

## Experiment 9 : Docker basics

### Aim :

To understand Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with Containers.

### Theory :

Docker is a platform designed to make it easier to create, deploy, and run applications by using containers. Containers allow a developer to package up an application with all parts it needs, such as libraries and other dependencies, and ship it all out as one package. Here's a detailed look at the basics of Docker:

#### 1. What is Docker?

Docker is an open-source platform that automates the deployment of applications inside lightweight, portable containers. A container is a standard unit of software that packages up code and all its dependencies so the application runs quickly and reliably from one computing environment to another.

---

#### 2. Key Concepts in Docker

##### Containers

- **Definition:** Containers are isolated environments where applications run with everything they need to function.
- **Features:** They are lightweight, fast, and share the host OS kernel, making them more efficient than virtual machines.

##### Images

- **Definition:** An image is a read-only template used to create containers. It includes the application code, libraries, and other dependencies.

- **How it works:** You build an image, then run a container based on that image.

#### Docker Engine

- The core component of Docker that runs and manages containers.
- It has two main parts:
  - **Server:** A long-running daemon process (`dockerd`) that manages containers.
  - **Client:** The command-line interface (`docker`) that users interact with.

#### Docker Hub & Registry

- **Docker Hub:** A cloud-based registry service where Docker images are stored and shared.
  - **Registry:** A service for storing and distributing Docker images. Docker Hub is the default registry, but you can set up private registries.
- 

### 3. How Docker Works

- **Dockerfile:** A script that contains instructions to assemble a Docker image. It defines the base image, application code, and dependencies.
  - **Building Images:** Using the command `docker build`, Docker reads the Dockerfile and creates an image.
  - **Running Containers:** Using `docker run`, Docker starts a container from an image.
- 

### 4. Why Use Docker?

- **Portability:** Containers can run on any system that has Docker installed, regardless of the underlying hardware or OS.

- **Consistency:** The application runs the same way in development, testing, and production environments.
  - **Isolation:** Each container is isolated from others, preventing conflicts between applications.
  - **Efficiency:** Containers are lightweight, using fewer resources compared to virtual machines.
- 

## 5. Basic Docker Commands

- `docker --version`: Check Docker version.
  - `docker pull <image>`: Download an image from Docker Hub.
  - `docker build -t <name> .`: Build an image from a Dockerfile.
  - `docker run <image>`: Run a container from an image.
  - `docker ps`: List running containers.
  - `docker ps -a`: List all containers (including stopped ones).
  - `docker stop <container_id>`: Stop a running container.
  - `docker rm <container_id>`: Remove a container.
  - `docker rmi <image_name>`: Remove an image.
- 

## 6. Docker Compose

- A tool for defining and running multi-container Docker applications.
- Uses a YAML file (`docker-compose.yml`) to configure services, networks, and volumes.
- Command: `docker-compose up` to start all services defined in the file.

## 7. Real-World Use Cases

- **Microservices Architecture:** Running different microservices in isolated containers.
- **Continuous Integration/Continuous Deployment (CI/CD):** Automating testing and deployment processes.
- **DevOps and Infrastructure as Code:** Simplifying the deployment of complex applications.

