

OPERATING SYSTEM LABORATORY MANUAL



UNIVERSITY OF THE PUNJAB

FACULTY OF COMPUTING & INFORMATION TECHNOLOGY, LAHORE

DEPARTMENT OF COMPUTER SCIENCE

Course:	Operating System Lab	Date:
Course Code:	CC-217-3L	Max Marks: 40
Faculty/Instructor's Name & Email:	Dr. Ahmad Hassan Butt (ahmad.hassan@pucit.edu.pk)	

LAB MANUAL # 2 (SPRING 2023)

Name: _____ Enroll No: _____

Objective(s) :

Installation of VMWare and Ubuntu.

Lab Tasks :

Task 1 + 2 : Installation of VMWare

Task 3 + 4 : Installation of Ubuntu

Lab Grading Sheet :

Task	Max Marks	Obtained Marks	Comments(<i>if any</i>)
1.	10		
2.	10		
3.	10		
4.	10		
Total	40		Signature

Note : Attempt all tasks and get them checked by your Instructor

Lab 02: Installation of VMWare and Ubuntu

Objective(s):

Installation of VMWare and Ubuntu.

Tool(s) used:

Ubuntu

UNIX OPERATING SYSTEM

An operating system is the program that controls all the other parts of a computer system - both the hardware and the software. Most importantly, it allows you to make use of the facilities provided by the system. Example of operating system are Windows XP, Windows NT, UNIX, Linux, ..etc.

UNIX is an operating system which was first developed in the 1960s, and has been under constant development ever since. By operating system, we mean the suite of programs which make the computer work. It is a stable, multi-user, multi-tasking system for servers, desktops and laptops.

UNIX systems also have a graphical user interface (GUI) similar to Microsoft Windows which provides an easy to use environment. However, knowledge of UNIX is required for operations which aren't covered by a graphical program, or for when there is no windows interface available, for example, in a telnet session.

Different Versions of Unix

There are many different versions of UNIX, although they share common similarities. The most popular varieties of UNIX are:

Sun Solaris,
GNU/Linux, and
MacOS X.

UBUNTU Operating System

Ubuntu is a Debian-based Linux operating system for personal computers, tablets and smartphones, where Ubuntu Touch edition is used; and also runs network servers, usually with the Ubuntu Server edition, either on physical or virtual servers (such as on mainframes) or with containers, that is with enterprise-class features; runs on the most popular architectures, including server-class ARM-based.

Installation of UBUNTU

The installation system is easy to use even if you lack previous knowledge of Linux or computer networks. If you select default options, Ubuntu provides a complete desktop operating system, including productivity applications, Internet utilities, and desktop tools. Ubuntu Workstation is a reliable, user-friendly, and powerful operating system for your laptop or desktop computer. It supports a wide range of developers, from hobbyists and students to professionals in corporate environments.

Installing VMware Tools

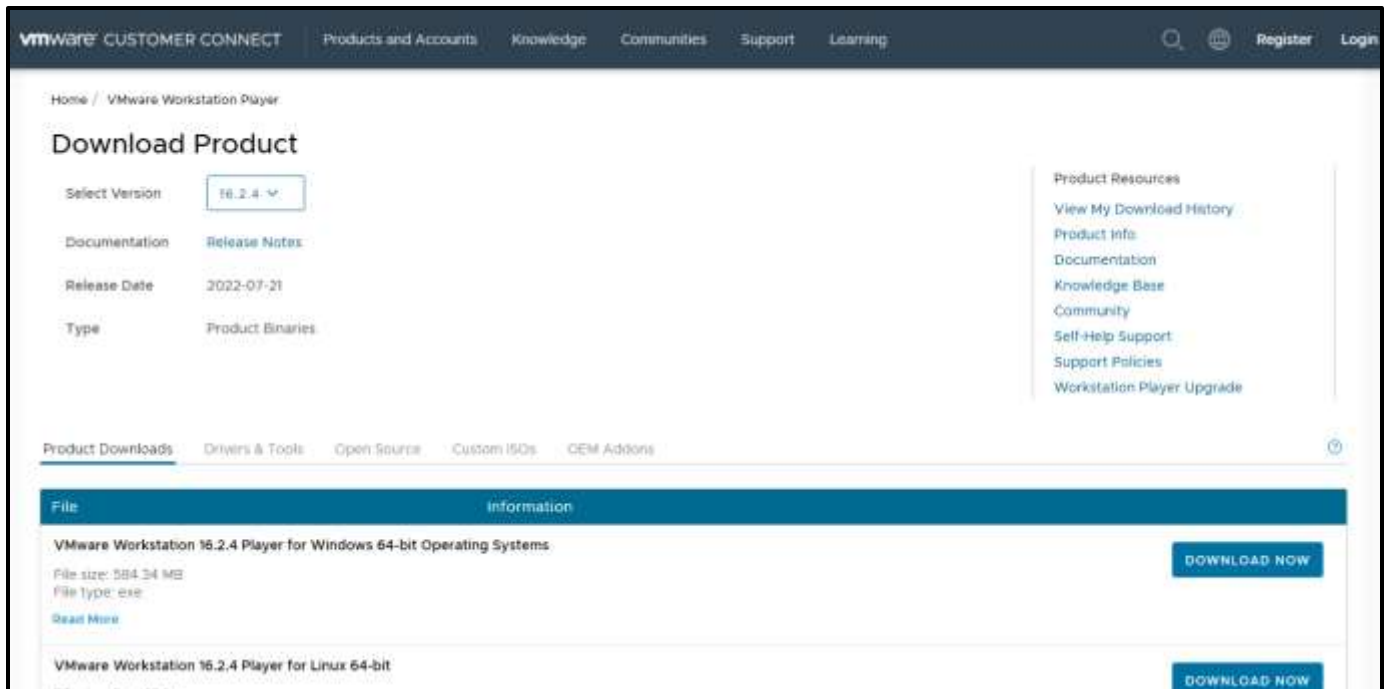
The following are general steps used to start the VMware Tools installation in most VMware products. Certain guest operating systems may require different steps, but these steps work for most operating systems. Links to more detailed steps for different operating systems are included in this article. Make sure to review the VMware documentation for the product you are using.

VMware develops virtualization Software. Virtualization software creates an abstraction layer over computer hardware that allows the hardware elements of a single computer processors, memory, storage, and more to be divided into multiple virtual computers, commonly called virtual machines (VMs). Each virtual machine runs its own operating system (OS) and behaves like an independent computer, even though it is running on a portion of the actual underlying computer hardware. A VM is a software-based representation of a physical computer. An operating system (OS) running in a VM is called a guest OS.

Method 01: Setting up Ubuntu with Vmware

1. Installing VMware Workstation from given below link. There are two options for downloading one is Windows and other for Linux.

<https://customerconnect.vmware.com/en/downloads/details?downloadGroup=WKST-PLAYER-1624&productId=1039&rPid=91446>



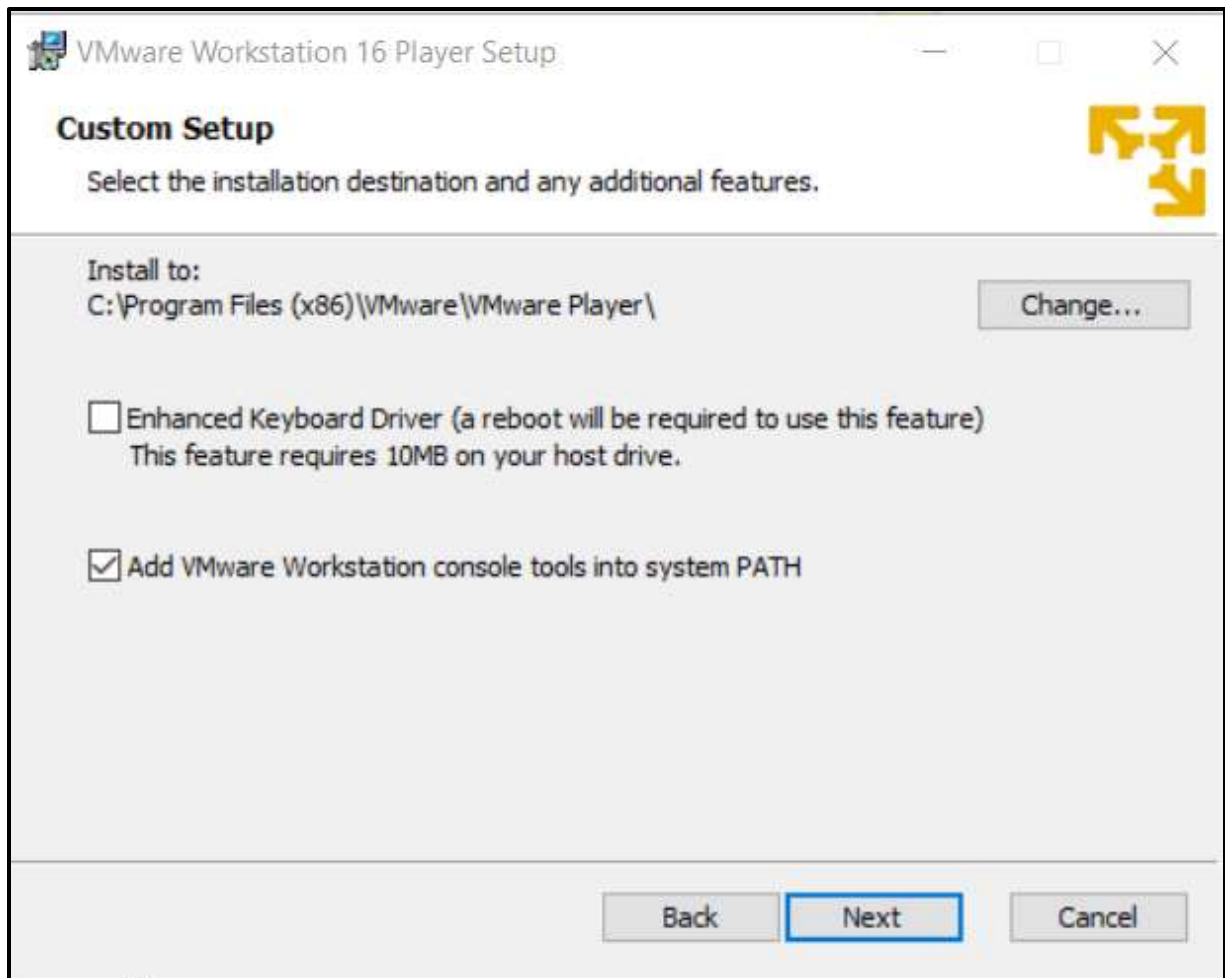
2. Run the VMware downloaded File and Click on Next to the Installation wizard.



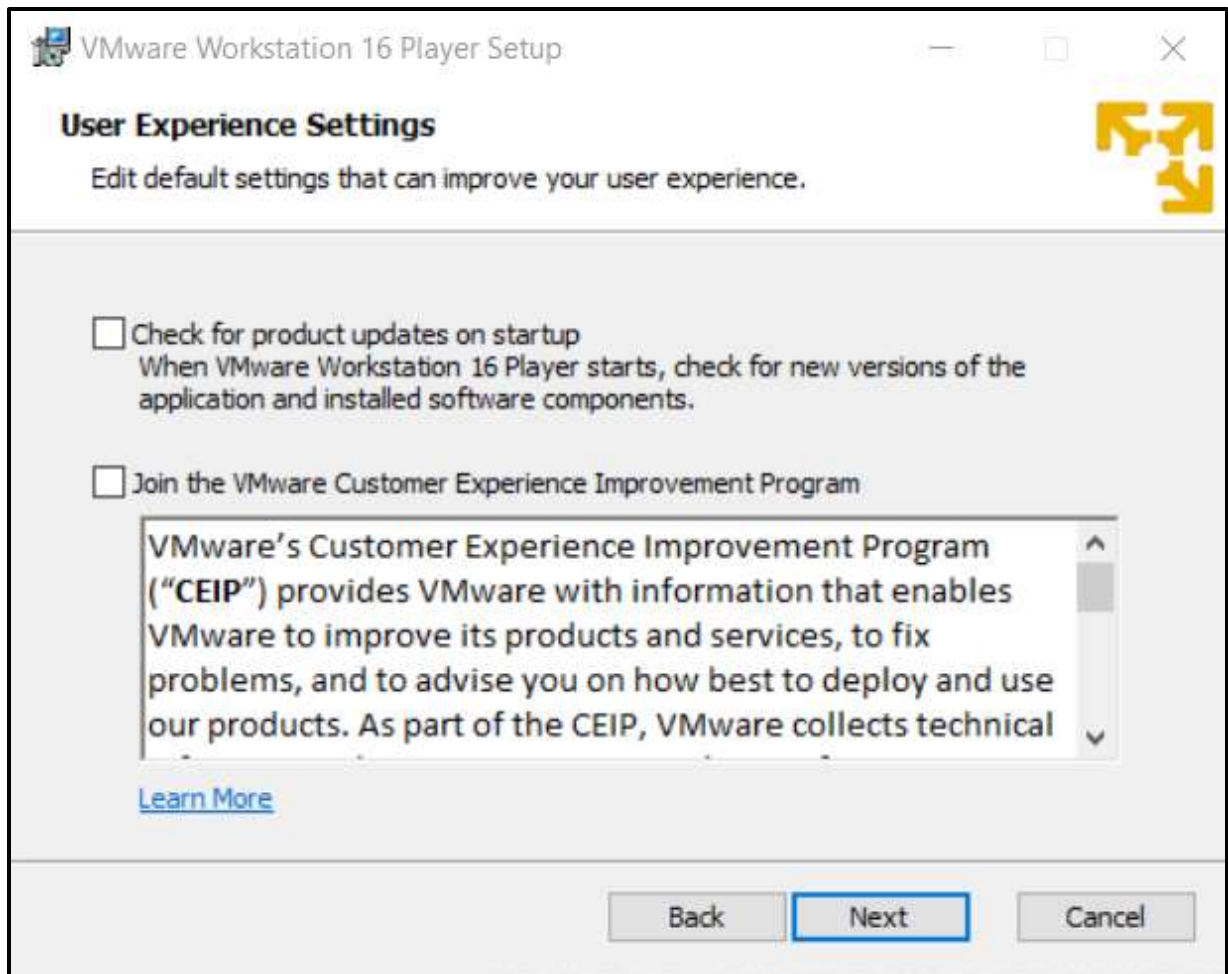
3. Accept user license agreement and click on next.



