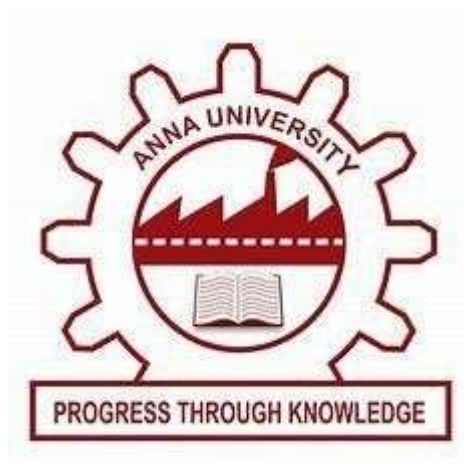


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DSC ASSIGNMENT- 3

**TITLE : Implementation of Virtual Machine and containers using VMware
and Docker**

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1.Introduction

Implementing different types of virtual machines by creating:

1. A **System Virtual Machine** using VMware, and
2. An **OS-Level Virtual Machine** using Docker containers, and to demonstrate multiple container instances.

2. Requirements

Software Requirements

- Host Operating System: Windows / Linux
- VMware Workstation
- Ubuntu Linux (Guest OS)
- Docker Engine
- Terminal

Hardware Requirements

- Minimum 8 GB RAM
- Intel/AMD processor with virtualization support

3. Implementation

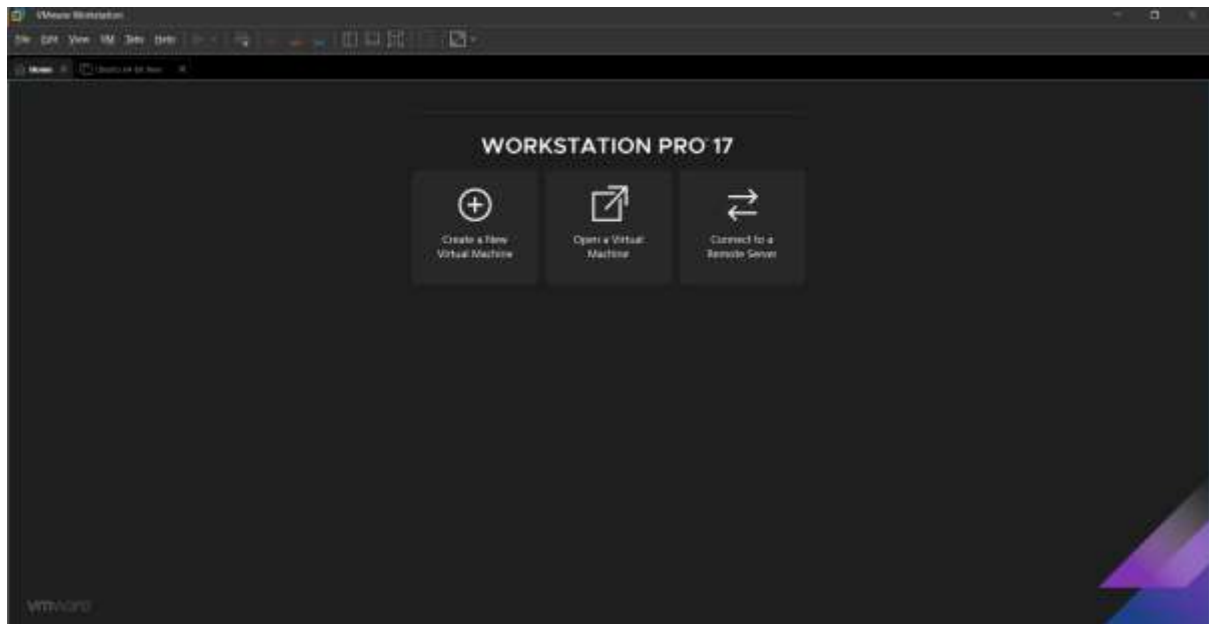
Creation of System Virtual Machine using VMware

Step 1: Launch VMware Workstation

VMware Workstation was launched on the host system.

