Software Engineering and Project Management Lab Experiment No: - 09
Aim: To Study and Implement a Container using Docker.

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 an open-source platform that enables developers to automate the deployment of applications inside lightweight, portable, and self-sufficient containers. Containers package the application along with its dependencies and environment, ensuring consistent behavior across different systems.

Key Features of Docker:

- Lightweight: Shares the host OS kernel, reducing overhead compared to VMs.
- Portability: Runs the same container on any environment (dev, test, prod).
- Isolation: Applications run in isolated environments with their own file systems and dependencies.
- Fast startup: Containers start in seconds, enabling rapid deployment.
- Version control: Docker images can be versioned and managed easily.
- Microservices-friendly: Perfect for deploying individual services in a microservices architecture.

Docker as a Containerization Tool

Docker uses containerization to simplify software development, testing, and deployment. It provides tools to build, ship, and run applications inside containers.

Key Docker Components:

Docker Engine Core service for building and running containers

Docker Image Read-only template used to create containers

Docker Container A runnable instance of a Docker image

Dockerfile A script with instructions to build a Docker image

Docker Hub Cloud-based registry to share and download images

Docker Compose Tool for defining and running multi-container apps

Docker Volume Persistent storage for containers

Docker Network Manage communication between containers

Demonstration of Docker (Theoretical Steps)

1. Install Docker
   i. Download Docker Desktop from https://www.docker.com.
   ii. Install and start Docker Engine on your system (Linux, Windows, or macOS).
   iii. Verify installation by running: *docker --version*

2. Pull a Docker Image

i. Use Docker Hub to pull a pre-built image:
docker pull nginx

3. Run a Docker Container
   i. Start a container using the pulled image:
   docker run -d -p 8080:80 nginx
   ii. Access the web server by navigating to http://localhost:8080 in your browser.

4. Build a Custom Docker Image
   i. Create a file named Dockerfile:
   FROM python:3.10
   COPY app.py /app/app.py
   WORKDIR /app
   CMD ["python", "app.py"] ii.
   Build the image using: *docker build -t my-python-app .*
   iii. Run the container:
   docker run -d -p 5000:5000 my-python-app

5. Manage Containers
   i. View running containers:
   docker ps
   ii. Stop a container: *docker stop <container_id>*
   iii. Remove a container:
   docker rm <container_id>

6. Use Docker Compose (Optional)
   i. Create a docker-compose.yml file to define multiple services.
   ii. Start all services using:
   docker-compose up

Use Case Example:

- ❖ Containerizing web applications for consistent deployment
- ❖ Running microservices architecture in isolated containers
- ❖ Developing and testing across different environments
- ❖ Deploying scalable applications on cloud or on-premises
- ❖ Creating reproducible development environments
- ❖ CI/CD pipeline integration for automated testing and delivery ❖ Education and experimentation with different tech stacks

Implementation:

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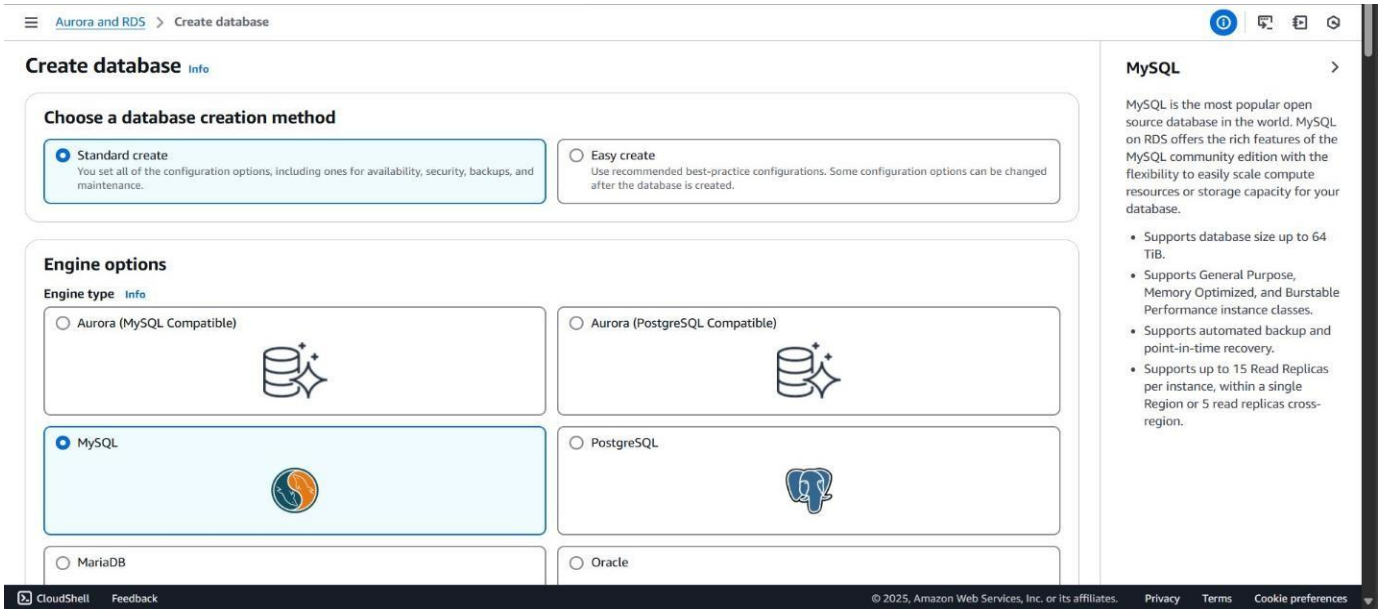

