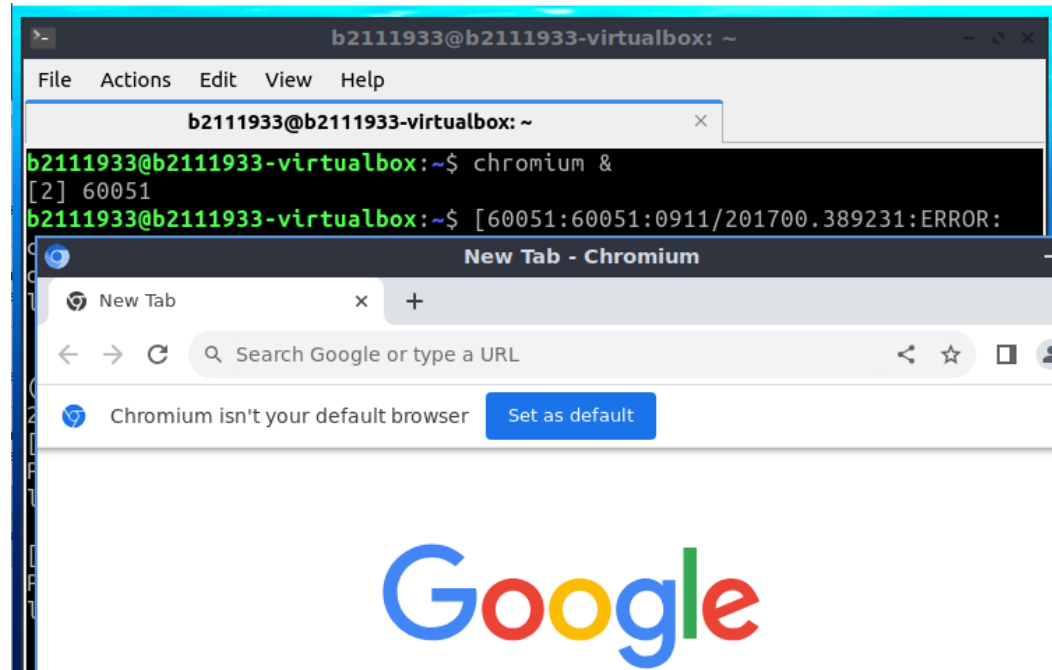


Installed **VScode** successfully

(take a screenshot of the console)

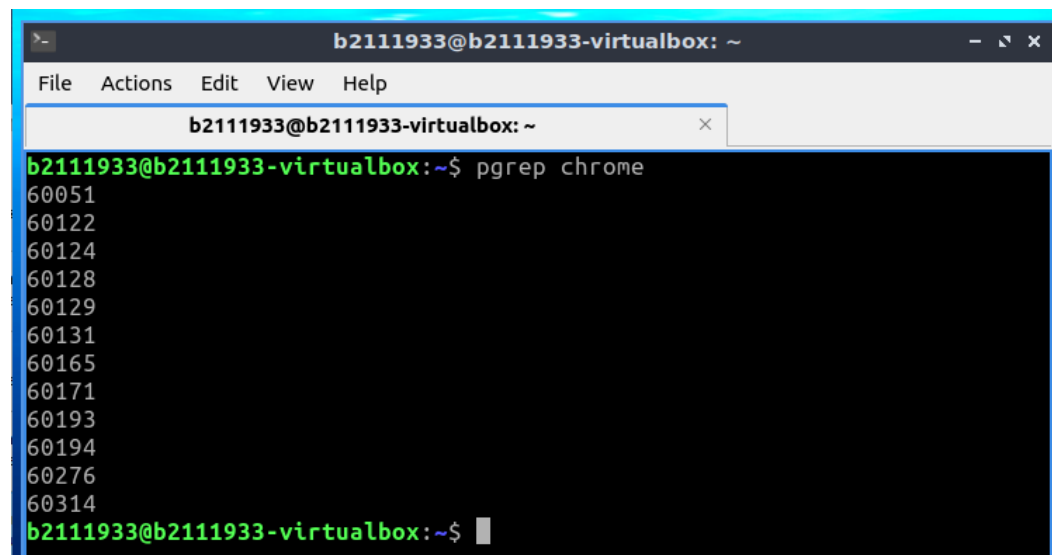
#### 4. Process and daemons (services)

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



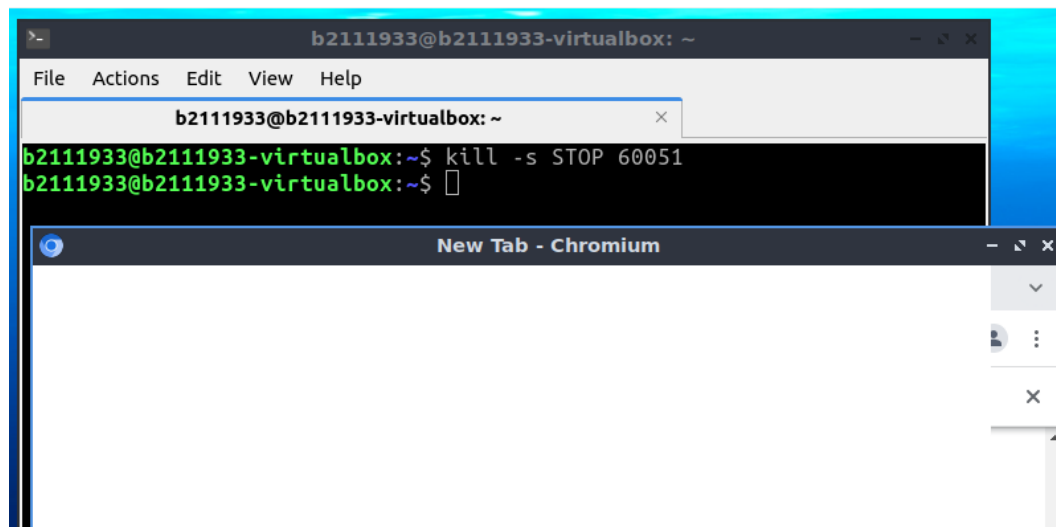
Run **chromium-browser** application in background with “&”