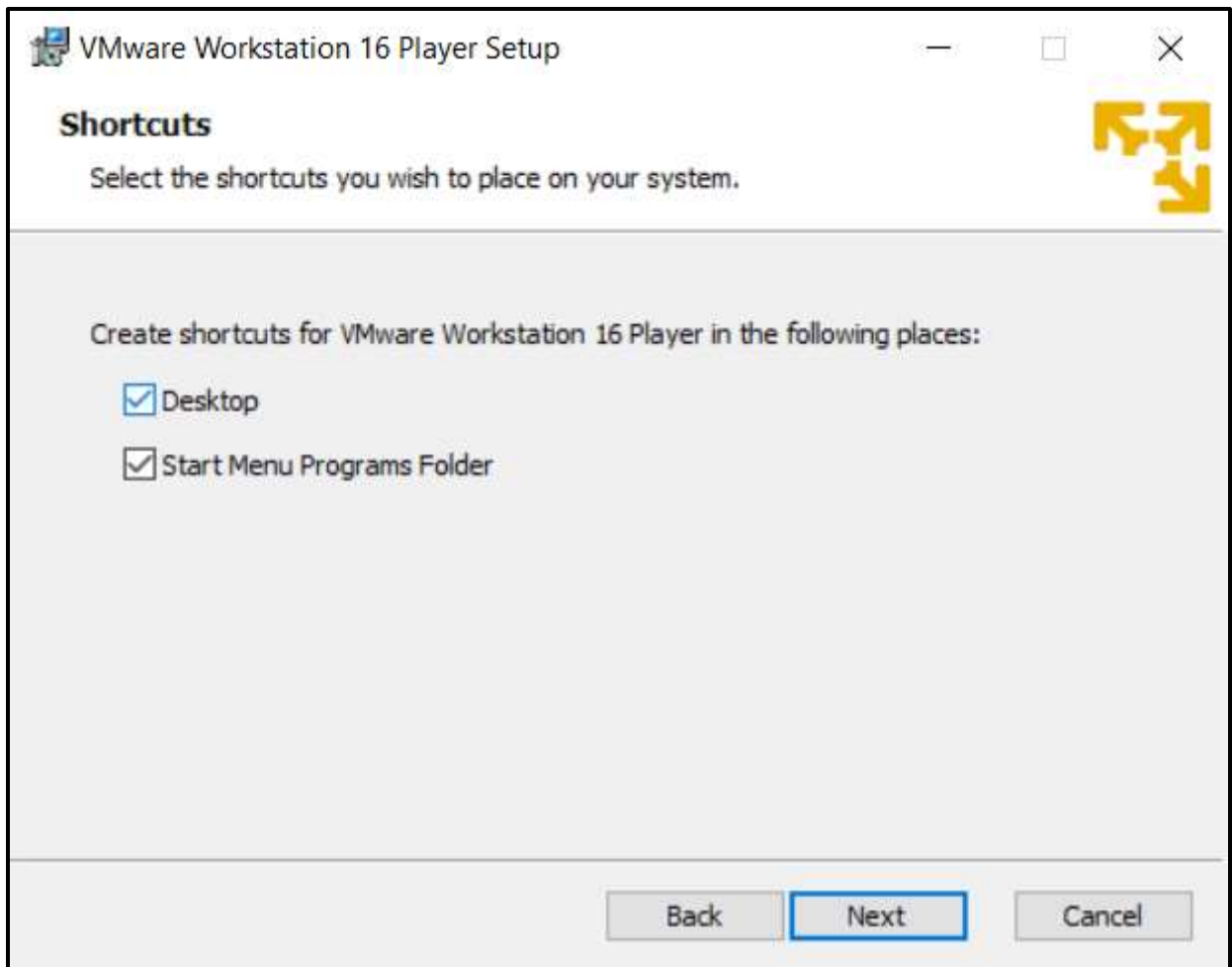
4. Specify the Installation directory. You can also enable Enhance keyboard driver here. Click Next to continue.



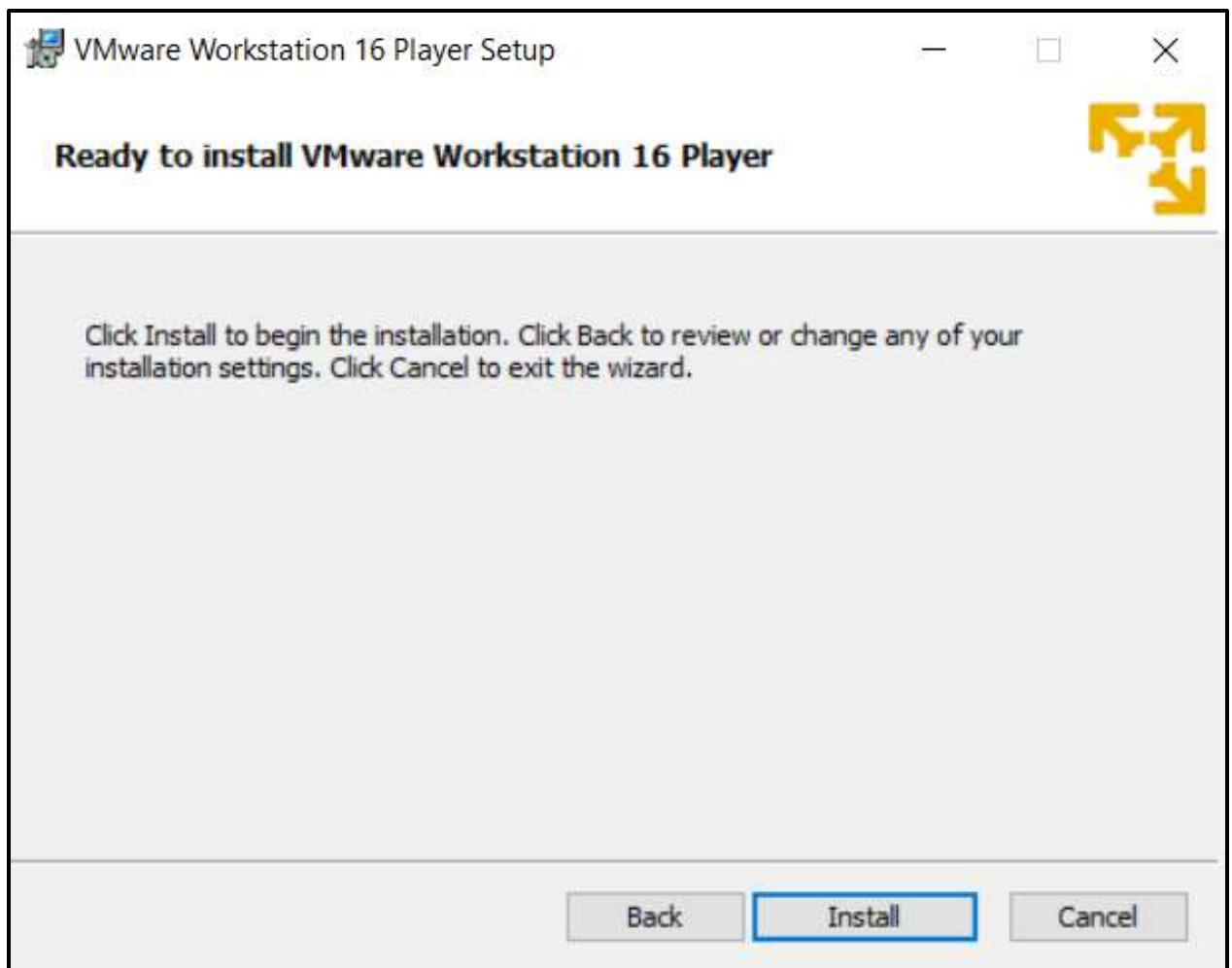
5. You can enable product startup and join the VMware Customer experience Improvement program here. Click Next to Continue.



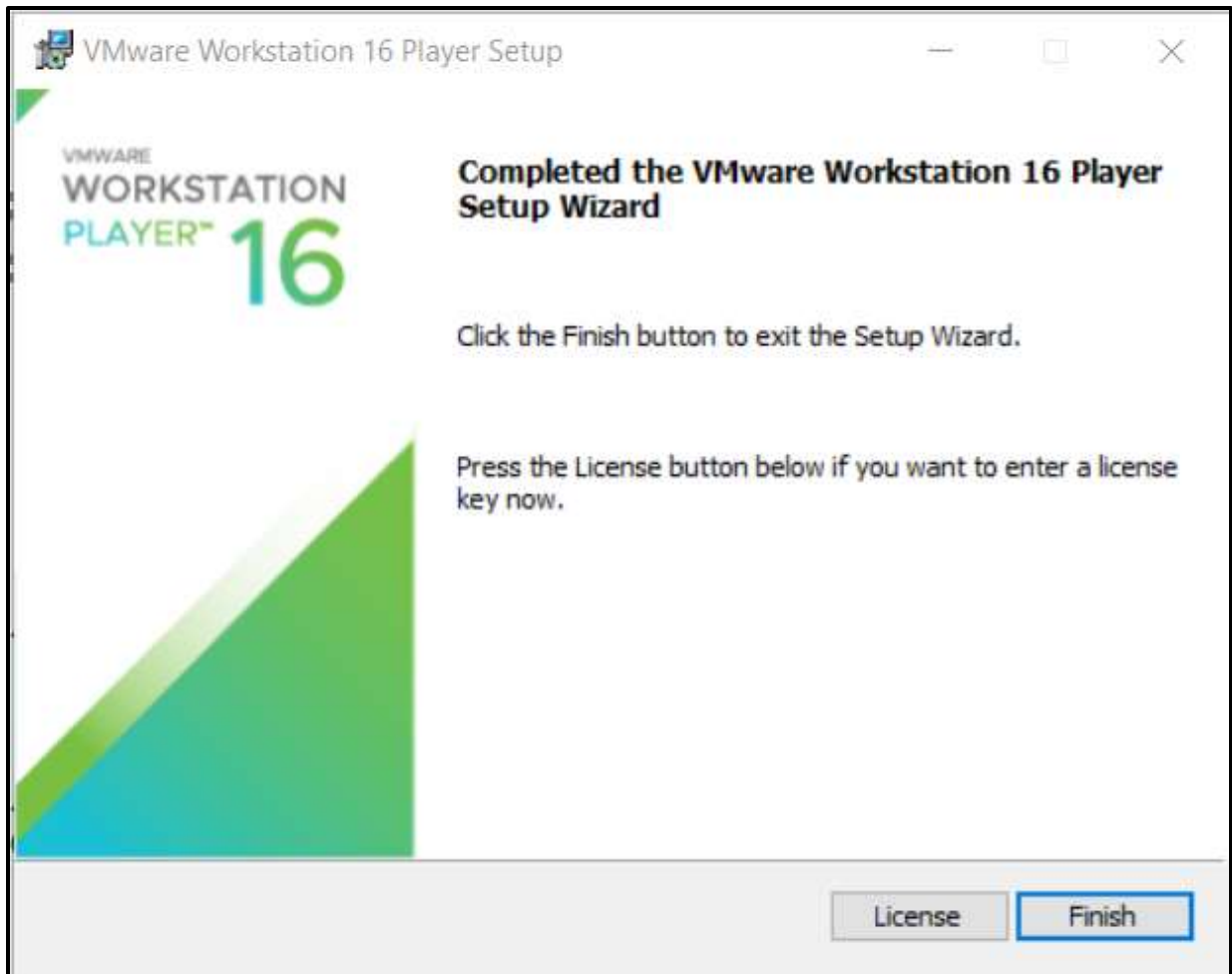
6. Select the shortcuts you want to create for easy access to VMware Workstation. Click Next to Continue.



