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**Subject:** Cloud Computing

**Year:** 2022-23

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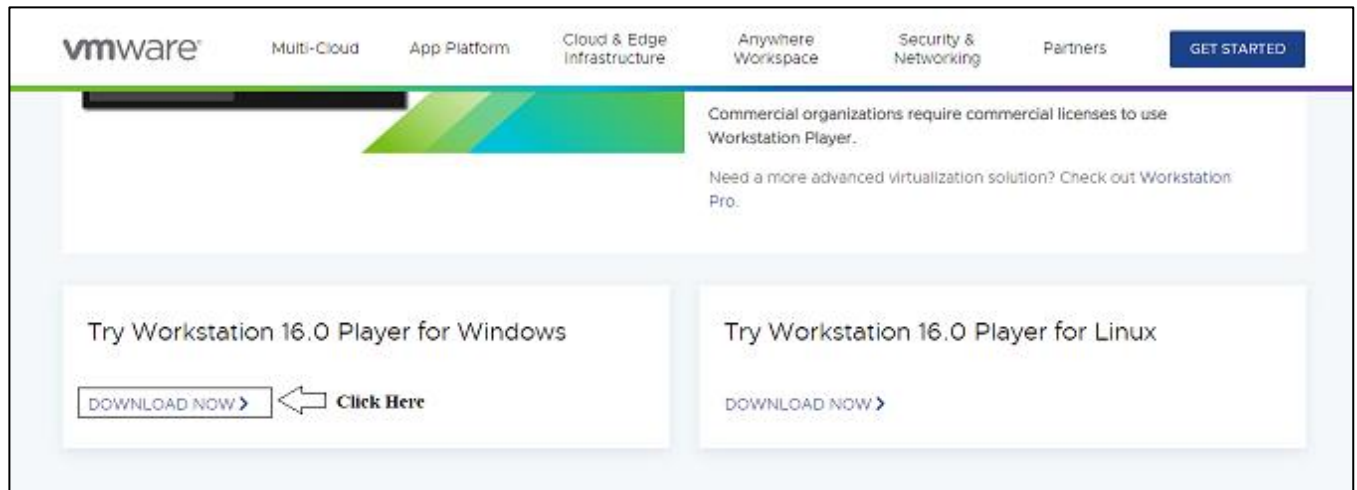
## Practical 1

**Aim:** Implementation of Bare-metal and hosted virtualization

**Code:**

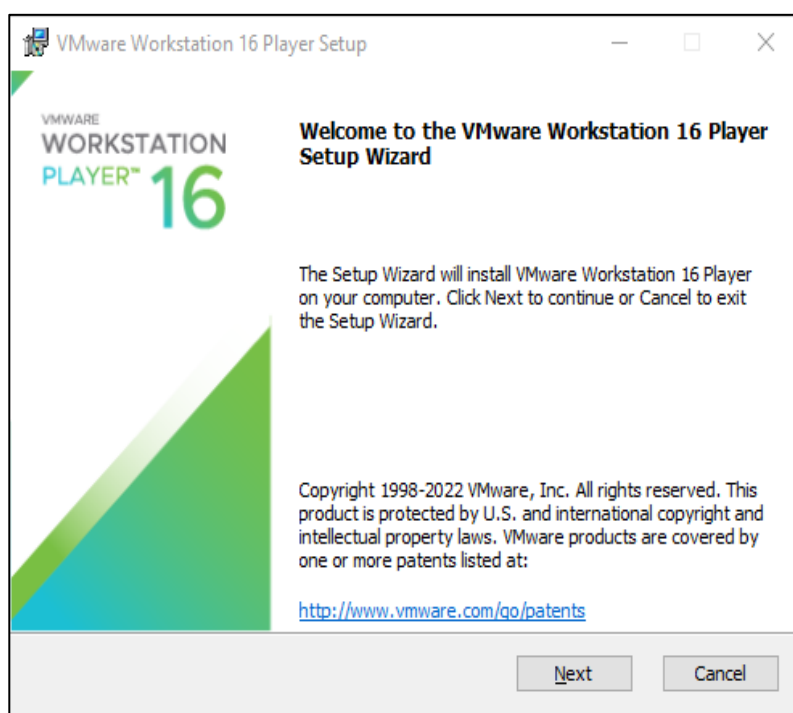
### Installation of VMWare WorkStation

Step 1: [Click here](#) and download the Work Station

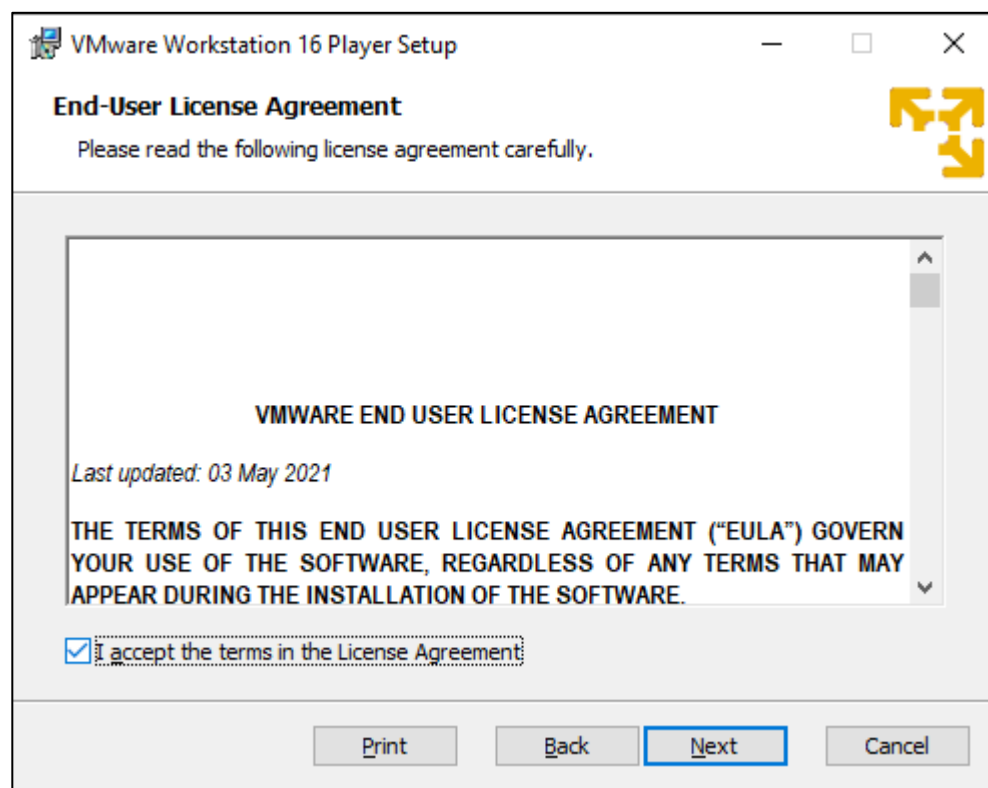
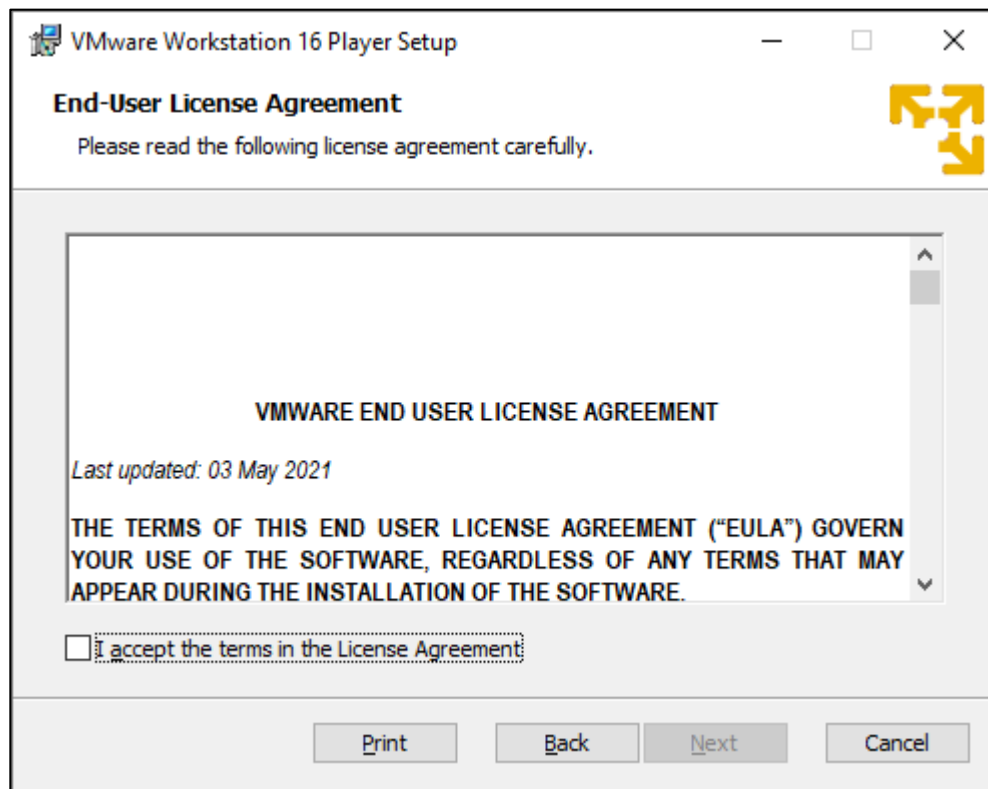


