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Experiment 9 : Docker basics

<u>Aim</u>:

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.

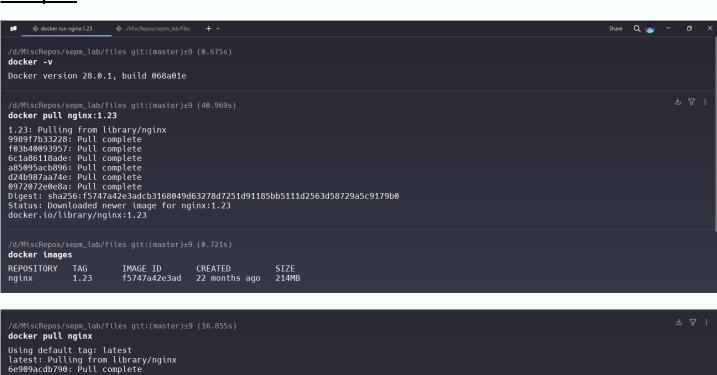
6. Docker Compose

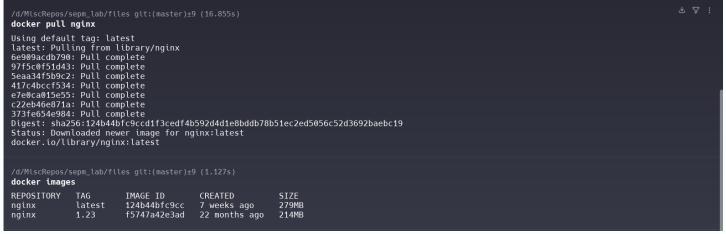
- A tool for defining and running multi-container Docker applications.
- Uses a YAML file (docker-compose.yml) to configure services, networks, and volumes.
- Command: docker-compose up to start all services defined in the file.

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.

