ROUNAK KATIYAR
Batch: T - 13
Roll no. 47

EXPERIMENT 9

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:

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.

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.

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.

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.

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 -a : List all containers (including stopped ones)

- docker ps : List running containers.
- docker stop <container_id> : Stop a running container.
- docker rm <container_id> : Remove a container.
- docker rmi <image_name> : Remove an image.

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.

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.

DEMONSTRATION:

```
/d/MiscRepos/sepm_lab/files git:(master)±0 (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

/d/MiscRepos/sepm_lab/files git:(master)±0 (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)±0
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)±0 (0.772s)
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)✗ ±0
```

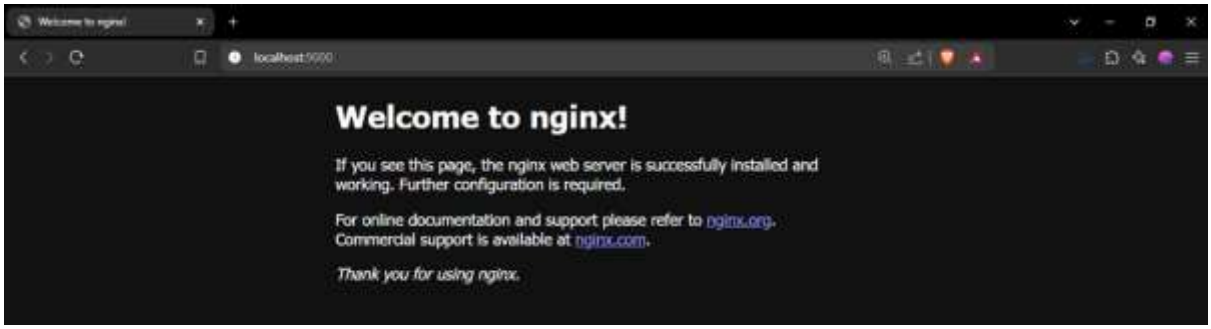
```
/d/MiscRepos/sepm_lab/files git:(master)±0 (2.013s)
docker run -d nginx:1.23

a8c8bd4b3b4912b37e3d487427e975a56fd722df027f0012e2c83c4199f77291

/d/MiscRepos/sepm_lab/files git:(master)±0 (0.704s)
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)±0 (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)✗ ±0
```

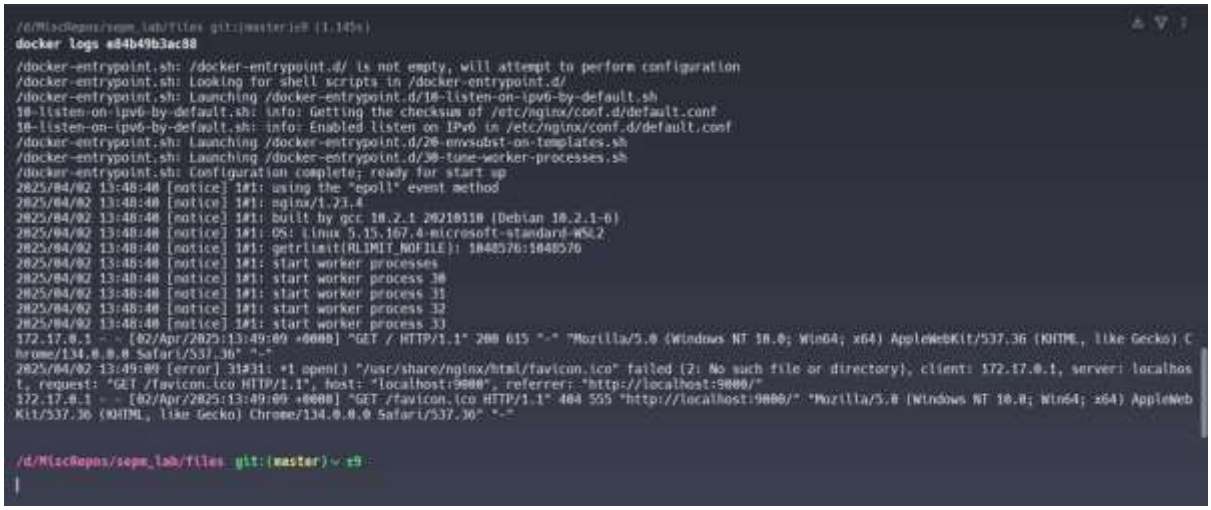
```
/d/MiscRepos/sepm_lab/files git:(master)±0
docker run nginx:latest

/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)±0 (0.668s)
docker ps
CONTAINER ID   IMAGE          COMMAND                  CREATED          STATUS          PORTS     NAMES
b59d87d59184   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)✓ ±0
```