\$pgrep chrome



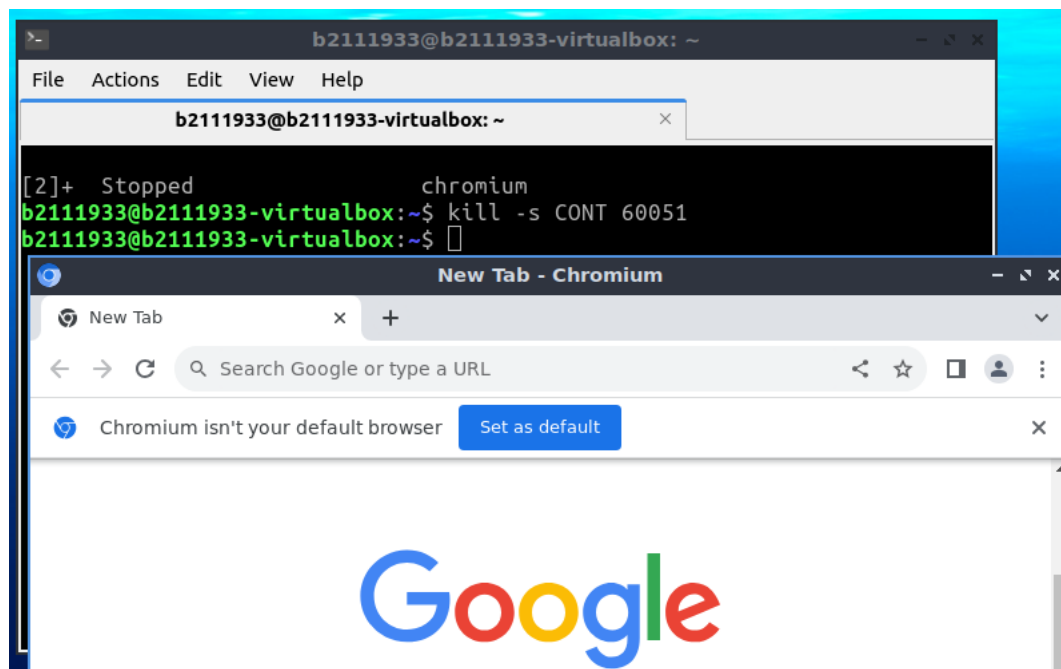
Found its **PID** using **pgrep** command

- Stop/continue/terminate **chromium-browser** application using **kill** command  
`$kill -s STOP <PID>`



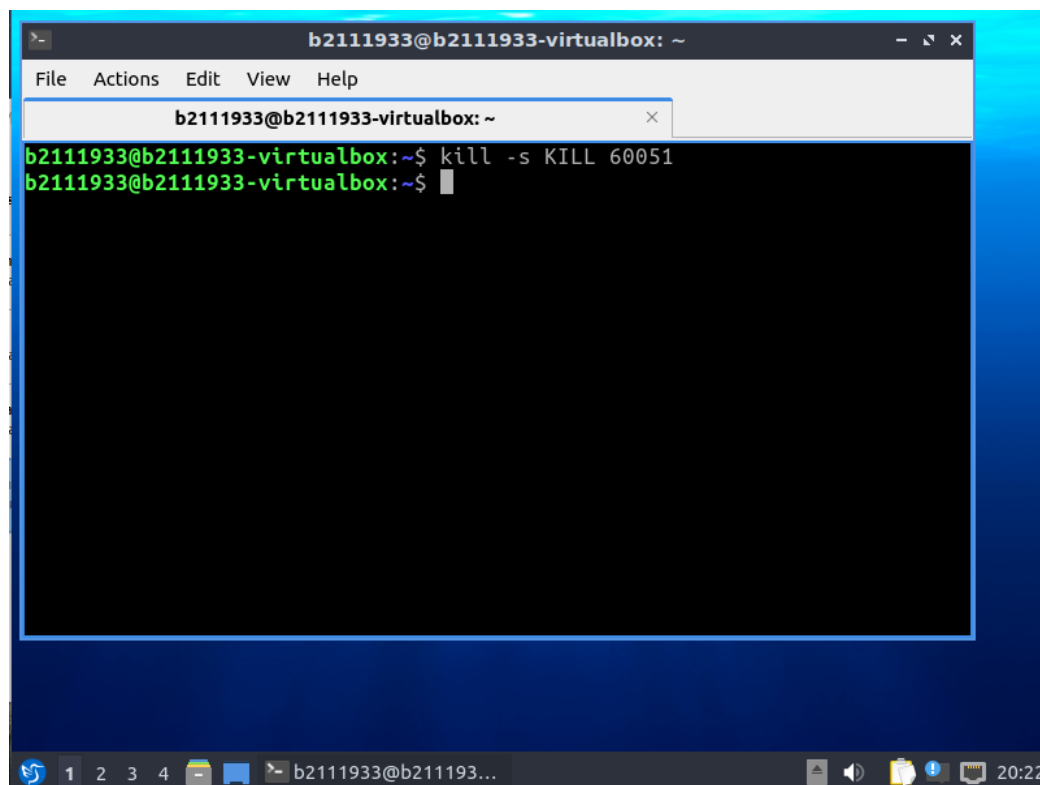
**Chromium** is stop working

`$kill -s CONT <PID>`



Now **Chromium** is working again

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

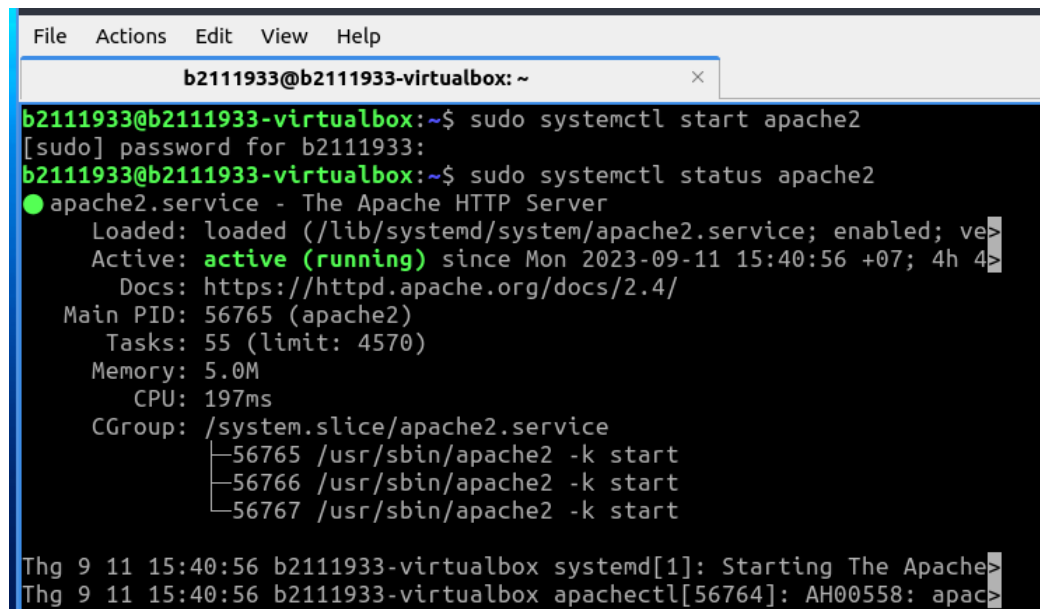


The screenshot shows a terminal window titled "b2111933@b2111933-virtualbox: ~". The terminal has a menu bar with "File", "Actions", "Edit", "View", and "Help". The command prompt shows the user "b2111933" at the host "b2111933-virtualbox". The user enters the command `kill -s KILL 60051`, and the prompt returns to `b2111933@b2111933-virtualbox:~$`. The terminal window is part of a desktop environment with a taskbar at the bottom showing icons for a file manager, terminal, and other applications, along with the system clock showing 20:22.