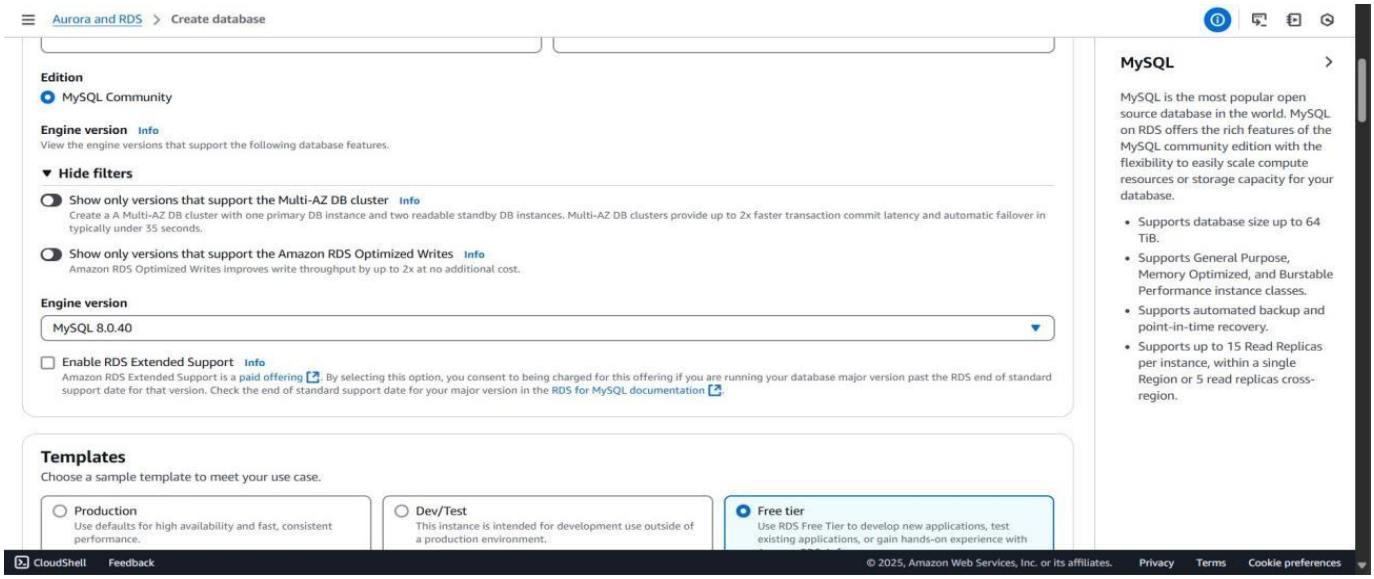

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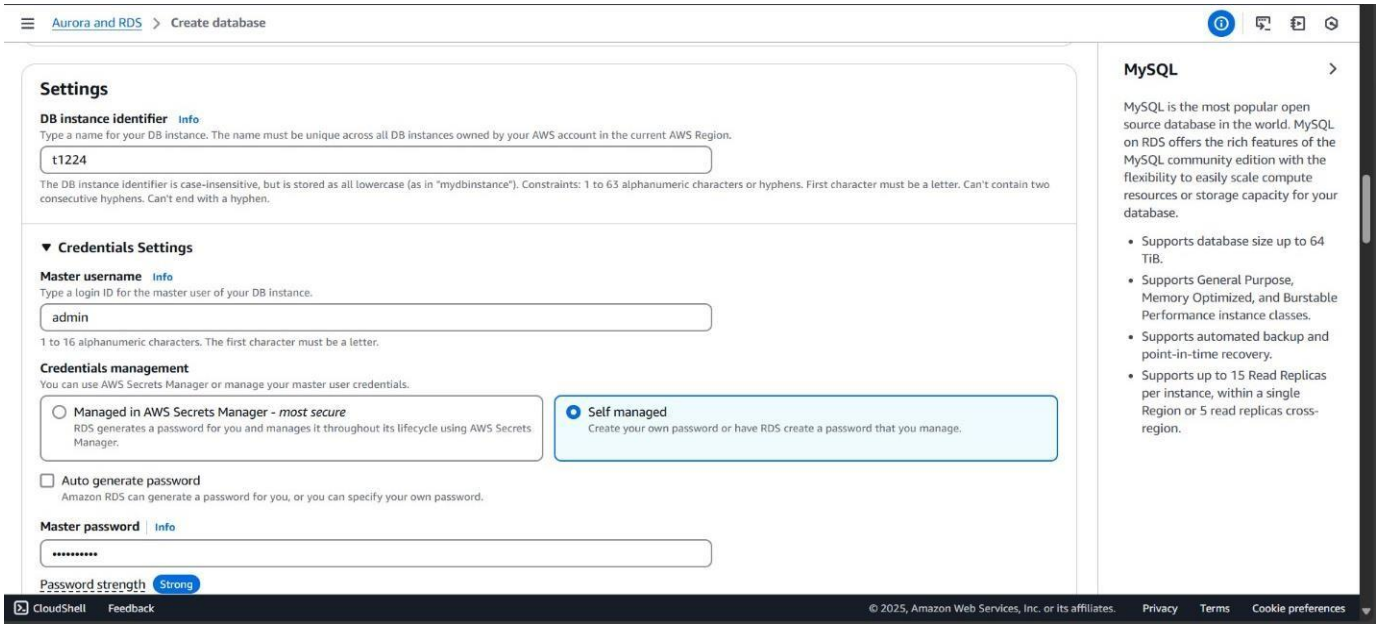