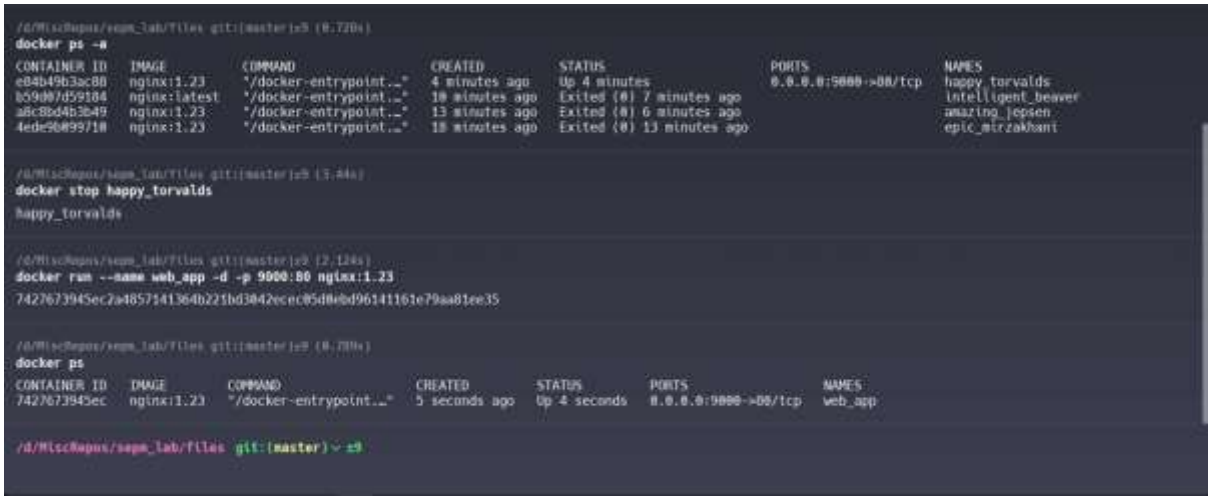
```
/d/MiscRepos/sepm_lab/files git:(master)±0 (0.775s)
docker ps
CONTAINER ID   IMAGE          COMMAND                  CREATED          STATUS          PORTS     NAMES
a8c8bd4b3b49   nginx:1.23     "/docker-entrypoint.…"   6 minutes ago    Up 6 minutes    80/tcp    amazing_jepsen

/d/MiscRepos/sepm_lab/files git:(master)±0 (1.199s)
docker stop a8c8bd4b3b49
a8c8bd4b3b49

/d/MiscRepos/sepm_lab/files git:(master)±0 (0.688s)
docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES

/d/MiscRepos/sepm_lab/files git:(master)✓ ±0
```

```
/d/MiscRepos/sepm_lab/files git:(master)±0 (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)±0 (2.851s)
docker run -d -p 9000:80 nginx:1.23
e84b49b3ac88f8be69f82ce3fc6032c1294c29506389074099762f43d0c0fe93

/d/MiscRepos/sepm_lab/files git:(master)±0 (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)✓ ±0
```





```
/d/MiscRepos/sepm_lab/files git:(master)±0 (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 20210110 (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) C
hrome/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: localhos
t, request: "GET /favicon.ico HTTP/1.1", host: "localhost:9000", referrer: "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) AppleWeb
Kit/537.36 (KHTML, like Gecko) Chrome/134.0.0.0 Safari/537.36" "-"

/d/MiscRepos/sepm_lab/files git:(master)✗ ±0
```



```
/d/MiscRepos/sepm_lab/files git:(master)±0 (0.720s)
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
b59d07d59104   nginx:latest   "/docker-entrypoint.…"   10 minutes ago   Exited (0) 7 minutes ago                             intelligent_beaver
a8c88d4b3b49   nginx:1.23     "/docker-entrypoint.…"   13 minutes ago   Exited (0) 6 minutes ago                             amazing_lepsen
4ede9b099710   nginx:1.23     "/docker-entrypoint.…"   18 minutes ago   Exited (0) 13 minutes ago                            epic_mirzakhani

/d/MiscRepos/sepm_lab/files git:(master)±0 (3.44s)
docker stop happy_torvalds
happy_torvalds

/d/MiscRepos/sepm_lab/files git:(master)±0 (2.124s)
docker run --name web_app -d -p 9000:80 nginx:1.23
7427673945ec2a485714364b221bd3042ecec85d0e0d96141161e79aa81ee35

/d/MiscRepos/sepm_lab/files git:(master)±0 (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)✗ ±0
```

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.