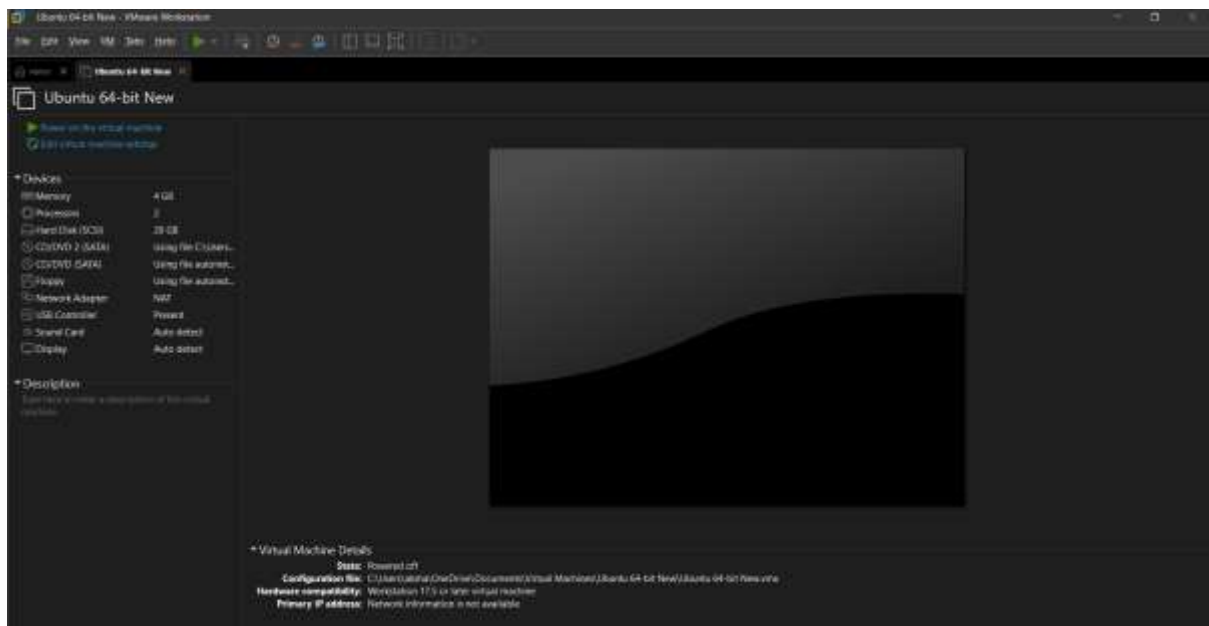
Step 2: Create a New Virtual Machine

- Selected **Create a New Virtual Machine**
- Chose **Typical** configuration
- Selected Ubuntu ISO file
- Allocated memory and disk space



Step 3: Install Ubuntu Operating System

Ubuntu Linux was installed inside VMware, resulting in a fully functional **System Virtual Machine**.



Creation of OS-Level Virtual Machine using Docker

Docker was installed inside the Ubuntu system virtual machine.

