Placement Empowerment Program

Cloud Computing and DevOps Centre

Run Multiple Docker Containers and Monitor Them: Run multiple containers (e.g., Nginx and MySQL) and monitor their resource usage.

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Introduction

Docker is a containerization platform that allows developers to package applications and their dependencies into isolated environments called **containers**. Running multiple containers efficiently is crucial for microservices-based architectures. In this Proof of Concept (POC), we will deploy and manage multiple Docker containers—**Nginx** (a web server) and **MySQL** (a database). We will also monitor their resource usage using docker stats.

Overview

This POC demonstrates the process of:

1. **Setting up Docker on Windows**
2. **Running multiple containers** (Nginx and MySQL)
3. **Managing containers** (starting, stopping, removing)
4. **Monitoring container resource usage** (CPU, memory, network, and disk I/O)

We will use:

docker run to launch the containers

docker ps to check running containers

docker stats to monitor container performance

Objectives

1. Understand the fundamentals of **Docker containerization**.

2. Learn how to **deploy multiple containers** using the Docker CLI.

3. Gain hands-on experience with **managing containerized applications**.

4. Explore **resource monitoring techniques** for containerized applications.

5. Learn to troubleshoot **performance issues** using docker stats.

Importance

1. **Real-World Relevance** – Running multiple containers is essential for building scalable applications in **DevOps** and **Cloud environments**.

2. **Microservices & Scalability** – Modern applications rely on **multiple services** running in separate containers, such as **frontend, backend, and database services**.

3. **Performance Optimization** – Monitoring CPU, memory, and network usage helps **optimize resource allocation**, preventing application slowdowns.

4. **Foundation for Kubernetes & Docker Compose** – Understanding container monitoring lays the groundwork for **orchestrating containers using Kubernetes or Docker Compose**.

Step-by-Step Overview

Step 1:

Pull the Required Docker Images

Before running the containers, pull the necessary images from Docker Hub.

docker pull nginx

docker pull mysql

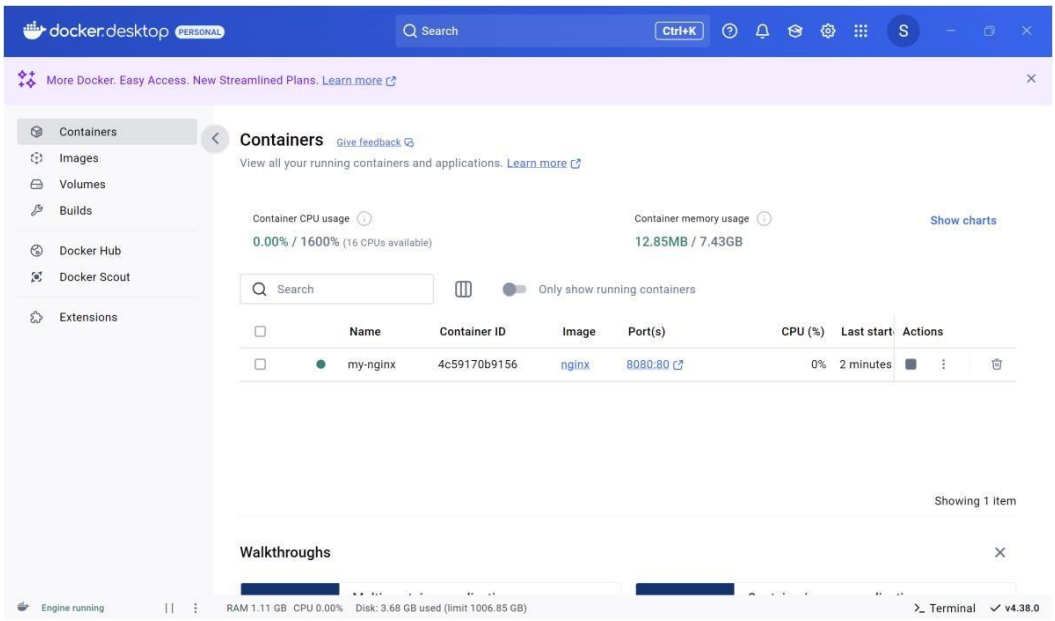
```
C:\Users\Hi>docker pull nginx
Using default tag: latest
latest: Pulling from library/nginx
84cade77a831: Download complete
976e8f6b25dd: Download complete
6c78b0ba1a32: Download complete
e19db8451adb: Download complete
24ff42a0d907: Download complete
c558df217949: Download complete
c29f5b76f736: Download complete
Digest: sha256:91734281c0ebfc6f1aea979cffeed5079cfe786228a71cc6f1f46a228cde6e34
Status: Downloaded newer image for nginx:latest
docker.io/library/nginx:latest

C:\Users\Hi>docker pull mysql
Using default tag: latest
latest: Pulling from library/mysql
277ab5f6ddde: Download complete
df1ba1ac457a: Download complete
cc9646b08259: Download complete
f56a22f949f9: Download complete
23d22e42ea50: Download complete
893b018337e2: Download complete
43759093d4f6: Download complete
2be0d473cadf: Download complete
d255dceb9ed5: Download complete
431b106548a3: Download complete
Digest: sha256:146682692a3aa409eae7b7dc6a30f637c6cb49b6ca901c2cd160becc81127d3b
Status: Downloaded newer image for mysql:latest
docker.io/library/mysql:latest
```

