Deployment of Flask Backend & Express Frontend on AWS

Aim

The aim of this assignment is to deploy a complete full-stack application consisting of:

- **Flask backend (Python)**
- **Express frontend (Node.js)**

across three different deployment approaches on AWS:

1. Deployment on a **single EC2 instance**
2. Deployment on **two separate EC2 instances**
3. Deployment using **Docker containers with AWS ECR, ECS, and VPC**

The purpose of this assignment is to learn cloud deployment, containerization, AWS services, and real-world infrastructure setup practices.

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1. Introduction

Modern applications often require separate frontend and backend components, deployed in flexible cloud environments. In this project, the Express frontend communicates with the Flask backend over REST APIs.

I deployed this system in three ways:

1. Traditional deployment on EC2
2. Distributed deployment (frontend + backend separated)
3. Containerized microservices deployment using ECR + ECS + VPC

This assignment demonstrates understanding of:

- Linux server configuration
- EC2 setup & security groups
- Docker containerization
- Private container registry (ECR)
- ECS cluster, task definitions & services
- VPC networking concepts

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2. Application Overview

2.1 Flask Backend (Python)

- Provides REST APIs.
- Handles business logic.
- Runs on port **5000**.
- Supports health-check endpoints.

2.2 Express Frontend (Node.js)

- Runs user interface.
- Sends API requests to Flask backend.
- Runs on port **3000**.

2.3 Communication Flow

Frontend → calls → Backend → returns → JSON response

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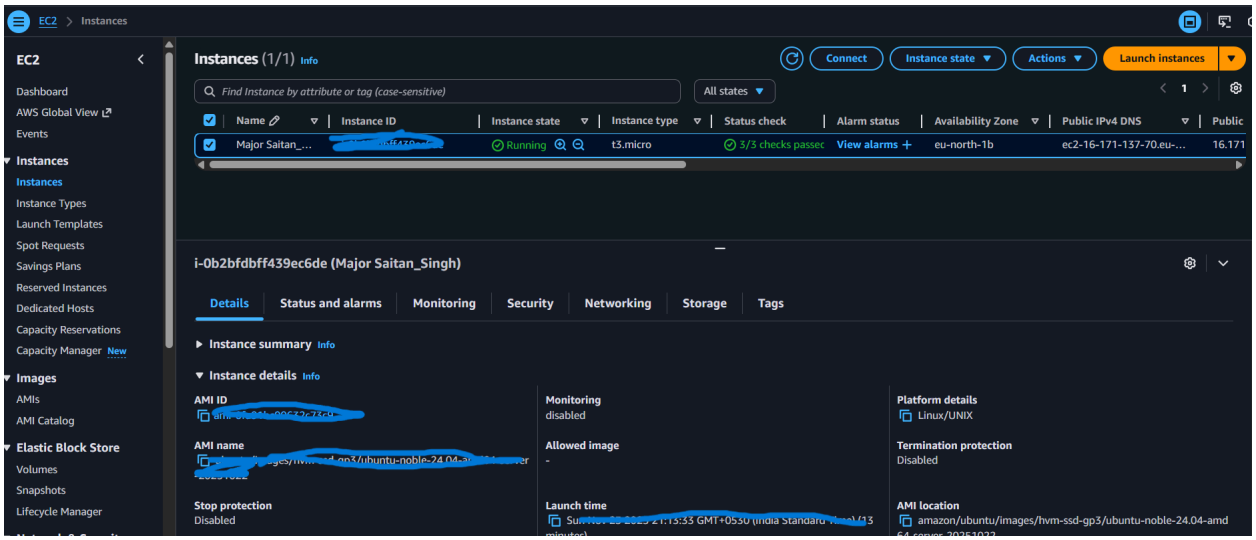
3. Deployment – Single EC2 Instance

In this method, both applications run inside a single EC2 instance.

Steps Performed

1. Created an EC2 instance (Ubuntu).
2. Installed:
    - Node.js & npm
    - Python3, pip
3. Cloned GitHub repository.
4. Started backend on port 5000 and frontend on 3000.
5. Modified security groups to allow both ports.