Step 1: Install Docker

```
sudo apt update
```

```
sudo apt install docker.io
```

```
Ubuntu 24.04 LTS - VMware Workstation
akshaya@akshaya-Virtual-Platform: ~$ docker --version
Docker version 20.10.17, build 100c7013
Command 'docker' not found, but can be installed with:
sudo snap install docker -- * version 20.10.17, or
sudo apt install docker.io -- * version 20.10.17-ubuntu-24.04.1
sudo apt install podman-docker -- * version 4.9.1-dbi-ubuntu-24.04.1
See 'snap info docker' for additional versions.
akshaya@akshaya-Virtual-Platform: ~$ sudo apt install
[sudo] password for akshaya:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following package was automatically installed and is no longer required:
  libltdl9
Use 'sudo apt autoremove' to remove it.
0 upgraded, 0 newly installed, 0 to remove and 25 not upgraded.
akshaya@akshaya-Virtual-Platform: ~$ sudo apt update
Get:1 http://security.ubuntu.com/ubuntu noble-security InRelease [126 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu noble InRelease [126 kB]
Get:3 http://security.ubuntu.com/ubuntu noble-security/main amd64 Packages [1,418 kB]
Get:4 http://in.archive.ubuntu.com/ubuntu noble-updates/main amd64 Packages [1,717 kB]
Get:5 http://security.ubuntu.com/ubuntu noble-security/main amd64 Packages [1,418 kB]
Get:6 http://in.archive.ubuntu.com/ubuntu noble-updates/main amd64 Packages [1,717 kB]
Get:7 http://security.ubuntu.com/ubuntu noble-security/main Translation-en [229 kB]
Get:8 http://in.archive.ubuntu.com/ubuntu noble-updates/main Translation-en [212 kB]
Get:9 http://security.ubuntu.com/ubuntu noble-security/main amd64 Components [25.1 kB]
Get:10 http://security.ubuntu.com/ubuntu noble-security/main amd64 c-n-f Metadata [9,828 B]
Get:11 http://security.ubuntu.com/ubuntu noble-security/restricted amd64 Packages [2,369 kB]
Get:12 http://in.archive.ubuntu.com/ubuntu noble-updates/main amd64 Components [275 kB]
Get:13 http://in.archive.ubuntu.com/ubuntu noble-updates/main amd64 c-n-f Metadata [10.8 kB]
Get:14 http://security.ubuntu.com/ubuntu noble-security/restricted amd64 Packages [2,326 kB]
Get:15 http://security.ubuntu.com/ubuntu noble-security/restricted Translation-en [548 kB]
Get:16 http://in.archive.ubuntu.com/ubuntu noble-updates/restricted Translation-en [588 kB]
Get:17 http://security.ubuntu.com/ubuntu noble-security/restricted amd64 Components [212 B]
Get:18 http://security.ubuntu.com/ubuntu noble-security/restricted amd64 c-n-f Metadata [596 B]
Get:19 http://security.ubuntu.com/ubuntu noble-security/universe amd64 Packages [925 kB]
Get:20 http://in.archive.ubuntu.com/ubuntu noble-updates/restricted amd64 Components [212 B]
Get:21 http://in.archive.ubuntu.com/ubuntu noble-backports/multiverse amd64 Components [212 B]
Fetched 34.8 MB in 2s (16.8 MB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
373 packages can be upgraded. Run 'apt list --upgradable' to see them.
akshaya@akshaya-Virtual-Platform: ~$ sudo apt install docker.io
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following package was automatically installed and is no longer required:
  libltdl9
Use 'sudo apt autoremove' to remove it.
The following additional packages will be installed:
  bridge-utils containerd git git-man liberror-perl pigz runc ubuntu-fan
Suggested packages:
  (fdupes) aufs-tools attrfs progs cgroupfs-mount | cgroup-lite deboststrap docker-buildx docker-compose-v2 docker-doc rinse zfs-fuse | zfsutils-glt doomsd-run | gty-daemon-sysinit
