Placement Empowerment Program

Cloud Computing and DevOps Centre

Containerize a Multi-Tier Application: Create Docker containers for your web application and database. Configure them to communicate using a Docker network.

Name: SUBASHINI P

Department: IT

Introduction

In modern software development, applications often follow a **multitier architecture**, where different components such as the web application and database run separately to enhance scalability and maintainability. **Containerization** with Docker enables efficient deployment and management of such applications by packaging them with all their dependencies.

This PoC demonstrates how to **containerize a multi-tier application** using **Flask (web application) and MySQL (database)** in Docker on Windows. The goal is to ensure both containers communicate within a Docker network.

Overview

A **multi-tier application** consists of multiple layers:

1. **Web Application (Flask)** – Handles user interactions and sends queries to the database.
2. **Database (MySQL)** – Stores and manages data.
3. **Docker Network** – Enables communication between containers.

Key steps in this PoC:

1. Create a **Docker network** for communication.
2. Build and run a **MySQL database container** with environment variables.
3. Build and run a **Flask web application container** that connects to MySQL.
4. Test communication between the containers.

Objectives

✔ Learn to containerize a web application and database separately.

✔ Configure a **Docker network** to enable container communication.

✔ Use **environment variables** to manage database credentials securely.

✔ Deploy and test a working **multi-tier application** using Docker.

Importance

1. **Isolation:** Keeps the web app and database separate for better scalability.

2. **Portability:** Containers can run anywhere, making deployment easy.

3. **Efficiency:** Avoids conflicts between dependencies, ensuring a smooth development workflow.

4. **Scalability:** Supports future extensions like load balancing or additional services.

Step-by-Step Overview

Step 1:

Create a Project Folder

Open **Command Prompt** , then run:

mkdir C:\project
cd C:\project

```
C:\Users\subam>mkdir C:\project

C:\Users\subam>cd C:\project
```

Step 2:

Create the Flask Web Application

Inside C:\multi-tier-app, create a new Python file:

Create **app.py**

apps.py

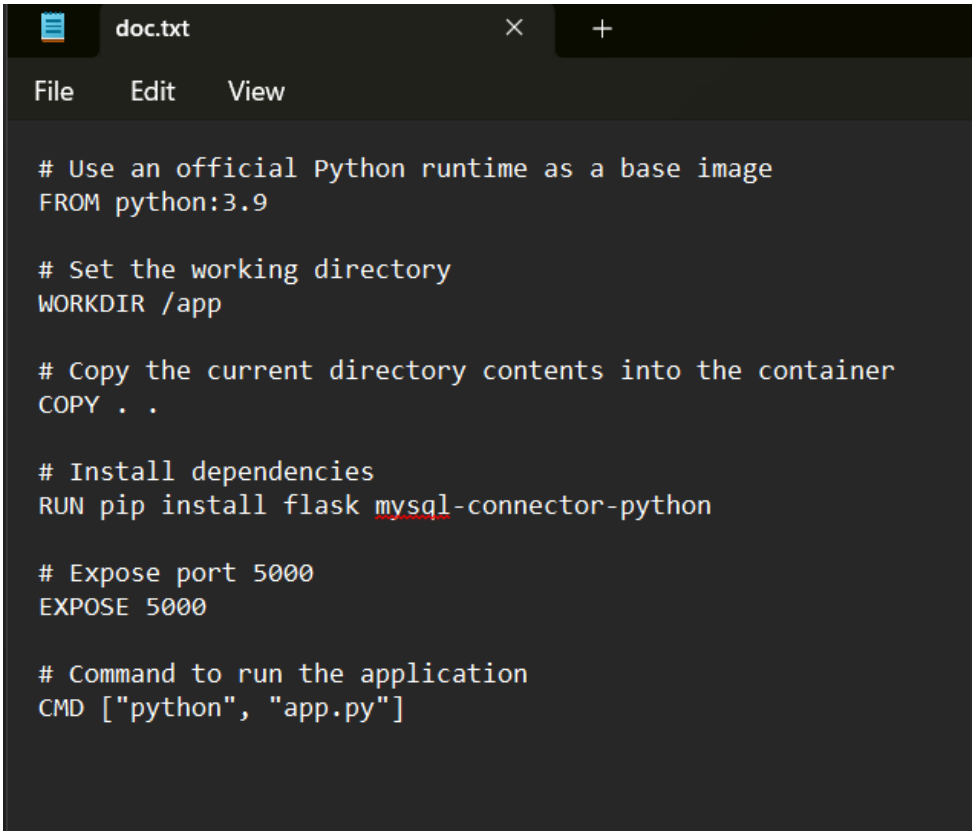
File Edit View

```
from flask import Flask
import mysql.connector

app = Flask(__name__)

@app.route('/')
def home():
    try:
        conn = mysql.connector.connect(
            host="db",
            user="root",
            password="rootpassword",
            database="testdb"
        )

        cursor = conn.cursor()
        cursor.execute("SELECT 'Hello from MySQL!'")
        result = cursor.fetchone()
        return result[0]

    except Exception as e:
        return f"Database connection error: {str(e)}"

if __name__ == '__main__':
    app.run(host='0.0.0.0', port=5000)
```