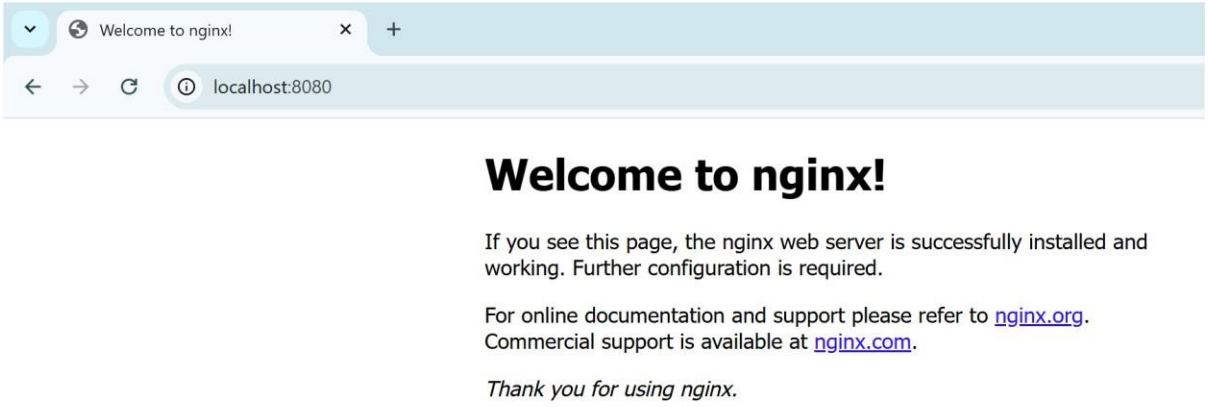
Step 2:

Run an **Nginx** container in detached mode (-d), mapping port 8080 on your host to port 80 inside the container. Verify it by Opening a new tab and search for **localhost:8080**

docker run -d --name my-nginx -p 8080:80 nginx

```
C:\Users\Hi>docker run -d --name my-nginx -p 8080:80 nginx
4c59170b9156378df7b3415b6999584e007a240101a2ce964b6bca3227d56feb
```