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 373 not upgraded.
Need to get 80.3 MB of archives.
After this operation, 312 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://in.archive.ubuntu.com/ubuntu noble/universe amd64 pigz amd64 2.0.1 [65.6 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu noble/main amd64 bridge-utils amd64 1.7.1-3ubuntu2 [33.9 kB]
Get:3 http://in.archive.ubuntu.com/ubuntu noble-updates/main amd64 runc amd64 1.3.3-3ubuntu-24.04.1 [9,815 kB]
Get:4 http://in.archive.ubuntu.com/ubuntu noble-updates/main amd64 containerd amd64 1.7.20-ubuntu-24.04.2 [38.4 MB]
Get:5 http://in.archive.ubuntu.com/ubuntu noble-updates/universe amd64 docker.io amd64 20.10.24-24.04.1 [28.2 MB]
Get:6 http://in.archive.ubuntu.com/ubuntu noble/main amd64 liberror-perl all 0.17029-2 [10.8 kB]
Get:7 http://in.archive.ubuntu.com/ubuntu noble-updates/main amd64 git-man all 1:2.43.0-1ubuntu0.3 [1,124 kB]
Get:8 http://in.archive.ubuntu.com/ubuntu noble-updates/main amd64 git amd64 1:2.43.0-1ubuntu0.3 [1,124 kB]
Get:9 http://in.archive.ubuntu.com/ubuntu noble-updates/universe amd64 ubuntu-fan all 0.12-24.04.1 [10.8 kB]
Get:10 http://in.archive.ubuntu.com/ubuntu noble-updates/main amd64 containerd amd64 1.7.20-ubuntu-24.04.2 [38.4 MB]
Get:11 http://in.archive.ubuntu.com/ubuntu noble-updates/universe amd64 docker.io amd64 20.10.24-24.04.1 [28.2 MB]
Fetched 80.3 MB in 2s (34.8 MB/s)
debconf: delaying package configuration, since apt-utils is not installed
Selecting previously unselected package bridge-utils.
(Reading database ... 123456789 files and directories currently installed.)
Preparing to unpack .../bridge-utils_1.7.1-3ubuntu2_amd64.deb ...
Unpacking bridge-utils (1.7.1-3ubuntu2) ...
Selecting previously unselected package containerd.
Preparing to unpack .../containerd_1.7.20-ubuntu-24.04.2_amd64.deb ...
Unpacking containerd (1.7.20-ubuntu-24.04.2) ...
Selecting previously unselected package docker.io.
Preparing to unpack .../docker.io_20.10.24-24.04.1_amd64.deb ...
Unpacking docker.io (20.10.24-24.04.1) ...
Selecting previously unselected package git.
Preparing to unpack .../git_1:2.43.0-1ubuntu0.3_amd64.deb ...
Unpacking git (1:2.43.0-1ubuntu0.3) ...
Selecting previously unselected package git-man.
Preparing to unpack .../git-man_1:2.43.0-1ubuntu0.3_all.deb ...
Unpacking git-man (1:2.43.0-1ubuntu0.3) ...
Selecting previously unselected package liberror-perl.
Preparing to unpack .../liberror-perl_0.17029-2_all.deb ...
Unpacking liberror-perl (0.17029-2) ...
Selecting previously unselected package pigz.
Preparing to unpack .../pigz_2.0.1_amd64.deb ...
Unpacking pigz (2.0.1) ...
Selecting previously unselected package runc.
Preparing to unpack .../runc_1.3.3-3ubuntu-24.04.1_amd64.deb ...
Unpacking runc (1.3.3-3ubuntu-24.04.1) ...
Selecting previously unselected package ubuntu-fan.
Preparing to unpack .../ubuntu-fan_0.12-24.04.1_all.deb ...
Unpacking ubuntu-fan (0.12-24.04.1) ...
Setting up bridge-utils (1.7.1-3ubuntu2) ...
Setting up containerd (1.7.20-ubuntu-24.04.2) ...
Setting up docker.io (20.10.24-24.04.1) ...
Setting up git (1:2.43.0-1ubuntu0.3) ...
Setting up git-man (1:2.43.0-1ubuntu0.3) ...
Setting up liberror-perl (0.17029-2) ...
Setting up pigz (2.0.1) ...
Setting up runc (1.3.3-3ubuntu-24.04.1) ...
Setting up ubuntu-fan (0.12-24.04.1) ...
Processing triggers for systemd (255-2ubuntu1) ...
To start input to this VM, move the mouse pointer inside or press Ctrl+G.
```