Output Screenshot



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4. Deployment – Separate EC2 Instances

In this approach:

- One EC2 instance runs the **backend**
- One EC2 instance runs the **frontend**

Steps Performed

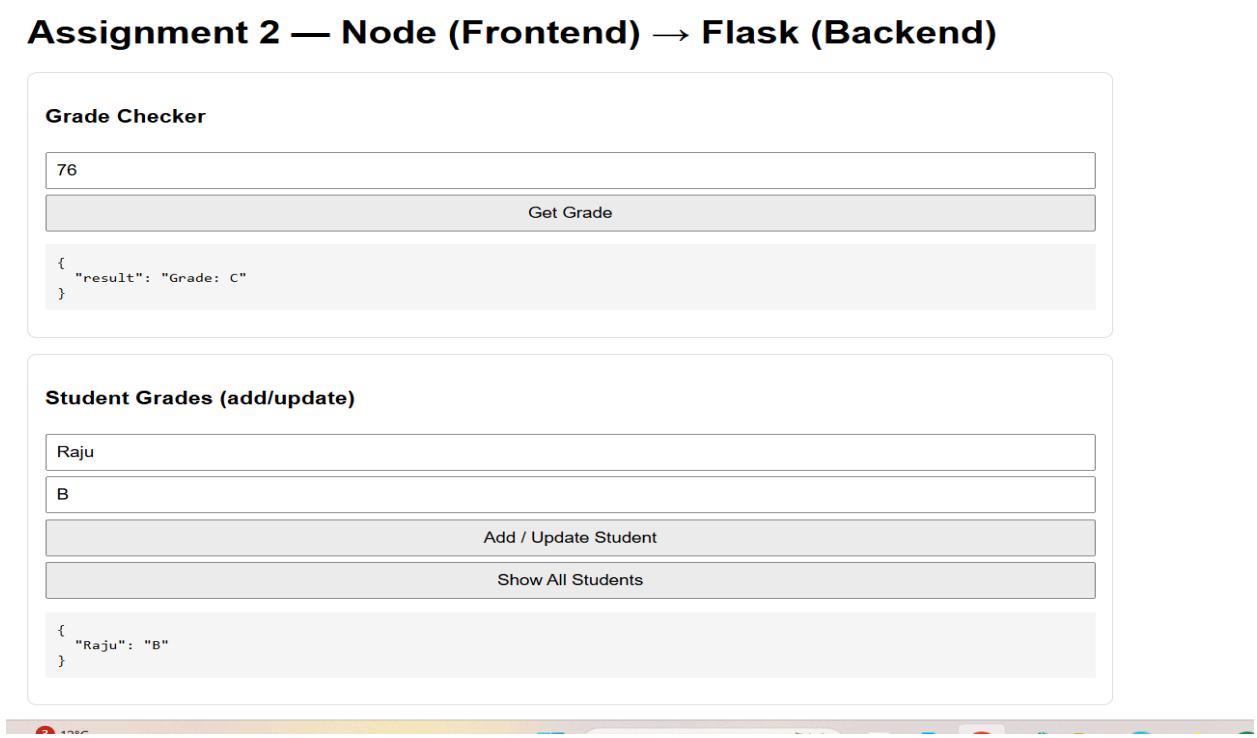
Backend EC2

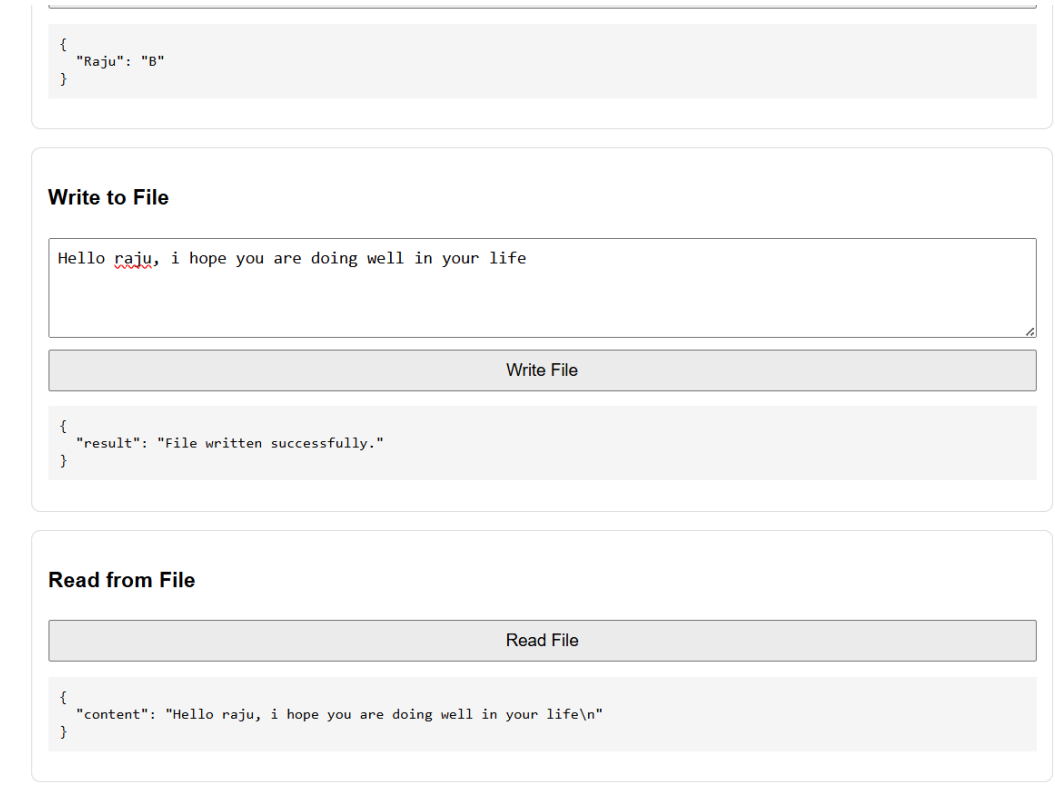
1. Installed Python3 + pip
2. Ran Flask backend on port 5000
3. Allowed inbound rule: port **5000**

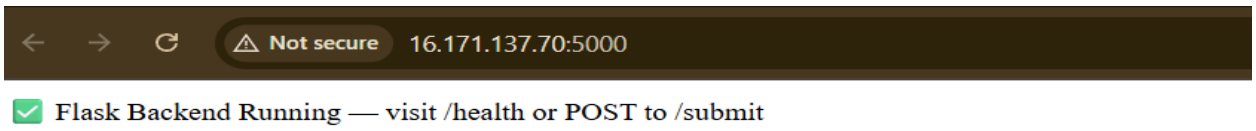
Frontend EC2

1. Installed Node.js
2. Updated API URL to point to backend instance’s public IP