Step 2: Once Downloaded double tap to start the installation

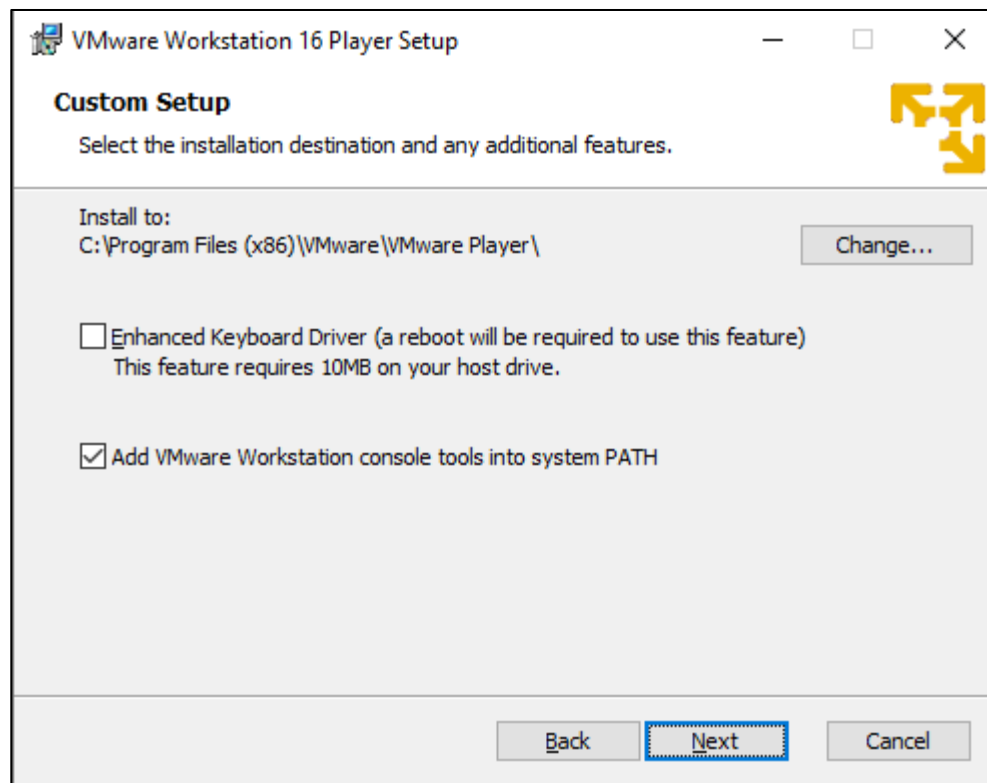
Step 3: Click on Next



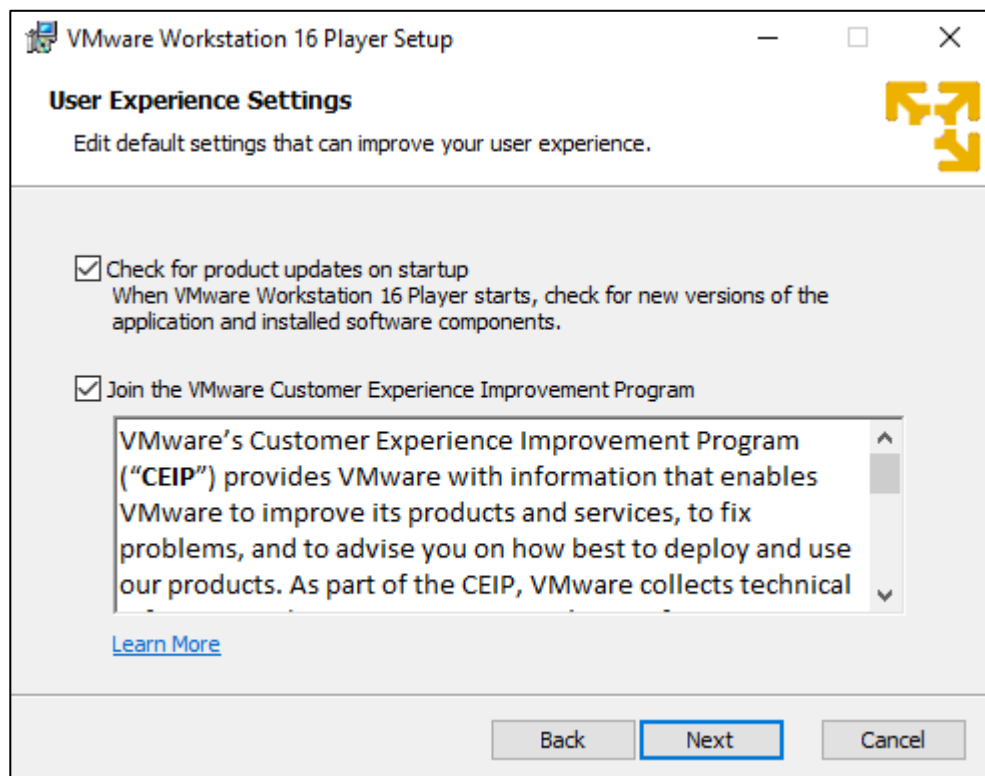
Step 4: Check the terms and conditions and click on NEXT



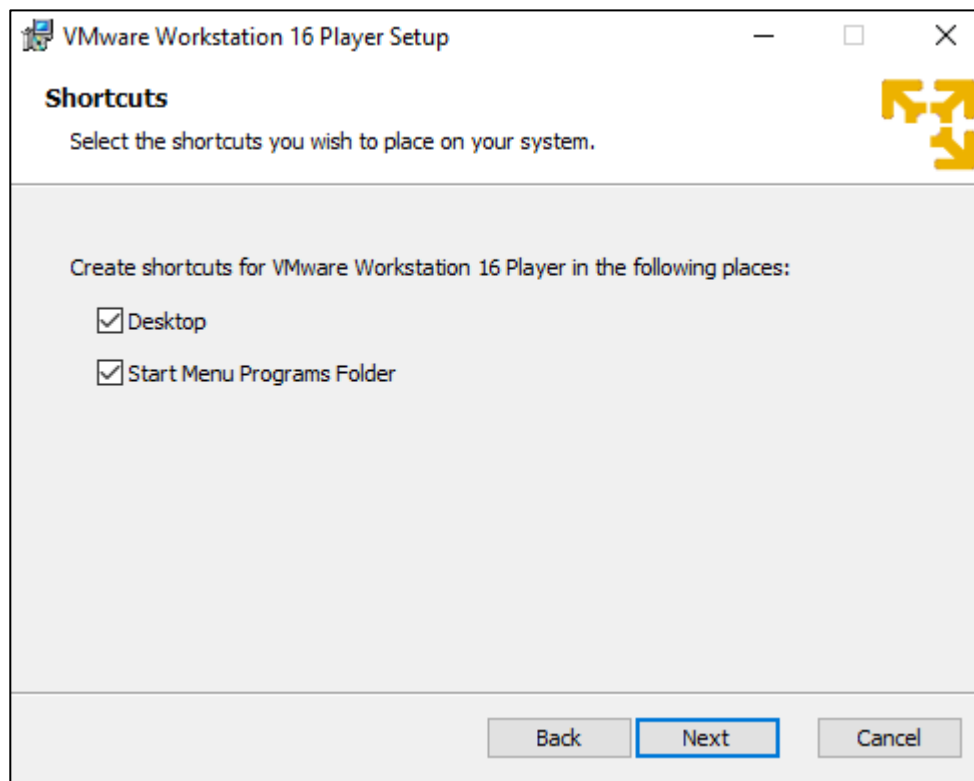
Step 5: Keep the default setup and Click on NEXT



