✅ What is Docker?

Docker is a **platform that allows you to package, ship, and run applications in lightweight containers**. A **Docker container** includes everything an application needs to run — code, runtime, libraries, environment variables, and system tools — so it can run **consistently across any environment**.

💡 Real-Time Scenario (Java Backend Example)

🧑‍💻 You're a Java Backend Developer working on a Spring Boot project:

1. You develop a Spring Boot app locally.
2. On your machine, it works fine — but when you send the code to QA/DevOps, they say:

> "It's not working here!"

3. Why?
    - They may have a different Java version.
    - Missing dependencies.
    - Database config mismatch.
    - OS differences.

🐳 Docker Solution:

1. You **create a Dockerfile** that defines:
    - Base image (e.g., openjdk:17)
    - App JAR file
    - Startup command (e.g., `java -jar app.jar`)

You **build a Docker image**:

```
docker build -t my-spring-app .
```

Now you (or DevOps) can run it **anywhere** with just:

```
docker run -p 8080:8080 my-spring-app
```

✅ It works the same on:

- Developer laptops
- QA/Testing servers
- Staging or production
- Even on cloud VMs like AWS EC2

📦 Real-World Benefits:

Problem	Docker Solution
"It works on my machine" issues	Containerized consistency everywhere
Manual server setup	Automated, repeatable builds
Different environments	Same Docker container works everywhere
Deployment complexity	Easy container start/stop, CI/CD friendly

Absolutely! Here's a full, beginner-to-pro-level explanation of **Docker concepts** and how they work together — including real-world usage on **multiple EC2 instances**.

🐳 What Is Docker?

Docker is a containerization platform that allows you to **build, share, and run applications** in **isolated environments** called **containers**.

🔧 1. Docker Engine

Docker Engine is the **runtime** that allows you to run Docker containers. It has:

- **Docker Daemon**: Runs in the background and manages containers/images.
- **Docker CLI**: Command-line tool you use (`docker run`, `docker build`, etc.).

You install **Docker Engine** on any machine (Linux, Windows, Mac, EC2 VM, etc.) to make it "Docker ready."

📝 2. Dockerfile

A **Dockerfile** is a **blueprint** or **script** used to build a Docker image.

🧾 Example:

```
# Start from Java image
FROM openjdk:17

# Add your app jar file
COPY target/app.jar app.jar

# Run the app
ENTRYPOINT ["java", "-jar", "app.jar"]
```

This file tells Docker:

> "Start with a Java base, add my app, and run it."

📦 3. Docker Image

A **Docker image** is a **read-only snapshot** built from your Dockerfile.

- It contains: OS, runtime, code, libraries, environment
- It's reusable and shareable

```
docker build -t my-backend-app .
```

This creates an image called `my-backend-app`.

🚀 4. Docker Container

A **container** is a **running instance** of an image.
It's lightweight, fast, and isolated.

Run a container:

bash
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```
docker run -p 8080:8080 my-backend-app
```

☁️ 5. Docker Hub

Docker Hub is a **cloud-based image registry** (like GitHub for Docker).

Use cases:

Push your image:

```
docker tag my-backend-app username/my-backend-app
docker push username/my-backend-app
```

-

Pull it on another machine:

```
docker pull username/my-backend-app
```

-

☁️ Real-Time EC2 Scenario (Multiple VMs)

Let's say your app needs to run on **3 EC2 instances**:

Step-by-Step:

1. **Install Docker Engine** on each EC2 instance

Pull your image from Docker Hub:

```
docker pull username/my-backend-app
```

2.

Run the container:

```
docker run -d -p 8080:8080 username/my-backend-app
```

3.

✅ Now your app is running **consistently** on all 3 servers — no manual setup!

🎯 How Docker Helps in Real Projects

Problem	Docker Benefit
Different environments	Docker ensures same environment everywhere
Tedious manual setup	Dockerfile automates builds
Scaling on multiple servers	Pull same image on all VMs (e.g., EC2)
CI/CD Pipelines	Jenkins can build & push Docker images
Fast rollback & testing	Just stop/start containers instantly
No “it works on my machine” bugs	Everyone uses the same container

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🔁 Typical DevOps Workflow with Docker

1. Developer writes code + Dockerfile
2. Builds image locally: `docker build`
3. Pushes image to Docker Hub

4. Jenkins pulls the code, builds, and deploys
5. QA or Prod EC2 VMs pull image and run the container

Would you like a working example project with a Spring Boot Dockerfile and deployment script for EC2?

🚫 Quick Answer:

You **cannot run multiple Docker images in a single container** — **one container = one image**.
Each container is based on **one Docker image**, running **one main process**.

✅ But You Can Do This Instead:

To run **multiple applications together**, you have 3 proper ways:

✅ 1. Use Multiple Containers (Best Practice)

Each image → separate container → connect them via **Docker network** or **Docker Compose**.

🔧 Example using Docker Compose:

You want to run:

- A Spring Boot app (backend)
- A MySQL database

yaml
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```
# docker-compose.yml
version: '3'
services:
  backend:
    image: my-spring-app
    ports:
      - "8080:8080"
    depends_on:
      - db

  db:
    image: mysql:8
    environment:
      MYSQL_ROOT_PASSWORD: root
      MYSQL_DATABASE: myapp
```

Then run:

bash
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```
docker-compose up
```

✅ This runs both containers together, **networked automatically**.

✅ 2. Use a Process Supervisor (Not Recommended)

You can install tools like `supervisord` inside a Dockerfile to run multiple processes, but this goes **against Docker philosophy** (1 process per container).

✅ 3. Use Kubernetes / Docker Swarm (For scalable microservices)

If you're managing lots of containers (e.g., in production), use Kubernetes to orchestrate:

- Spring Boot in one Pod
- DB in another
- Redis in another

All networked and monitored.

🧠 Summary

Want to do this...	Recommended Way
Run multiple services	Use **Docker Compose**
Share network between containers	Use **Docker networks** or Compose
Run background scripts/tasks	Add them as separate containers or volumes
Run 2 images in 1 container	❌ Not allowed (one container = one image)

Would you like a working Spring Boot + MySQL Docker Compose example?

Great real-world scenario! You're building a **microservices-based travel app** with separate services for:

- ✈️ Flight Booking
- 🚆 Train Booking
- 🚗 Car Booking
  Each with its **own database** (best practice in microservices: database per service).

Here's how you would handle **Dockerizing**, **running**, and **managing** all these services — using **best practices**.

✅ 1. Folder Structure (Best Practice)

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```
travel-booking/
├── flight-service/
│   ├── src/
│   ├── Dockerfile
│   └── application.properties
├── train-service/
│   ├── src/
│   ├── Dockerfile
│   └── application.properties
├── car-service/
│   ├── src/
│   ├── Dockerfile
│   └── application.properties
├── docker-compose.yml
```

Each service has its own **Dockerfile** and codebase.

✅ 2. Dockerfile (for Each Service)

Example: `flight-service/Dockerfile`

Dockerfile
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```
FROM openjdk:17
COPY target/flight-service.jar flight-service.jar
ENTRYPOINT ["java", "-jar", "flight-service.jar"]
```

Repeat similarly for `train-service` and `car-service`.

✅ 3. Build Docker Images

In each service folder:

bash
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```
docker build -t flight-service:1.0 .
docker build -t train-service:1.0 .
docker build -t car-service:1.0 .
```