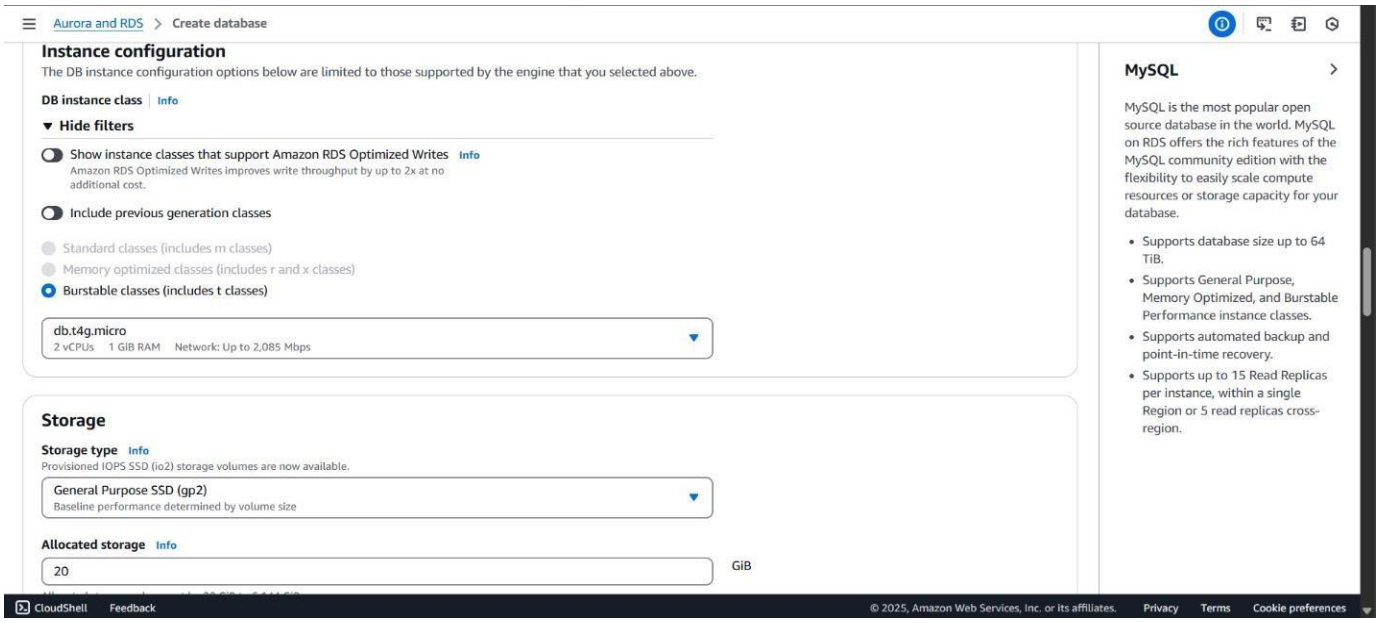

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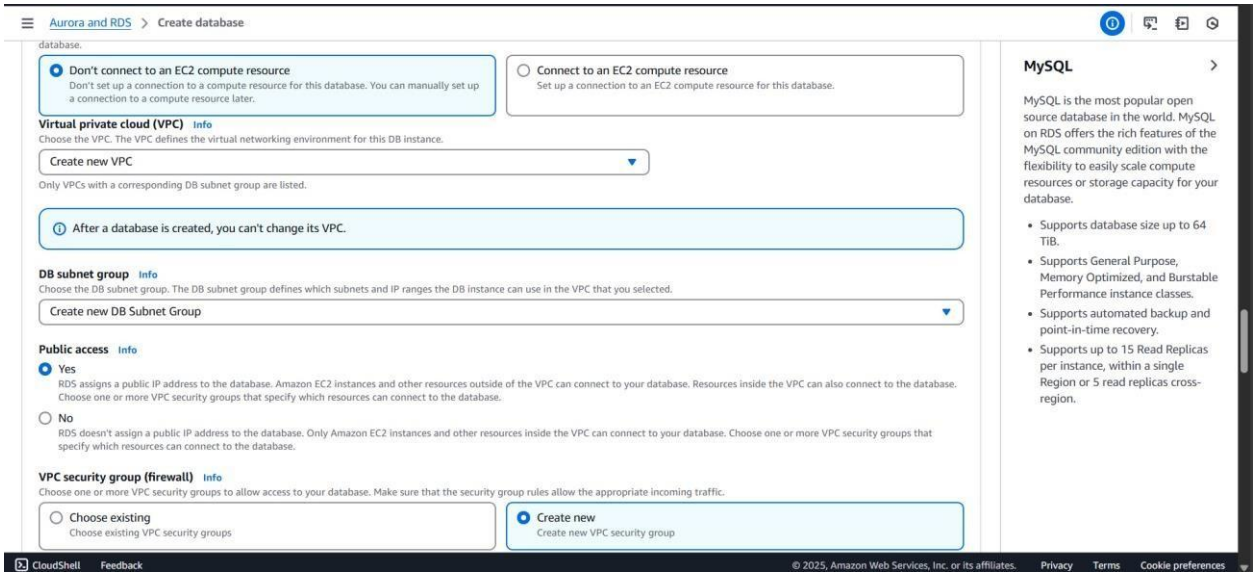