Step 3:

Create a doc.txt

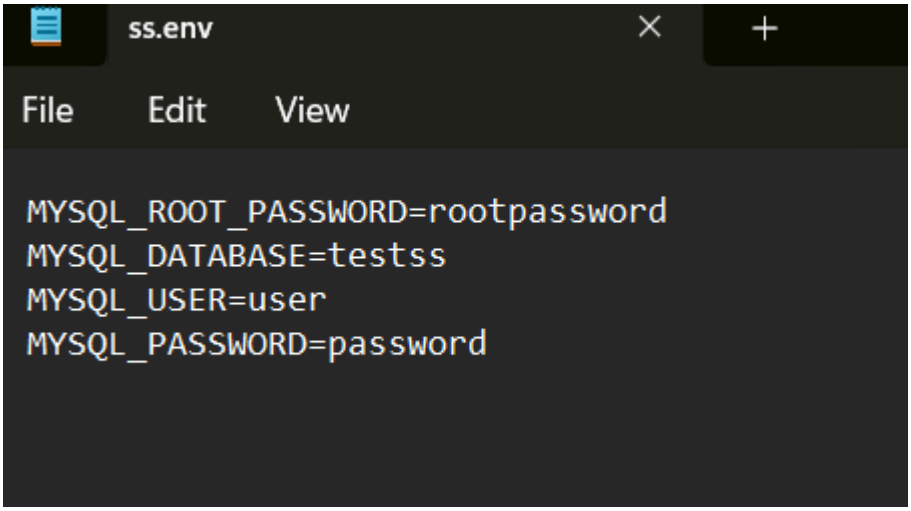
In the **same folder**, create a file named Dockerfile (without an extension):



Step 4:

Create the MySQL Database Environment File

Create a new file named ss.env in the same folder:



Step 5:

Create a Docker Network

Open Command Prompt (cmd) and create a network: **docker**

network create app-network

```
C:\project>docker network create app-network
ef519cb5731329057a75461d17d774cfeb96398cb3a8e7ffa13d607debf9de16
```

Step 6:

Run the MySQL Database Container

Start the MySQL container using the network:

docker run -d --name ss --network app-network --env-file C:\multi-tier-app\db.env mysql:5.7

```
C:\project>docker run -d --name ss --network app-network --env-file C:\project\ss.env mysql:
```

Step 7:

Build and Run the Flask Web App Container

Navigate to your project folder:

cd C:\project

```
C:\project>cd C:\project
```

Step 8:

Build the Docker image:

docker build -t web-app .

```
C:\project>docker build -t web-app .
```

Step 9:

Run the container and connect it to the network:

docker run -d --name web --network app-network -p 5000:5000 web-app

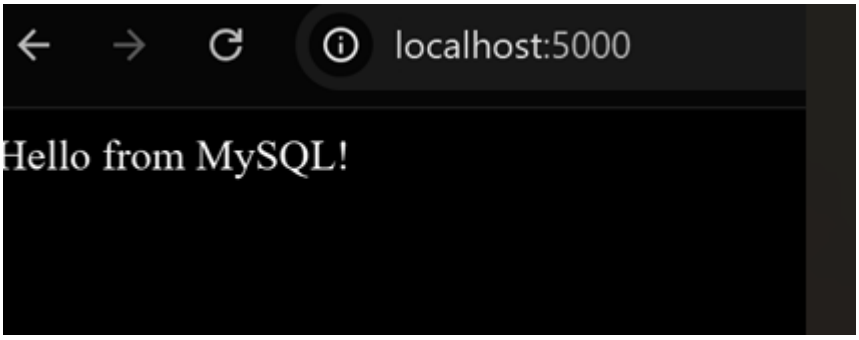
```
C:\project>docker run -d --name web --network app-network -p 5000:5000 web-app
```

Step 10:

Test the Web App . Open a browser and go to:

http://localhost:5000

You should see: Hello from MySQL!



Outcomes

By completing this PoC, you will:

1. **Master Multi-Tier Containerization** – Gain hands-on experience in containerizing both a web application and a database separately, ensuring modular and scalable deployments.

2. **Set Up Docker Networking** – Learn how to create and configure a **Docker network** to enable secure communication between application containers.

3. **Work with Environment Variables** – Understand how to securely manage database credentials and configurations using an **env file** in Docker.

4. **Enhance Docker Command Proficiency** – Improve skills in using essential Docker commands like docker network create, docker run, docker build, and docker exec for efficient container management.

5. **Test and Debug Containerized Applications** – Learn how to verify container communication using tools like docker logs and docker exec for debugging and troubleshooting.