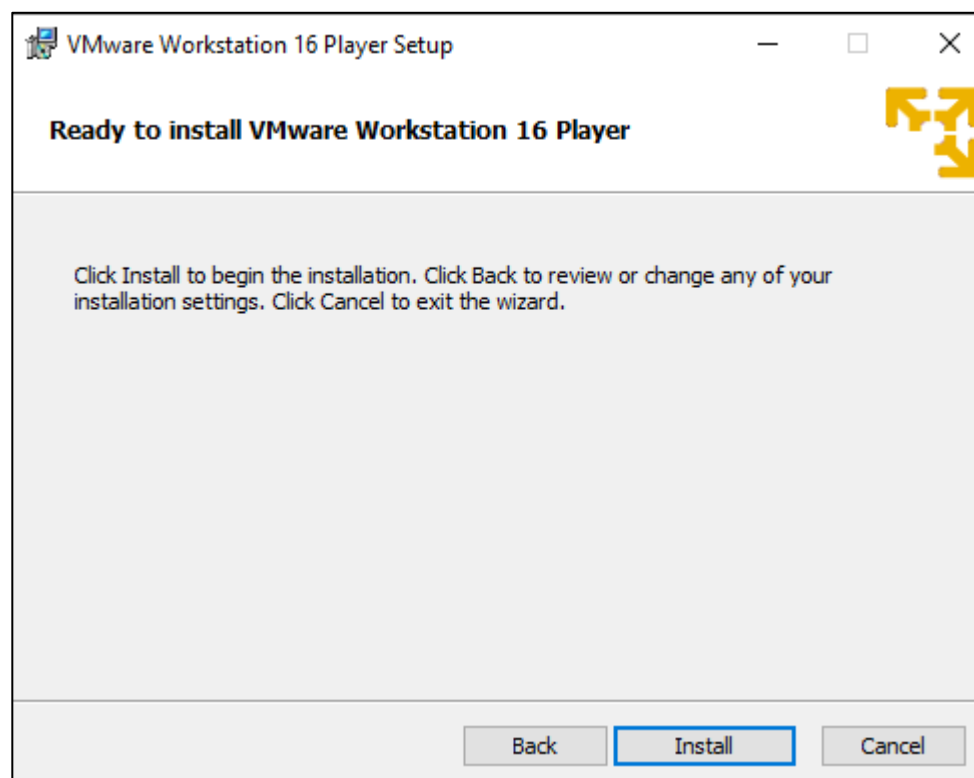
Step 6: Click on NEXT



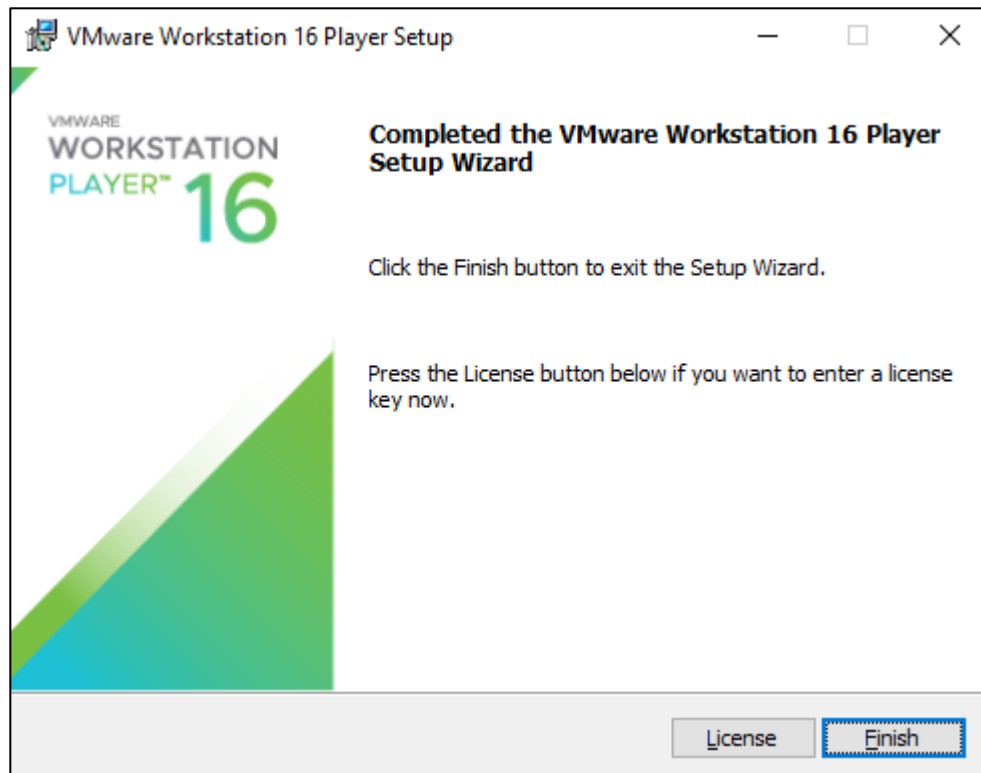
Step 7: Click on NEXT



Step 8: Click on INSTALL

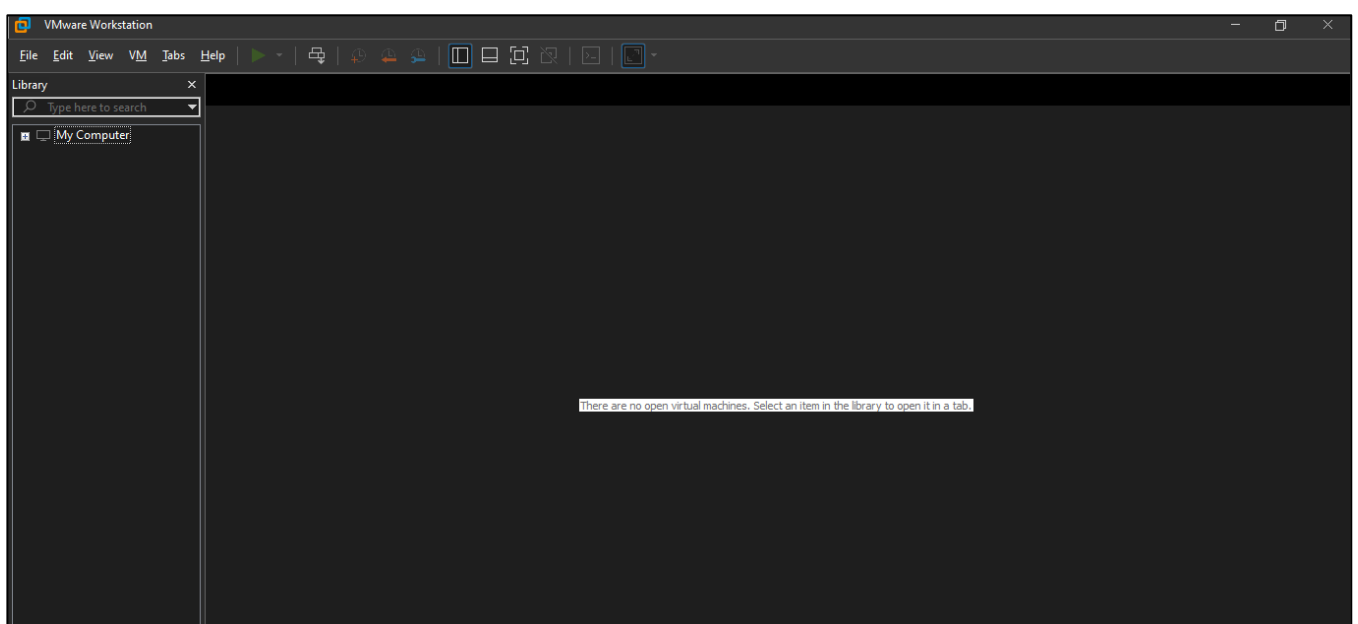


Step 9: Once Finish the installation and you have the License Key then CLICK on the License Button and add the license key else click on FINISH