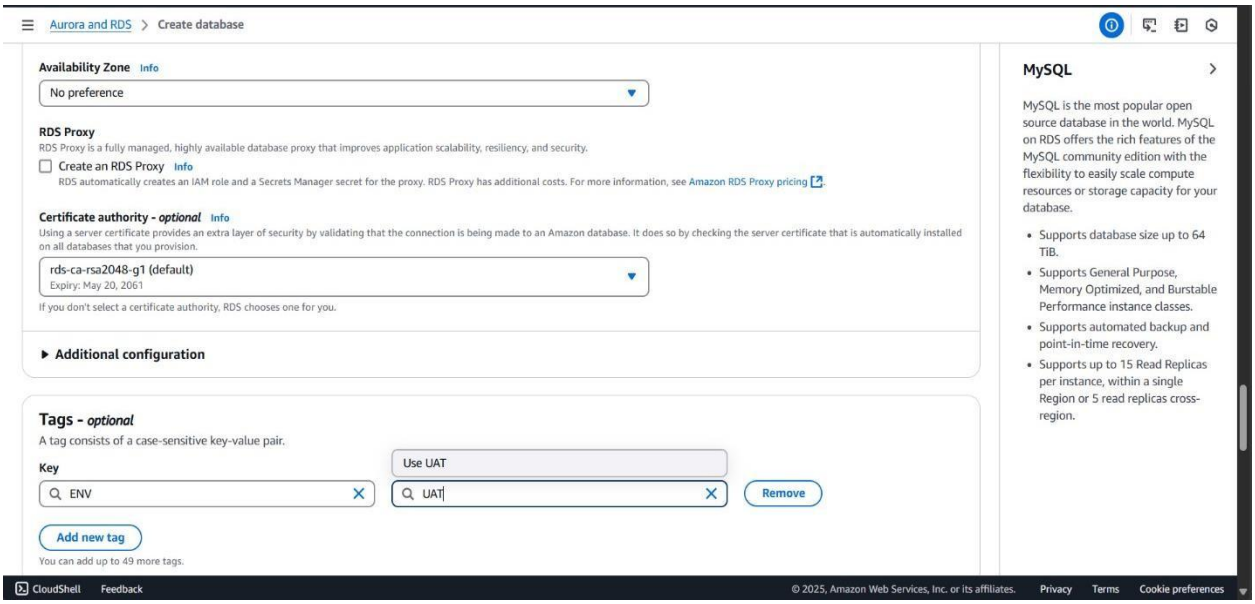

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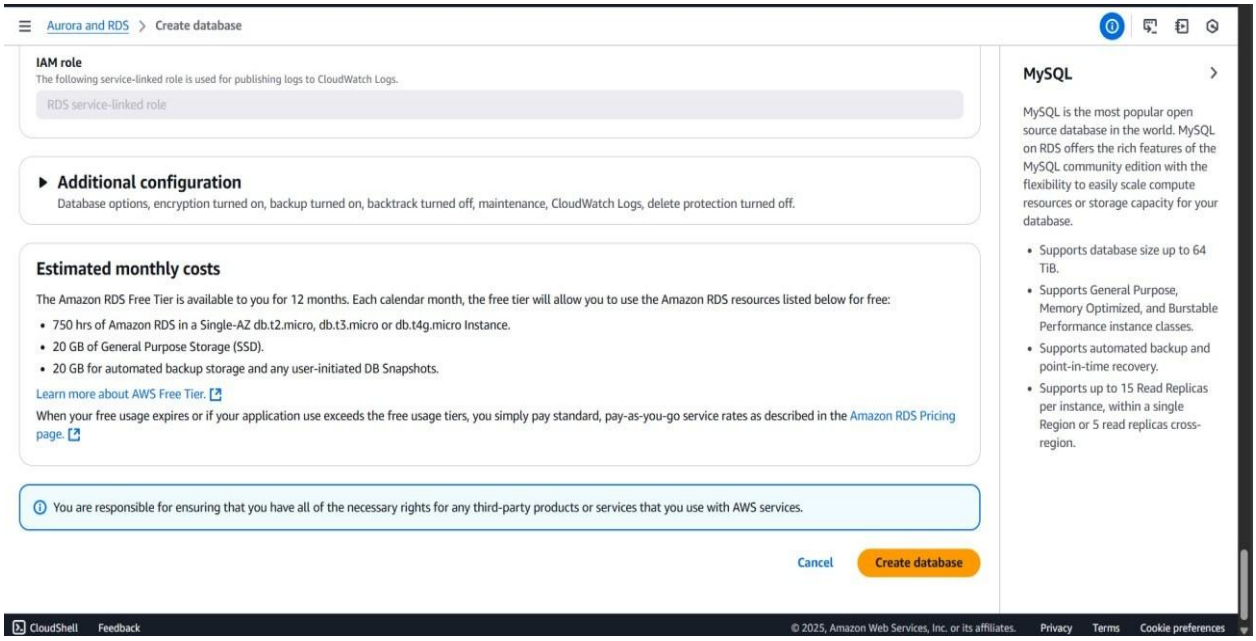