## Output :

```
docker run nginx:1.23
./MiscRepos/sepm_lab/files git:(master)±9 (0.675s)
docker -v
Docker version 28.0.1, build 068a01e

./MiscRepos/sepm_lab/files git:(master)±9 (40.969s)
docker pull nginx:1.23
1.23: Pulling from library/nginx
9989f7b33228: Pull complete
f03b40093957: Pull complete
6c1a86118ade: Pull complete
a85095acb896: Pull complete
d24b987aa74e: Pull complete
0972072e0e8a: Pull complete
Digest: sha256:f5747a42e3adcb3168049d63278d7251d91185bb5111d2563d58729a5c9179b0
Status: Downloaded newer image for nginx:1.23
docker.io/library/nginx:1.23

./MiscRepos/sepm_lab/files git:(master)±9 (0.721s)
docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
nginx         1.23      f5747a42e3ad   22 months ago 214MB
```

```
./MiscRepos/sepm_lab/files git:(master)±9 (16.855s)
docker pull nginx
Using default tag: latest
latest: Pulling from library/nginx
6e909acdb790: Pull complete
97f5c0f51d43: Pull complete
5eaa34f5b9c2: Pull complete
417c4bccf534: Pull complete
e7e0ca015e55: Pull complete
c22eb46e871a: Pull complete
373fe654e984: Pull complete
Digest: sha256:124b44bfc9ccd1f3cedf4b592d4d1e8bddb78b51ec2ed5056c52d3692baebc19
Status: Downloaded newer image for nginx:latest
docker.io/library/nginx:latest

./MiscRepos/sepm_lab/files git:(master)±9 (1.127s)
docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
nginx         latest    124b44bfc9cc   7 weeks ago   279MB
nginx         1.23      f5747a42e3ad   22 months ago 214MB
```

```

/d/MiscRepos/sepm_lab/files git:(master)±9
docker run nginx:1.23

/docker-entrypoint.sh: /docker-entrypoint.d/ is not empty, will attempt to perform configuration
/docker-entrypoint.sh: Looking for shell scripts in /docker-entrypoint.d/
/docker-entrypoint.sh: Launching /docker-entrypoint.d/10-listen-on-ipv6-by-default.sh
10-listen-on-ipv6-by-default.sh: info: Getting the checksum of /etc/nginx/conf.d/default.conf
10-listen-on-ipv6-by-default.sh: info: Enabled listen on IPv6 in /etc/nginx/conf.d/default.conf
/docker-entrypoint.sh: Launching /docker-entrypoint.d/20-envsubst-on-templates.sh
/docker-entrypoint.sh: Launching /docker-entrypoint.d/30-tune-worker-processes.sh
/docker-entrypoint.sh: Configuration complete; ready for start up
2025/04/02 13:34:51 [notice] 1#1: using the "epoll" event method
2025/04/02 13:34:51 [notice] 1#1: nginx/1.23.4
2025/04/02 13:34:51 [notice] 1#1: built by gcc 10.2.1 20210110 (Debian 10.2.1-6)
2025/04/02 13:34:51 [notice] 1#1: OS: Linux 5.15.167.4-microsoft-standard-WSL2
2025/04/02 13:34:51 [notice] 1#1: getrlimit(RLIMIT_NOFILE): 1048576:1048576
2025/04/02 13:34:51 [notice] 1#1: start worker processes
2025/04/02 13:34:51 [notice] 1#1: start worker process 29
2025/04/02 13:34:51 [notice] 1#1: start worker process 30
2025/04/02 13:34:51 [notice] 1#1: start worker process 31
2025/04/02 13:34:51 [notice] 1#1: start worker process 32

```

```

/d/MiscRepos/sepm_lab/files git:(master)±9 (0.712s)
docker ps

```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
4ede9b099710	nginx:1.23	"/docker-entrypoint. ...."	About a minute ago	Up About a minute	80/tcp	epic_mirzakhani

```

/d/MiscRepos/sepm_lab/files git:(master)~ ±9

```

```

/d/MiscRepos/sepm_lab/files git:(master)±9 (2.813s)
docker run -d nginx:1.23
a8c8bd4b3b4912b37e3d407427e975a56fd722df027f0012e2c03c4199f77291

/d/MiscRepos/sepm_lab/files git:(master)±9 (0.784s)
docker ps

```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
a8c8bd4b3b49	nginx:1.23	"/docker-entrypoint. ...."	8 seconds ago	Up 6 seconds	80/tcp	amazing_jepsen

```

/d/MiscRepos/sepm_lab/files git:(master)±9 (0.647s)
docker logs a8c8bd4b3b49

/docker-entrypoint.sh: /docker-entrypoint.d/ is not empty, will attempt to perform configuration
/docker-entrypoint.sh: Looking for shell scripts in /docker-entrypoint.d/
/docker-entrypoint.sh: Launching /docker-entrypoint.d/10-listen-on-ipv6-by-default.sh
10-listen-on-ipv6-by-default.sh: info: Getting the checksum of /etc/nginx/conf.d/default.conf
10-listen-on-ipv6-by-default.sh: info: Enabled listen on IPv6 in /etc/nginx/conf.d/default.conf
/docker-entrypoint.sh: Launching /docker-entrypoint.d/20-envsubst-on-templates.sh
/docker-entrypoint.sh: Launching /docker-entrypoint.d/30-tune-worker-processes.sh
/docker-entrypoint.sh: Configuration complete; ready for start up
2025/04/02 13:40:12 [notice] 1#1: using the "epoll" event method
2025/04/02 13:40:12 [notice] 1#1: nginx/1.23.4
2025/04/02 13:40:12 [notice] 1#1: built by gcc 10.2.1 20210110 (Debian 10.2.1-6)
2025/04/02 13:40:12 [notice] 1#1: OS: Linux 5.15.167.4-microsoft-standard-WSL2
2025/04/02 13:40:12 [notice] 1#1: getrlimit(RLIMIT_NOFILE): 1048576:1048576
2025/04/02 13:40:12 [notice] 1#1: start worker processes
2025/04/02 13:40:12 [notice] 1#1: start worker process 29
2025/04/02 13:40:12 [notice] 1#1: start worker process 30
2025/04/02 13:40:12 [notice] 1#1: start worker process 31
2025/04/02 13:40:12 [notice] 1#1: start worker process 32