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

```
$sudo systemctl start apache2
```

```
$sudo systemctl status apache2
```

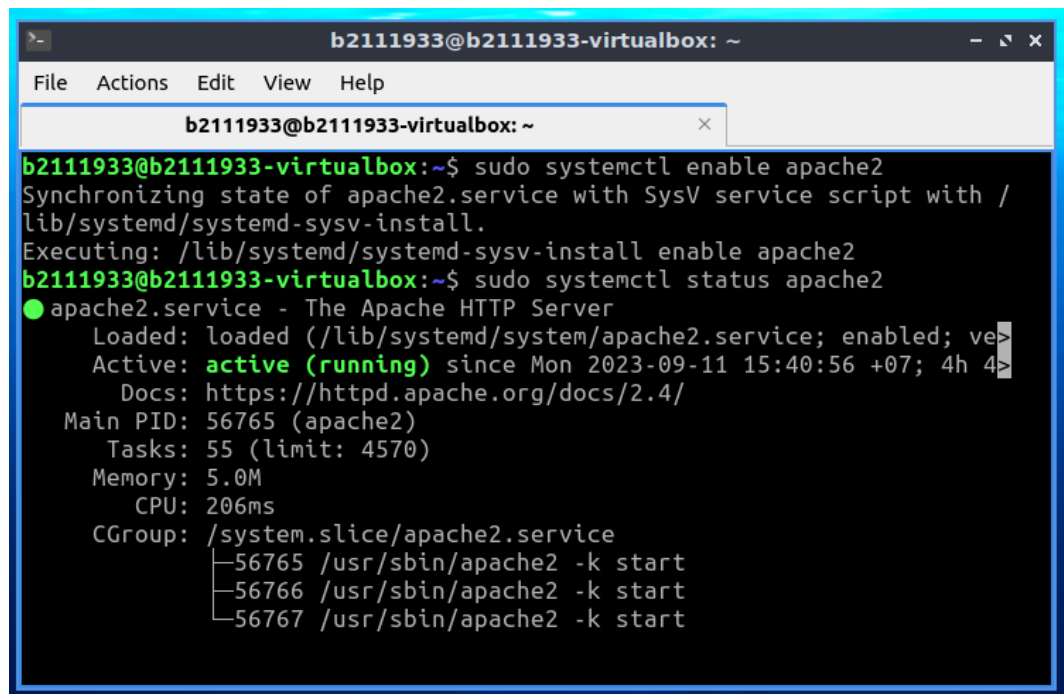


The screenshot shows a terminal window titled "b2111933@b2111933-virtualbox: ~". The user enters `sudo systemctl start apache2`, and the terminal shows the password prompt "[sudo] password for b2111933:". Then, the user enters `sudo systemctl status apache2`, and the terminal displays the status of the `apache2.service`. The status shows that the service is loaded, enabled, and active (running) since Mon 2023-09-11 15:40:56 +07; 4h 4m. The main PID is 56765, and there are 55 tasks. The memory usage is 5.0M and CPU usage is 197ms. The CGroup is `/system.slice/apache2.service`, and it lists three processes: 56765, 56766, and 56767, all running `/usr/sbin/apache2 -k start`. At the bottom, there are two log messages: "Thg 9 11 15:40:56 b2111933-virtualbox systemd[1]: Starting The Apache" and "Thg 9 11 15:40:56 b2111933-virtualbox apachectl[56764]: AH00558: apac".

Start and display the status of **apache2** using **systemctl** command (started)

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

```
$sudo systemctl enable apache2
```



```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox:~$ sudo systemctl enable apache2  
Synchronizing state of apache2.service with SysV service script with /  
lib/systemd/systemd-sysv-install.  
Executing: /lib/systemd/systemd-sysv-install enable apache2  
b2111933@b2111933-virtualbox:~$ sudo systemctl status apache2  
● apache2.service - The Apache HTTP Server  
   Loaded: loaded (/lib/systemd/system/apache2.service; enabled; ve>  
   Active: active (running) since Mon 2023-09-11 15:40:56 +07; 4h 4>  
     Docs: https://httpd.apache.org/docs/2.4/  
   Main PID: 56765 (apache2)  
     Tasks: 55 (limit: 4570)  
    Memory: 5.0M  
       CPU: 206ms  
    CGroup: /system.slice/apache2.service  
            └─56765 /usr/sbin/apache2 -k start  
              └─56766 /usr/sbin/apache2 -k start  
                └─56767 /usr/sbin/apache2 -k start
```

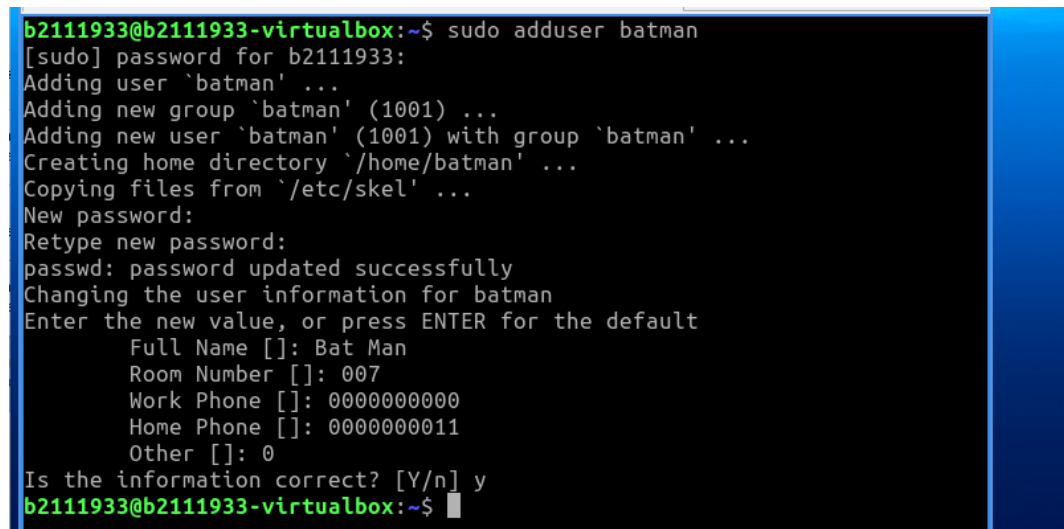
Enable **apache2** web server starting on booting time and display its status  
(take a screenshot of the console)

## 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**.

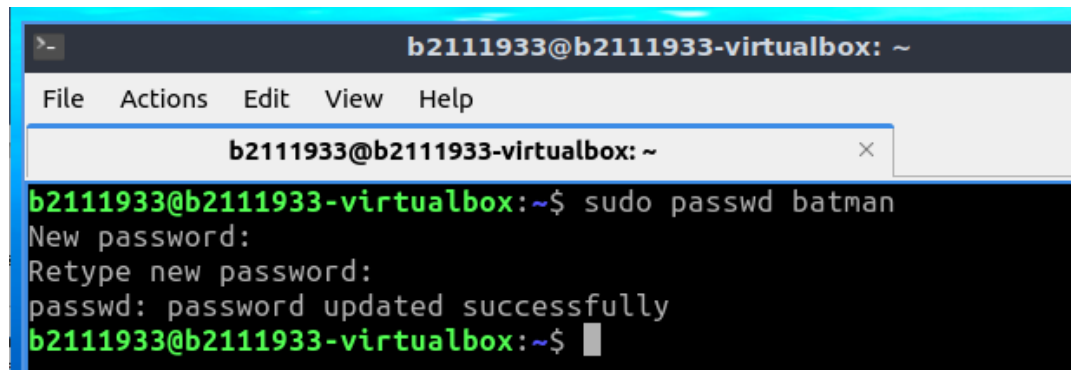
```
$sudo adduser batman
```



```
b2111933@b2111933-virtualbox:~$ sudo adduser batman  
[sudo] password for b2111933:  
Adding user `batman' ...  
Adding new group `batman' (1001) ...  
Adding new user `batman' (1001) with group `batman' ...  
Creating home directory `/home/batman' ...  
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 []: Bat Man  
   Room Number []: 007  
   Work Phone []: 0000000000  
   Home Phone []: 0000000011  
   Other []: 0  
Is the information correct? [Y/n] y  
b2111933@b2111933-virtualbox:~$
```