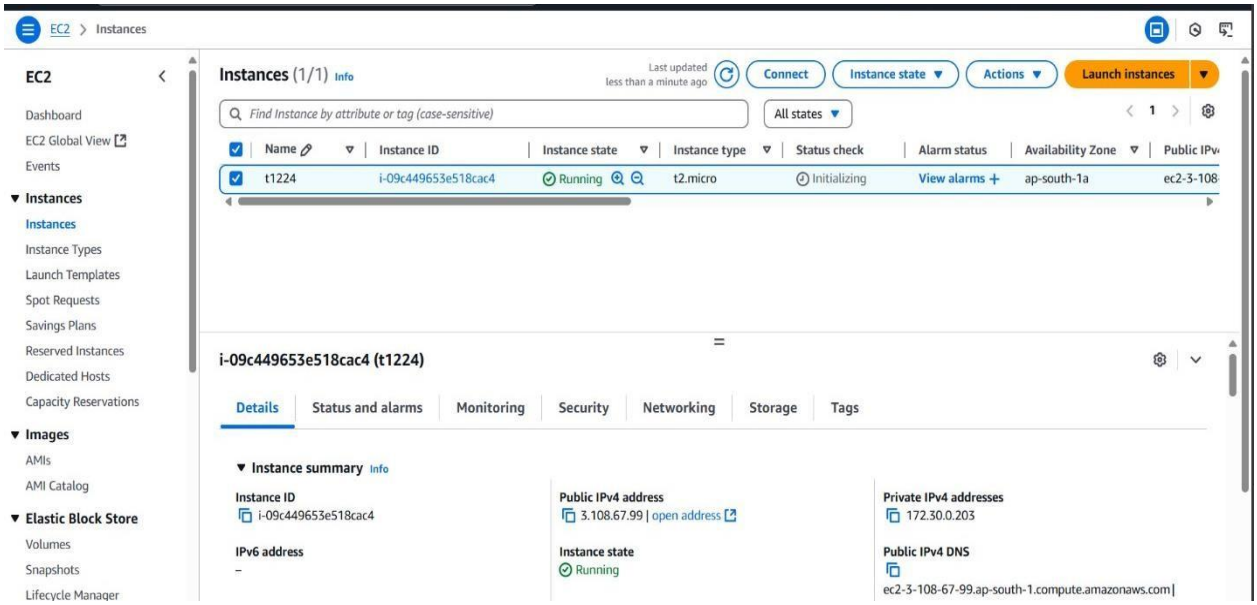

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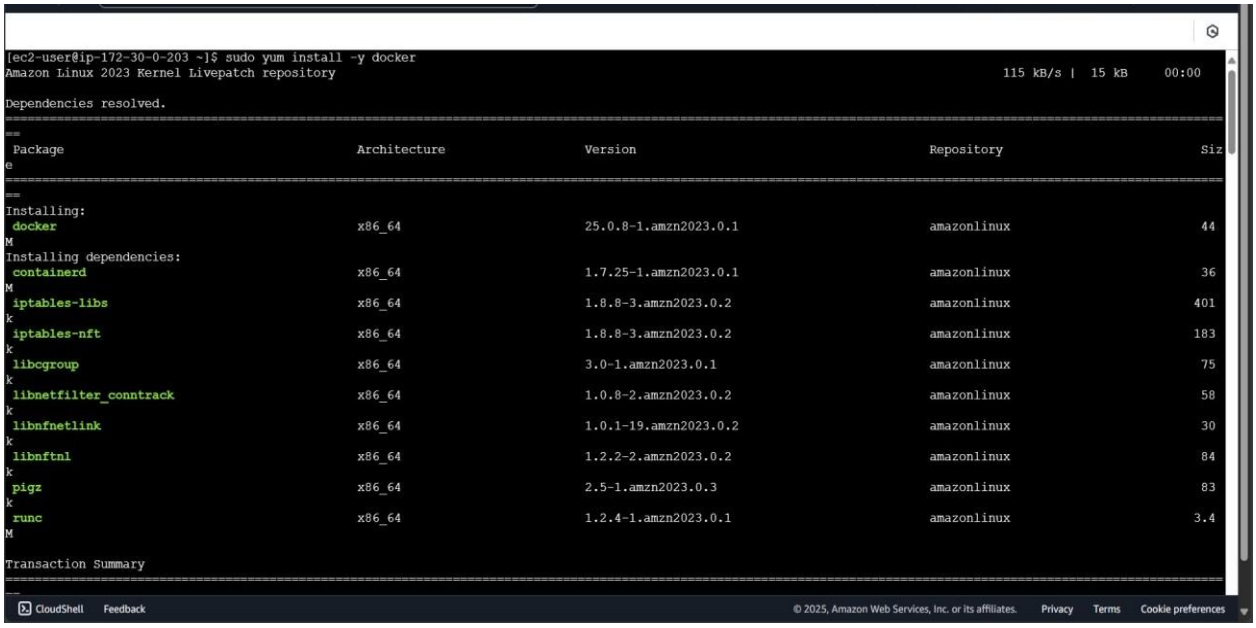

```
[ec2-user@ip-172-30-0-203 ~]$ sudo yum install -y docker
Amazon Linux 2023 Kernel Livepatch repository                                                    115 kB/s |  15 kB     00:00

Dependencies resolved.
================================================================================================================================
 Package                         Architecture            Version                         Repository                      Size
================================================================================
Installing:
 docker                          x86_64                  25.0.8-1.amzn2023.0.1           amazonlinux                     44
Installing dependencies:
 containerd                      x86_64                  1.7.25-1.amzn2023.0.1           amazonlinux                     36
 iptables-libs                   x86_64                  1.8.8-3.amzn2023.0.2            amazonlinux                    401
 iptables-nft                    x86_64                  1.8.8-3.amzn2023.0.2            amazonlinux                    183
 libcgroup                       x86_64                  3.0-1.amzn2023.0.1              amazonlinux                     75
 libnetfilter_conntrack          x86_64                  1.0.8-2.amzn2023.0.2            amazonlinux                     58
 libnfnetlink                    x86_64                  1.0.1-19.amzn2023.0.2           amazonlinux                     30
 libnftnl                        x86_64                  1.2.2-2.amzn2023.0.2            amazonlinux                     84
 pigz                            x86_64                  2.5-1.amzn2023.0.3              amazonlinux                     83
 runc                            x86_64                  1.2.4-1.amzn2023.0.1            amazonlinux                    3.4

Transaction Summary
================================================================================
CloudShell  Feedback                © 2025, Amazon Web Services, Inc. or its affiliates.  Privacy  Terms  Cookie preferences
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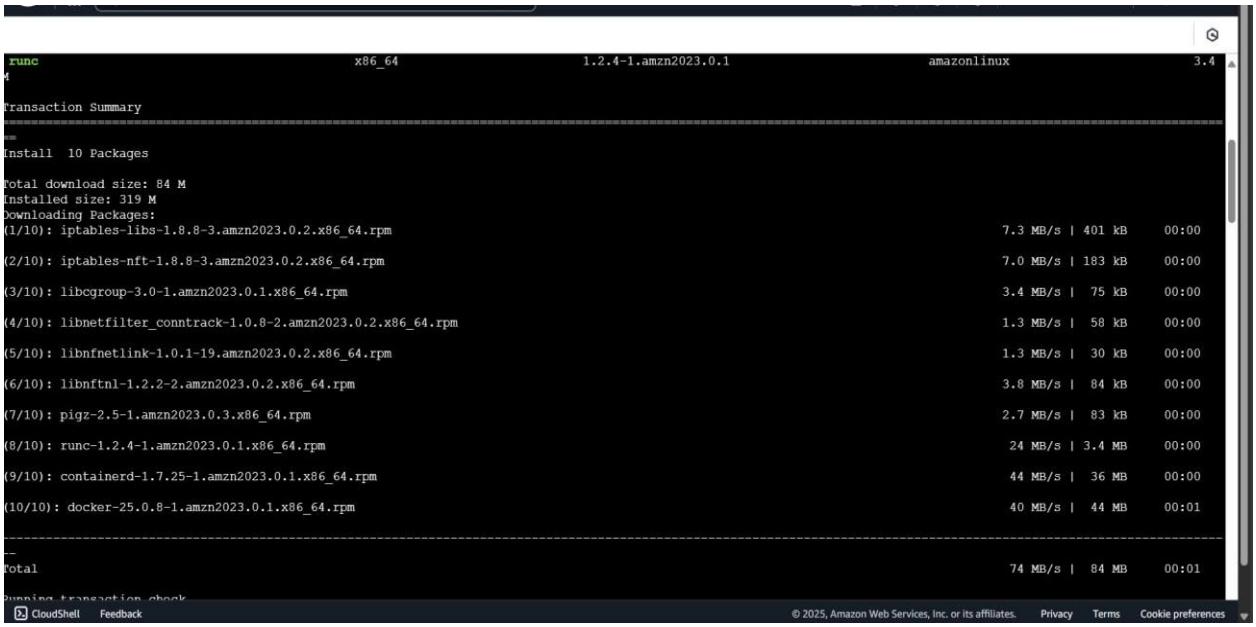

```
 runc                            x86_64                  1.2.4-1.amzn2023.0.1            amazonlinux                    3.4

Transaction Summary
================================================================================
Install  10 Packages

Total download size: 84 M
Installed size: 319 M
Downloading Packages:
(1/10): iptables-libs-1.8.8-3.amzn2023.0.2.x86_64.rpm                            7.3 MB/s | 401 kB     00:00

(2/10): iptables-nft-1.8.8-3.amzn2023.0.2.x86_64.rpm                             7.0 MB/s | 183 kB     00:00

(3/10): libcgroup-3.0-1.amzn2023.0.1.x86_64.rpm                                  3.4 MB/s |  75 kB     00:00

(4/10): libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64.rpm                   1.3 MB/s |  58 kB     00:00

(5/10): libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64.rpm                            1.3 MB/s |  30 kB     00:00

(6/10): libnftnl-1.2.2-2.amzn2023.0.2.x86_64.rpm                                 3.8 MB/s |  84 kB     00:00

(7/10): pigz-2.5-1.amzn2023.0.3.x86_64.rpm                                       2.7 MB/s |  83 kB     00:00

