Terna Engineering College

Computer Engineering Department
Program: Sem VI

Course: Cloud Computing Lab (CSL605)

PART A
(PART A: TO BE REFFERED BY STUDENTS)

Experiment No.9

Title: To study and Implement Containerization using Docker

A.1 Objective: To know the basic differences between Virtual machine and Container. It involves demonstration of creating, finding, and building, installing, and running Linux/Windows application containers inside local machine or cloud platform.

A.2 Prerequisite:

Knowledge of Networking, Distributed Computing and knowledge of Software architectures.

A.3 Objective:

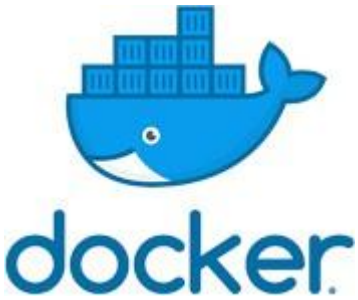
Objectives this experiment is to provide students an overview AWS, its Features and Services.

A.4 Outcome: (LO3)

After successful completion of this experiment student will be able to run Linux/ windows application containers inside local machine.

A.5 Theory :

Docker is the containerization platform that is used to package your application and all its dependencies together in the form of containers to make sure that your application works seamlessly in any environment which can be developed or tested or in production.



Containerization:
Containerization is OS-based virtualization that creates multiple virtual units in the userspace, known as Containers. Containers share the same host kernel but are isolated from each other through private namespaces and resource control mechanisms at the OS level. Container-based Virtualization provides a different level of abstraction in terms of virtualization and isolation when compared with hypervisors. Hypervisors use a lot of hardware which results in overhead in terms of virtualizing hardware and virtual device drivers. A full operating system (e.g -Linux, Windows) runs on top of this virtualized hardware in each virtual machine instance.
But in contrast, containers implement isolation of processes at the operating system level, thus avoiding such overhead. These containers run on top of the same shared operating system kernel of the underlying host machine and one or more processes can be run within each container. In containers you don't have to pre-allocate any RAM, it is allocated dynamically during the creation of containers while in VMs you need to first pre-allocate the memory and then create the virtual machine. Containerization has better resource utilization compared to VMs and a short boot-up process. It is the next evolution in virtualization.

Containers can run virtually anywhere, greatly easy development and deployment: on Linux, Windows, and Mac operating systems; on virtual machines or bare metal, on a developer's machine or in data centers on-premises; and of course, in the public cloud. Containers virtualize CPU, memory, storage, and network resources at the OS level, providing developers with a sandboxed view of the OS logically isolated from other applications. Docker is the most popular open-source container format available and is supported on Google Cloud Platform and by Google Kubernetes Engine.

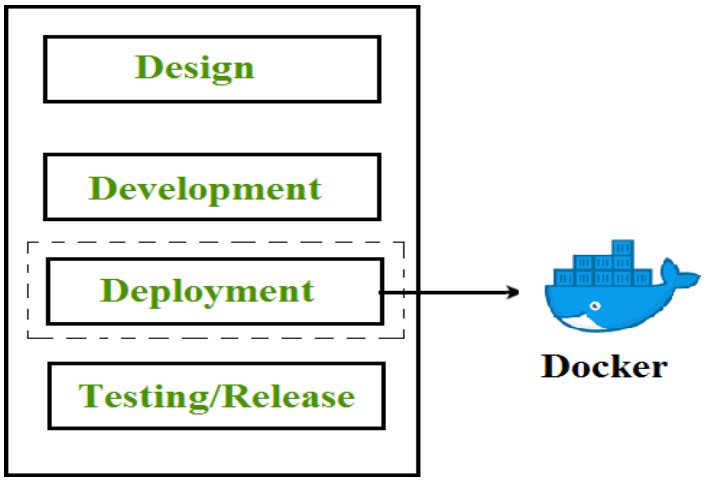
After you understand the concept of Docker, now let's get into the implementation. There are several steps that we will do:

1. Install Docker

2. Create a file called Dockerfile

3. Build the image

4. Run the image



Useful link:

https://docs.docker.com/

PART B

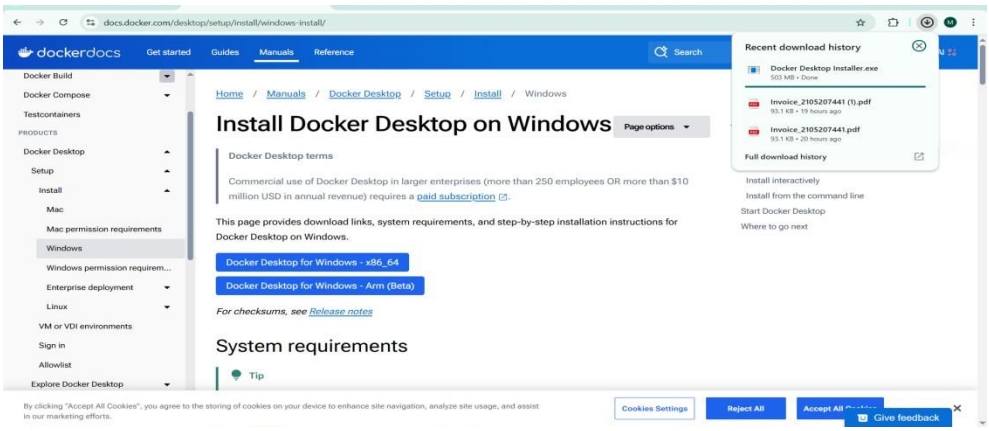
(PART B: TO BE COMPLETED BY STUDENTS)