Created a **new user** with username "**batman**" and filled the information

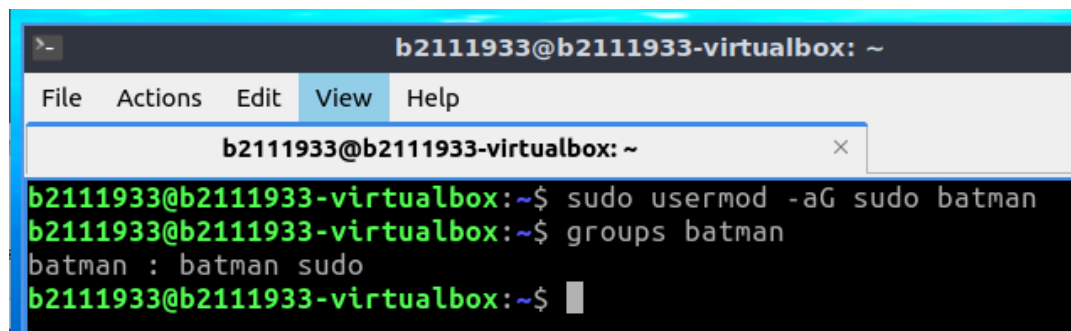
```
$sudo passwd batman
```

A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'sudo passwd batman' being executed. The output is: 'New password:', 'Retype new password:', 'passwd: password updated successfully', and the prompt 'b2111933@b2111933-virtualbox:~\$'.

Updated **password** for user "**batman**"

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

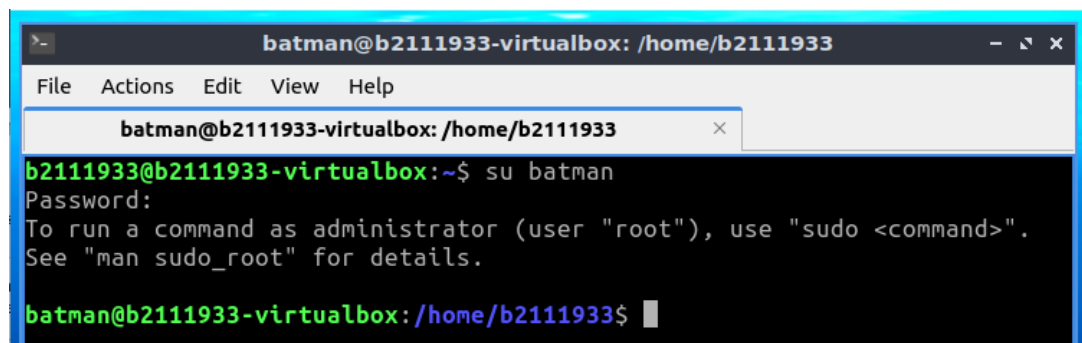
```
$sudo usermod -aG sudo batman
```

A terminal window titled 'b2111933@b2111933-virtualbox: ~' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'sudo usermod -aG sudo batman' being executed. The output is: 'b2111933@b2111933-virtualbox:~\$ groups batman', 'batman : batman sudo', and the prompt 'b2111933@b2111933-virtualbox:~\$'.

Added "**batman**" to "**sudo**" group to be able to use **sudo** command

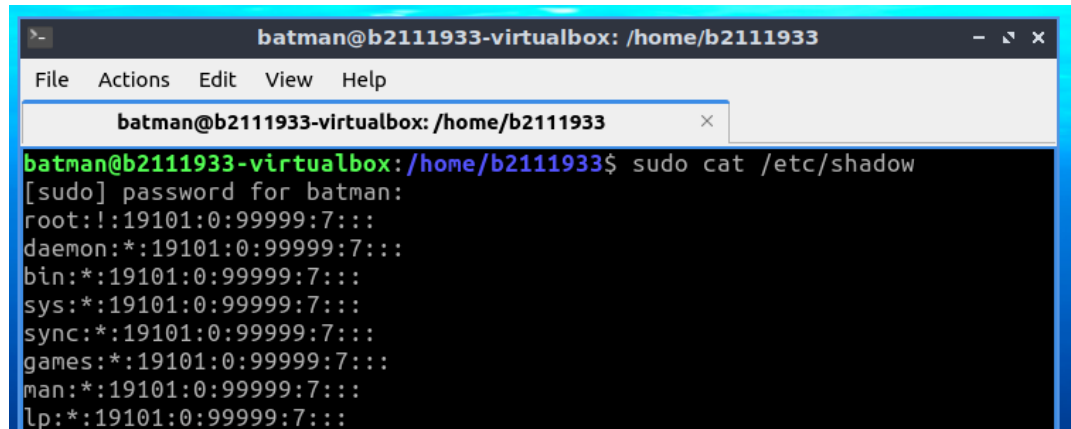
- Login as or switch to this new user and make sure you can execute a command (cat /etc/shadow) that requires root privilege.

```
$su batman
```

A terminal window titled 'batman@b2111933-virtualbox: /home/b2111933' with a menu bar (File, Actions, Edit, View, Help). The terminal shows the command 'su batman' being executed. The output is: 'Password:', 'To run a command as administrator (user "root"), use "sudo <command>". See "man sudo\_root" for details.', and the prompt 'batman@b2111933-virtualbox: /home/b2111933\$'.