(8/10): runc-1.2.4-1.amzn2023.0.1.x86_64.rpm                                      24 MB/s | 3.4 MB     00:00

(9/10): containerd-1.7.25-1.amzn2023.0.1.x86_64.rpm                               44 MB/s |  36 MB     00:00

(10/10): docker-25.0.8-1.amzn2023.0.1.x86_64.rpm                                  40 MB/s |  44 MB     00:01

--------------------------------------------------------------------------------
Total                                                                             74 MB/s |  84 MB     00:01

Running transaction check
CloudShell  Feedback                © 2025, Amazon Web Services, Inc. or its affiliates.  Privacy  Terms  Cookie preferences
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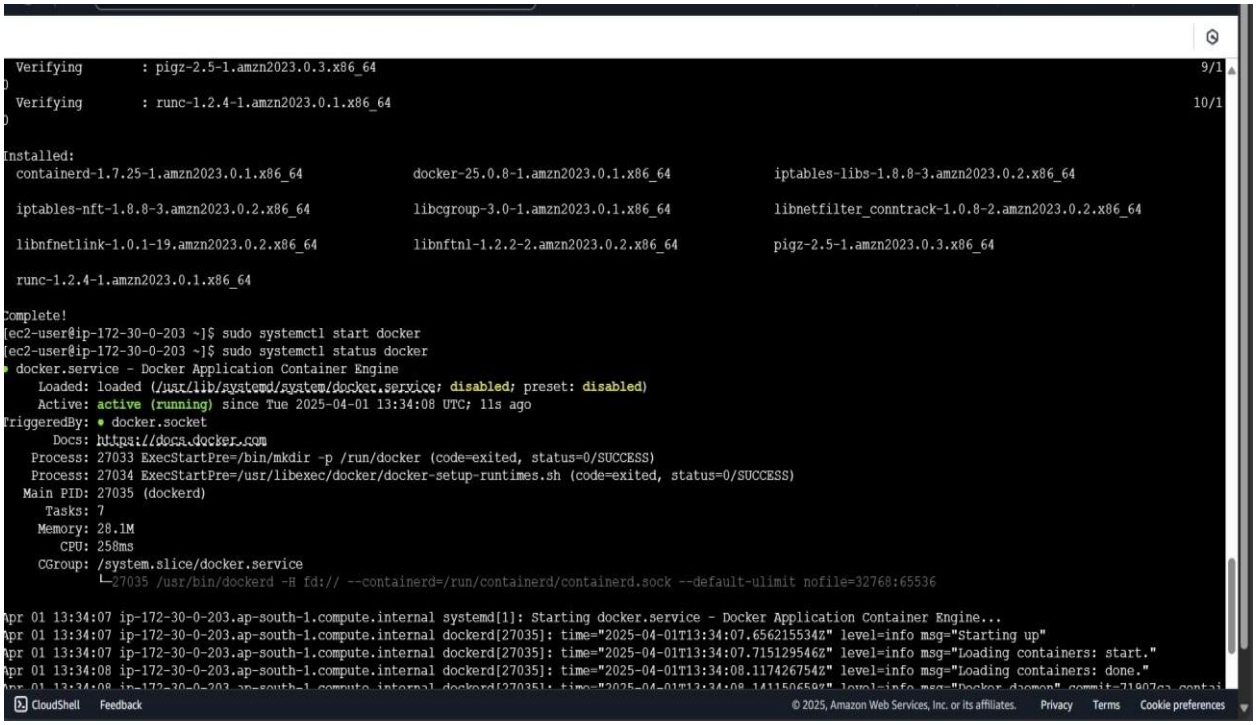