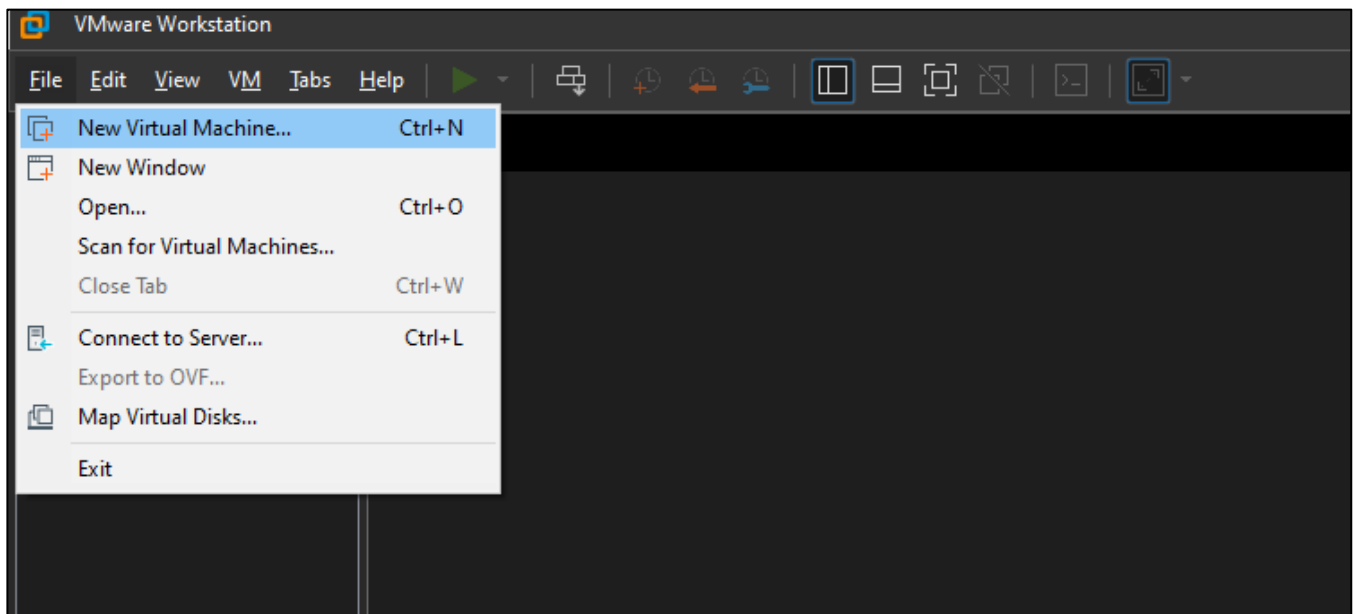


## Creation of the Virtual Machine in VMWare Workstation Pro

Step 1: Open VM Ware WorkStation



Step 2: Click on File → Create New Virtual Machine

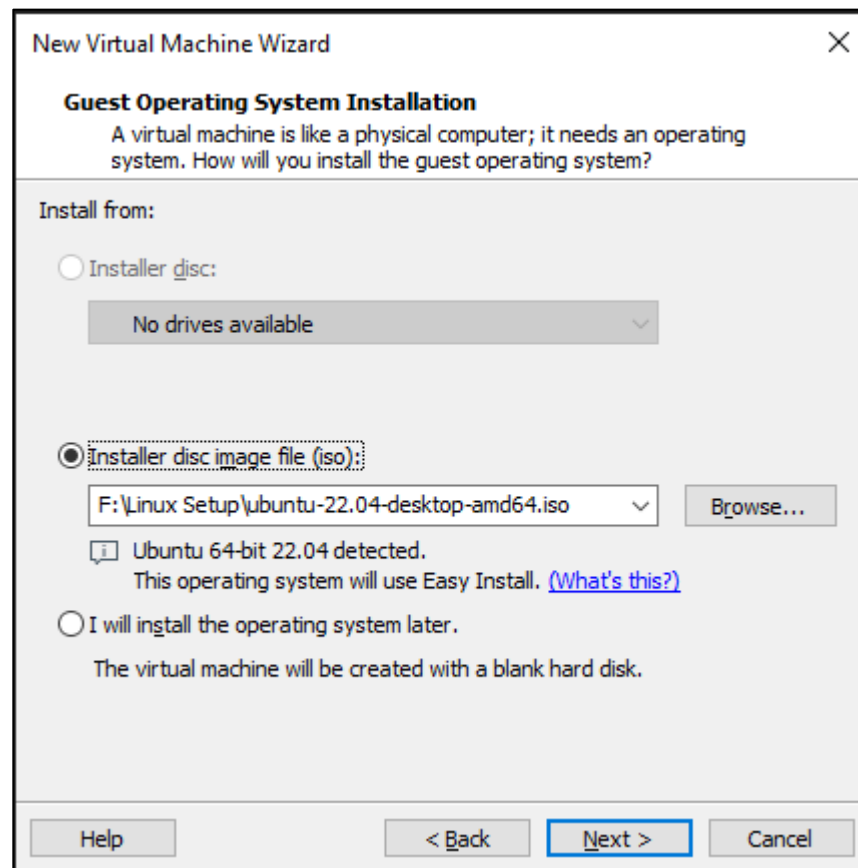


Step 3: Select Typical and click on NEXT

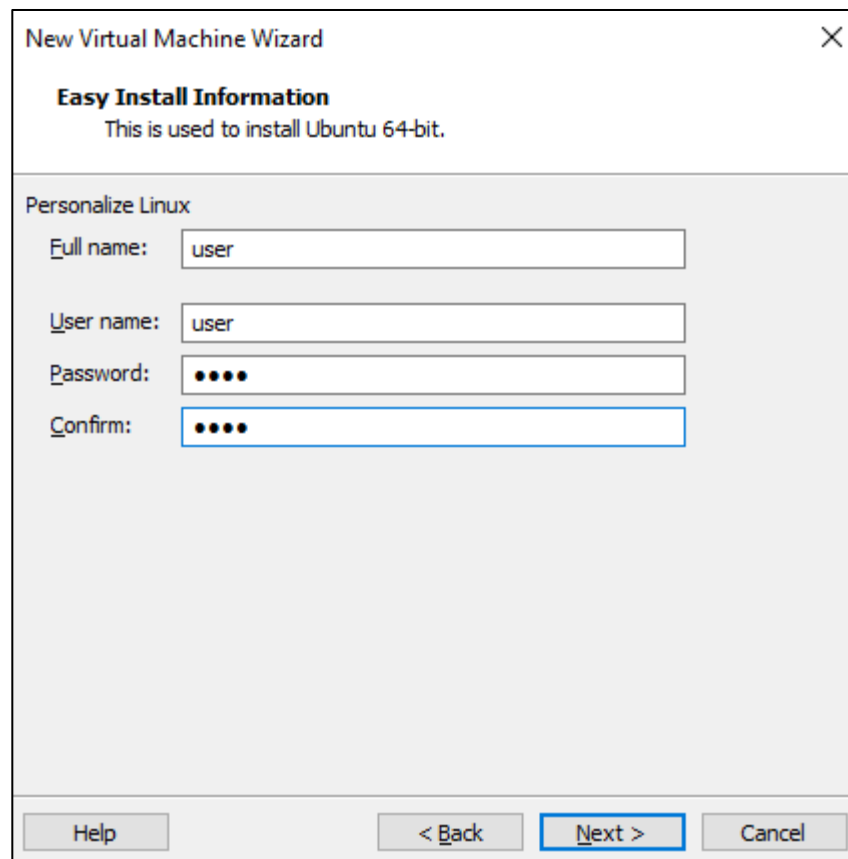




Step 4: Click on Installer Disc\_Image file and provide the ISO file path and click on NEXT



Step 5: Provide the Full Name, Username and password and click on NEXT



**New Virtual Machine Wizard** [X]

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

Personalize Linux

Full name:

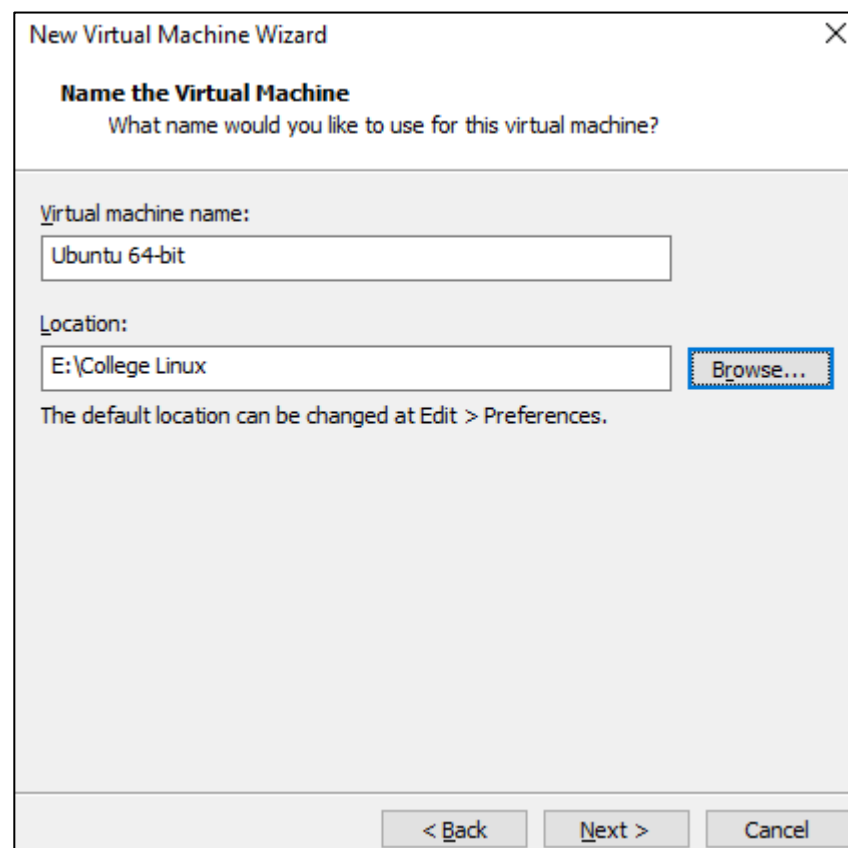
User name:

Password:

Confirm:

Help < Back **Next >** Cancel

Step 6: Provide the Virtual Machine Name and the path where to save the image



**New Virtual Machine Wizard** [X]

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

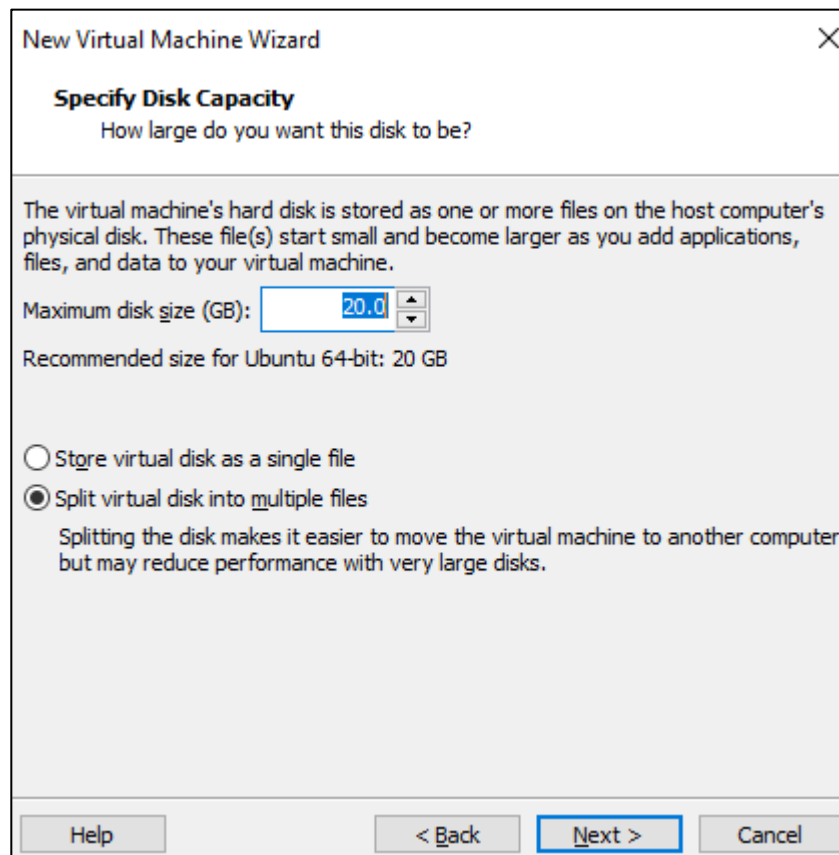
Virtual machine name:

Location:  
 **Browse...**

The default location can be changed at Edit > Preferences.

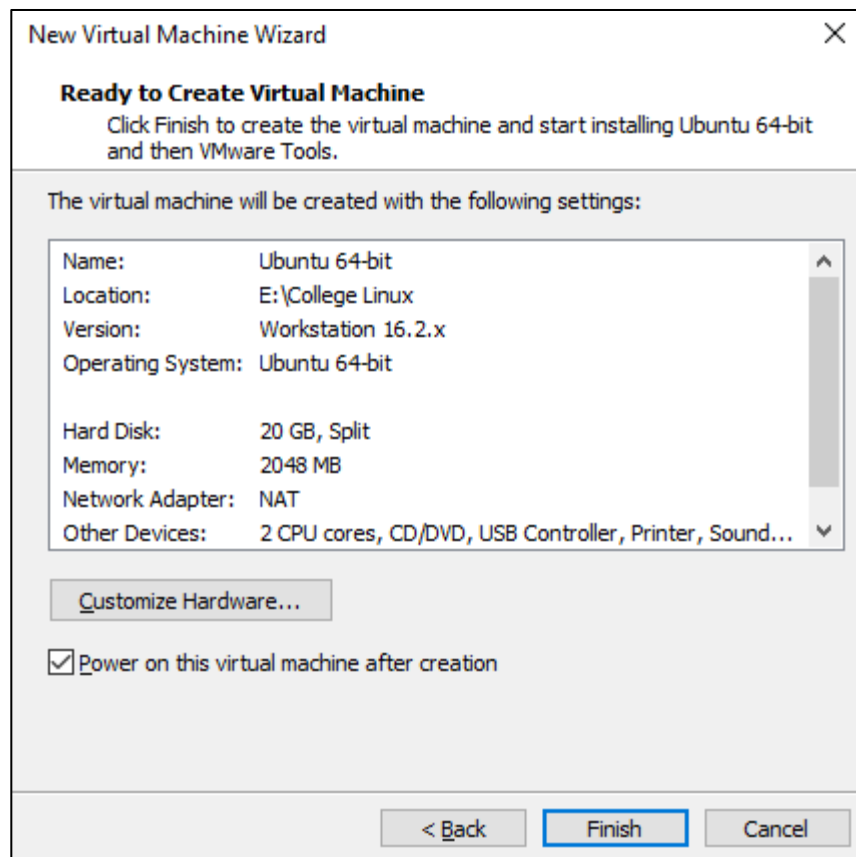
< Back **Next >** Cancel

Step 7: Provide the disk Size (Recommended 20GB) and click on NEXT



The screenshot shows a 'New Virtual Machine Wizard' window with a close button (X) in the top right corner. The title bar is '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.' Below the text box, there is a label 'Maximum disk size (GB):' followed by a text input field containing '20.0' and a spinner control. Below the input field, 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). Below the selected option, a note 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'. The 'Next >' button is highlighted with a blue border.