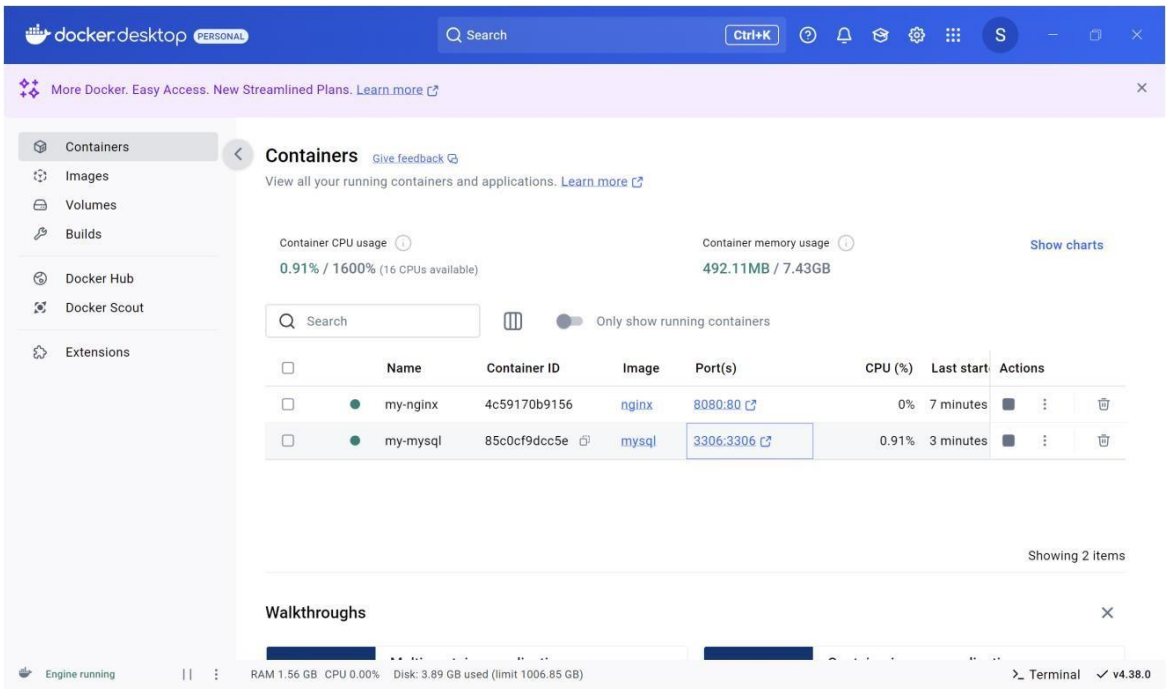


Step 3:

Run a **MySQL** container with environment variables for database credentials.

docker run -d --name my-mysql -e MYSQL_ROOT_PASSWORD=rootpassword -e MYSQL_DATABASE=mydb -p 3306:3306 mysql

```
C:\Users\Hi>docker run -d --name my-mysql -e MYSQL_ROOT_PASSWORD=rootpassword -e MYSQL_DATABASE=mydb -p 3306:3306 mysql
85c0cf9dcc5ec3b1794282928754c199e9d17c014520c43a78289a7b679ebd71
```



Step 4:

To check if the containers are running, use:

docker ps

This will show a list of active containers with details like container ID, image, ports, and status.

```
C:\Users\Hi>docker ps
CONTAINER ID   IMAGE     COMMAND                  CREATED         STATUS         PORTS                                 NAMES
85c0cf9dcc5e   mysql     "docker-entrypoint.s…"   2 minutes ago   Up 2 minutes   0.0.0.0:3306->3306/tcp, 33060/tcp     my-mysql
4c59170b9156   nginx     "/docker-entrypoint.…"   6 minutes ago   Up 6 minutes   0.0.0.0:8080->80/tcp                  my-nginx
```

Step 5:

To monitor specific containers:

docker stats my-nginx my-mysql

```
C:\Users\Hi>docker stats my-nginx my-mysql
```

```
C:\Users\Hi>docker pull nginx
Using default tag: latest
latest: Pulling from library/nginx
84cade77a831: Download complete
976e8f6b25dd: Download complete
6c78b0ba1a32: Download complete
CONTAINER ID   NAME       CPU %     MEM USAGE / LIMIT     MEM %     NET I/O           BLOCK I/O   PIDS
4c59170b9156   my-nginx   0.00%     12.81MiB / 7.606GiB   0.16%     1.09kB / 0B       0B / 0B     17
85c0cf9dcc5e   my-mysql   0.83%     479.3MiB / 7.606GiB   6.15%     4.88kB / 1.98kB   0B / 0B     41
```

Step 6:

To stop the containers:

docker stop my-nginx my-mysql

To remove the containers:

docker rm my-nginx my-mysql

```
C:\Users\Hi>docker stop my-nginx my-mysql
my-nginx
my-mysql

C:\Users\Hi>docker rm my-nginx my-mysql
my-nginx
my-mysql
```

Outcomes

By completing this POC, you will:

1. **Run Multiple Containers** – Deploy and manage multiple containers (Nginx and MySQL) simultaneously.

2. **Use Essential Docker Commands** – Gain hands-on experience with docker run, docker ps, docker stop, and docker rm for container management.

3. **Monitor Container Resource Usage** – Learn to track CPU, memory, and network usage using docker stats.

4. **Expose and Access Services** – Map host ports to container ports to interact with running applications (Nginx on port 8080, MySQL on 3306).

5. **Set Up and Manage Environment Variables** – Use -e flags to configure MySQL credentials inside a container.

6. **Understand Containerization Benefits** – Explore how Docker simplifies application deployment, enhances portability, and optimizes resource management.

7. **Perform Cleanup Operations** – Learn how to free up system resources by removing unused containers and images using docker system prune -a.