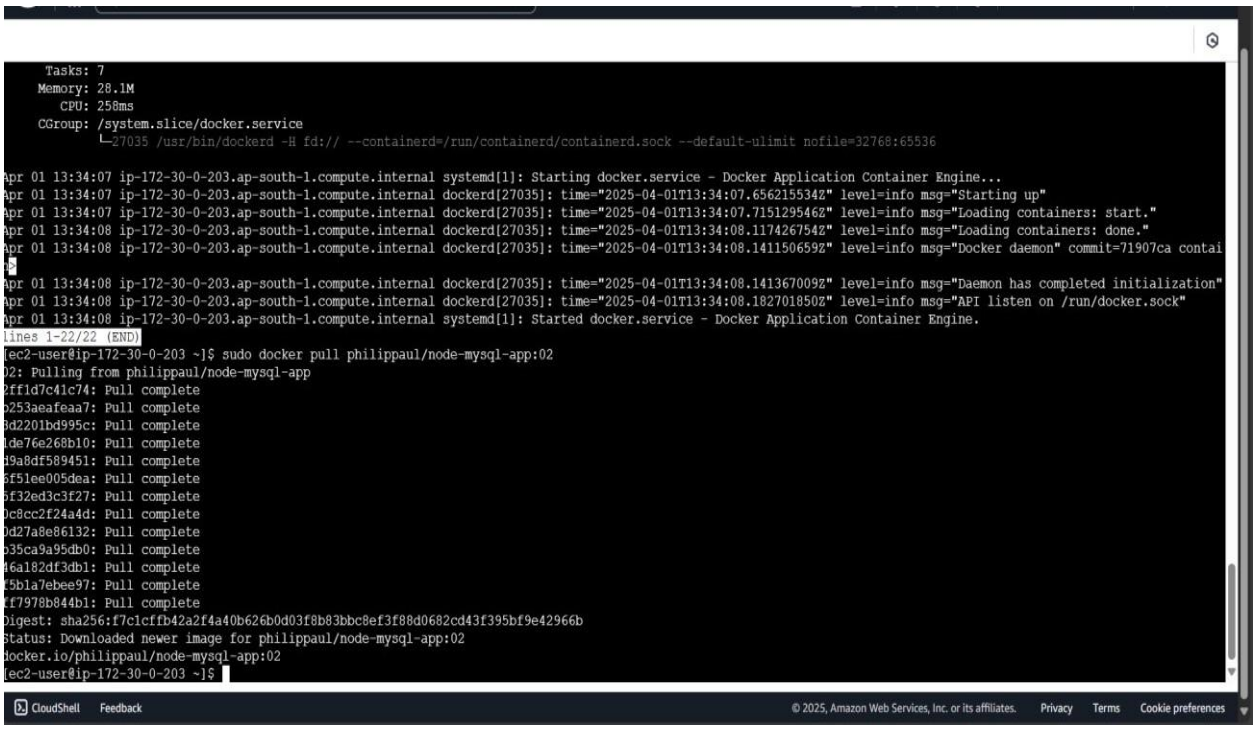

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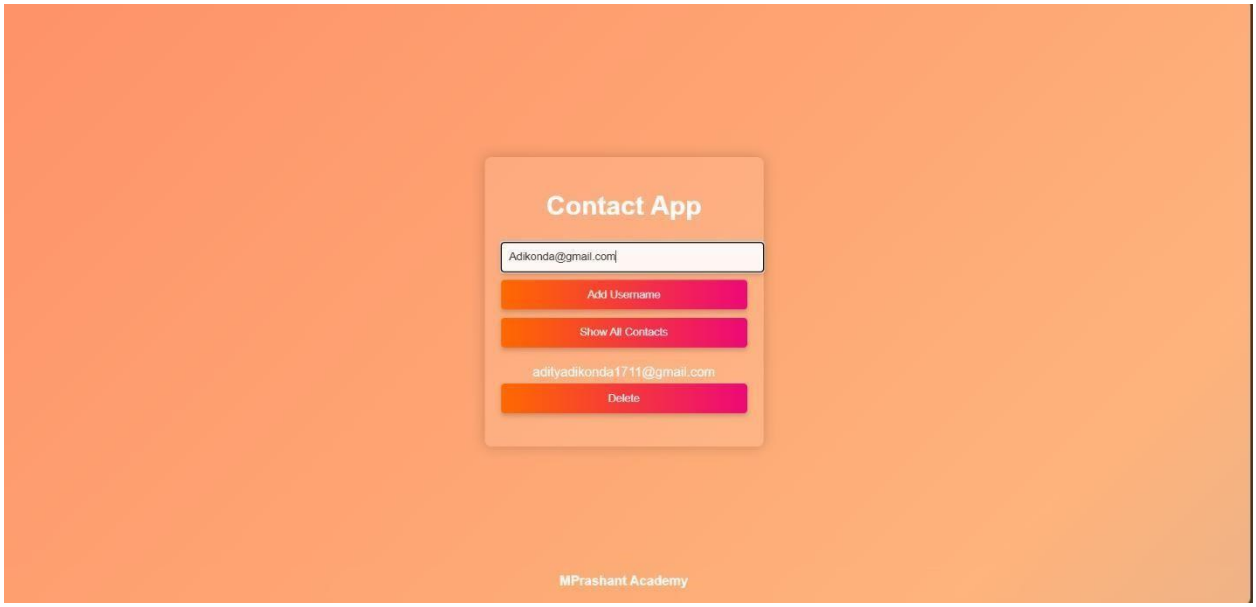