3. Allowed inbound rule: **3000**

Output Screenshot







Flask Backend Running — visit /health or POST to /submit

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5. Deployment – Dockerized Using AWS ECR, ECS, VPC

This was the main part of the assignment and required detailed work.

5.1 Containerization Using Docker

Steps:

1. Created **Dockerfile for Flask backend**
2. Created **Dockerfile for Express frontend**
3. Built images using:

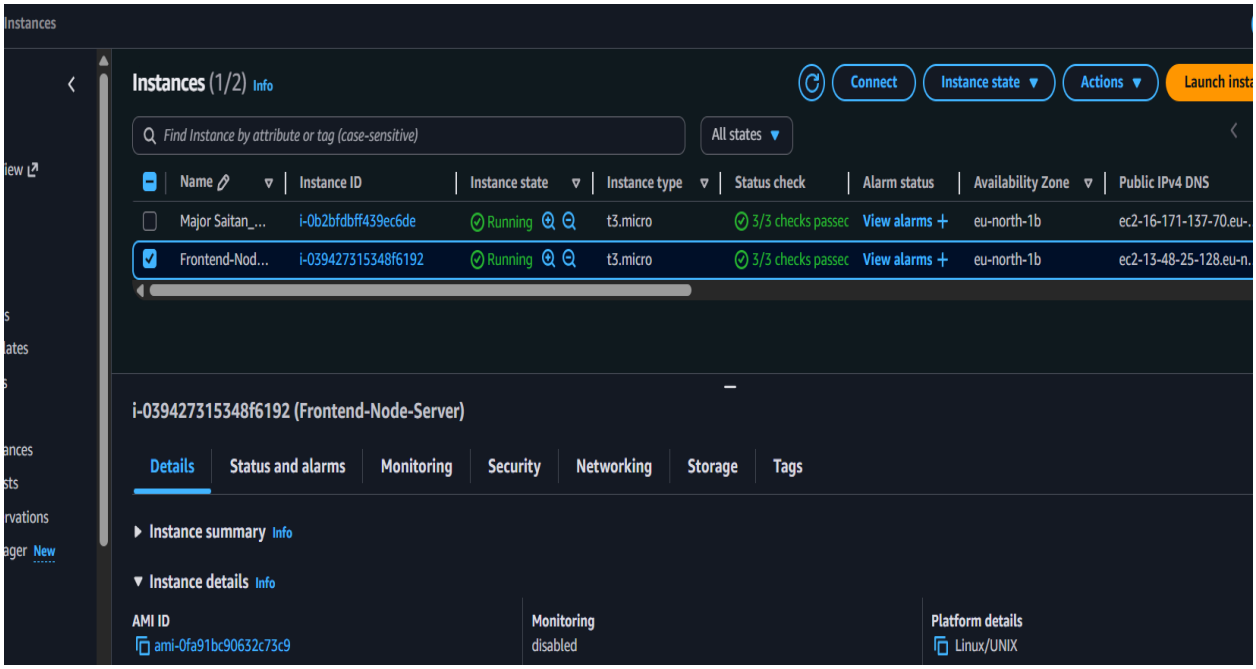
```
docker build -t flask-backend .
docker build -t node-frontend .
```