✅ 4. Use Docker Compose to Manage Everything

Create a single `docker-compose.yml` at root:

yaml
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```
version: '3'
services:

  flight-service:
    image: flight-service:1.0
```

```yaml
    build: ./flight-service
    ports:
      - "8081:8080"
    depends_on:
      - flight-db

  flight-db:
    image: mysql:8
    environment:
      MYSQL_DATABASE: flightdb
      MYSQL_ROOT_PASSWORD: root

  train-service:
    image: train-service:1.0
    build: ./train-service
    ports:
      - "8082:8080"
    depends_on:
      - train-db

  train-db:
    image: mysql:8
    environment:
      MYSQL_DATABASE: traindb
      MYSQL_ROOT_PASSWORD: root

  car-service:
    image: car-service:1.0
    build: ./car-service
    ports:
      - "8083:8080"
    depends_on:
      - car-db

  car-db:
    image: mysql:8
    environment:
      MYSQL_DATABASE: cardb
      MYSQL_ROOT_PASSWORD: root
```

✅ 5. Run Everything at Once

In the root folder:

bash
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```
docker-compose up --build
```

- It builds all 3 services and runs them
- Each on its own port (e.g., 8081, 8082, 8083)
- Each connects to its own MySQL DB
- Services can communicate via Docker internal networking if needed

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🧠 Summary of Best Practices

Task	Best Practice
Service isolation	1 microservice = 1 image = 1 container
DB isolation	Separate DB for each service
Build & run	Dockerfile for each, managed via `docker-compose`
CI/CD	Push to Docker Hub/GitHub Container Registry, then pull in prod
Port mapping	Expose different ports per service
Configuration	Use environment variables or config server (Spring Cloud Config)

✅ 6. How to Deploy on EC2 or Multiple VMs

On each EC2 instance:

1. Install Docker & Docker Compose
2. Clone your repo or SCP the files

Run:

bash
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```
docker-compose up --build -d
```

3.

OR split services across EC2s if scaling (e.g., Flight on EC2-A, Train on EC2-B)

Would you like the actual `docker-compose.yml` and sample Spring Boot config for one of the services?

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You said:
yes

ChatGPT said:

Great! Below is a **fully working example** for one microservice — let's take the **Flight Booking Service** — including:

1. ✅ Spring Boot configuration
2. ✅ Dockerfile
3. ✅ MySQL config
4. ✅ `docker-compose.yml`

You can replicate this structure for `train-service` and `car-service`.

📁 Folder Structure

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```
flight-service/
├── src/
├── target/
│   └── flight-service.jar
├── Dockerfile
├── application.properties
└── docker-compose.yml
```

✅ 1. application.properties

properties
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```
server.port=8080
spring.datasource.url=jdbc:mysql://flight-db:3306/flightdb
spring.datasource.username=root
spring.datasource.password=root
spring.jpa.hibernate.ddl-auto=update
spring.jpa.show-sql=true
```

Note:

- `flight-db` is the **service name** of the MySQL container in Docker Compose.
- Ports and credentials are passed by Compose automatically.

✅ 2. Dockerfile

dockerfile
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```
# Use OpenJDK base image
FROM openjdk:17

# Copy built jar file into the container
COPY target/flight-service.jar app.jar

# Run the application
ENTRYPOINT ["java", "-jar", "app.jar"]
```

✅ 3. docker-compose.yml

Place this file in the **root folder** where you run your services:

yaml
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```
version: '3'
services:

  flight-service:
    build: ./flight-service
    image: flight-service:1.0
    ports:
      - "8081:8080"
    depends_on:
      - flight-db

  flight-db:
    image: mysql:8
    restart: always
    environment:
      MYSQL_ROOT_PASSWORD: root
      MYSQL_DATABASE: flightdb
    ports:
      - "3307:3306"
```

✅ 4. Build and Run

From the root directory where `docker-compose.yml` is:

bash
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```
docker-compose up --build
```

✅ 5. Test It

Once it's running:

- Backend should be live at: `http://localhost:8081`
- MySQL DB at: `localhost:3307` (outside the container)

🔁 To Add Other Services

Just repeat the steps for:

- `train-service` with port `8082`
- `car-service` with port `8083`

Would you like me to generate full code and API example for one of the services (like `FlightController`)?