Step 2: Start Docker Service

sudo systemctl start docker

sudo systemctl enable docker

Step 3: Create OS-Level Virtual Machine (Container)

sudo docker run -it ubuntu

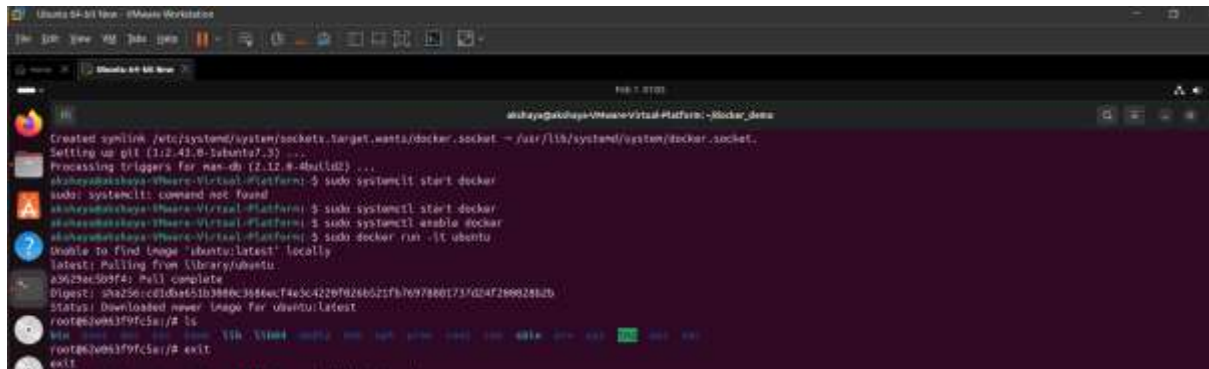
This command creates a Docker container, which acts as an **OS-Level Virtual Machine**.

Creation of Different Types of Containers

Container Type 1: Ubuntu Base Container

```
sudo docker run -it ubuntu
```

This container provides a minimal Ubuntu environment.



```
Created symlink /etc/systemd/system/sockets.target.wants/docker.socket → /usr/lib/systemd/system/docker.socket.
Setting up glib (1:2.42-4ubuntu2.3) ...
Processing triggers for man-db (2.12.8-4ubuntu1) ...
akshay@akshaya-Virtual-Platform:~$ sudo systemctl start docker
sudo: systemctl: command not found
akshay@akshaya-Virtual-Platform:~$ sudo systemctl start docker
akshay@akshaya-Virtual-Platform:~$ sudo systemctl enable docker
akshay@akshaya-Virtual-Platform:~$ sudo docker run -it ubuntu
Unable to find image 'ubuntu:latest' locally
Docker: Pulling from library/ubuntu
5d629c309f4: Pull complete
Digest: sha256:c01d4d51b388ec3466ac74e3c4226f926b521fb76978801737d04f26902812b
Status: Downloaded newer image for ubuntu:latest
root@629d613f9f5a:/# ls
bin  boot  dev  etc  home  lib  lib64  media  mnt  opt  proc  sbin  sys  tmp  usr  var
root@629d613f9f5a:/# exit
exit
```

Container Type 2: Custom Python Container

Dockerfile

```
FROM ubuntu
```

```
RUN apt update
```

```
RUN apt install -y python3
```