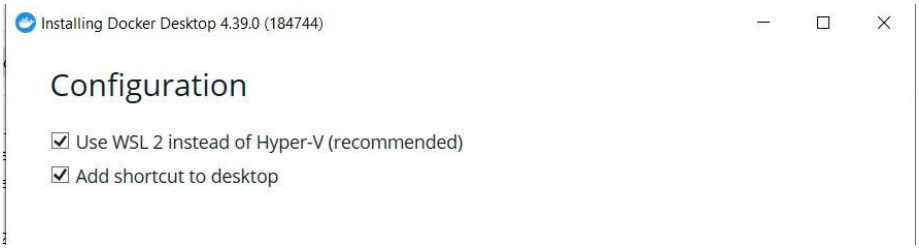
(Students must submit the soft copy as per following segments within two hours of the practical. The soft copy must be uploaded on the ERP or emailed to the concerned lab in charge faculties at the end of the practical in case the there is no ERP access available)

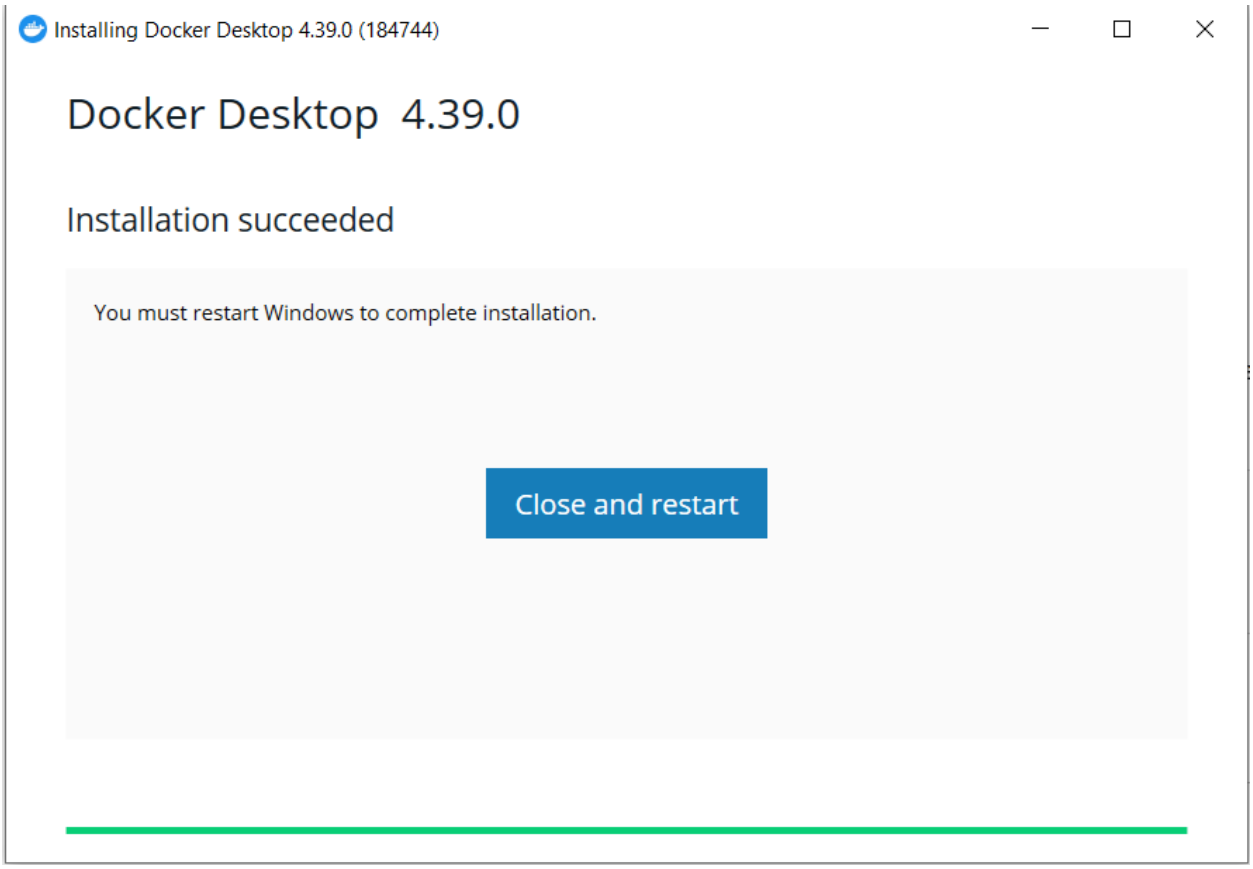
Roll No. B30	Name: Pranjal Bhatt
Class : TE B Comps	Batch : B2
Date of Experiment:	Date of Submission:
Grade :	