Switched to the new user "**batman**"

```
$sudo cat /etc/shadow
```



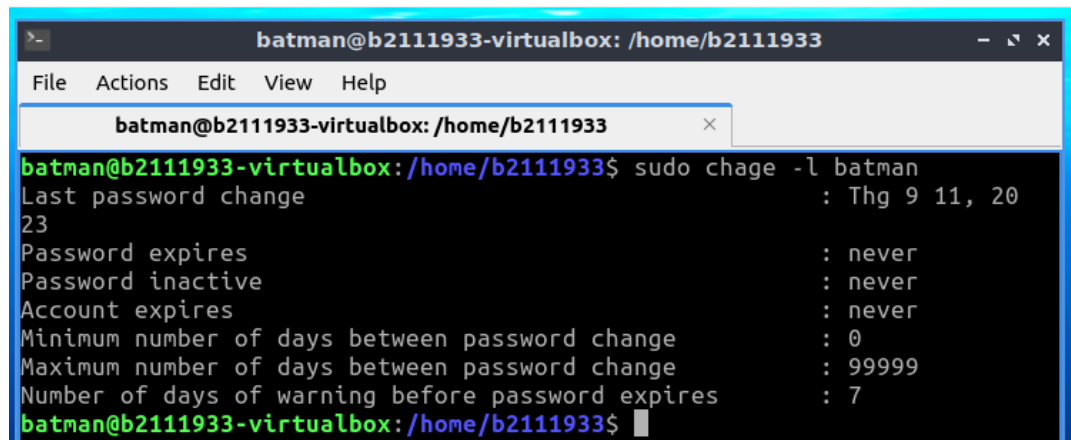
```
batman@b2111933-virtualbox: /home/b2111933$ sudo cat /etc/shadow
[sudo] password for batman:
root!!:19101:0:99999:7:::
daemon*:19101:0:99999:7:::
bin*:19101:0:99999:7:::
sys*:19101:0:99999:7:::
sync*:19101:0:99999:7:::
games*:19101:0:99999:7:::
man*:19101:0:99999:7:::
lp*:19101:0:99999:7:::
```

User “batman” can execute a command (cat /etc/shadow) that requires root privilege  
(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
```

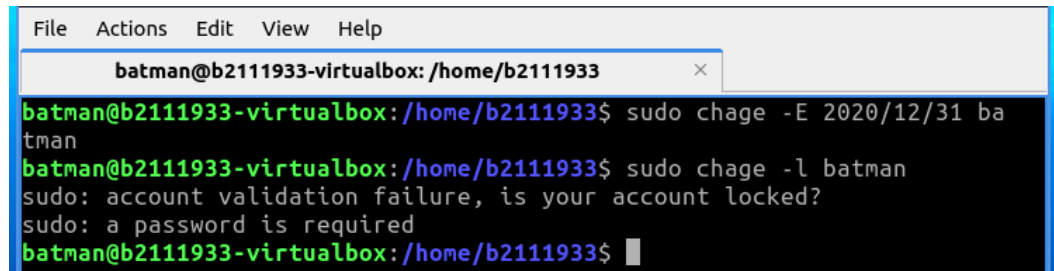


```
batman@b2111933-virtualbox: /home/b2111933$ sudo chage -l batman
Last password change           : Thg 9 11, 20
23
Password expires               : never
Password inactive              : never
Account expires                : never
Minimum number of days between password change : 0
Maximum number of days between password change : 99999
Number of days of warning before password expires : 7
batman@b2111933-virtualbox: /home/b2111933$
```

Password aging for the user “batman”

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

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

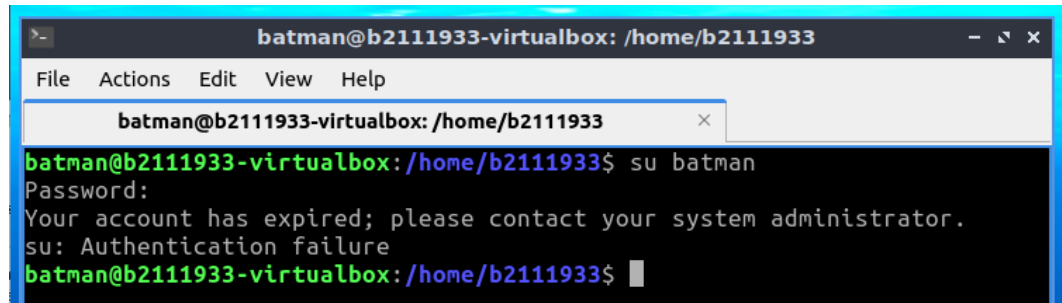


```
batman@b2111933-virtualbox: /home/b2111933$ sudo chage -E 2020/12/31 batman
batman@b2111933-virtualbox: /home/b2111933$ sudo chage -l batman
sudo: account validation failure, is your account locked?
sudo: a password is required
batman@b2111933-virtualbox: /home/b2111933$
```

Modified the expiration date for user “batman”, now it is locked



```
$su batman
```



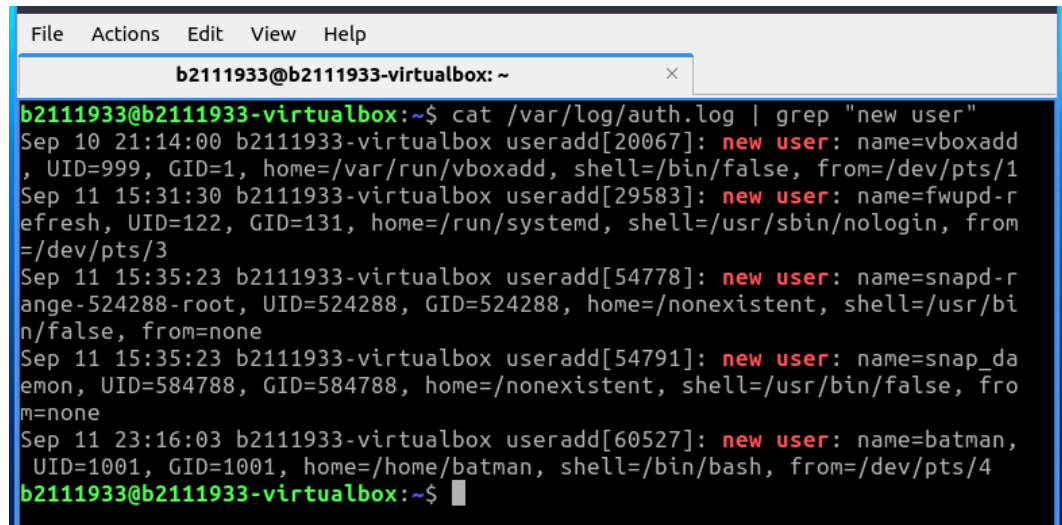
```
batman@b2111933-virtualbox: /home/b2111933
File Actions Edit View Help
batman@b2111933-virtualbox: /home/b2111933
batman@b2111933-virtualbox: /home/b2111933$ su batman
Password:
Your account has expired; please contact your system administrator.
su: Authentication failure
batman@b2111933-virtualbox: /home/b2111933$
```

Account “batman” has expired as you can see  
(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"
```