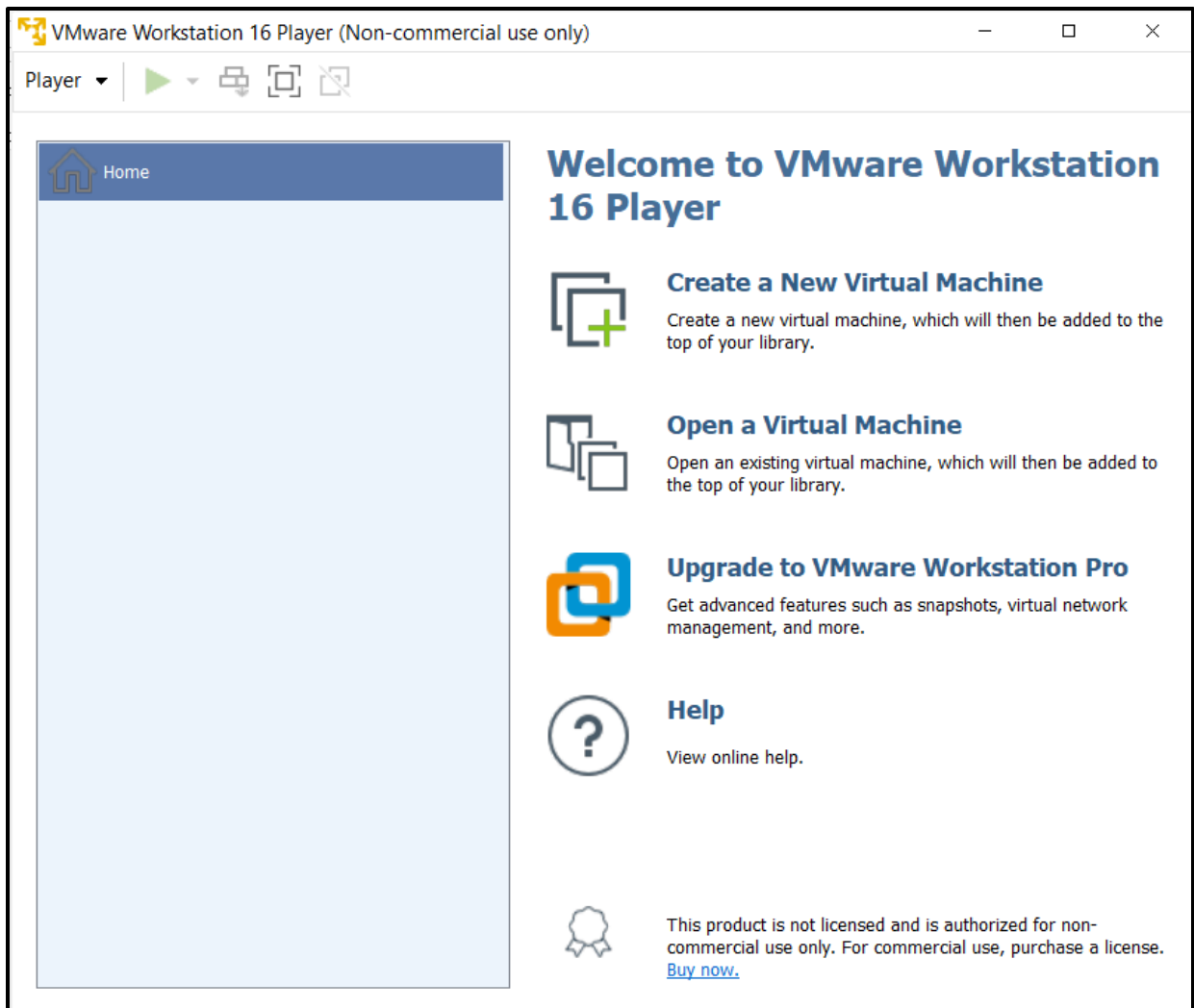
7. Click Install button to start the installation.



8. Installation will take just few seconds to complete. Click finish.

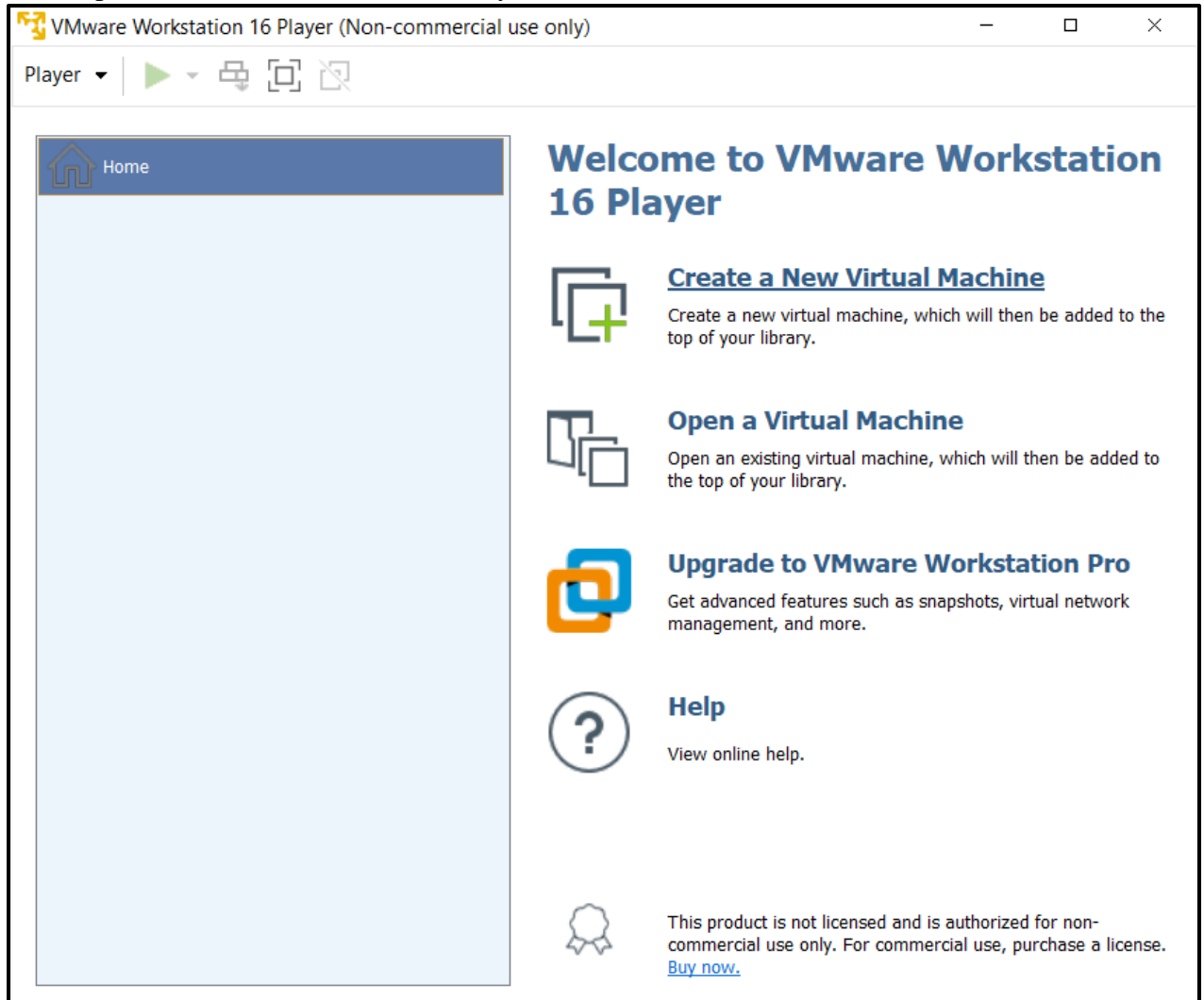


9. Now you can start the VMware Workstation Player by clicking on the shortcut on Desktop. Below is the home screen of the VMware Workstation player.

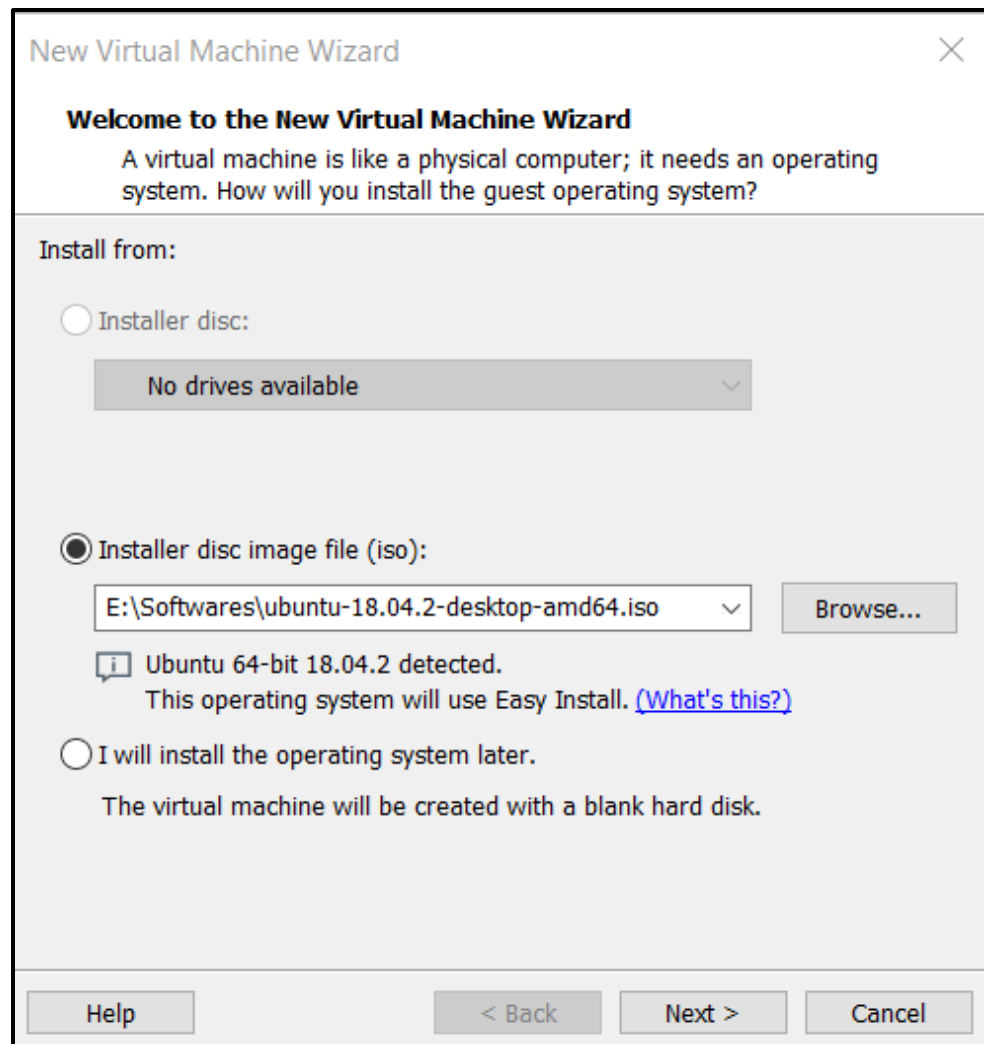


Install Ubuntu Linux on VMWare Workstation

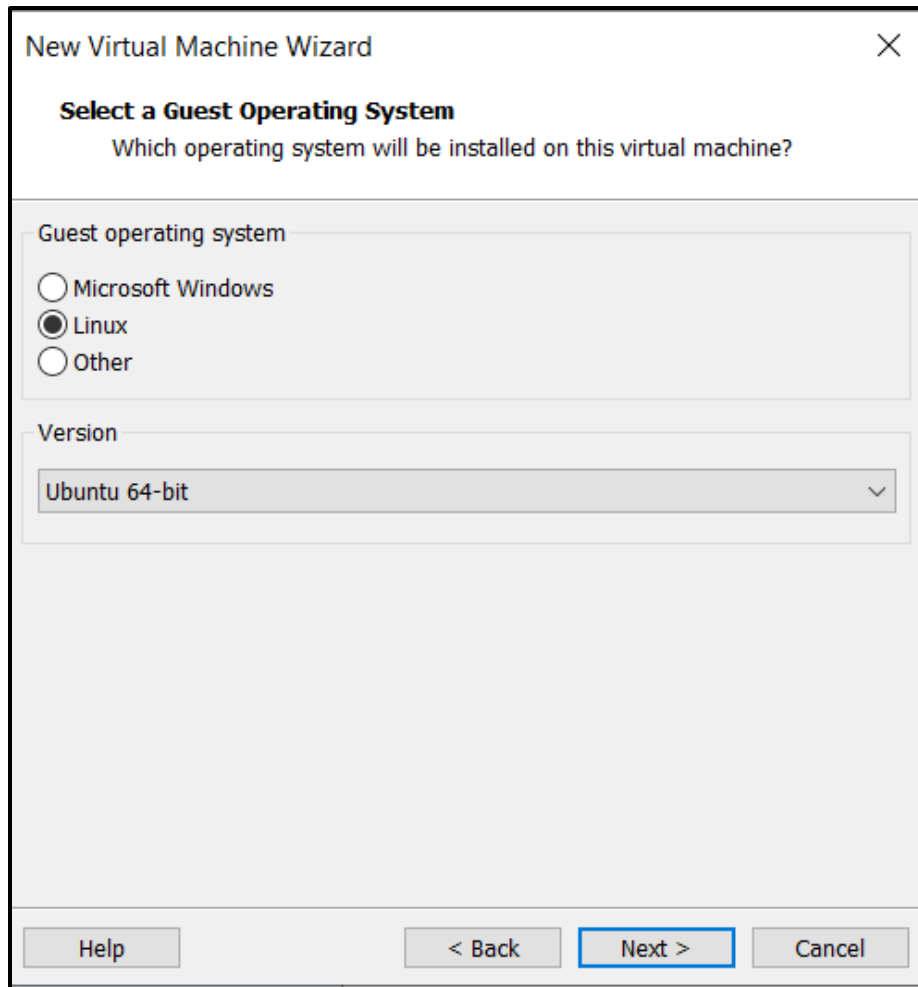
1. Open the VMware Workstation Player after installation. Create a new Virtual Machine.