Step 1: Install Docker on Windows

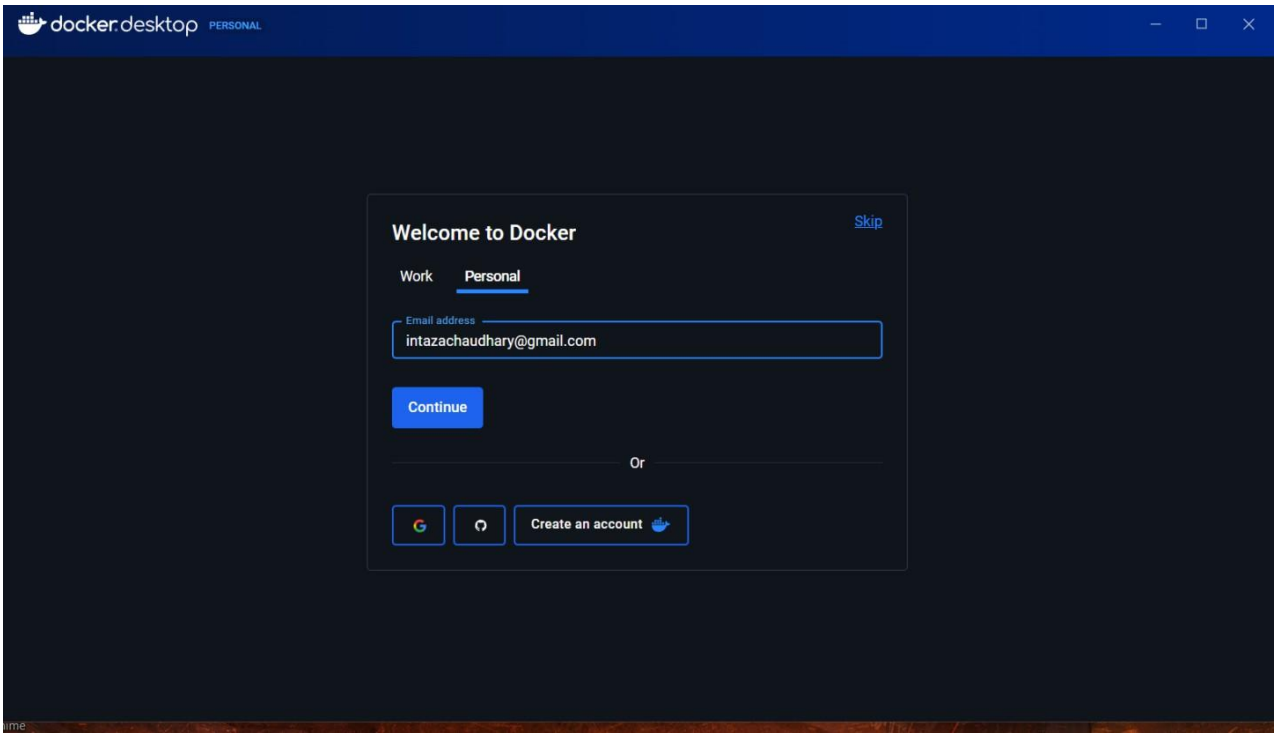
1. Go to the official Docker download page:
   - https://docs.docker.com/desktop/install/windows-install
2. **Download Docker Desktop for Windows**.
3. **Run the installer** and follow the on-screen instructions:
   - Ensure **WSL 2** is enabled (Docker will prompt you to install it if needed).
   - You may need to restart your system.
4. After installation, **launch Docker Desktop**. You should see the whale icon in the system tray.


docs.docker.com/desktop/setup/install/windows-install/
dockerdocs
Get started
Guides
Manuals
Reference
Search
Recent download history
Docker Desktop Installer.exe
503 MB • Done
Invoice_2105207441 (1).pdf
93.1 KB • 19 hours ago
Invoice_2105207441.pdf
93.1 KB • 20 hours ago
Full download history
Docker Build
Docker Compose
Testcontainers
PRODUCTS
Docker Desktop
Setup
Install
Mac
Mac permission requirements
Windows
Windows permission requirem...
Enterprise deployment
Linux
VM or VDI environments
Sign in
Allowlist
Explore Docker Desktop
Home / Manuals / Docker Desktop / Setup / Install / Windows
Install Docker Desktop on Windows
Page options
Docker Desktop terms
Commercial use of Docker Desktop in larger enterprises (more than 250 employees OR more than $10 million USD in annual revenue) requires a paid subscription.
This page provides download links, system requirements, and step-by-step installation instructions for Docker Desktop on Windows.
Docker Desktop for Windows - x86_64
Docker Desktop for Windows - Arm (Beta)
For checksums, see Release notes
System requirements
Tip
Install interactively
Install from the command line
Start Docker Desktop
Where to go next
By clicking "Accept All Cookies", you agree to the storing of cookies on your device to enhance site navigation, analyze site usage, and assist in our marketing efforts.
Cookies Settings
Reject All
Accept All
Give feedback


Installing Docker Desktop 4.39.0 (184744)
Configuration
Use WSL 2 instead of Hyper-V (recommended)
Add shortcut to desktop


Installing Docker Desktop 4.39.0 (184744)
Docker Desktop 4.39.0
Installation succeeded
You must restart Windows to complete installation.
Close and restart


Finish setting up Docker Desktop
version 4.39.0 (184744)
Complete the installation of Docker Desktop.
Use recommended settings (requires administrator password)
Docker Desktop automatically sets the necessary configurations that work for most developers.
Use advanced settings
You manually set your preferred configurations.
Finish



docker

Sign in

Using Docker for work? We recommend signing in with your work email address.