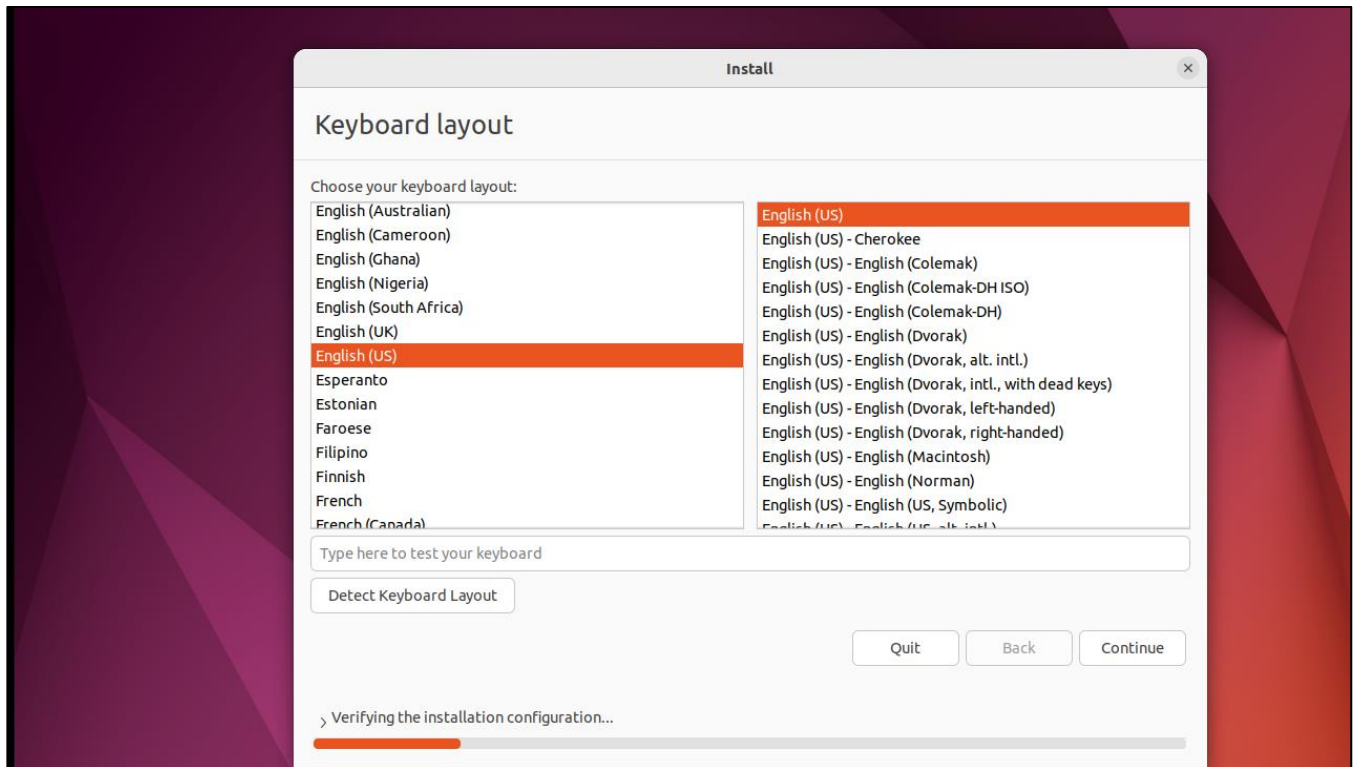
Step 8: Click on FINISH



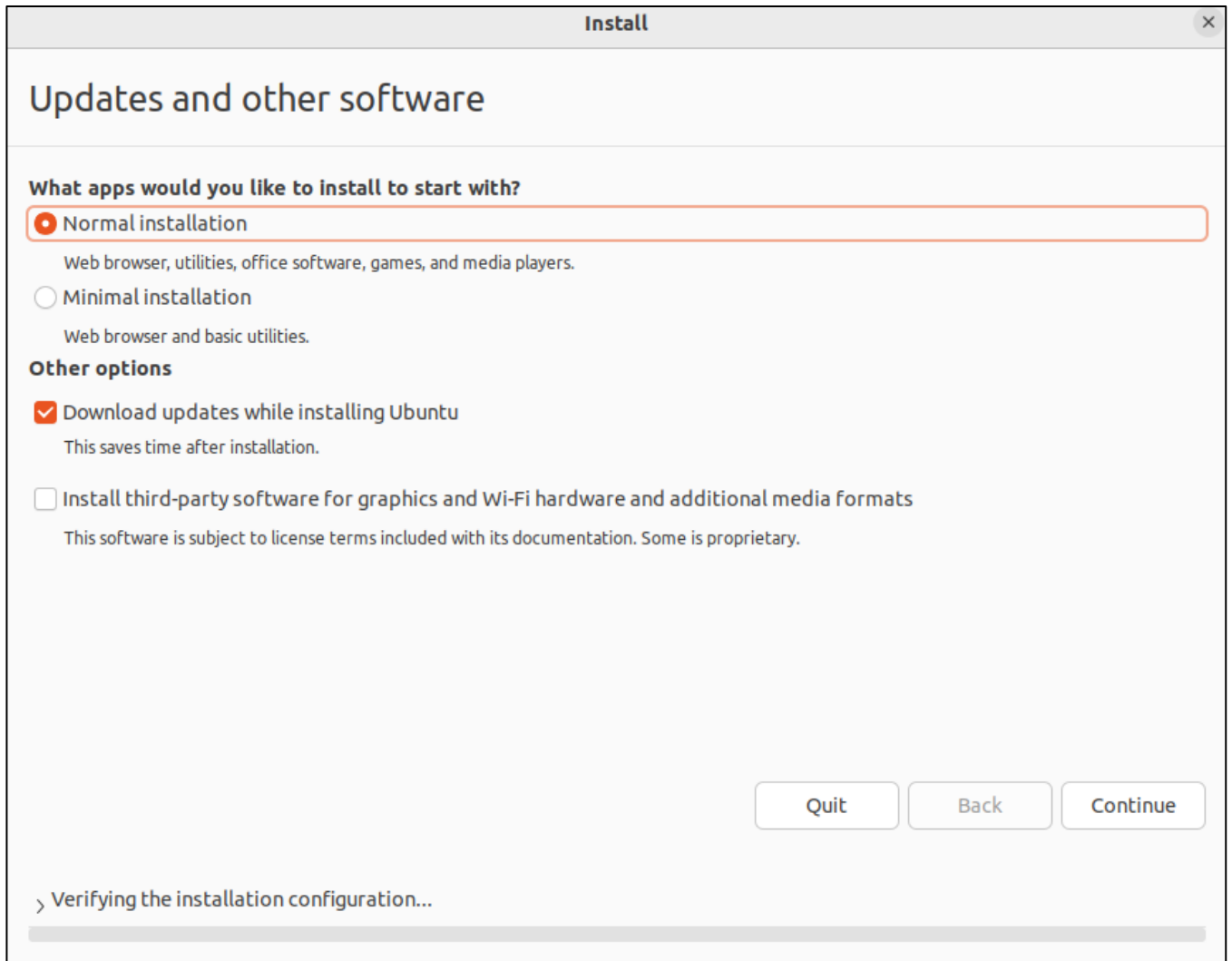
## Configuring and Installing Ubuntu

Step 1: Run the Machine

Step 2: Select the language and click on CONTINUE



Step 3: Click on CONTINUE



Step 4: Click on Erase Disk and click on INSTALL

Install

Installation type

This computer currently has no detected operating systems. What would you like to do?

☒ Erase disk and install Ubuntu

**Warning:** This will delete all your programs, documents, photos, music, and any other files in all operating systems.

Advanced features... None selected

☐ Something else

You can create or resize partitions yourself, or choose multiple partitions for Ubuntu.

Quit

Back

Install Now

> Verifying the installation configuration...

Write the changes to disks?

If you continue, the changes listed below will be written to the disks. Otherwise, you will be able to make further changes manually.

The partition tables of the following devices are changed:  
SCSI33 (0,0,0) (sda)

The following partitions are going to be formatted:  
partition #2 of SCSI33 (0,0,0) (sda) as ESP  
partition #3 of SCSI33 (0,0,0) (sda) as ext4

Go Back

Continue

Step 5: Select the Country and click on Continue

**Install**

**Where are you?**



> Creating ext4 file system for / in partition #3 of SCSI33 (0,0,0) (sda)...

Step 6: Provide the Name, Username, and Password and click on Continue




## Install

### Who are you?

Your name:  ✓

Your computer's name:  ✓  
The name it uses when it talks to other computers.