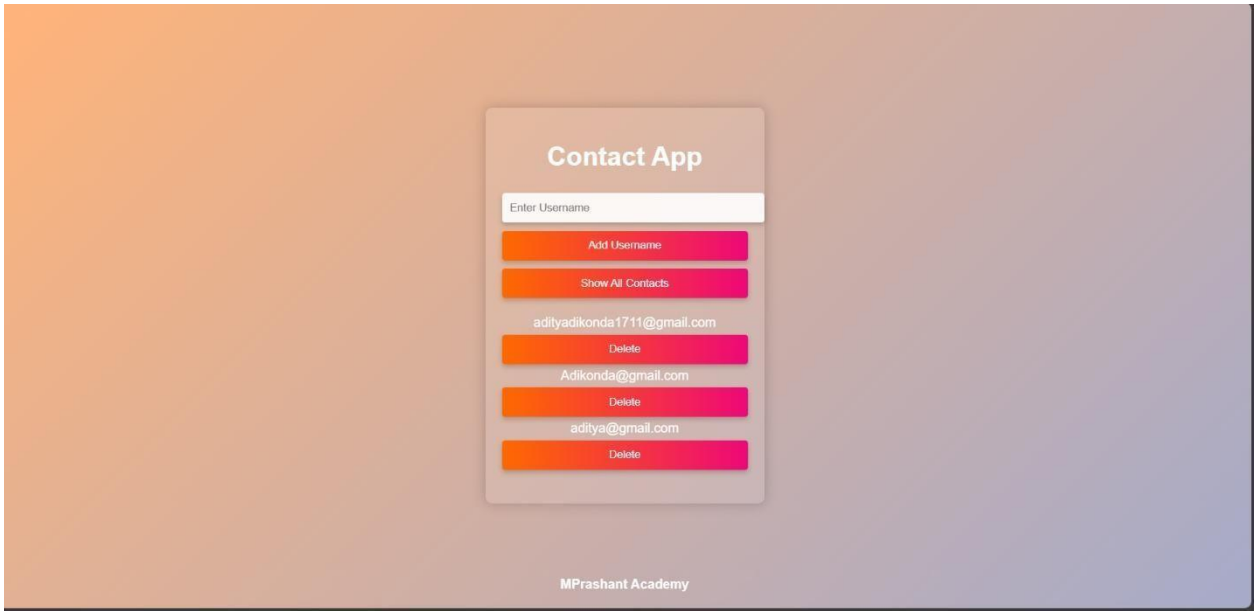

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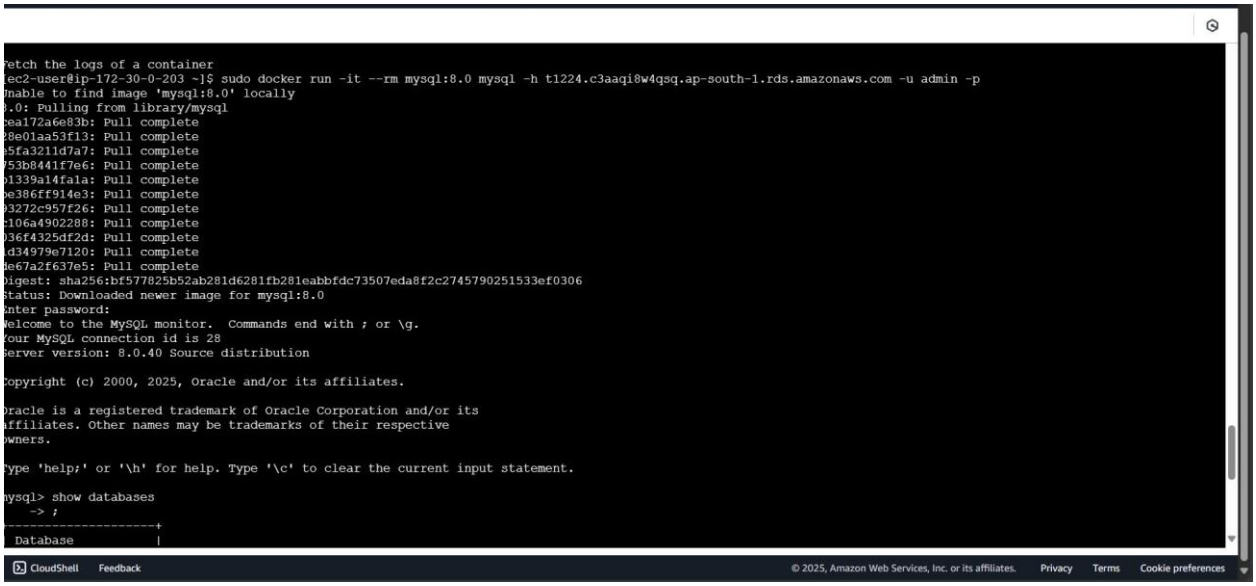

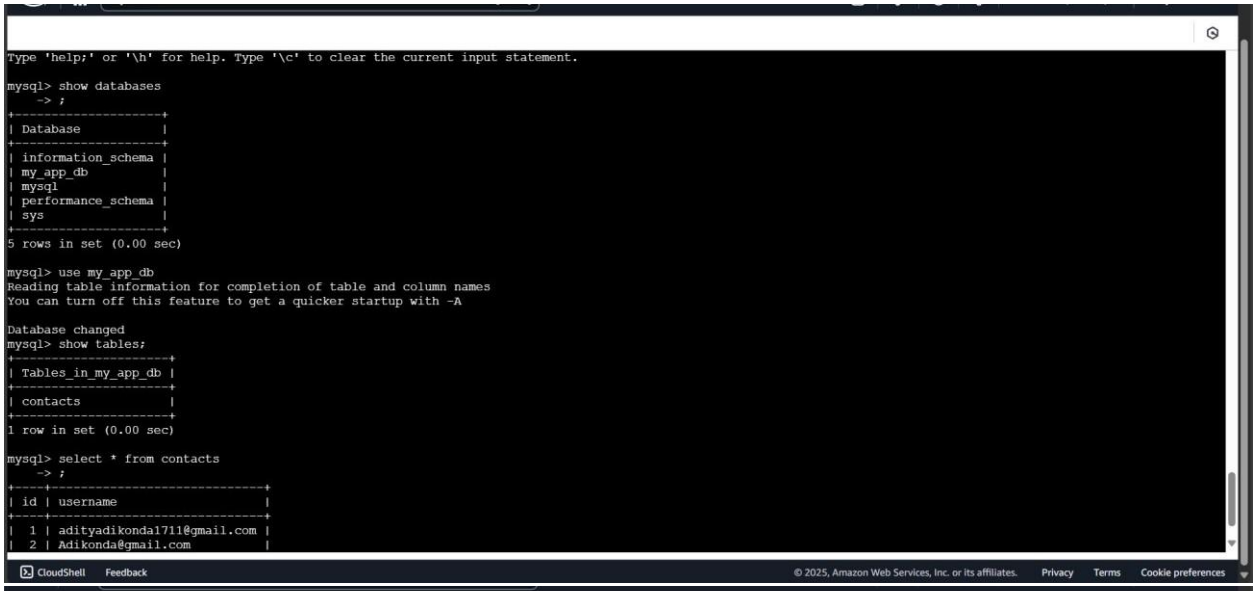

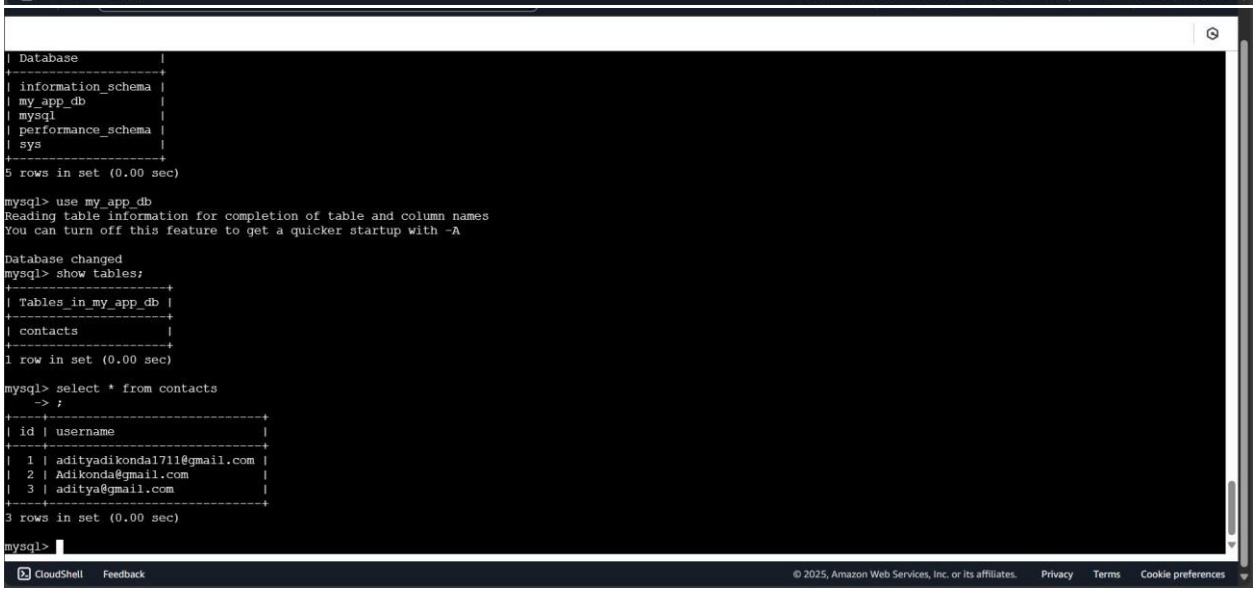

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Conclusion: We have successfully understood Docker Architecture and Container Life Cycle, installed Docker and executed docker commands to manage images and interact with containers.

LO Mapping: *LO is mapped*