```

```

/d/MiscRepos/sepm_lab/files git:(master)~ ±9

```

```

/d/MiscRepos/sepm_lab/files git:(master)±9
docker run nginx:latest

/docker-entrypoint.sh: /docker-entrypoint.d/ is not empty, will attempt to perform configuration
/docker-entrypoint.sh: Looking for shell scripts in /docker-entrypoint.d/
/docker-entrypoint.sh: Launching /docker-entrypoint.d/10-listen-on-ipv6-by-default.sh
10-listen-on-ipv6-by-default.sh: info: Getting the checksum of /etc/nginx/conf.d/default.conf
10-listen-on-ipv6-by-default.sh: info: Enabled listen on IPv6 in /etc/nginx/conf.d/default.conf
/docker-entrypoint.sh: Sourcing /docker-entrypoint.d/15-local-resolvers.envsh
/docker-entrypoint.sh: Launching /docker-entrypoint.d/20-envsubst-on-templates.sh
/docker-entrypoint.sh: Launching /docker-entrypoint.d/30-tune-worker-processes.sh
/docker-entrypoint.sh: Configuration complete; ready for start up
2025/04/02 13:43:21 [notice] 1#1: using the "epoll" event method
2025/04/02 13:43:21 [notice] 1#1: nginx/1.27.4
2025/04/02 13:43:21 [notice] 1#1: built by gcc 12.2.0 (Debian 12.2.0-14)
2025/04/02 13:43:21 [notice] 1#1: OS: Linux 5.15.167.4-microsoft-standard-WSL2
2025/04/02 13:43:21 [notice] 1#1: getrlimit(RLIMIT_NOFILE): 1048576:1048576
2025/04/02 13:43:21 [notice] 1#1: start worker processes
2025/04/02 13:43:21 [notice] 1#1: start worker process 29
2025/04/02 13:43:21 [notice] 1#1: start worker process 30
2025/04/02 13:43:21 [notice] 1#1: start worker process 31
2025/04/02 13:43:21 [notice] 1#1: start worker process 32

```

```
/d/MiscRepos/sepm_lab/files git:(master)±9 (0.668s)
docker ps
CONTAINER ID   IMAGE      COMMAND                  CREATED        STATUS        PORTS        NAMES
b59d07d59184   nginx:latest  "/docker-entrypoint..."  11 seconds ago  Up 10 seconds  80/tcp      intelligent_beaver
a8c8bd4b3b49   nginx:1.23   "/docker-entrypoint..."  3 minutes ago   Up 3 minutes   80/tcp      amazing_jepsen
```

```
/d/MiscRepos/sepm_lab/files git:(master)~ ±9
```

```
/d/MiscRepos/sepm_lab/files git:(master)±9 (0.775s)
docker ps
CONTAINER ID   IMAGE      COMMAND                  CREATED        STATUS        PORTS        NAMES
a8c8bd4b3b49   nginx:1.23   "/docker-entrypoint..."  6 minutes ago   Up 6 minutes   80/tcp      amazing_jepsen
```

```
/d/MiscRepos/sepm_lab/files git:(master)±9 (1.199s)
docker stop a8c8bd4b3b49
a8c8bd4b3b49
```

```
/d/MiscRepos/sepm_lab/files git:(master)±9 (0.668s)
docker ps
CONTAINER ID   IMAGE      COMMAND                  CREATED        STATUS        PORTS        NAMES
```

```
/d/MiscRepos/sepm_lab/files git:(master)~ ±9
```

```
/d/MiscRepos/sepm_lab/files git:(master)±9 (1.164s)
docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
nginx         latest    124b44bfc9cc   7 weeks ago    279MB
nginx         1.23     f5747a42e3ad   22 months ago  214MB
```

```
/d/MiscRepos/sepm_lab/files git:(master)±9 (2.851s)
docker run -d -p 9000:80 nginx:1.23
e84b49b3ac88f8be69f82ce3fc6032c1294c29506389674099762f43d0c0fe93
```

```
/d/MiscRepos/sepm_lab/files git:(master)±9 (0.729s)
docker ps
CONTAINER ID   IMAGE      COMMAND                  CREATED        STATUS        PORTS        NAMES
e84b49b3ac88   nginx:1.23   "/docker-entrypoint..."  17 seconds ago  Up 15 seconds  0.0.0.0:9000->80/tcp  happy_torvalds
```

```
/d/MiscRepos/sepm_lab/files git:(master)~ ±9
```

Welcome to nginx!

localhost:9000

# Welcome to nginx!

If you see this page, the nginx web server is successfully installed and working. Further configuration is required.