Pick a username:  ✓

Choose a password:   **Short password**

Confirm your password:  ✓

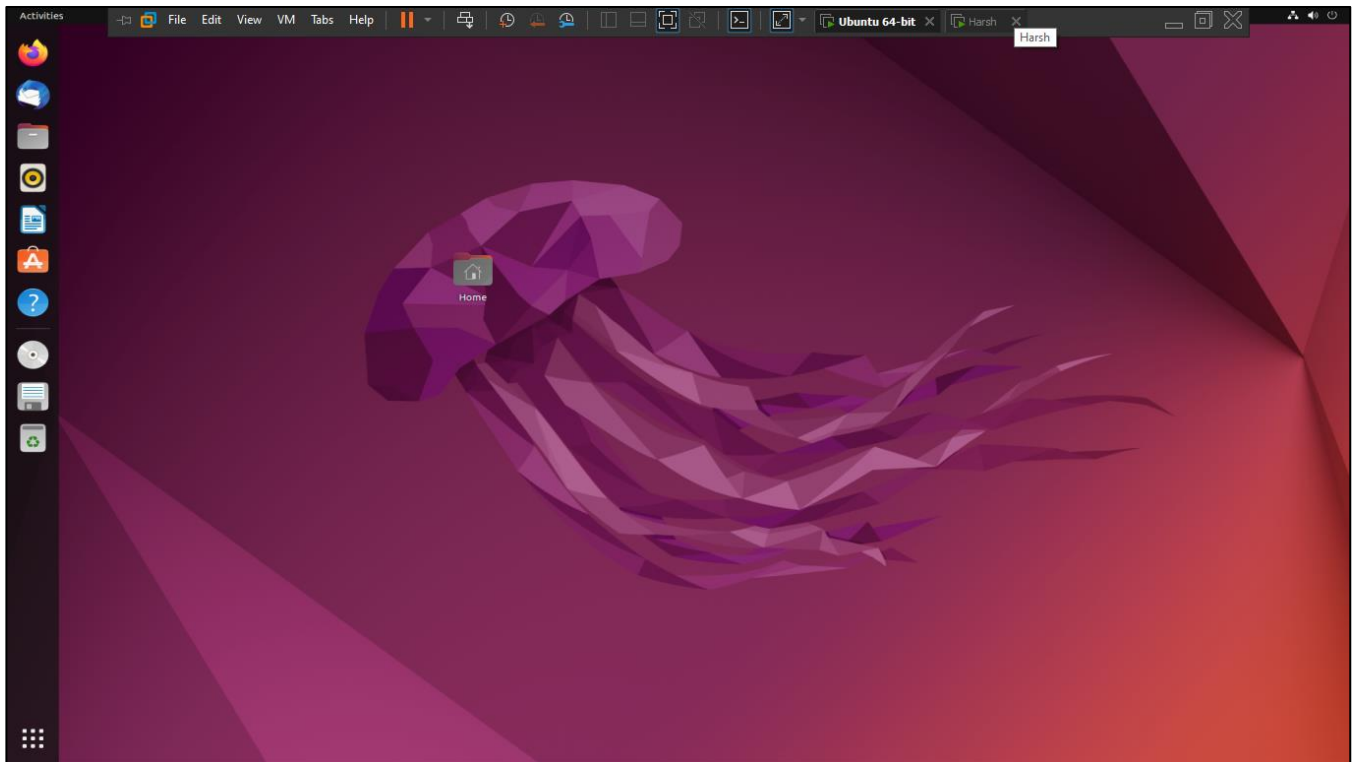
☒ Log in automatically

☐ Require my password to log in

☐ Use Active Directory  
You'll enter domain and other details in the next step.

[Back](#) [Continue](#)

> Copying files...



## Practical 2

**Aim:** Implementation of containerization using Docker

**Code:**

### Installation of Docker

```
apt -y install docker.io
```

```
root@harsh-virtual-machine:~# apt -y install docker.io
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  bridge-utils containerd git git-man liberror-perl pigz runc ubuntu-fan
Suggested packages:
  ifupdown aufs-tools btrfs-progs cgroupfs-mount | cgroup-lite debootstrap docker-doc rinse zfs-fuse | zfsutils git-daemon-run | git-daemon-sysvinit git-doc git-email
  git-gui gitk gitweb git-cvs
  git-mediawiki git-svn
The following NEW packages will be installed:
  bridge-utils containerd docker.io git git-man liberror-perl pigz runc ubuntu-fan
0 upgraded, 9 newly installed, 0 to remove and 314 not upgraded.
Need to get 69.4 MB of archives.
After this operation, 303 MB of additional disk space will be used.
Get:1 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 pigz amd64 2.6-1 [63.6 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 bridge-utils amd64 1.7-1ubuntu3 [34.4 kB]
Get:3 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 runc amd64 1.1.0-0ubuntu1 [4,087 kB]
Get:4 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 containerd amd64 1.5.9-0ubuntu3 [27.0 MB]
Get:5 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 docker.io amd64 20.10.12-0ubuntu4 [34.0 MB]
Get:6 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 liberror-perl all 0.17029-1 [26.5 kB]
Get:7 http://in.archive.ubuntu.com/ubuntu jammy-updates/main amd64 git-man all 1:2.34.1-1ubuntu1.4 [952 kB]
Get:8 http://in.archive.ubuntu.com/ubuntu jammy-updates/main amd64 git amd64 1:2.34.1-1ubuntu1.4 [3,131 kB]
Get:9 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 ubuntu-fan all 0.12.16 [35.2 kB]
Fetched 69.4 MB in 11s (6,425 kB/s)
Preconfiguring packages ...
Selecting previously unselected package pigz.
(Reading database ... 159854 files and directories currently installed.)
Preparing to unpack .../0-pigz_2.6-1_amd64.deb ...
Unpacking pigz (2.6-1) ...
Selecting previously unselected package bridge-utils.
Preparing to unpack .../1-bridge-utils_1.7-1ubuntu3_amd64.deb ...
Unpacking bridge-utils (1.7-1ubuntu3) ...
Selecting previously unselected package runc.
Preparing to unpack .../2-runc_1.1.0-0ubuntu1_amd64.deb ...
Unpacking runc (1.1.0-0ubuntu1) ...
Selecting previously unselected package containerd.
Preparing to unpack .../3-containerd_1.5.9-0ubuntu3_amd64.deb ...
Unpacking containerd (1.5.9-0ubuntu3) ...
Selecting previously unselected package docker.io.
Preparing to unpack .../4-docker.io_20.10.12-0ubuntu4_amd64.deb ...
Unpacking docker.io (20.10.12-0ubuntu4) ...
Selecting previously unselected package liberror-perl.
Preparing to unpack .../5-liberror-perl_0.17029-1_all.deb ...
Unpacking liberror-perl (0.17029-1) ...
```

### Docker Version

```
docker version
```

```
root@harsh-virtual-machine:~# docker version
Client:
Version:           20.10.12
API version:       1.41
Go version:        go1.17.3
Git commit:        20.10.12-0ubuntu4
Built:             Mon Mar  7 17:10:06 2022
OS/Arch:           linux/amd64
Context:           default
Experimental:      true

Server:
Engine:
Version:           20.10.12
API version:       1.41 (minimum version 1.12)
Go version:        go1.17.3
Git commit:        20.10.12-0ubuntu4
Built:             Mon Mar  7 15:57:50 2022
OS/Arch:           linux/amd64
Experimental:      false
containerd:
Version:           1.5.9-0ubuntu3
GitCommit:
runc:
Version:           1.1.0-0ubuntu1
GitCommit:
docker-init:
Version:           0.19.0
GitCommit:
root@harsh-virtual-machine:~#
```

Download an official image and create a container and output the words [Welcome to the Docker World] inside the container

Downloading the official image

```
docker pull ubuntu
```

```
root@harsh-virtual-machine:~# docker pull ubuntu
Using default tag: latest
latest: Pulling from library/ubuntu
2b55860d4c66: Pull complete
Digest: sha256:20fa2d7bb4de7723f542be5923b06c4d704370f0390e4ae9e1c833c8785644c1
Status: Downloaded newer image for ubuntu:latest
docker.io/library/ubuntu:latest
root@harsh-virtual-machine:~# █
```

Run echo inside the Container

```
docker run ubuntu /bin/echo "Welcome to the Docker World!"
```

```
root@harsh-virtual-machine:~# docker run ubuntu /bin/echo "Welcome to the Docker World!"
Welcome to the Docker World!
root@harsh-virtual-machine:~# █
```

Connect to the interactive session of a Container with [i] and [t] option like follows. If exit from the Container session, the process of a Container finishes.

```
docker run -it ubuntu /bin/bash

uname -a

exit
```

```
root@harsh-virtual-machine:~# docker run -it ubuntu /bin/bash
root@657d7215c3dc:/# uname -a
Linux 657d7215c3dc 5.15.0-25-generic #25-Ubuntu SMP Wed Mar 30 15:54:22 UTC 2022 x86_64 x86_64 x86_64 GNU/Linux
root@657d7215c3dc:/# exit
exit
root@harsh-virtual-machine:~#
```

If exit from the Container session with keeping container's process, push [Ctrl+p] and [Ctrl+q] key.

```
docker run -it ubuntu /bin/bash
```

```
root@harsh-virtual-machine:~# docker run -it ubuntu /bin/bash
root@6f6b3bb2cbce:/#
root@6f6b3bb2cbce:/# root@harsh-virtual-machine:~# CTRL + p , CTRL +q
```

Show docker processes

```
docker ps
```

```
root@harsh-virtual-machine:~# docker ps
CONTAINER ID   IMAGE     COMMAND                  CREATED        STATUS        PORTS          NAMES
6f6b3bb2cbce   ubuntu   "/bin/bash"             3 minutes ago Up 3 minutes             serene_hodgkin
5db3fece30ce   ubuntu   "/bin/bash"             3 minutes ago Up 3 minutes             dazzling_hamilton
root@harsh-virtual-machine:~#
```