Username or email address*

intazachaudhary@gmail.com

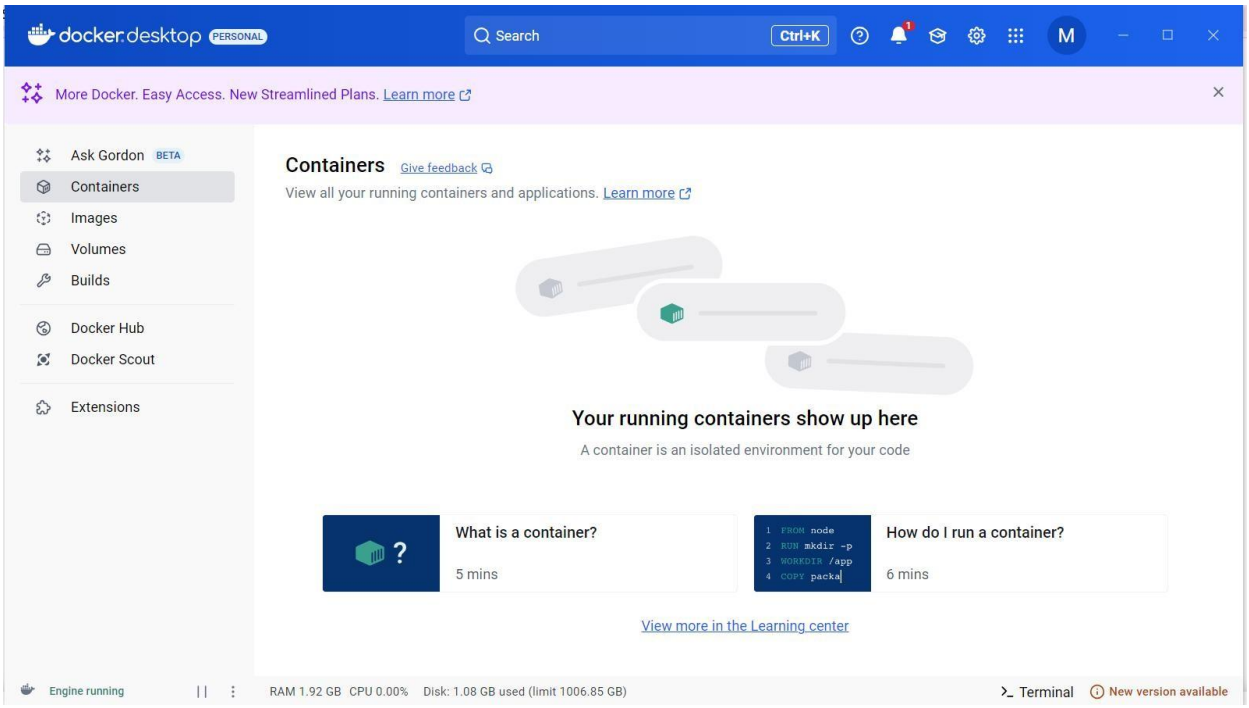
Continue

OR

Continue with Google

Continue with GitHub

Continue with SSO

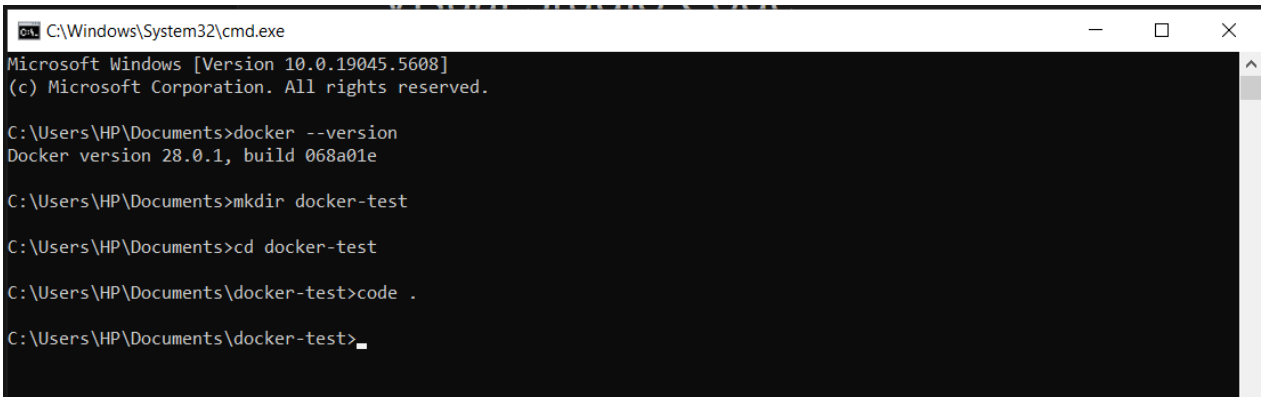


Step 2:To verify installation, open **Command Prompt (CMD)** or **PowerShell** and type:

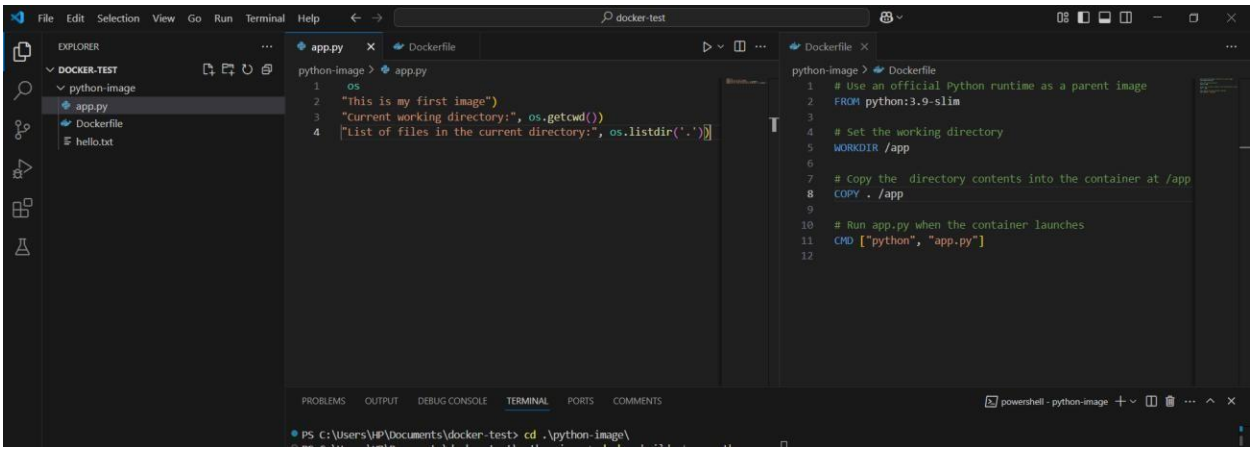
```
docker –version
```

Create a new folder for your project:

```
mkdir docker-test
cd docker-test
```



Step 3:Open any code editor (e.g., VS Code) and create a file named `Dockerfile` (no extension).