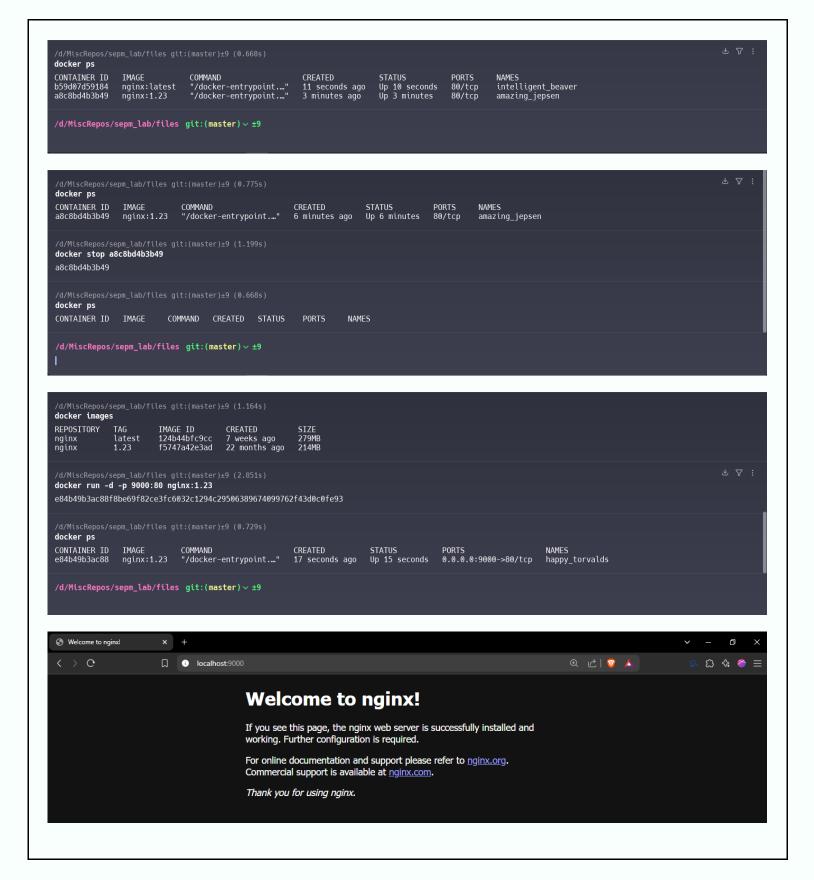
Output:





```
/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: Looking for shell scripts in /docker-entrypoint.d/ /docker-entrypoint.sh: Launching /docker-entrypoint.d/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/20-envsubst-on-templates.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: using the "epoll" event method 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: 05: Linux 5.15.167.4-microsoft-standard-WSL2 2025/04/02 13:34:51 [notice] 1#1: start worker processes 2025/04/02 13:34:51 [notice] 1#1: start worker process 20 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 31 2025/04/02 13:34:51 [notice] 1#1: start worker process 32
   docker ps
  CONTAINER ID
                                                                                IMAGE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 PORTS
                                                                              nginx:1.23 "/docker-entrypoint..."
   4ede9b099710
                                                                                                                                                                                                                                                                                        About a minute ago
                                                                                                                                                                                                                                                                                                                                                                                                      Up About a minute
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                80/tcp
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    epic_mirzakhani
   /d/MiscRepos/sepm_lab/files git:(master) v ±9
   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 a8c8bd4b3b49 nginx:1.23 "/docker-entrypoint..." 8 seconds ago Up 6 seconds
                                                                                                                                                                                                                                                                                                                                                                                                                   PORTS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                   NAMES
                                                                                                                                                                                                                                                                                                                                                                                                                 80/tcp
                                                                                                                                                                                                                                                                                                                                                                                                                                                                   amazing_jepsen
   docker logs a8c8bd4b3b49
 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: Looking for shell scripts in /docker-entrypoint.d/ /docker-entrypoint.sh: Launching /docker-entrypoint.d/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: Getting the checksum of /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 "eppll" event method 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: built by gcc 10.2.1 20210110 (Debian 10.2.1-6) 2025/04/02 13:40:12 [notice] 1#1: start worker processes 2025/04/02 13:40:12 [notice] 1#1: start worker process 20 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) v ±9
   docker run nginx:latest
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: 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-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: using the "epoll" event method
2025/04/02 13:43:21 [notice] 1#1: 05: Linux 5.15.167.4-microsoft-standard-WSL2
2025/04/02 13:43:21 [notice] 1#1: start worker processes
2025/04/02 13:43:21 [notice] 1#1: start worker process 20
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/MtscRepos/sepm_lab/files glt:(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: looking for shell scripts in /docker-entrypoint.d/
/docker-entrypoint.sh: launching /docker-entrypoint.d/lel-listen-on-lpv6-by-default.sh: info: Getting the checksum of /etc/nginx/conf.d/default.conf

10-listen-on-lpv6-by-default.sh: info: Getting the checksum of /etc/nginx/conf.d/default.conf
/docker-entrypoint.sh: domination /docker-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d/le-entrypoint.d
```

```
docker ps -a
CONTAINER ID
                      IMAGE
                                             COMMAND
                                                                                   CREATED
                                                                                                              STATUS
                                                                                                            STATUS
Up 4 minutes
Exited (0) 7 minutes ago
Exited (0) 6 minutes ago
Exited (0) 13 minutes ago
                                                                                   4 minutes ago
10 minutes ago
13 minutes ago
18 minutes ago
                      nginx:1.23 "/docker-entrypoint..."
nginx:latest "/docker-entrypoint..."
nginx:1.23 "/docker-entrypoint..."
                                                                                                                                                                                           happy_torvalds
intelligent_beaver
                     nginx:1.23
                                                                                                                                                        0.0.0.0:9000->80/tcp
b59d07d59184
a8c8bd4b3b49
                                                                                                                                                                                           amazing_jepsen
epic_mirzakhani
                                             "/docker-entrypoint..."
4ede9b099710
                      nginx:1.23
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
docker ps
                                                                                                                               PORTS
0.0.0.0:9000->80/tcp
CONTAINER ID IMAGE COMMAND CREATED 7427673945ec nginx:1.23 "/docker-entrypoint..." 5 seconds ago
                                                                                                         STATUS
                                                                                                       Up 4 seconds
/d/MiscRepos/sepm_lab/files git:(master) v ±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.