Connect to container's Session

```
docker attach 6f6b3bb2cbce
```

```
root@harsh-virtual-machine:~# docker ps
CONTAINER ID   IMAGE     COMMAND                  CREATED        STATUS        PORTS          NAMES
6f6b3bb2cbce   ubuntu   "/bin/bash"             3 minutes ago Up 3 minutes           serene_hodgkin
5db3fece30ce   ubuntu   "/bin/bash"             3 minutes ago Up 3 minutes           dazzling_hamilton
root@harsh-virtual-machine:~# docker attach 6f6b3bb2cbce
root@6f6b3bb2cbce:/#
```

```
root@harsh-virtual-machine:~# docker ps
CONTAINER ID   IMAGE     COMMAND                  CREATED        STATUS        PORTS          NAMES
6f6b3bb2cbce   ubuntu   "/bin/bash"             3 minutes ago Up 3 minutes           serene_hodgkin
5db3fece30ce   ubuntu   "/bin/bash"             3 minutes ago Up 3 minutes           dazzling_hamilton
root@harsh-virtual-machine:~# docker attach 6f6b3bb2cbce
root@6f6b3bb2cbce:/#
```

Shutdown container's process from Host's console

```
docker kill 6f6b3bb2cbce
```

```
root@harsh-virtual-machine:~# docker ps
CONTAINER ID   IMAGE     COMMAND                  CREATED        STATUS        PORTS          NAMES
6f6b3bb2cbce   ubuntu   "/bin/bash"             3 minutes ago Up 3 minutes           serene_hodgkin
5db3fece30ce   ubuntu   "/bin/bash"             3 minutes ago Up 3 minutes           dazzling_hamilton
root@harsh-virtual-machine:~# docker attach 6f6b3bb2cbce
root@6f6b3bb2cbce:/# read escape sequence
root@harsh-virtual-machine:~# docker kill 6f6b3bb2cbce
6f6b3bb2cbce
root@harsh-virtual-machine:~# docker ps
CONTAINER ID   IMAGE     COMMAND                  CREATED        STATUS        PORTS          NAMES
5db3fece30ce   ubuntu   "/bin/bash"             7 minutes ago Up 7 minutes           dazzling_hamilton
root@harsh-virtual-machine:~#
```

Add Container images you created.

For example, update official image with installing Nginx and add it as a new image for container. The container is generated every time for executing docker run command, so add the latest executed container like follows.

Show images

```
docker images
```

```
root@harsh-virtual-machine:~# docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
ubuntu        latest    2dc39ba059dc   2 weeks ago    77.8MB
root@harsh-virtual-machine:~#
```

Start a container and install nginx

```
docker run ubuntu /bin/bash -c "apt-get update; apt-get -y install nginx"
```

```

root@harsh-virtual-machine:~# docker run ubuntu /bin/bash -c "apt-get update; apt-get -y install nginx"
Get:1 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]
Get:2 http://archive.ubuntu.com/ubuntu jammy InRelease [270 kB]
Get:3 http://archive.ubuntu.com/ubuntu jammy-updates InRelease [114 kB]
Get:4 http://archive.ubuntu.com/ubuntu jammy-backports InRelease [99.8 kB]
Get:5 http://security.ubuntu.com/ubuntu jammy-security/main amd64 Packages [402 kB]
Get:6 http://archive.ubuntu.com/ubuntu jammy/restricted amd64 Packages [164 kB]
Get:7 http://archive.ubuntu.com/ubuntu jammy/main amd64 Packages [1792 kB]
Get:8 http://security.ubuntu.com/ubuntu jammy-security/restricted amd64 Packages [357 kB]
Get:9 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 Packages [349 kB]
Get:10 http://security.ubuntu.com/ubuntu jammy-security/multiverse amd64 Packages [4644 B]
Get:11 http://archive.ubuntu.com/ubuntu jammy/universe amd64 Packages [17.5 MB]
Get:12 http://archive.ubuntu.com/ubuntu jammy/multiverse amd64 Packages [266 kB]
Get:13 http://archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages [525 kB]
Get:14 http://archive.ubuntu.com/ubuntu jammy-updates/multiverse amd64 Packages [8088 B]
Get:15 http://archive.ubuntu.com/ubuntu jammy-updates/restricted amd64 Packages [398 kB]
Get:16 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [724 kB]
Get:17 http://archive.ubuntu.com/ubuntu jammy-backports/main amd64 Packages [3175 B]
Get:18 http://archive.ubuntu.com/ubuntu jammy-backports/universe amd64 Packages [7276 B]
Fetched 23.1 MB in 58s (394 kB/s)
Reading package lists...
Reading package lists...
Building dependency tree...
Reading state information...
The following additional packages will be installed:
  fontconfig-config fonts-dejavu-core iproute2 libatm1 libbpf0 libbrotli1
  libbsd0 libcap2-bin libdeflate0 libelf1 libexpat1 libfontconfig1
  libfreetype6 libgd3 libcubic7 libjpeg-turbo8 libjpeg8 libmaxminddb0
  libmd0 libmnl0 libnginx-mod-http-geoip2 libnginx-mod-http-image-filter
  libnginx-mod-http-xslt-filter libnginx-mod-mail libnginx-mod-stream
  libnginx-mod-stream-geoip2 libpam-cap libpng16-16 libtiff5 libwebp7 libx11-6
  libx11-data libxau6 libxcb1 libxdmcp6 libxml2 libxpm4 libxslt1.1
  libxtables12 nginx-common nginx-core ucf
Suggested packages:
  iproute2-doc libgd-tools mmdns-bin fcgiwrap nginx-doc ssl-cert
The following NEW packages will be installed:
  fontconfig-config fonts-dejavu-core iproute2 libatm1 libbpf0 libbrotli1
  libbsd0 libcap2-bin libdeflate0 libelf1 libexpat1 libfontconfig1
  libfreetype6 libgd3 libcubic7 libjpeg-turbo8 libjpeg8 libmaxminddb0
  libmd0 libmnl0 libnginx-mod-http-geoip2 libnginx-mod-http-image-filter
  libnginx-mod-http-xslt-filter libnginx-mod-mail libnginx-mod-stream
  libnginx-mod-stream-geoip2 libpam-cap libpng16-16 libtiff5 libwebp7 libx11-6
  libx11-data libxau6 libxcb1 libxdmcp6 libxml2 libxpm4 libxslt1.1
  libxtables12 nginx nginx-common nginx-core ucf
0 upgraded, 44 newly installed, 0 to remove and 4 not upgraded.
Need to get 17.5 MB of archives.
After this operation, 56.4 MB of additional disk space will be used.
Get:1 http://archive.ubuntu.com/ubuntu jammy/main amd64 libelf1 amd64 0.186-1build1 [51.0 kB]
Get:2 http://archive.ubuntu.com/ubuntu jammy/main amd64 libbpf0 amd64 1:0.5.0-1 [140 kB]
Get:3 http://archive.ubuntu.com/ubuntu jammy/main amd64 libmd0 amd64 1.0.4-1build1 [23.0 kB]
Get:4 http://archive.ubuntu.com/ubuntu jammy/main amd64 libbsd0 amd64 0.11.5-1 [44.8 kB]

```

```
docker ps -a | head -2
```

```

root@harsh-virtual-machine:~# docker ps -a | head -2
CONTAINER ID   IMAGE     COMMAND                  CREATED        STATUS        PORTS          NAMES
2ea735ff2f51   ubuntu   "/bin/bash -c 'apt-g..."  2 minutes ago   Exited (0)    35 seconds ago         objective_cor1
root@harsh-virtual-machine:~#

```

Add the image

```
docker commit 2ea735ff2f51 srv.world/ubuntu-nginx
```

```

root@harsh-virtual-machine:~# docker ps -a | head -2
CONTAINER ID   IMAGE     COMMAND                  CREATED        STATUS        PORTS          NAMES
2ea735ff2f51   ubuntu   "/bin/bash -c 'apt-g..."  2 minutes ago   Exited (0)    35 seconds ago         objective_cor1
root@harsh-virtual-machine:~# docker commit 2ea735ff2f51 srv.world/ubuntu-nginx
sha256:3efa7fe549f6d2d2ead74c6ea072aa77671f207e4f93ff29622ca0616802bd35
root@harsh-virtual-machine:~#

```

```
docker images
```

```
root@harsh-virtual-machine:~# docker images
REPOSITORY          TAG             IMAGE ID        CREATED         SIZE
srv.world/ubuntu-nginx  latest         3efa7fe549f6   44 seconds ago 170MB
ubuntu               latest         2dc39ba059dc   2 weeks ago    77.8MB
root@harsh-virtual-machine:~#
```

Generate a container from the new image and execute [which] to make sure nginx exists

```
docker run srv.world/ubuntu-nginx /usr/bin/which nginx
```

```
root@harsh-virtual-machine:~# docker run srv.world/ubuntu-nginx /usr/bin/which nginx
/usr/sbin/nginx
root@harsh-virtual-machine:~#
```