2. Select ubuntu iso file and click on next to continue.



3. Select Linux and version of the Linux.



New Virtual Machine Wizard

Select a Guest Operating System
Which operating system will be installed on this virtual machine?

Guest operating system

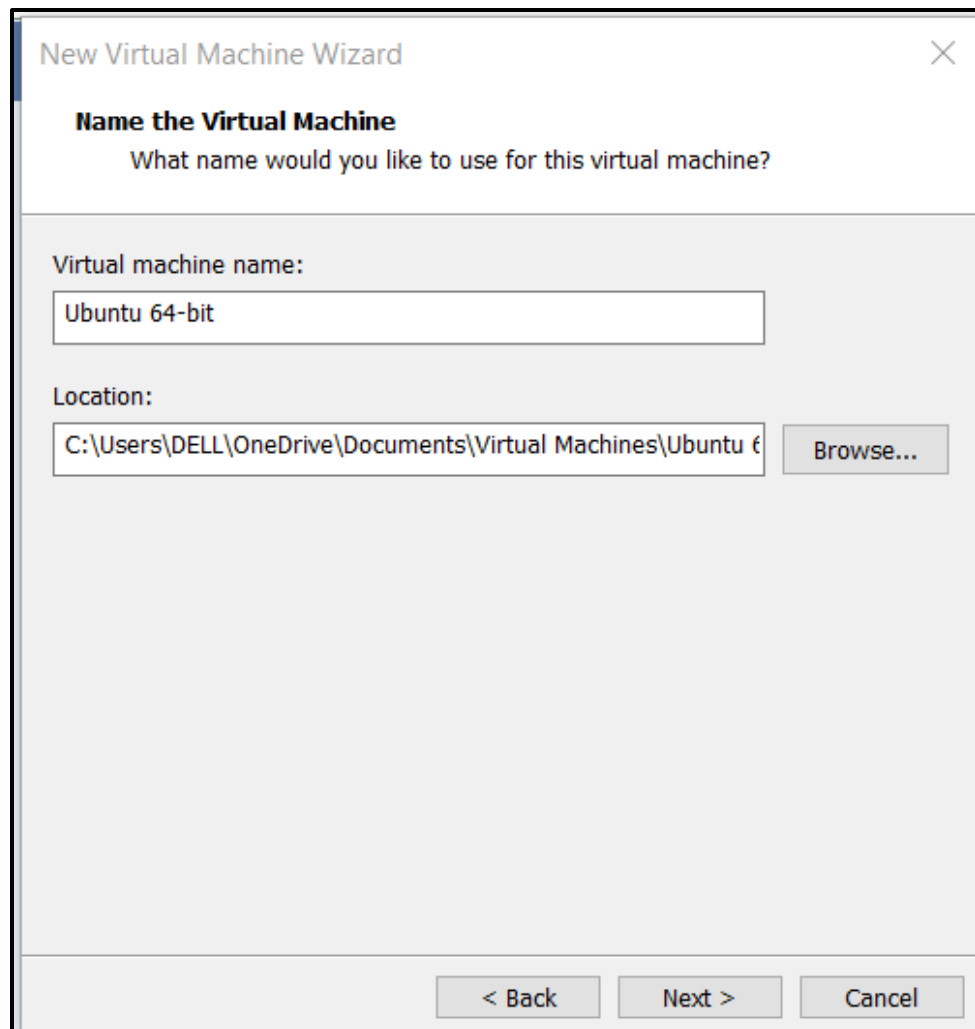
☐ Microsoft Windows
☒ Linux
☐ Other

Version

Ubuntu 64-bit

Help < Back Next > Cancel

4. Name the virtual machine.



The screenshot shows a Windows-style dialog box titled "New Virtual Machine Wizard" with a close button (X) in the top right corner. The main heading is "Name the Virtual Machine" followed by the instruction "What name would you like to use for this virtual machine?". Below this, there are two input fields. The first is labeled "Virtual machine name:" and contains the text "Ubuntu 64-bit". The second is labeled "Location:" and contains the path "C:\Users\DELL\OneDrive\Documents\Virtual Machines\Ubuntu 64-bit". To the right of the location field is a "Browse..." button. At the bottom of the dialog, there are three buttons: "< Back", "Next >", and "Cancel".

5. Provide credentials for new virtual machine. And click on next to continue.

Note: remember these credentials for future login.

New Virtual Machine Wizard

Easy Install Information
This is used to install Ubuntu 64-bit.

Personalize Linux

Full name: Romana Ali

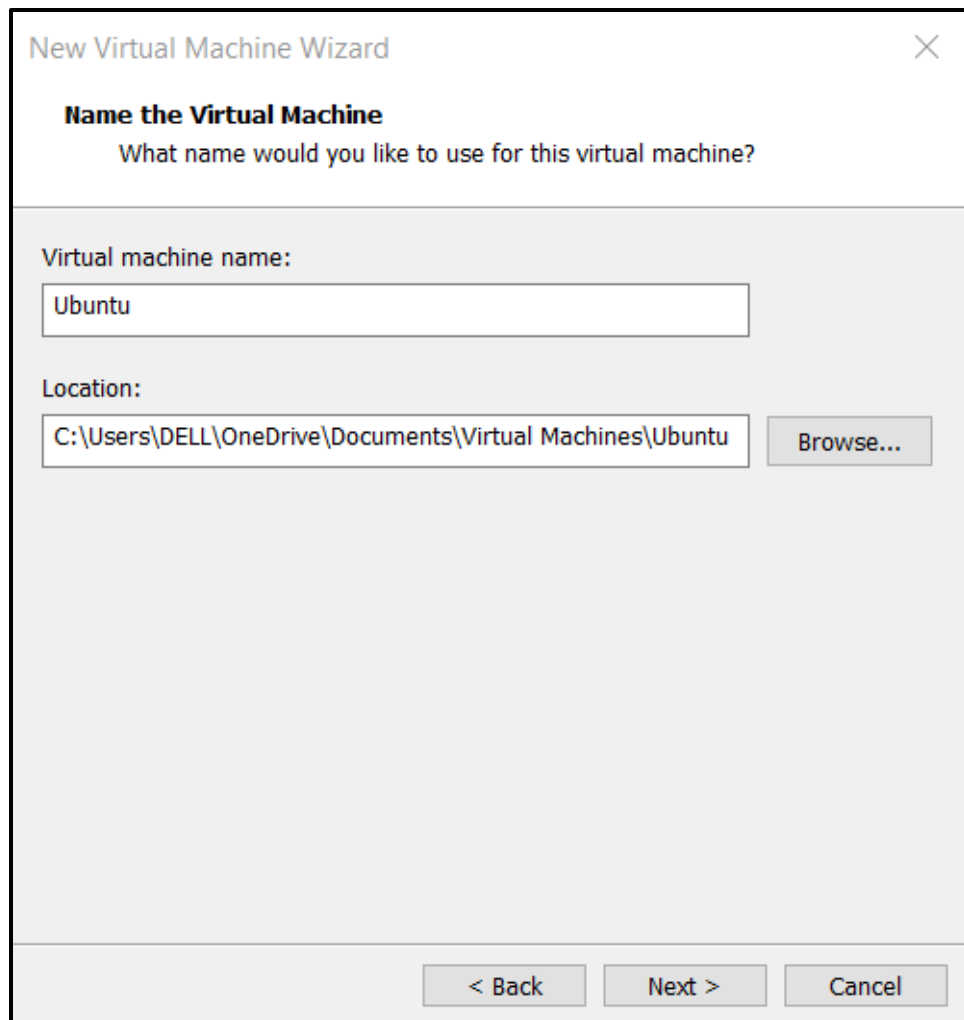
User name: romana

Password: •••••

Confirm: •••••

Help < Back Next > Cancel

6. Set name for the new virtual machine. And click on next to continue.



New Virtual Machine Wizard

Name the Virtual Machine
What name would you like to use for this virtual machine?

Virtual machine name:

Location:

7. Use recommended settings but you can reduce its size. click on next to continue.

The screenshot shows a 'New Virtual Machine Wizard' window with a close button (X) in the top right corner. The title bar reads 'New Virtual Machine Wizard'. The main heading is 'Specify Disk Capacity' with a subtitle 'How large do you want this disk to be?'. Below this, a text box explains: 'The virtual machine's hard disk is stored as one or more files on the host computer's physical disk. These file(s) start small and become larger as you add applications, files, and data to your virtual machine.' A label 'Maximum disk size (GB):' is followed by a text input field containing '20.0' and a spinner control. Below this, it says 'Recommended size for Ubuntu 64-bit: 20 GB'. There are two radio button options: 'Store virtual disk as a single file' (unselected) and 'Split virtual disk into multiple files' (selected). A note below the selected option states: 'Splitting the disk makes it easier to move the virtual machine to another computer but may reduce performance with very large disks.' At the bottom, there are four buttons: 'Help', '< Back', 'Next >', and 'Cancel'.

New Virtual Machine Wizard

Specify Disk Capacity
How large do you want this disk to be?

The virtual machine's hard disk is stored as one or more files on the host computer's physical disk. These file(s) start small and become larger as you add applications, files, and data to your virtual machine.

Maximum disk size (GB):