Step 4: Add the following sample content

App.py

```
import os
print("This is my first image")
print("Current working directory:", os.getcwd())
print("List of files in the current directory:", os.listdir('.'))
```

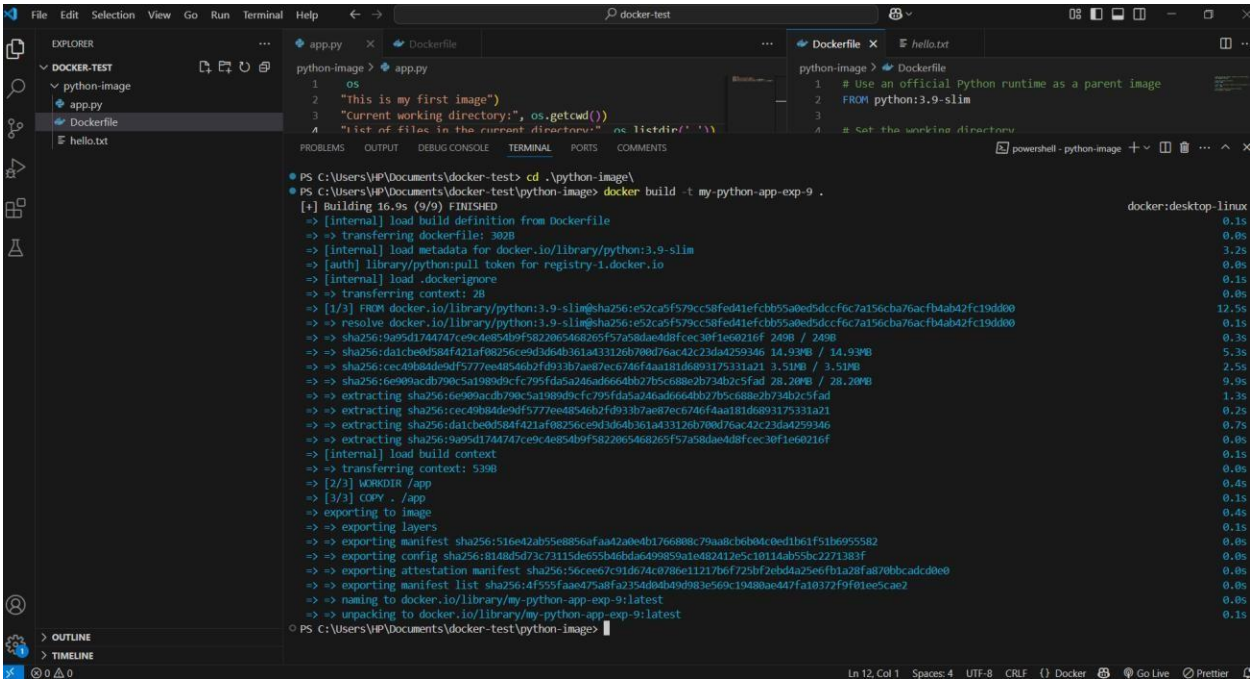
Dockerfile

```
# Use an official Python runtime as a parent image
FROM python:3.9-slim

# Set the working directory
WORKDIR /app

# Copy the  directory contents into the container at /app
COPY . /app

# Run app.py when the container launches
CMD ["python", "app.py"]
```