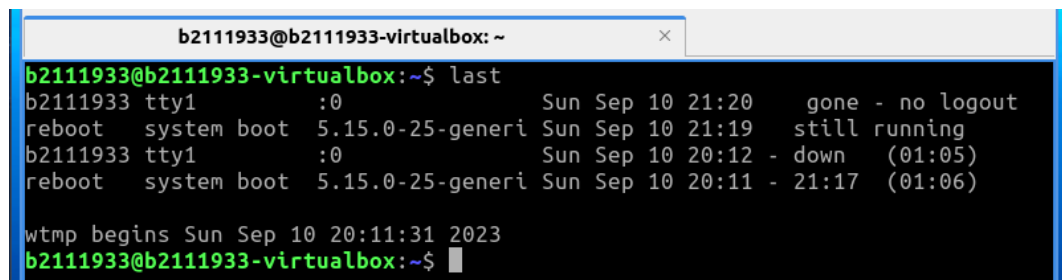


```
b2111933@b2111933-virtualbox: ~
File Actions Edit View Help
b2111933@b2111933-virtualbox: ~
b2111933@b2111933-virtualbox:~$ cat /var/log/auth.log | grep "new user"
Sep 10 21:14:00 b2111933-virtualbox useradd[20067]: new user: name=vboxadd
, UID=999, GID=1, home=/var/run/vboxadd, shell=/bin/false, from=/dev/pts/1
Sep 11 15:31:30 b2111933-virtualbox useradd[29583]: new user: name=fwupd-r
efresh, UID=122, GID=131, home=/run/systemd, shell=/usr/sbin/nologin, from
=/dev/pts/3
Sep 11 15:35:23 b2111933-virtualbox useradd[54778]: new user: name=snapd-r
ange-524288-root, UID=524288, GID=524288, home=/nonexistent, shell=/usr/bi
n/false, from=none
Sep 11 15:35:23 b2111933-virtualbox useradd[54791]: new user: name=snap_da
emon, UID=584788, GID=584788, home=/nonexistent, shell=/usr/bin/false, fro
m=none
Sep 11 23:16:03 b2111933-virtualbox useradd[60527]: new user: name=batman,
UID=1001, GID=1001, home=/home/batman, shell=/bin/bash, from=/dev/pts/4
b2111933@b2111933-virtualbox:~$
```

Check the **log file** that displays the time when **the user in 5.1** created

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

```
$last
```



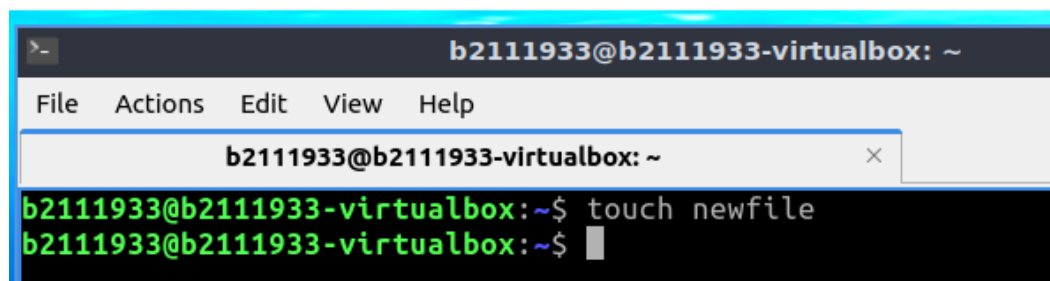
```
b2111933@b2111933-virtualbox: ~
b2111933@b2111933-virtualbox:~$ last
b2111933 tty1 :0 Sun Sep 10 21:20 gone - no logout
reboot system boot 5.15.0-25-generi Sun Sep 10 21:19 still running
b2111933 tty1 :0 Sun Sep 10 20:12 - down (01:05)
reboot system boot 5.15.0-25-generi Sun Sep 10 20:11 - 21:17 (01:06)

wtmp begins Sun Sep 10 20:11:31 2023
b2111933@b2111933-virtualbox:~$
```

The **last log in** to the system was **21:20 10/9/2023**  
(take a screenshot of the console)

## 6. File permissions

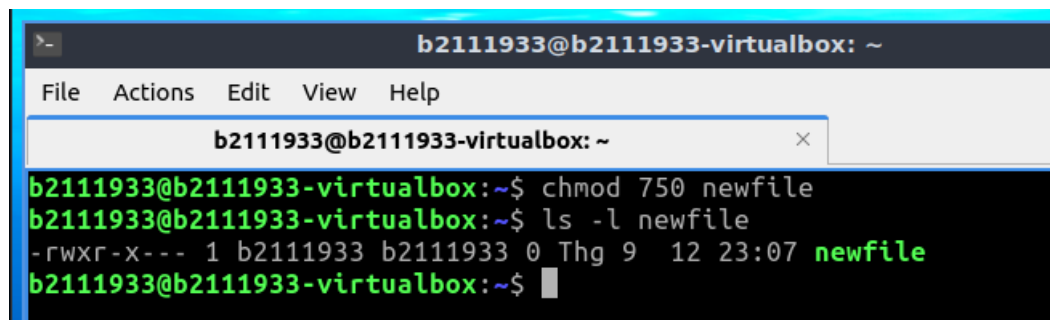
- Create a new file **newfile**; then change its permissions to **rwxr-x---**  
`$touch newfile`



The screenshot shows a terminal window titled "b2111933@b2111933-virtualbox: ~". The terminal has a menu bar with "File", "Actions", "Edit", "View", and "Help". Below the menu bar, there is a tab labeled "b2111933@b2111933-virtualbox: ~". The terminal prompt is "b2111933@b2111933-virtualbox:~\$". The user has entered the command "touch newfile", and the prompt has moved to the next line.

Created a new file named "newfile"

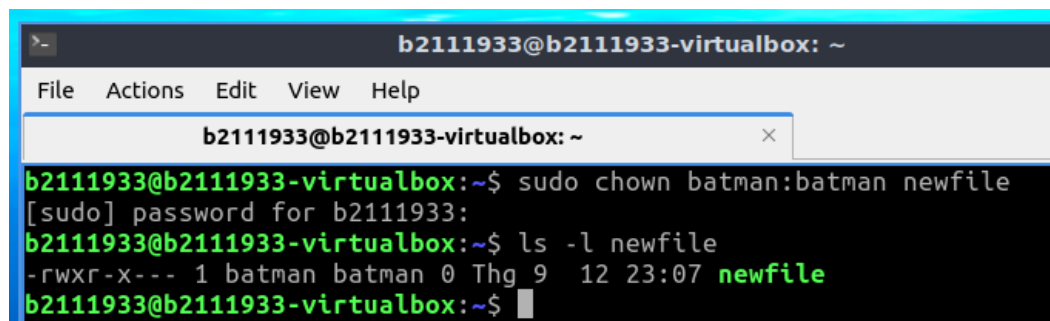
`$chmod 750 newfile`



The screenshot shows a terminal window titled "b2111933@b2111933-virtualbox: ~". The terminal has a menu bar with "File", "Actions", "Edit", "View", and "Help". Below the menu bar, there is a tab labeled "b2111933@b2111933-virtualbox: ~". The terminal prompt is "b2111933@b2111933-virtualbox:~\$". The user has entered the command "chmod 750 newfile". The prompt has moved to the next line. The user has entered the command "ls -l newfile". The output is "-rwxr-x--- 1 b2111933 b2111933 0 Thg 9 12 23:07 newfile". The prompt has moved to the next line.

Changed **newfile**'s permissions to **rwxr-x---**

- 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 "b2111933@b2111933-virtualbox: ~". The terminal has a menu bar with "File", "Actions", "Edit", "View", and "Help". Below the menu bar, there is a tab labeled "b2111933@b2111933-virtualbox: ~". The terminal prompt is "b2111933@b2111933-virtualbox:~\$". The user has entered the command "sudo chown batman:batman newfile". The prompt has moved to the next line. The user has entered the command "ls -l newfile". The output is "-rwxr-x--- 1 batman batman 0 Thg 9 12 23:07 newfile". The prompt has moved to the next line.