Recommended size for Ubuntu 64-bit: 20 GB

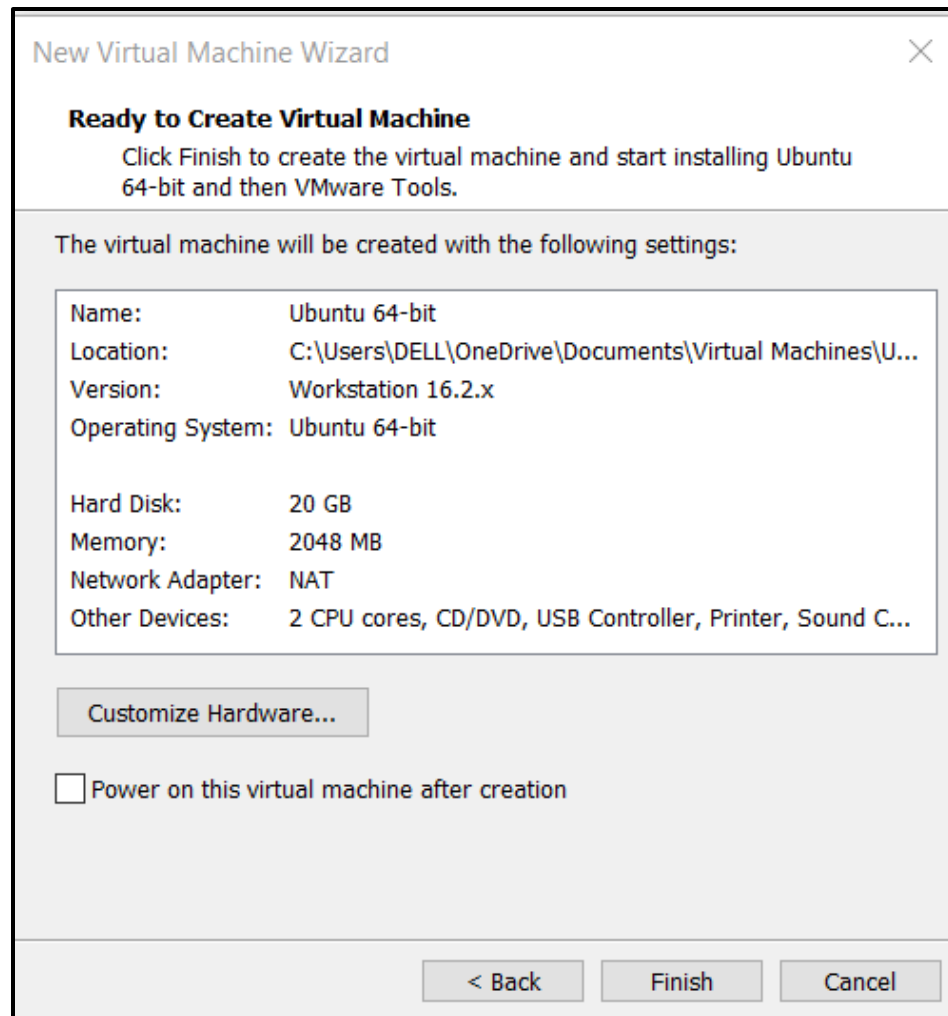
☐ Store virtual disk as a single file

☒ Split virtual disk into multiple files

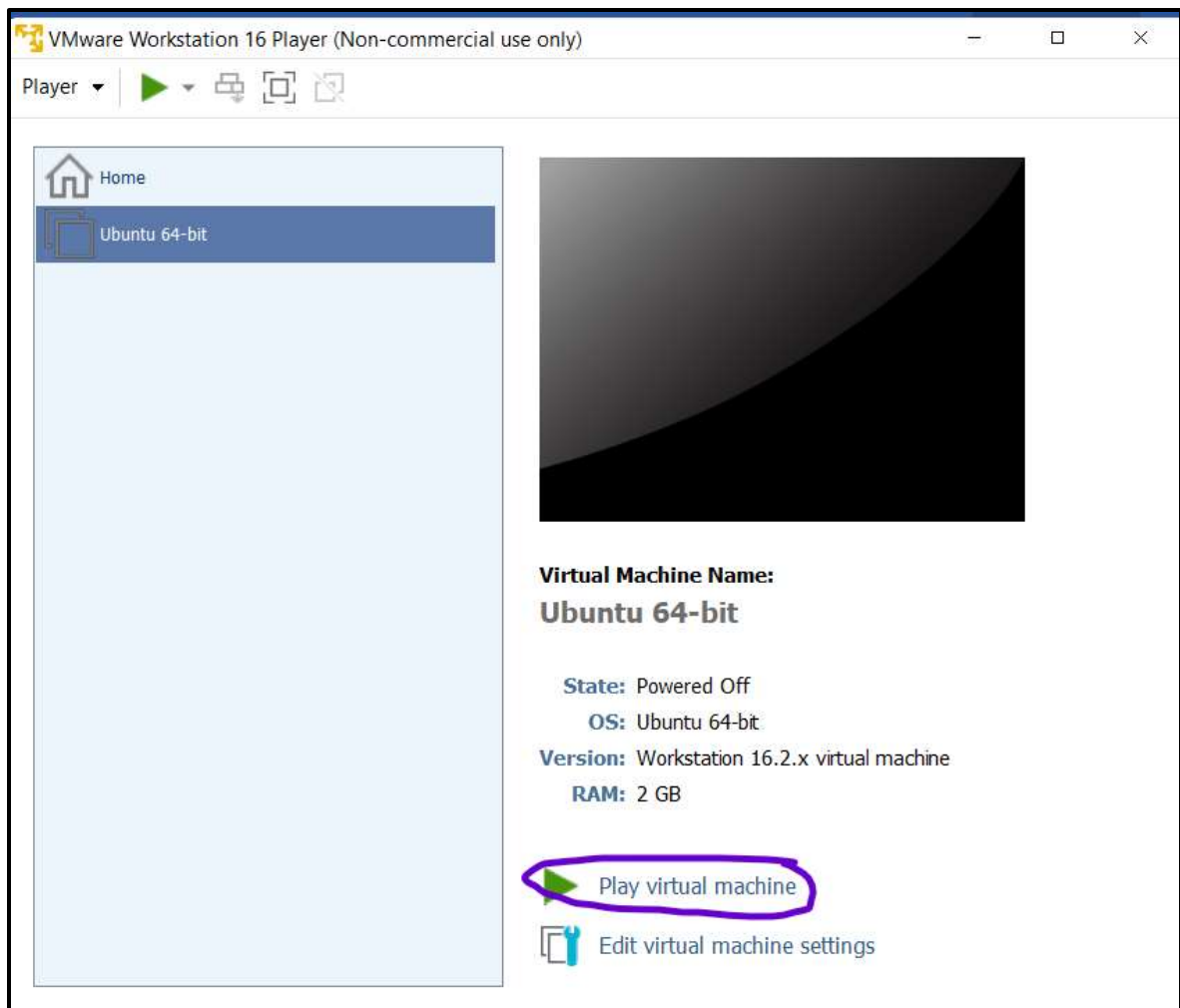
Splitting the disk makes it easier to move the virtual machine to another computer but may reduce performance with very large disks.

Help < Back Next > Cancel

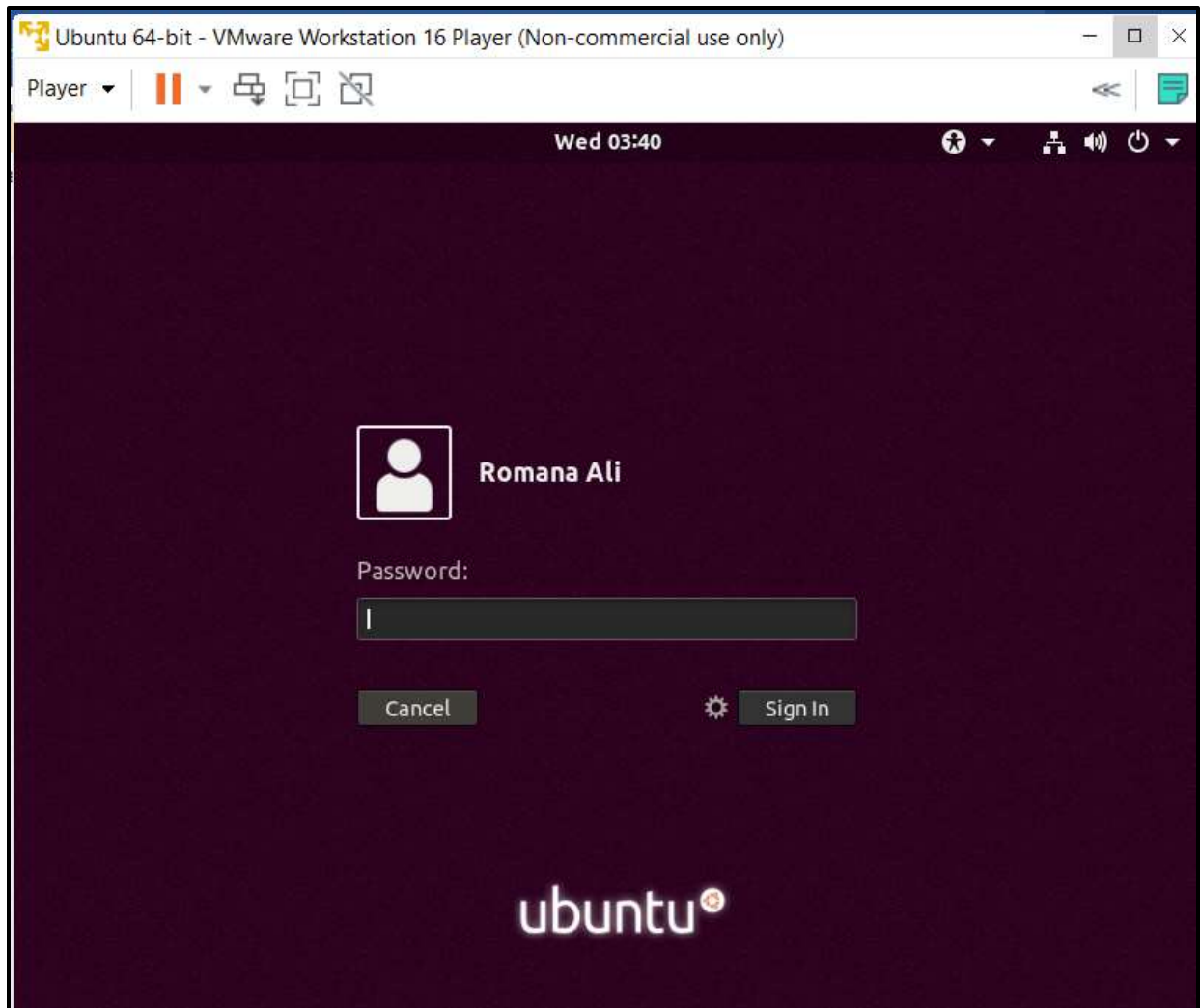
8. Click on finish to complete the setup.



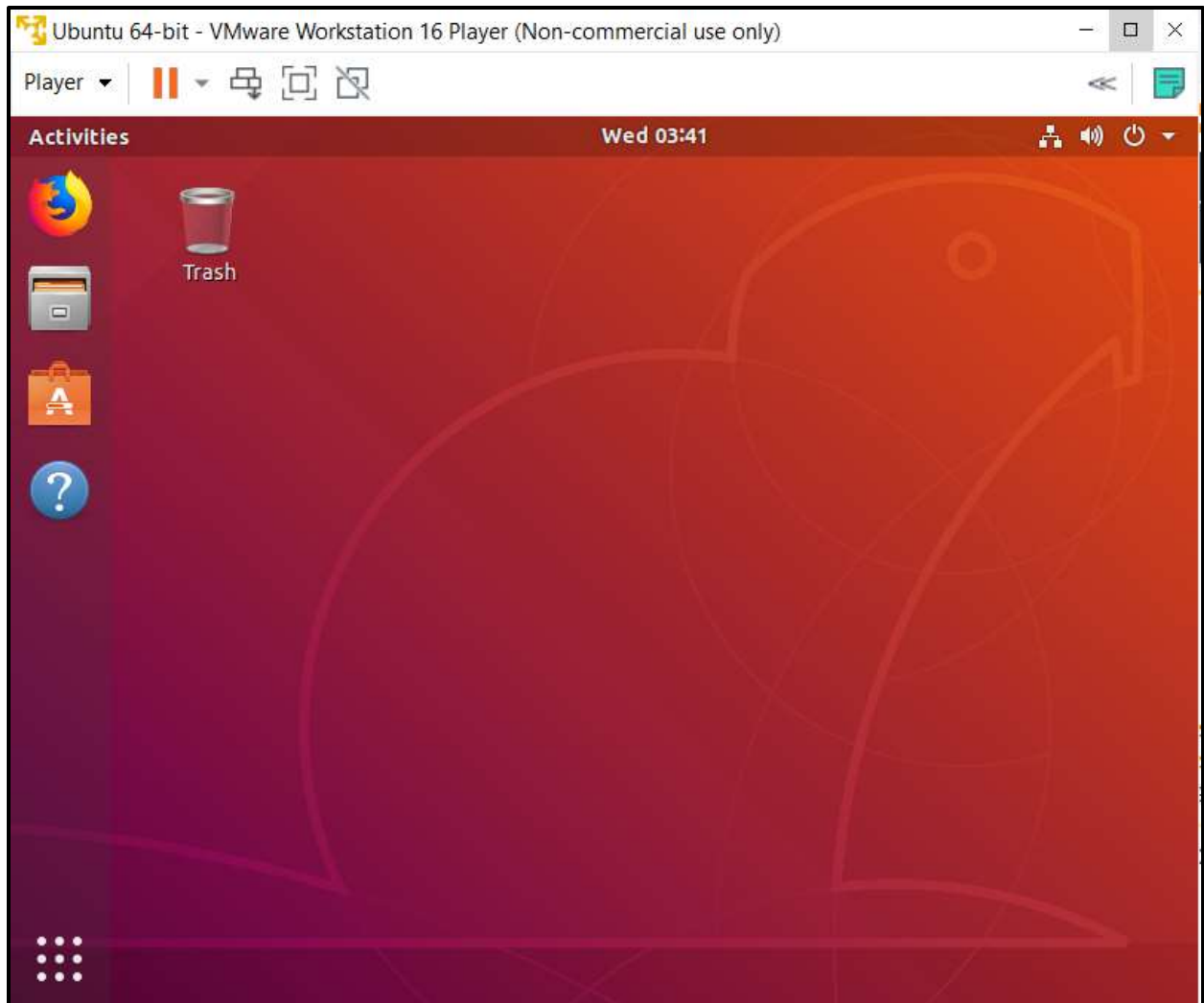
9. Play virtual machine. It will take some time for installation.



10. Provide the password as provided at step 5.



11. Welcome to Ubuntu Virtual Machine



Install G++ the C++ Compiler on Ubuntu VMWare

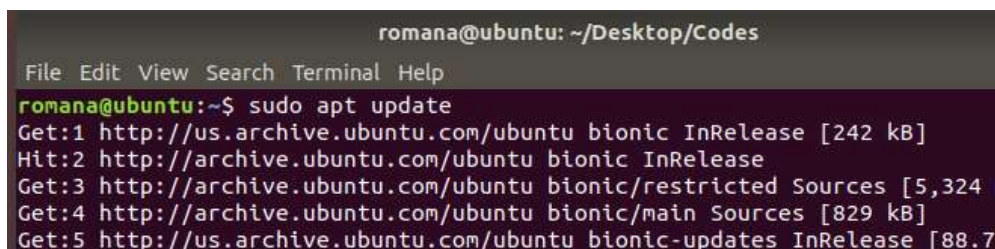
The GNU Compiler Collection (GCC) is a collection of compilers and libraries for C, C++. Many open-source projects, including the GNU tools and the Linux kernel, are compiled with GCC. To be able to add new repositories and install packages on your Ubuntu system, you must be logged in as root or user with sudo privileges.