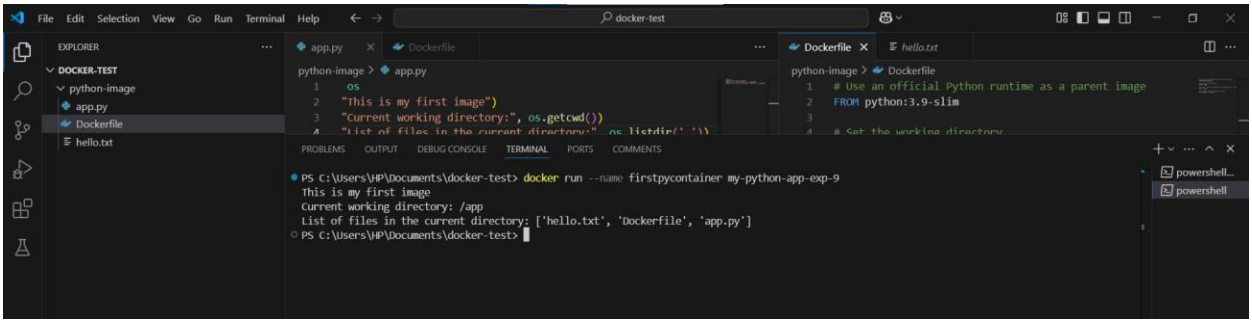
Hello.txt

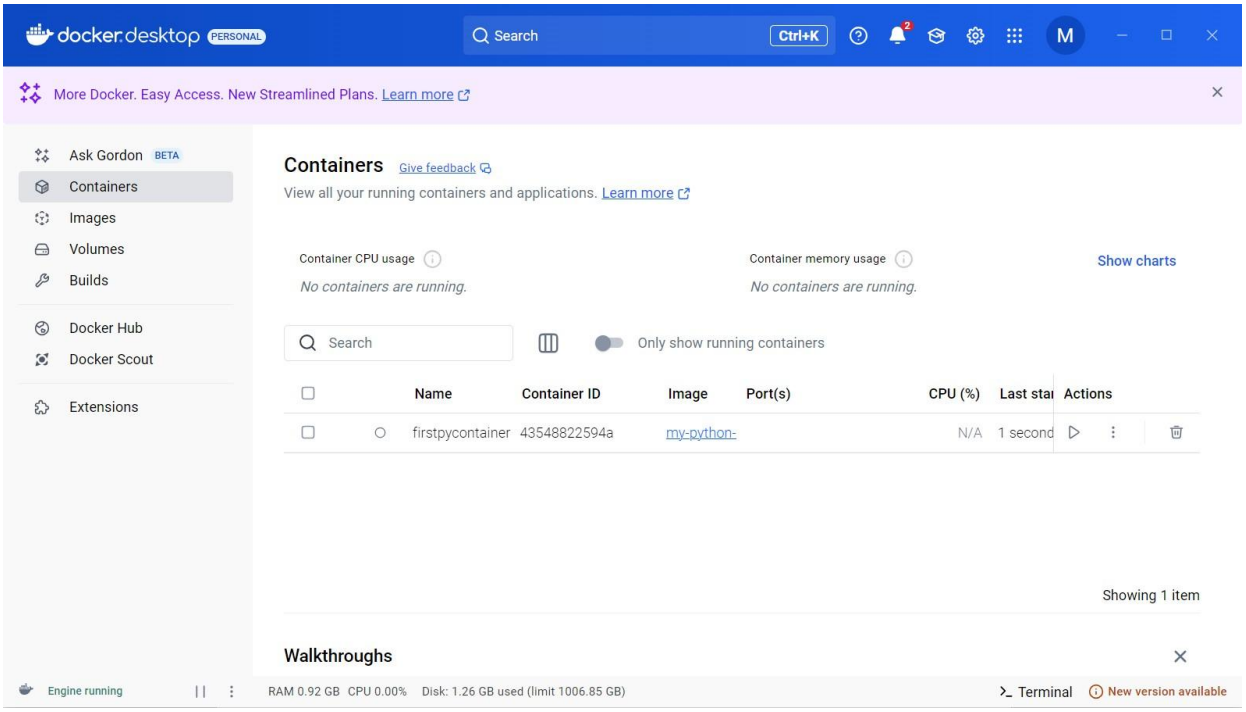
hii

Step 5;Build the Docker Image



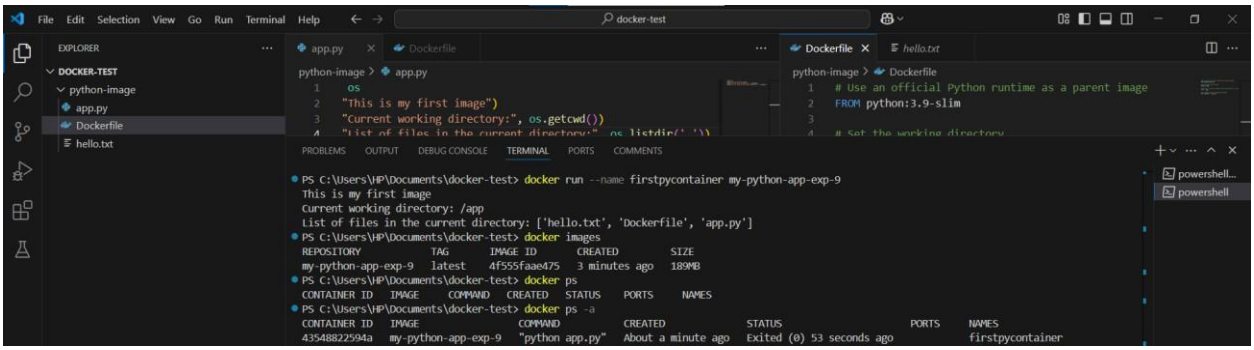
Step 6: Run the Docker Image

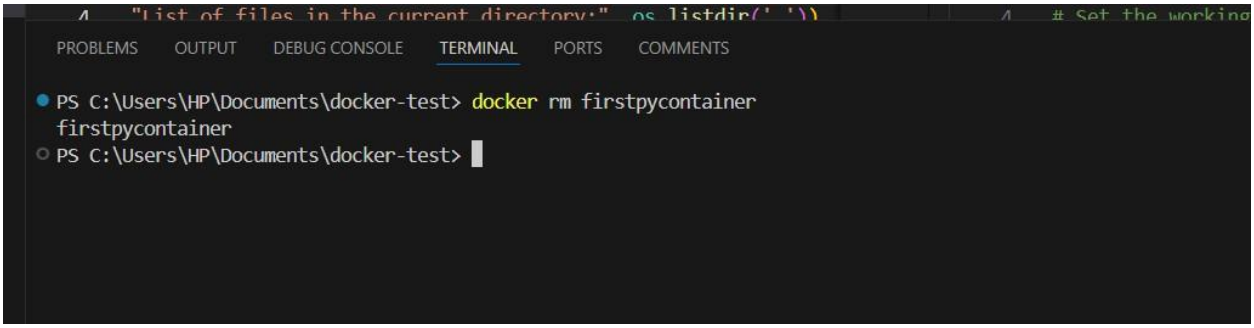


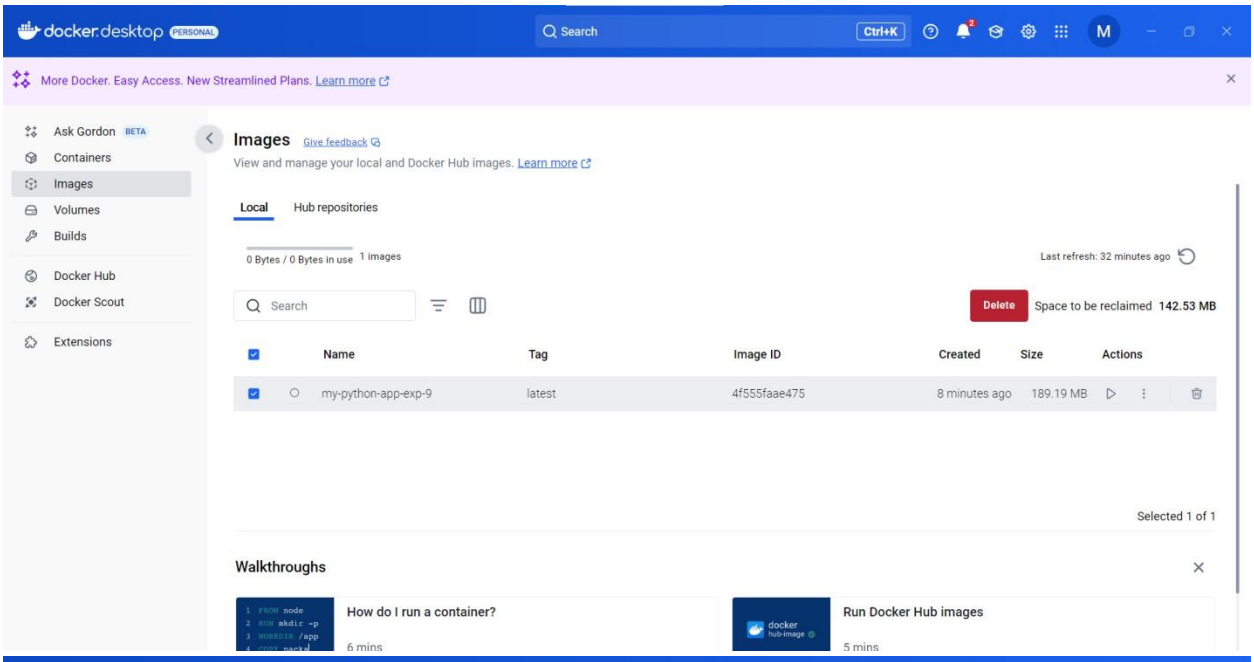


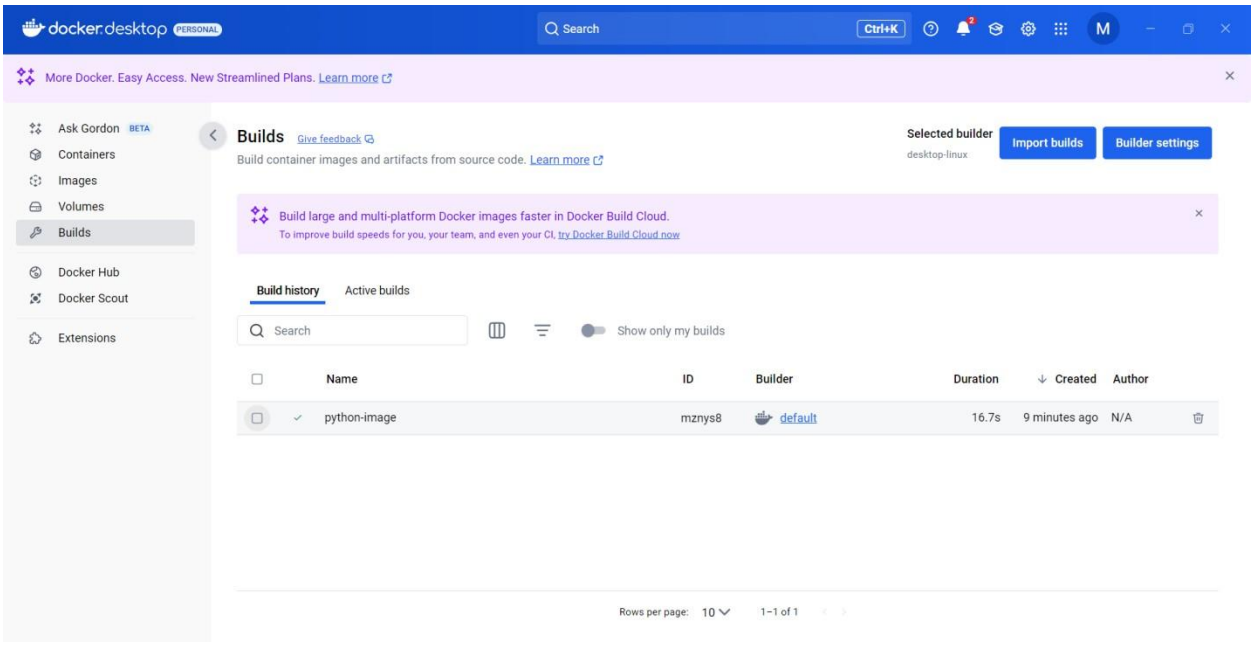
Step 7:Bonus Commands

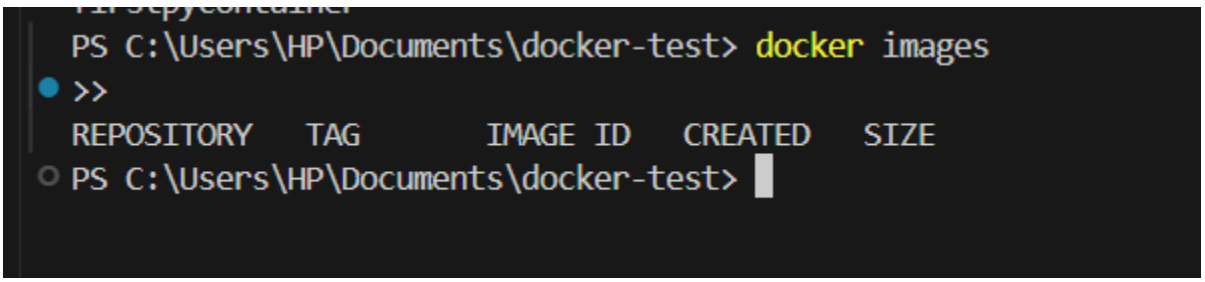
- **List all images**: `docker images`
- **List running containers**: `docker ps`
- **List all containers (including stopped)**: `docker ps -a`
- **Stop a running container** (use container ID): `docker stop <container-id>`






docker desktop PERSONAL
Search Ctrl+K
More Docker. Easy Access. New Streamlined Plans. Learn more
Ask Gordon BETA
Containers
Images
Volumes
Builds
Docker Hub
Docker Scout
Extensions
Images
Give feedback
View and manage your local and Docker Hub images. Learn more
Local
Hub repositories
0 Bytes / 0 Bytes in use
1 images
Last refresh: 32 minutes ago
Search
Delete
Space to be reclaimed 142.53 MB
Name
Tag
Image ID
Created
Size
Actions
my-python-app-exp-9
latest
4f555faae475
8 minutes ago
189.19 MB
Selected 1 of 1
Walkthroughs
How do I run a container?
6 mins
Run Docker Hub images
5 mins


docker desktop PERSONAL
Search Ctrl+K
More Docker. Easy Access. New Streamlined Plans. Learn more
Ask Gordon BETA
Containers
Images
Volumes
Builds
Docker Hub
Docker Scout
Extensions
Builds
Give feedback
Build container images and artifacts from source code. Learn more
Selected builder
desktop-linux
Import builds
Builder settings
Build large and multi-platform Docker images faster in Docker Build Cloud.
To improve build speeds for you, your team, and even your CI, try Docker Build Cloud now
Build history
Active builds
Search
Show only my builds