For online documentation and support please refer to [nginx.org](https://nginx.org).  
Commercial support is available at [nginx.com](https://nginx.com).

*Thank you for using nginx.*

```

/d/MiscRepos/sepm_lab/files git:(master)±9 (1.145s)
docker logs e84b49b3ac88
/docker-entrypoint.sh: /docker-entrypoint.d/ is not empty, will attempt to perform configuration
/docker-entrypoint.sh: Looking for shell scripts in /docker-entrypoint.d/
/docker-entrypoint.sh: Launching /docker-entrypoint.d/10-listen-on-ipv6-by-default.sh
10-listen-on-ipv6-by-default.sh: info: Getting the checksum of /etc/nginx/conf.d/default.conf
10-listen-on-ipv6-by-default.sh: info: Enabled listen on IPv6 in /etc/nginx/conf.d/default.conf
/docker-entrypoint.sh: Launching /docker-entrypoint.d/20-envsubst-on-templates.sh
/docker-entrypoint.sh: Launching /docker-entrypoint.d/30-tune-worker-processes.sh
/docker-entrypoint.sh: Configuration complete; ready for start up
2025/04/02 13:48:40 [notice] 1#1: using the "epoll" event method
2025/04/02 13:48:40 [notice] 1#1: nginx/1.23.4
2025/04/02 13:48:40 [notice] 1#1: built by gcc 10.2.1 202110110 (Debian 10.2.1-6)
2025/04/02 13:48:40 [notice] 1#1: OS: Linux 5.15.167.4-microsoft-standard-WSL2
2025/04/02 13:48:40 [notice] 1#1: getrlimit(RLIMIT_NOFILE): 1048576:1048576
2025/04/02 13:48:40 [notice] 1#1: start worker processes
2025/04/02 13:48:40 [notice] 1#1: start worker process 30
2025/04/02 13:48:40 [notice] 1#1: start worker process 31
2025/04/02 13:48:40 [notice] 1#1: start worker process 32
2025/04/02 13:48:40 [notice] 1#1: start worker process 33
172.17.0.1 - - [02/Apr/2025:13:49:09 +0000] "GET / HTTP/1.1" 200 615 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/134.0.0.0 Safari/537.36" "-"
2025/04/02 13:49:09 [error] 31#31: *1 open() "/usr/share/nginx/html/favicon.ico" failed (2: No such file or directory), client: 172.17.0.1, server: localhost, request: "GET /favicon.ico HTTP/1.1", host: "localhost:9000", referer: "http://localhost:9000/"
172.17.0.1 - - [02/Apr/2025:13:49:09 +0000] "GET /favicon.ico HTTP/1.1" 404 555 "http://localhost:9000/" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/134.0.0.0 Safari/537.36" "-"

/d/MiscRepos/sepm_lab/files git:(master)~ ±9
|

```

```

/d/MiscRepos/sepm_lab/files git:(master)±9 (0.728s)
docker ps -a

```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
e84b49b3ac88	nginx:1.23	"/docker-entrypoint..."	4 minutes ago	Up 4 minutes	0.0.0.0:9000->80/tcp	happy_torvalds
b59d07d59184	nginx:latest	"/docker-entrypoint..."	10 minutes ago	Exited (0) 7 minutes ago		intelligent_beaver
a8c8bd4b3b49	nginx:1.23	"/docker-entrypoint..."	13 minutes ago	Exited (0) 6 minutes ago		amazing_jepsen
4ede9b099710	nginx:1.23	"/docker-entrypoint..."	18 minutes ago	Exited (0) 13 minutes ago		epic_mirzakhani

```

/d/MiscRepos/sepm_lab/files git:(master)±9 (3.44s)
docker stop happy_torvalds
happy_torvalds

/d/MiscRepos/sepm_lab/files git:(master)±9 (2.124s)
docker run --name web_app -d -p 9000:80 nginx:1.23
7427673945ec2a4857141364b221bd3042ecec05d0ebd96141161e79aa81ee35

/d/MiscRepos/sepm_lab/files git:(master)±9 (0.789s)
docker ps

```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
7427673945ec	nginx:1.23	"/docker-entrypoint..."	5 seconds ago	Up 4 seconds	0.0.0.0:9000->80/tcp	web_app

```

/d/MiscRepos/sepm_lab/files git:(master)~ ±9

```

## Conclusion :

Docker revolutionizes the software development and deployment process by providing a powerful platform for containerization. By encapsulating applications and their dependencies into lightweight, portable containers.