Installing G++ on Ubuntu

The default Ubuntu repositories contain a meta-package named build-essential that contains the GCC compiler and a lot of libraries and other utilities required for compiling software.

1. Start by updating the packages list:

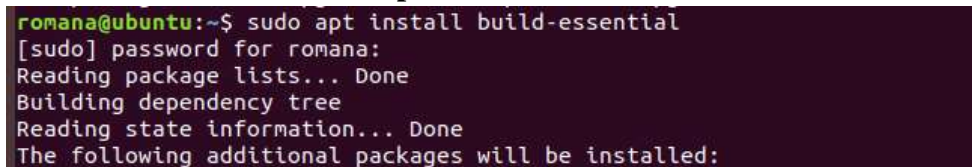
\$ sudo apt update



```
romana@ubuntu: ~/Desktop/Codes
File Edit View Search Terminal Help
romana@ubuntu:~$ sudo apt update
Get:1 http://us.archive.ubuntu.com/ubuntu bionic InRelease [242 kB]
Hit:2 http://archive.ubuntu.com/ubuntu bionic InRelease
Get:3 http://archive.ubuntu.com/ubuntu bionic/restricted Sources [5,324
Get:4 http://archive.ubuntu.com/ubuntu bionic/main Sources [829 kB]
Get:5 http://us.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7
```

2. Install the build-essential package by typing:

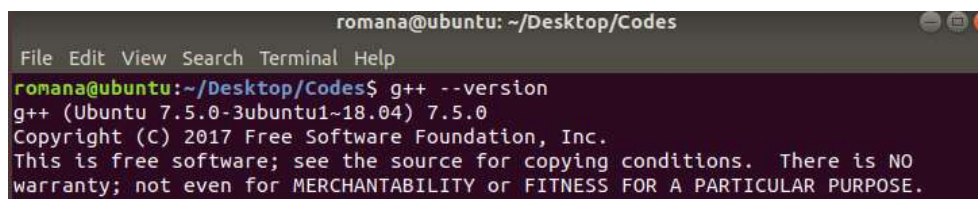
\$ sudo apt install build-essential



```
romana@ubuntu:~$ sudo apt install build-essential
[sudo] password for romana:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
```

3. Check the version of g++ compiler by following command.

\$ g++ --version



```
romana@ubuntu: ~/Desktop/Codes
File Edit View Search Terminal Help
romana@ubuntu:~/Desktop/Codes$ g++ --version
g++ (Ubuntu 7.5.0-3ubuntu1~18.04) 7.5.0
Copyright (C) 2017 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

Installing VSCode on Ubuntu

1. Install snap in order to download latest version of vs code by typing.

\$ sudo apt-get install snap

```
romana@ubuntu:~$ sudo apt-get install snap
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following NEW packages will be installed:
  snap
0 upgraded, 1 newly installed, 0 to remove and 580 not upgraded.
Need to get 375 kB of archives.
After this operation, 2,714 kB of additional disk space will be used.
Get:1 http://us.archive.ubuntu.com/ubuntu bionic/universe amd64 snap amd64 2013-11-29-8 [375 kB]
Fetched 375 kB in 3s (120 kB/s)
Selecting previously unselected package snap.
(Reading database ... 117109 files and directories currently installed.)
Preparing to unpack .../snap_2013-11-29-8_amd64.deb ...
Unpacking snap (2013-11-29-8) ...
Setting up snap (2013-11-29-8) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
```

2. Install VS code by following command.

\$ sudo snap install --classic code

```
romana@ubuntu:~$ sudo snap install --classic code
code c722ca6c from Visual Studio Code (vscode✓) installed
```

Basic C++ Program

let's create hello world C++ program. Save the following code as hello.cpp text file and run it. Perform the steps below.

1. Create a text file hello.cpp by following command and write simple code as shown in figure

\$ nano hello.cpp

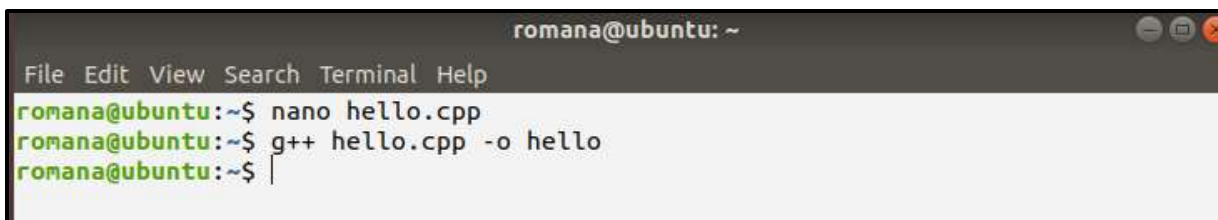


```
GNU nano 2.9.3      hello.cpp

#include <iostream>
using namespace std;
int main ()
{
    cout << " Hello World"<< endl;
    return 0;
}
```

2. Close the editor and compile it by using

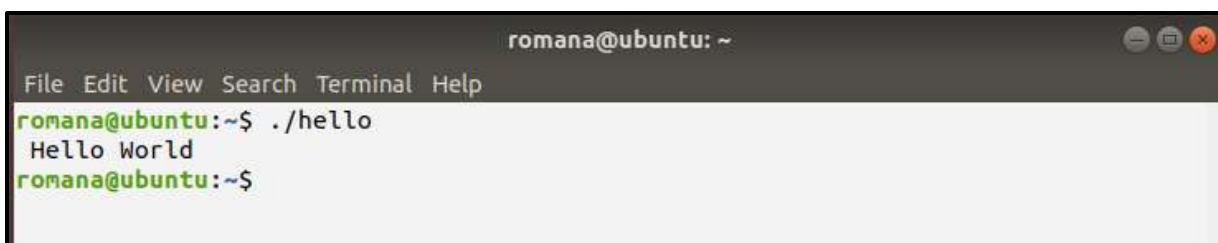
\$ program-source-code.cpp -o executable-file-name



```
romana@ubuntu: ~
File Edit View Search Terminal Help
romana@ubuntu:~$ nano hello.cpp
romana@ubuntu:~$ g++ hello.cpp -o hello
romana@ubuntu:~$
```

3. To run or execute the program use following command

\$./executable-file-name



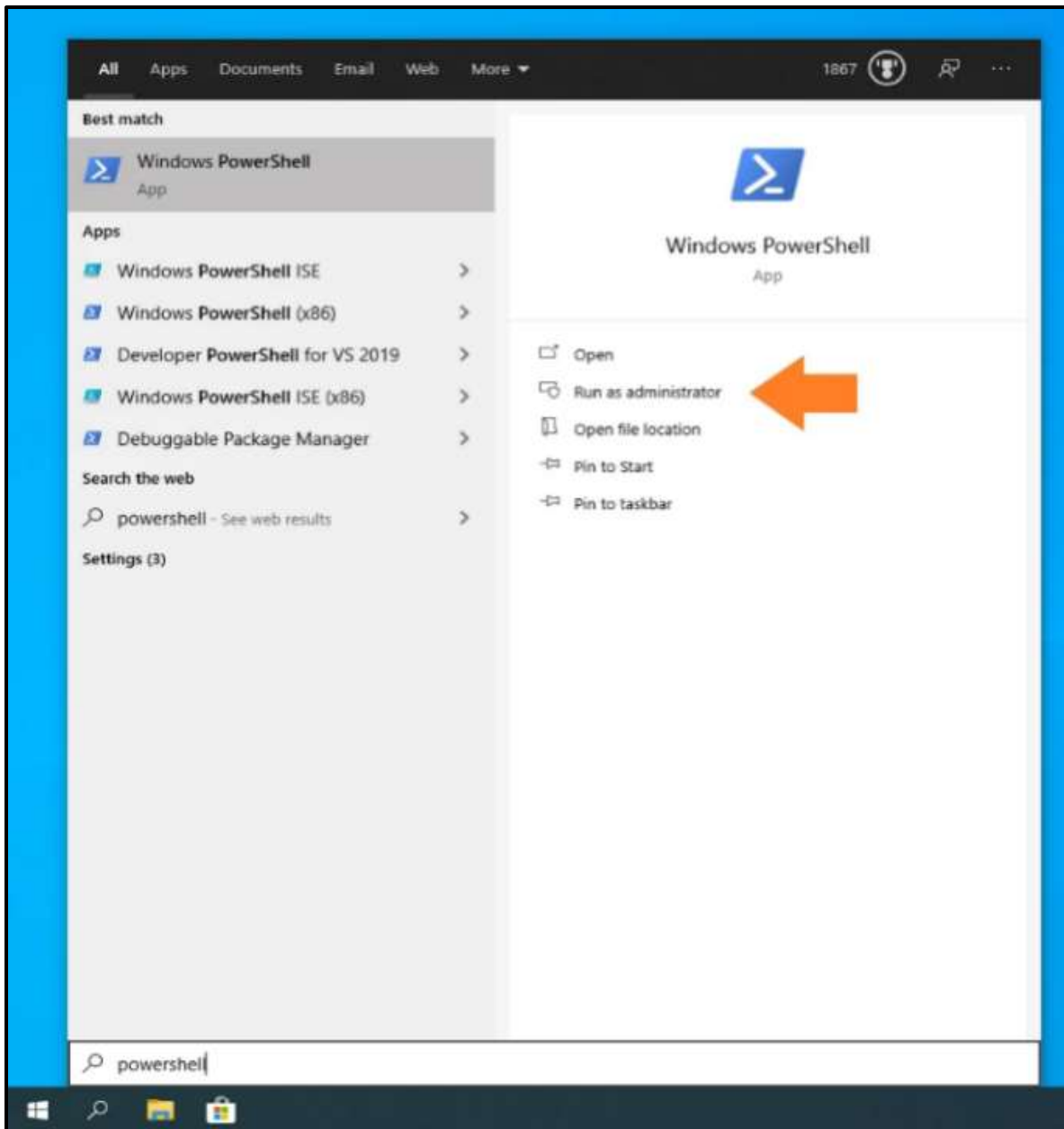
```
romana@ubuntu: ~
File Edit View Search Terminal Help
romana@ubuntu:~$ ./hello
Hello World
romana@ubuntu:~$
```

Method 02: Install Ubuntu on WSL2 on Windows 10

<https://ubuntu.com/tutorials/install-ubuntu-on-wsl2-on-windows-10#1-overview>

Windows Subsystem for Linux (WSL) allows you to install a complete Ubuntu terminal environment in minutes on your Windows machine, allowing you to develop cross-platform applications without leaving Windows.

1. Search for Windows PowerShell in your Windows search bar, then select **Run as administrator**.



2. At the command prompt type:

wsl --install

And wait for the process to complete. For WSL to be properly activated, you will now need to restart your computer.

3. WSL supports a variety of Linux distributions, including the latest Ubuntu release, Ubuntu 20.04 LTS and Ubuntu 18.04 LTS. You can find them by opening the Microsoft store app and searching for Ubuntu. Choose the distribution you prefer and then click on Get as shown in the following screenshot:

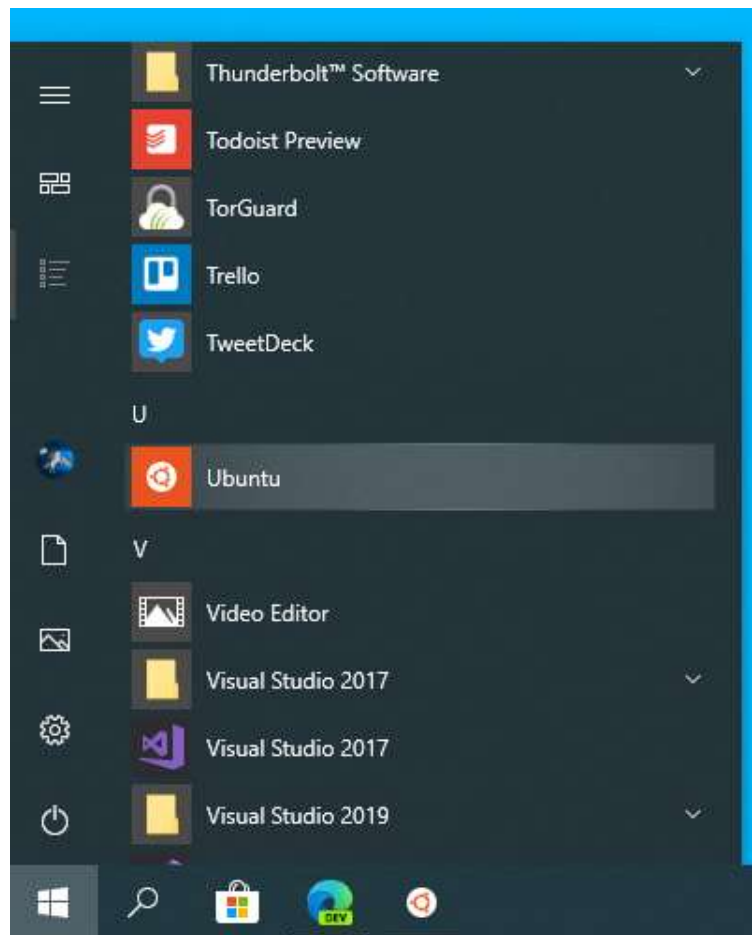


4. Ubuntu will then install on your machine.
5. There is a single command that will install both WSL and Ubuntu at the same time. When opening PowerShell for the first time, simply modify the initial instruction to:

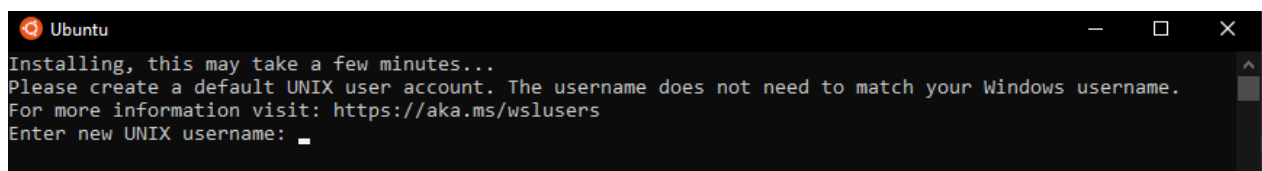
wsl --install -d ubuntu

This will install both WSL and Ubuntu! Don't forget to restart your machine before continuing.

6. Once installed, you can either launch the application directly from the store or search for **Ubuntu** in your Windows search bar.



7. Once Ubuntu has finished its initial setup you will need to create a username and password (this does not need to match your Windows user credentials).



8. Finally, it's always good practice to install the latest updates with the following commands, entering your password when prompted.

sudo apt update

Then

sudo apt upgrade

Press Y when prompted.

Install G++ the C++ Compiler and VS Code on Ubuntu WSL2

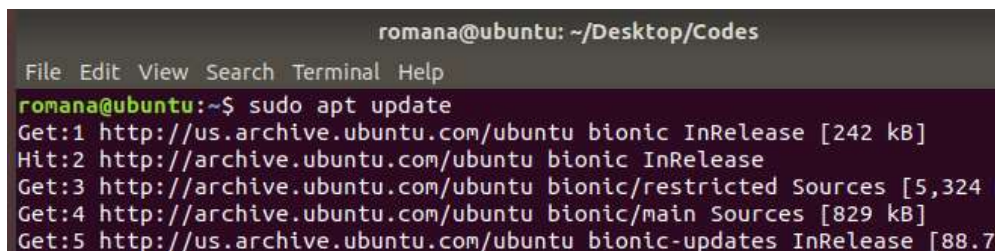
The GNU Compiler Collection (GCC) is a collection of compilers and libraries for C, C++. Many open-source projects, including the GNU tools and the Linux kernel, are compiled with GCC. To be able to add new repositories and install packages on your Ubuntu system, you must be logged in as root or user with sudo privileges.

Installing G++ on Ubuntu

Use following commands on Ubuntu to install compilers for running C++ programs on Ubuntu.

3. Start by updating the packages list:

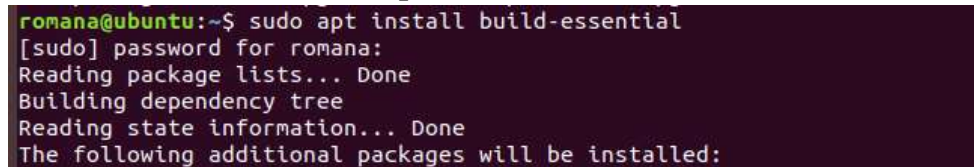
\$ sudo apt update