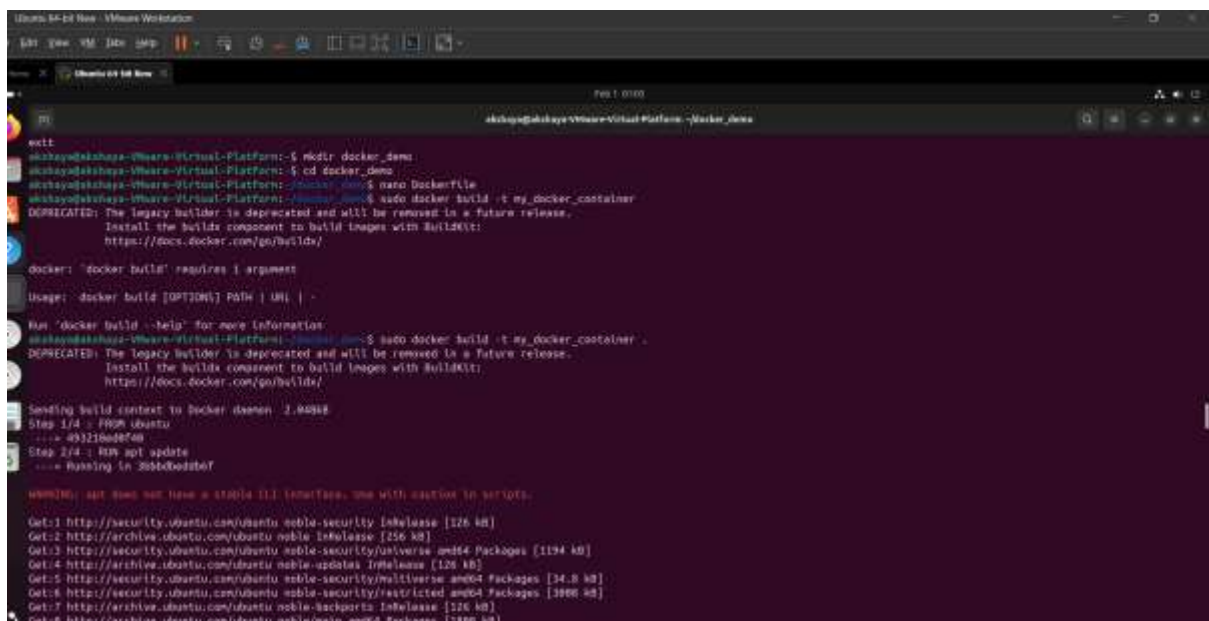
```
CMD ["python3"]
```

Build Image:

```
sudo docker build -t python_container .
```

Run Container

```
sudo docker run -it python_container
```



```
exit
akshay@akshaya-Virtual-Platform:~$ mkdir docker_demo
akshay@akshaya-Virtual-Platform:~$ cd docker_demo
akshay@akshaya-Virtual-Platform:~/docker_demo$ nano Dockerfile
DEPRECATED: The legacy builder is deprecated and will be removed in a future release.
Install the buildx component to build images with BuildKit:
https://docs.docker.com/go/buildx/

docker: 'docker build' requires 1 argument.

Usage: docker build [OPTIONS] PATH | URI | -

Run 'docker build --help' for more information
akshay@akshaya-Virtual-Platform:~/docker_demo$ sudo docker build -t my_python_container .
DEPRECATED: The legacy builder is deprecated and will be removed in a future release.
Install the buildx component to build images with BuildKit:
https://docs.docker.com/go/buildx/

Sending build context to Docker daemon  2.949kB
Step 1/4 : FROM ubuntu
----> 49321bde0f40
Step 2/4 : RUN apt update
----> Running in 30bb60dab0f7

WARNING: apt does not have a stable CLI interface. Use with caution in scripts.

Get:1 http://security.ubuntu.com/ubuntu noble-security InRelease [126 kB]
Get:2 http://archive.ubuntu.com/ubuntu noble InRelease [256 kB]
Get:3 http://security.ubuntu.com/ubuntu noble-security/universe amd64 Packages [1194 kB]
Get:4 http://archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]
Get:5 http://security.ubuntu.com/ubuntu noble-security/multiverse amd64 Packages [34.8 kB]
Get:6 http://security.ubuntu.com/ubuntu noble-security/restricted amd64 Packages [3080 kB]
Get:7 http://archive.ubuntu.com/ubuntu noble-backports InRelease [126 kB]
Get:8 http://archive.ubuntu.com/ubuntu noble/main amd64 Packages [7280 kB]
```

```
akshay@akshaya-Virtual-Platform: ~$ sudo docker run -it my_docker_container
Python 3.12.3 (main, Jan 6 2026, 11:30:50) [GCC 13.3.6] on linux
Type "help", "copyright", "credits" or "license()" for more information.
>>> print("hello from container")
hello from container
>>> exit()
akshay@akshaya-Virtual-Platform: ~$
```

4. Types of Virtual Machines Implemented

Virtual Machine Type	Technology Used	Description
System Virtual Machine	VMware	Full OS with separate kernel
OS-Level Virtual Machine	Docker	Lightweight container sharing host kernel

5. Observations

- System virtual machines provide strong isolation but consume more resources.
- OS-level virtual machines are lightweight and start quickly.
- Docker containers are suitable for distributed systems due to scalability and portability.