Change the user and group ownership of **newfile** to the user "batman"

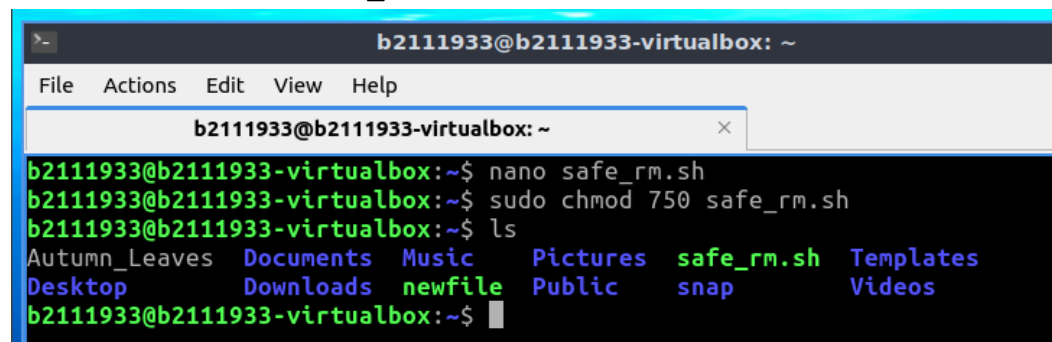
(take a screenshot of the console)

## 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 do 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 are 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 in the current working directory.

```
$nano safe_rm.sh
$sudo chmod 750 safe_rm.sh
```

A screenshot of a terminal window titled "b2111933@b2111933-virtualbox: ~". The window has a menu bar with "File", "Actions", "Edit", "View", and "Help". The terminal shows the following commands and output:

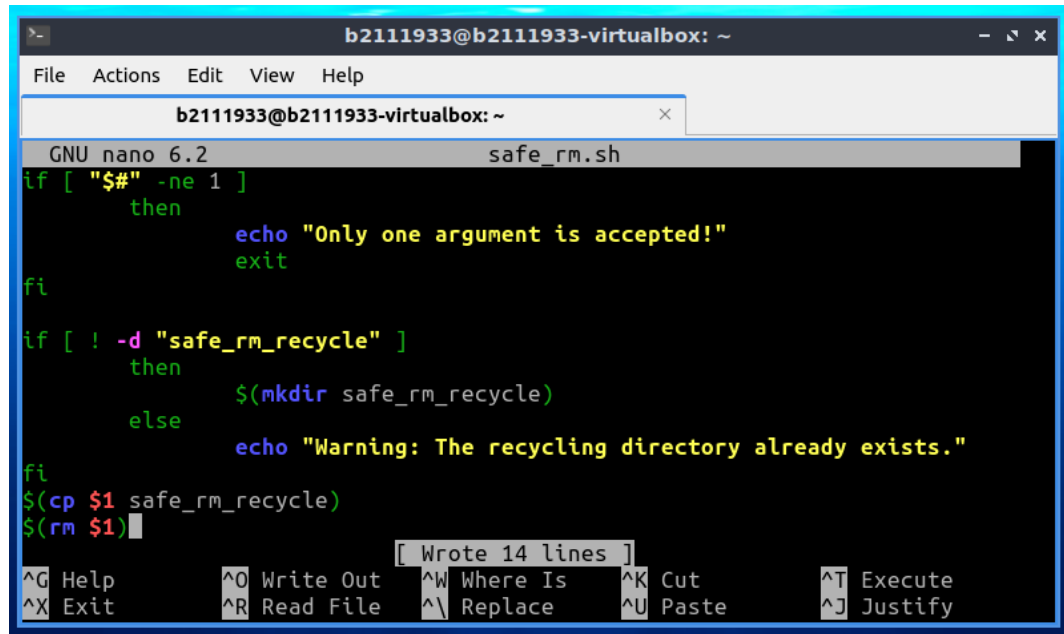
```
b2111933@b2111933-virtualbox:~$ nano safe_rm.sh
b2111933@b2111933-virtualbox:~$ sudo chmod 750 safe_rm.sh
b2111933@b2111933-virtualbox:~$ ls
Autumn_Leaves  Documents  Music      Pictures  safe_rm.sh  Templates
Desktop        Downloads  newfile    Public    snap        Videos
b2111933@b2111933-virtualbox:~$
```

Created file **safe\_rm.sh** with **nano** and changed its **permissions** to **-rwxr-x---**

```
safe_rm.sh
```

```
if [ "$#" -ne 1 ]
then
    echo "Only one argument is accepted!"
    exit
fi

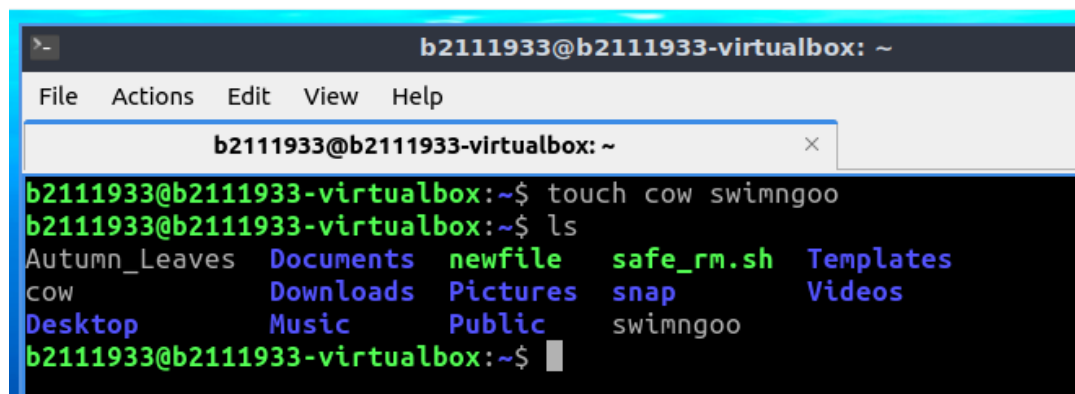
if [ ! -d "safe_rm_recycle" ]
then
    $(mkdir safe_rm_recycle)
else
    echo "Warning: The recycling
    directory already exists."
fi
$(cp $1 safe_rm_recycle)
$(rm $1)
```



```
b2111933@b2111933-virtualbox: ~
File Actions Edit View Help
b2111933@b2111933-virtualbox: ~
GNU nano 6.2 safe_rm.sh
if [ "$#" -ne 1 ]
then
    echo "Only one argument is accepted!"
    exit
fi
if [ ! -d "safe_rm_recycle" ]
then
    $(mkdir safe_rm_recycle)
else
    echo "Warning: The recycling directory already exists."
fi
$(cp $1 safe_rm_recycle)
$(rm $1)
```