```
romana@ubuntu: ~/Desktop/Codes
File Edit View Search Terminal Help
romana@ubuntu:~$ sudo apt update
Get:1 http://us.archive.ubuntu.com/ubuntu bionic InRelease [242 kB]
Hit:2 http://archive.ubuntu.com/ubuntu bionic InRelease
Get:3 http://archive.ubuntu.com/ubuntu bionic/restricted Sources [5,324 B]
Get:4 http://archive.ubuntu.com/ubuntu bionic/main Sources [829 kB]
Get:5 http://us.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
```

4. Install the build-essential package by typing:

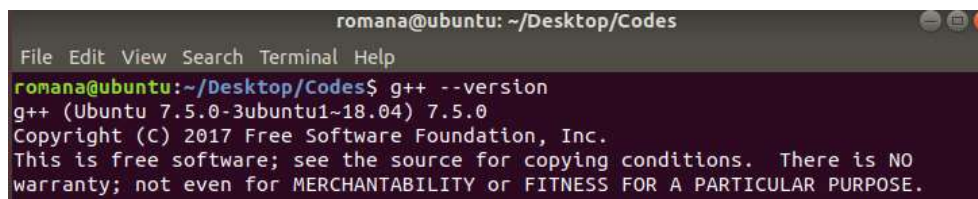
\$ sudo apt install build-essential



```
romana@ubuntu:~$ sudo apt install build-essential
[sudo] password for romana:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
```

5. Check the version of g++ compiler by following command.

\$ g++ --version



```
romana@ubuntu: ~/Desktop/Codes
File Edit View Search Terminal Help
romana@ubuntu:~/Desktop/Codes$ g++ --version
g++ (Ubuntu 7.5.0-3ubuntu1~18.04) 7.5.0
Copyright (C) 2017 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```


Installing VSCode on Ubuntu

6. Install snap inorder to download latest version of vs code by typing.

\$ sudo apt-get install snap

```
romana@ubuntu:~$ sudo apt-get install snap
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following NEW packages will be installed:
  snap
0 upgraded, 1 newly installed, 0 to remove and 580 not upgraded.
Need to get 375 kB of archives.
After this operation, 2,714 kB of additional disk space will be used.
Get:1 http://us.archive.ubuntu.com/ubuntu bionic/universe amd64 snap amd64 2013-11-29-8 [375 kB]
Fetched 375 kB in 3s (120 kB/s)
Selecting previously unselected package snap.
(Reading database ... 117109 files and directories currently installed.)
Preparing to unpack .../snap_2013-11-29-8_amd64.deb ...
Unpacking snap (2013-11-29-8) ...
Setting up snap (2013-11-29-8) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
```

7. Install VS code by following command.

\$ sudo snap install --classic code

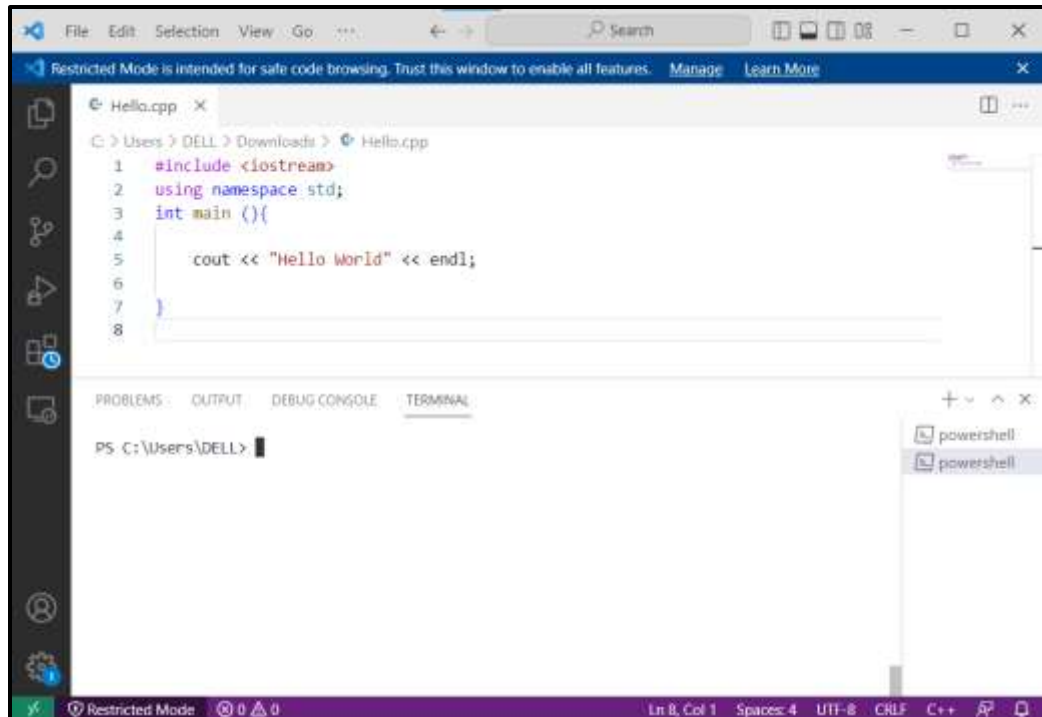
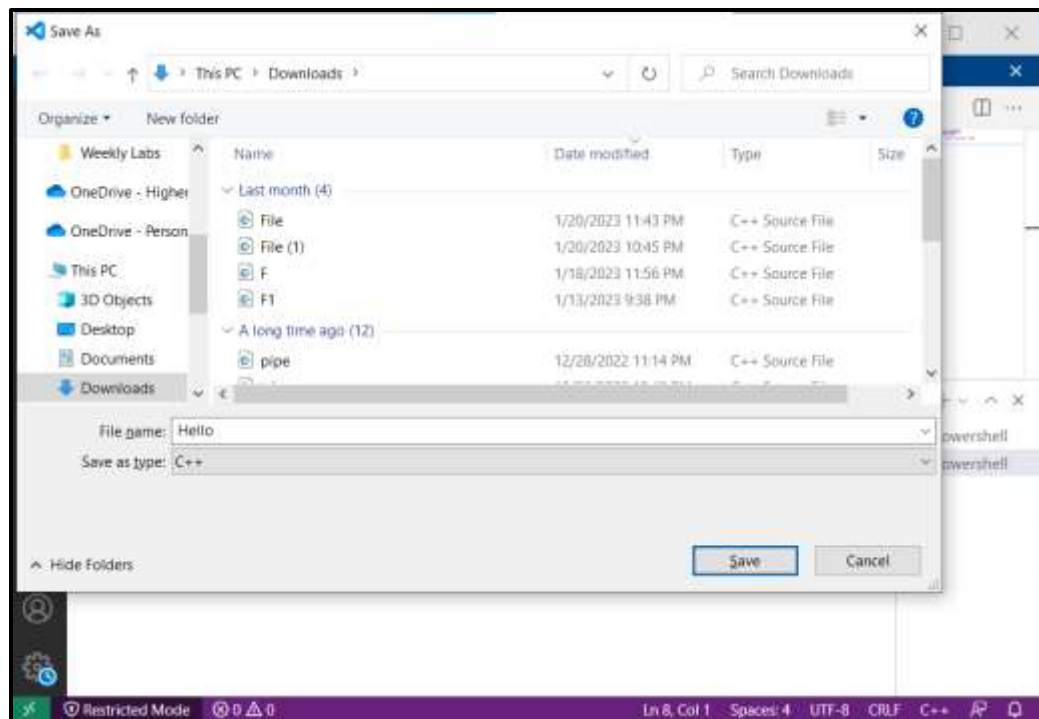
```
romana@ubuntu:~$ sudo snap install --classic code
code c722ca6c from Visual Studio Code (vscode✓) installed
```

8. Let's make a directory **Codes** on Desktop. Make and open a new file of VS Code in the Codes directory by following command