✅ **Yes, absolutely!** You can create and run **multiple Docker containers in a single VM** — including AWS EC2 or any Linux/Windows machine — and **this is actually a common real-world practice**.

💡 Real-World Use Case

Let's say you're using **one EC2 instance** (Ubuntu server), and you want to run:

- A **Spring Boot microservice** (`flight-service`)
- A **MySQL container**
- A **Jenkins container**
- A **Redis or RabbitMQ container**
- Another microservice (`train-service`)

✅ All of these can run **in parallel** inside the same VM, **as separate containers**.

✅ Why It Works

Docker containers are **lightweight** and **share the same OS kernel**, so unlike full virtual machines, they use fewer resources.

- A typical EC2 instance like **t2.medium (2 vCPU, 4GB RAM)** can easily run **5–10 containers** depending on their resource needs.

🧪 Example

bash
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```
# Start 3 containers
docker run -d --name flight -p 8081:8080 flight-service:1.0
docker run -d --name train -p 8082:8080 train-service:1.0
docker run -d --name mysql -e MYSQL_ROOT_PASSWORD=root -e
MYSQL_DATABASE=flightdb mysql:8
```

You now have **3 containers** running:

- Spring Boot app for flight (port 8081)
- Spring Boot app for train (port 8082)
- MySQL DB (internal port 3306)

📌 Best Practices

Practice	Why?
Use **Docker Compose**	Easily manage multiple containers