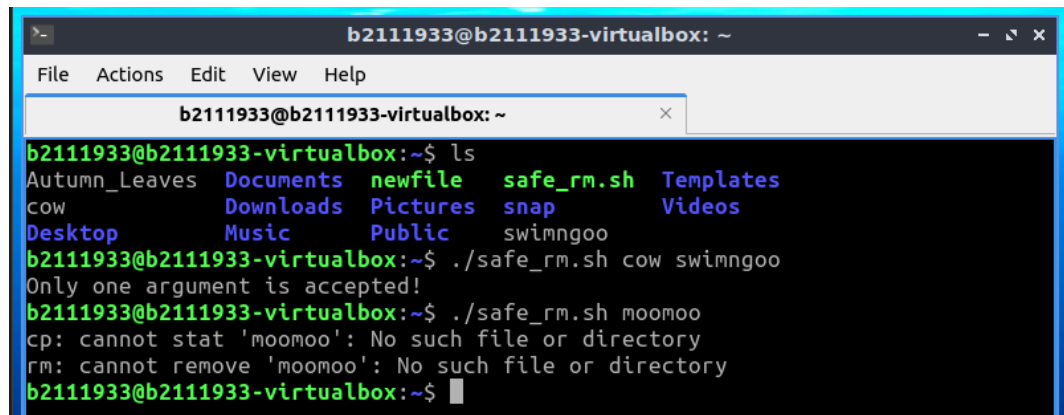
Wrote 14 lines

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

Contents of `safe_rm.sh`

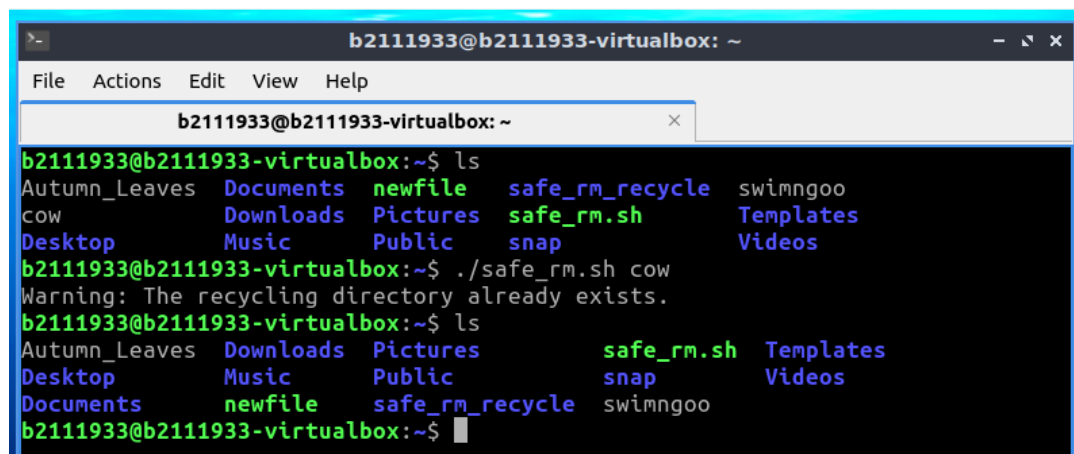
```
b2111933@b2111933-virtualbox: ~
File Actions Edit View Help
b2111933@b2111933-virtualbox: ~
b2111933@b2111933-virtualbox:~$ touch cow swimngoo
b2111933@b2111933-virtualbox:~$ ls
Autumn_Leaves Documents newfile safe_rm.sh Templates
cow Downloads Pictures snap Videos
Desktop Music Public swimngoo
b2111933@b2111933-virtualbox:~$
```

Created 2 files named "cow"&amp; "swimngoo" for testing



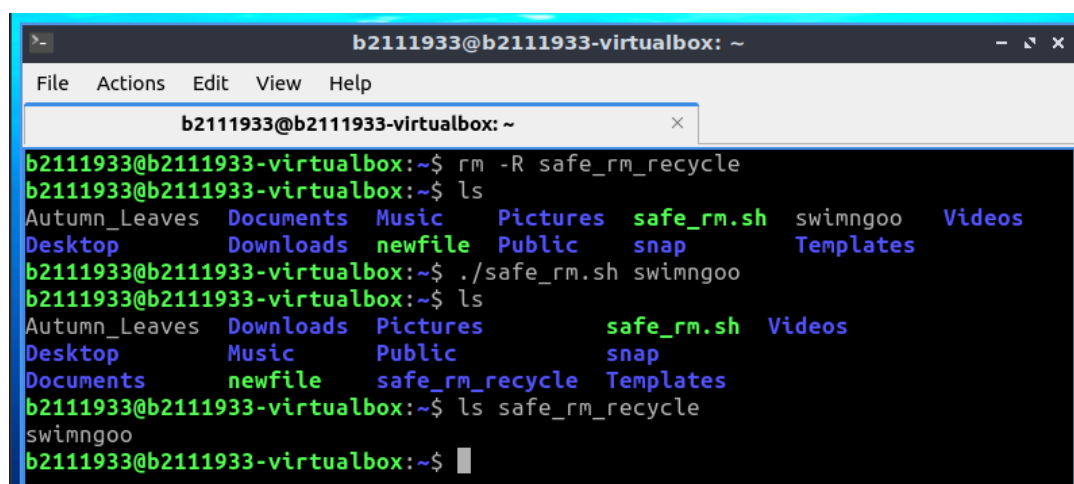
```
b2111933@b2111933-virtualbox: ~
File Actions Edit View Help
b2111933@b2111933-virtualbox: ~
b2111933@b2111933-virtualbox:~$ ls
Autumn_Leaves Documents newfile safe_rm.sh Templates
cow Downloads Pictures snap Videos
Desktop Music Public swimngoo
b2111933@b2111933-virtualbox:~$ ./safe_rm.sh cow swimngoo
Only one argument is accepted!
b2111933@b2111933-virtualbox:~$ ./safe_rm.sh moomoo
cp: cannot stat 'moomoo': No such file or directory
rm: cannot remove 'moomoo': No such file or directory
b2111933@b2111933-virtualbox:~$
```

Testing



```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox:~$ ls  
Autumn_Leaves Documents newfile safe_rm_recycle swimngoo  
cow Downloads Pictures safe_rm.sh Templates  
Desktop Music Public snap Videos  
b2111933@b2111933-virtualbox:~$ ./safe_rm.sh cow  
Warning: The recycling directory already exists.  
b2111933@b2111933-virtualbox:~$ ls  
Autumn_Leaves Downloads Pictures safe_rm.sh Templates  
Desktop Music Public snap Videos  
Documents newfile safe_rm_recycle swimngoo  
b2111933@b2111933-virtualbox:~$
```

Testing



```
b2111933@b2111933-virtualbox: ~  
File Actions Edit View Help  
b2111933@b2111933-virtualbox: ~  
b2111933@b2111933-virtualbox:~$ rm -R safe_rm_recycle  
b2111933@b2111933-virtualbox:~$ ls  
Autumn_Leaves Documents Music Pictures safe_rm.sh swimngoo Videos  
Desktop Downloads newfile Public snap Templates  
b2111933@b2111933-virtualbox:~$ ./safe_rm.sh swimngoo  
b2111933@b2111933-virtualbox:~$ ls  
Autumn_Leaves Downloads Pictures safe_rm.sh Videos  
Desktop Music Public snap  
Documents newfile safe_rm_recycle Templates  
b2111933@b2111933-virtualbox:~$ ls safe_rm_recycle  
swimngoo  
b2111933@b2111933-virtualbox:~$
```

Testing

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

---END---