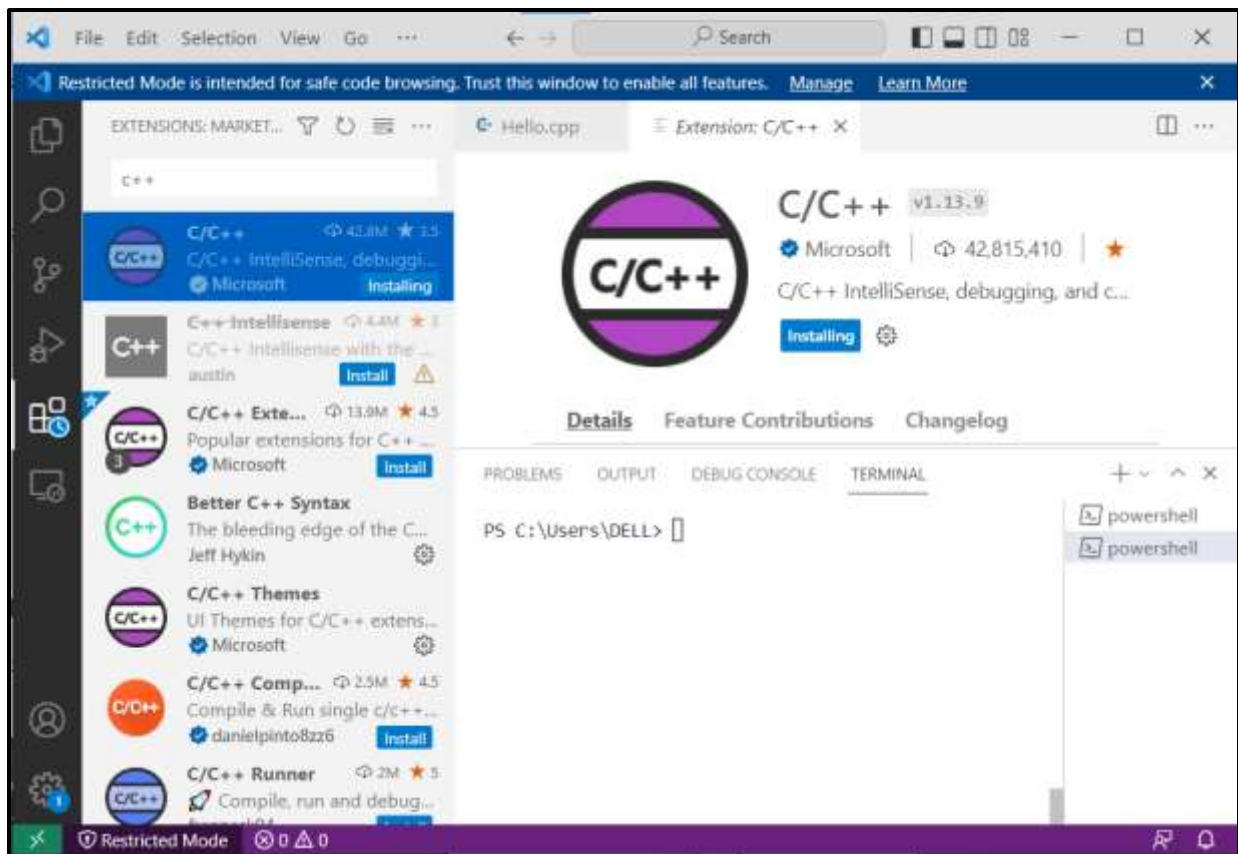
\$ code .

```
romana@ubuntu: ~/Desktop/Codes
File Edit View Search Terminal Help
romana@ubuntu:~/Desktop$ cd Codes
romana@ubuntu:~/Desktop/Codes$ code .
romana@ubuntu:~/Desktop/Codes$
```

9. In Code directory, write a simple hello world program and save the file as .cpp file.

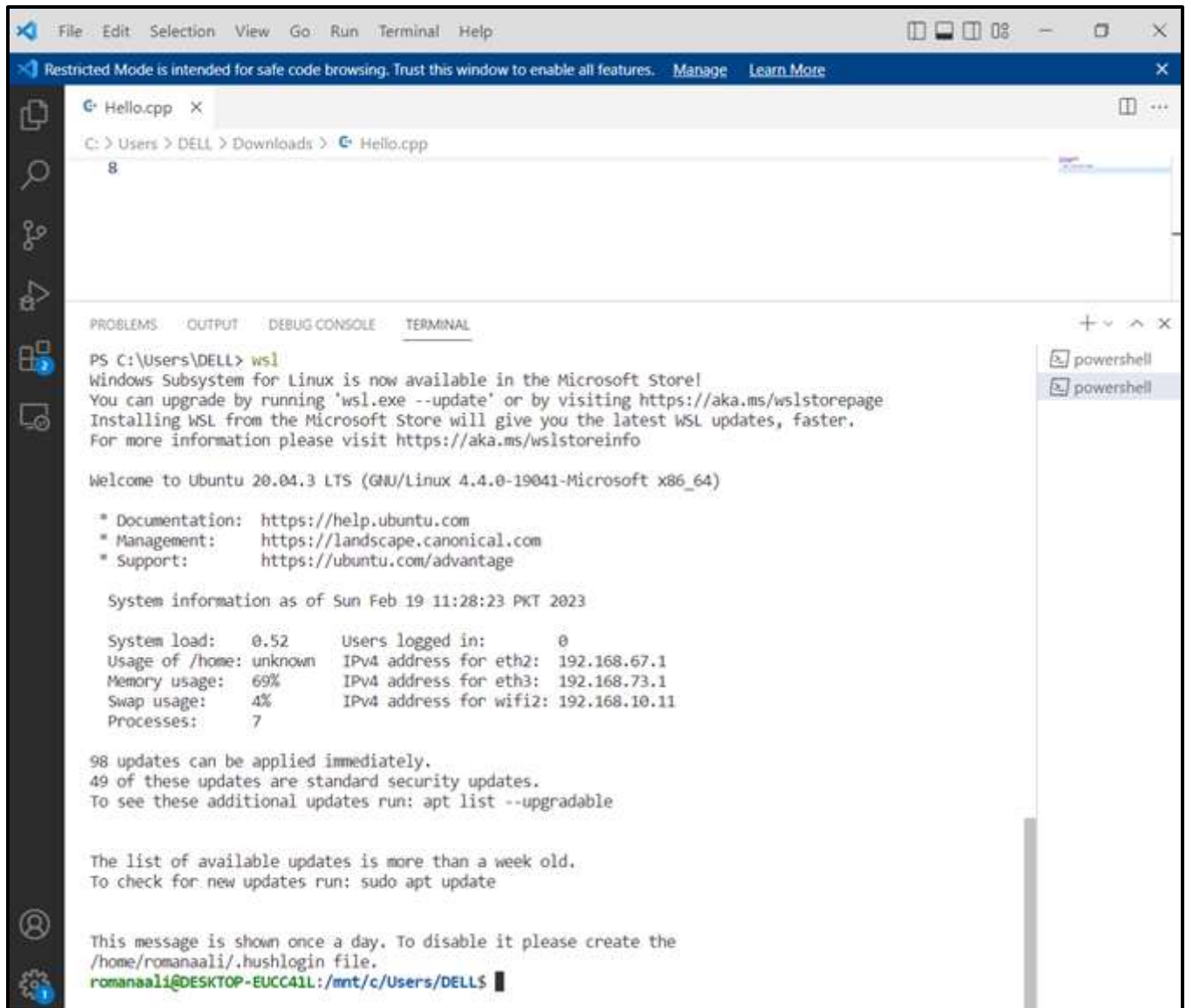


10. Install the C++ extensions and run the program using g++ compiler on terminal present in vs code.



11. In order to compile, code open ubuntu terminal. Write following in the vs code terminal and press enter. Ubuntu console will be opened in the vscode. As shown in the picture.

wsl



```
File Edit Selection View Go Run Terminal Help
Restricted Mode is intended for safe code browsing. Trust this window to enable all features. Manage Learn More

Hello.cpp x
C: > Users > DELL > Downloads > Hello.cpp
8

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
PS C:\Users\DELL> wsl
Windows Subsystem for Linux is now available in the Microsoft Store!
You can upgrade by running 'wsl.exe --update' or by visiting https://aka.ms/wslstorepage
Installing WSL from the Microsoft Store will give you the latest WSL updates, faster.
For more information please visit https://aka.ms/wslstoreinfo

Welcome to Ubuntu 20.04.3 LTS (GNU/Linux 4.4.0-19041-Microsoft x86_64)

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

System information as of Sun Feb 19 11:28:23 PKT 2023

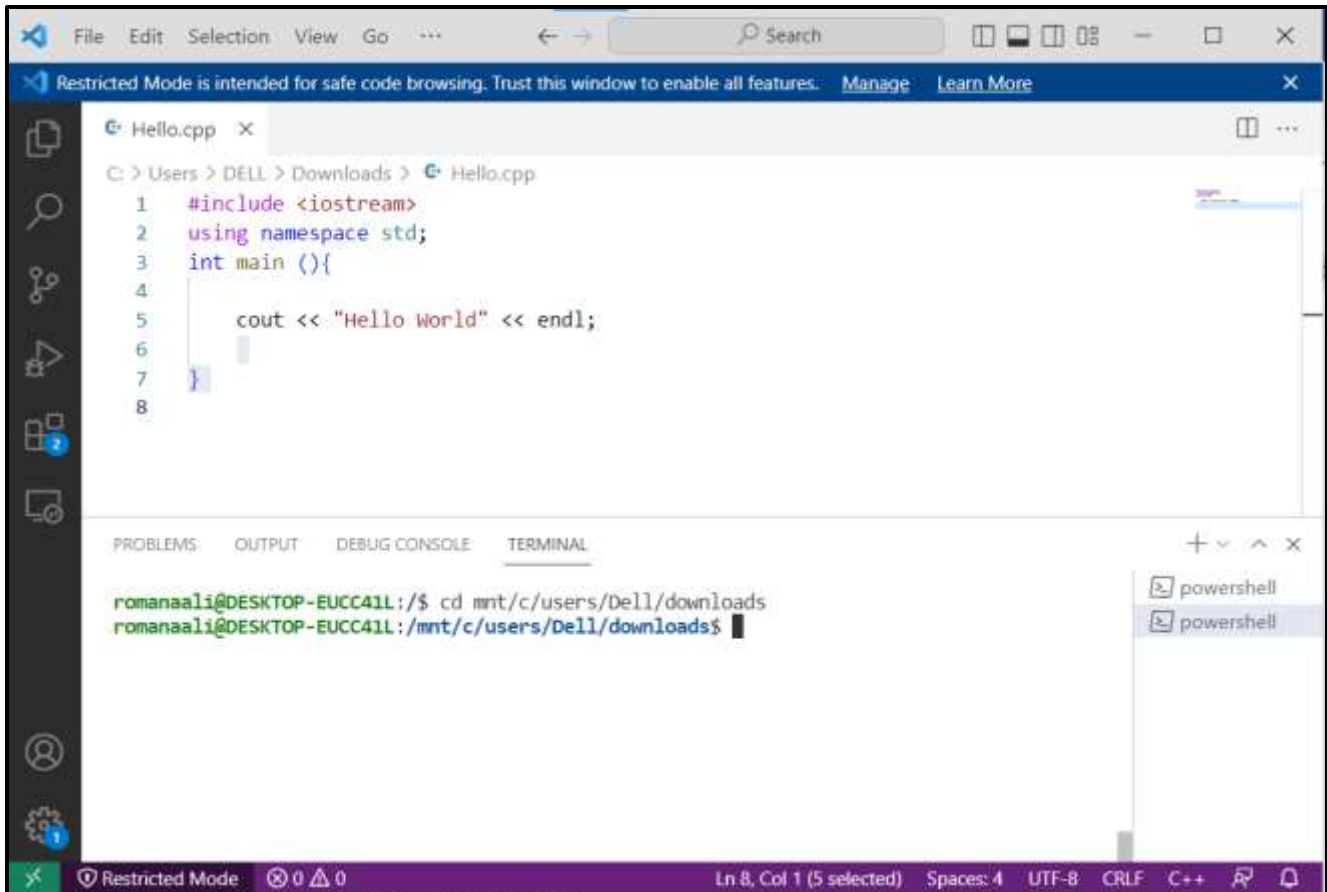
System load: 0.52      Users logged in: 0
Usage of /home: unknown IPv4 address for eth2: 192.168.67.1
Memory usage: 69%      IPv4 address for eth3: 192.168.73.1
Swap usage: 4%         IPv4 address for wifi2: 192.168.10.11
Processes: 7

98 updates can be applied immediately.
49 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

This message is shown once a day. To disable it please create the
/home/romanaali/.hushlogin file.
romanaali@DESKTOP-EUCC41L:/mnt/c/Users/DELL$
```

12. Hello.cpp is present in downloads in windows whose address is “/mnt/c/users/Dell/downloads”. We will change directories using **cd**.



The screenshot shows the Visual Studio Code editor interface. The top pane displays the file `Hello.cpp` with the following code:

```
1 #include <iostream>
2 using namespace std;
3 int main () {
4
5     cout << "Hello World" << endl;
6
7 }
8
```

The bottom pane shows the **TERMINAL** tab with the following commands and output:

```
romanaali@DESKTOP-EUCC41L:/$ cd /mnt/c/users/Dell/downloads
romanaali@DESKTOP-EUCC41L:/mnt/c/users/Dell/downloads$
```

The status bar at the bottom indicates the file is at `Ln 8, Col 1 (5 selected)`, with `Spaces: 4`, `UTF-8`, `CRLF`, and `C++` file type.

13. Use following command to compile the hello.cpp.

g++ Hello.cpp -o h

This command will create a object file of Hello.cpp named h. use following to run this object file/executable. As shown in the figure.

./h



The screenshot shows a code editor with a file named `Hello.cpp` open. The code is as follows:

```
1 #include <iostream>
2 using namespace std;
3 int main () {
4
5     cout << "Hello World" << endl;
6
7 }
8
```

Below the code editor is a terminal window. The terminal shows the following commands and output:

```
romanaali@DESKTOP-EUCC41L:/mnt/c/users/Dell/downloads$ g++ Hello.cpp -o h
romanaali@DESKTOP-EUCC41L:/mnt/c/users/Dell/downloads$ ./h
Hello World
romanaali@DESKTOP-EUCC41L:/mnt/c/users/Dell/downloads$
```

On the right side of the terminal, there are two tabs labeled "powershell".