Set custom ports (`-p`)	Avoid port conflicts
Use Docker networks	Let services talk to each other easily
Use volumes for DB persistence	So data isn't lost when container stops

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🧠 Summary

Can you run multiple containers on one VM?	✅ Yes
Typical use case	Microservices on EC2
Tool to simplify	Docker Compose
Port management	Use different ports per container

Would you like help creating a `docker-compose.yml` that runs **multiple microservices + their databases** on one EC2 VM?

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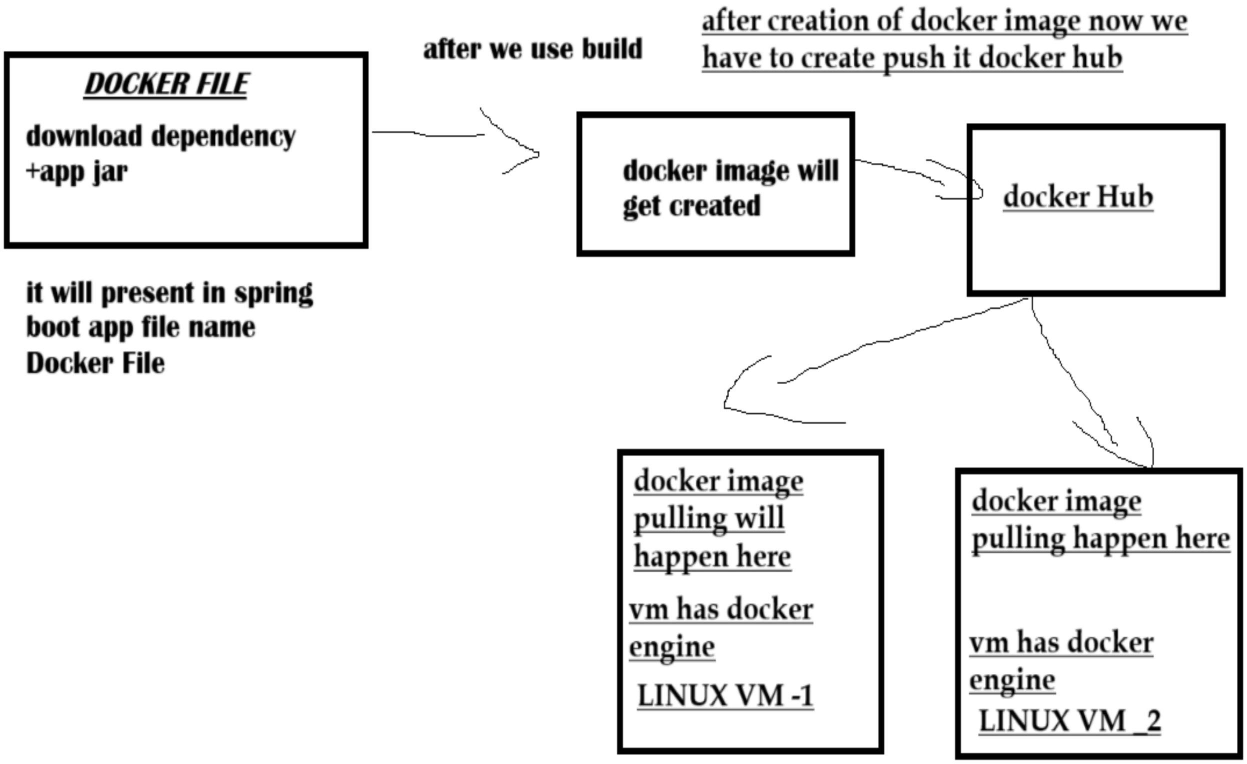
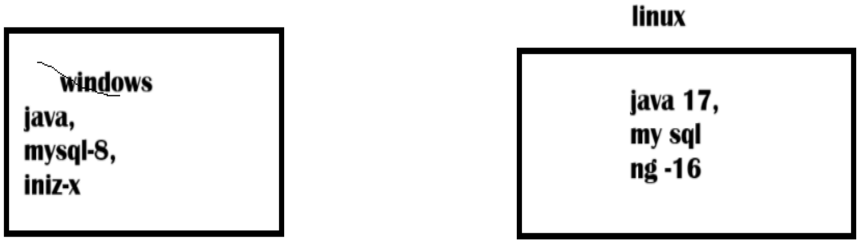
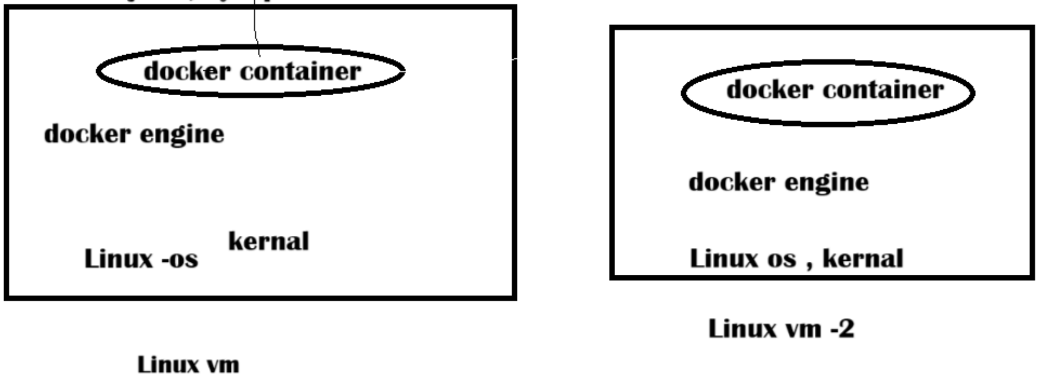

DOCKER FILE
download dependency +app jar
it will present in spring boot app file name Docker File
after we use build
docker image will get created
after creation of docker image now we have to create push it docker hub
docker Hub
docker image pulling will happen here
vm has docker engine
LINUX VM -1
docker image pulling happen here
vm has docker engine
LINUX VM _2

when we send application from windows to lunix we get compartablility issue , so we use docker here



isolated environment docker containor,container will provide app code with all the soft ware like java ,my sql



one server have only one docker engine but we can have multiple docker container