Name
ID
Builder
Duration
Created
Author
python-image
mznys8
default
16.7s
9 minutes ago
N/A
Rows per page: 10
1–1 of 1


PS C:\Users\HP\Documents\docker-test> docker images
>>
REPOSITORY TAG IMAGE ID CREATED SIZE
PS C:\Users\HP\Documents\docker-test>

B.1Question of Curiosity:

Q.1 *What is containerization*?

Ans: Containerization is a method of packaging, distributing, and running applications within isolated environments called containers. These containers encapsulate everythingneeded to run an application, including code, runtime, libraries, and dependencies. Unliketraditional virtual machines, containers share the host operating system's kernel, makingthem lightweight and more efficient. Containerization facilitates portability, scalability, and consistency across different computing environments, enabling developers to build, deploy, and manage applications more efficiently across various platforms and infrastructure.

Q.2 Difference between virtualization and containerization.

Aspect	Virtualization (VM)	Containerization (Docker)
Isolation	Full OS-level isolation with its own kernel	Process-level isolation using the host OS kernel
Resource Usage	Heavy; each VM runs its own full OS	Lightweight; containers share the host OS
Startup Time	Slow (in minutes)	Fast (in seconds)
Performance	Slower due to full OS overhead	Faster due to minimal abstraction
Size	Large (GBs, due to OS image)	Small (MBs, since only app and dependencies are included)
Portability	Less portable; depends on hypervisor and OS	Highly portable; runs the same way on any OS with Docker installed
Boot Process	Full OS boot required	Just starts the app process
Isolation Scope	Hardware-level using hypervisor	OS-level using namespaces and cgroups
Use Cases	Best for running multiple different OSes	Best for microservices, lightweight app deployment

Aspect	Virtualization (VM)	Containerization (Docker)
Example Tools	VMware, VirtualBox, Hyper-V	Docker, Podman, containerd

Q.3 What is docker image?

Ans: A Docker image is a lightweight, standalone, and executable package that contains all the necessary components to run a software application, including code, libraries, dependencies, and runtime environment. It serves as a blueprint for creating Docker containers. Docker images are built from a Docker file, which specifies the configuration and instructions for assembling the image layer by layer. These images can be easily shared, distributed, and deployed across different environments, ensuring consistency and reproducibility in application deployment processes.

Q.4 What is docker container?

Ans: A Docker container is a runtime instance of a Docker image. It is a lightweight, standalone, and executable environment that encapsulates an application along with its dependencies. Containers run isolated from each other and from the underlying host system, leveraging kernel-level features like namespaces and control groups for resourceisolation and management. Docker containers provide consistency in application deployment across different environments, enabling developers to package, deploy, and manage applications efficiently and reliably, irrespective of the underlying infrastructure.

B.3 Conclusion:

After performing this experiment, I learned the core concepts of containerization using Docker. I understood the difference between virtualization and containerization and successfully created and ran a Docker container on my local machine. This will help me deploy apps in a more efficient and portable way.