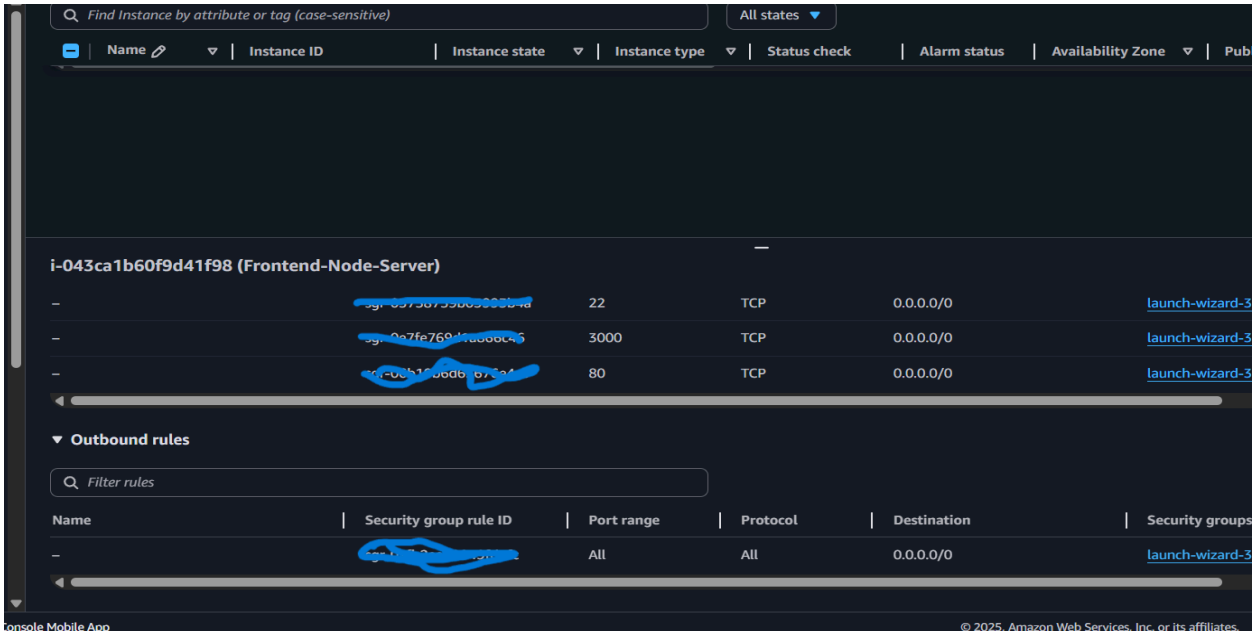
4. Tagging images:

```
docker tag flask-backend:latest
<aws-account>.dkr.ecr.<region>.amazonaws.com/flask-backend:latest
docker tag node-frontend:latest
<aws-account>.dkr.ecr.<region>.amazonaws.com/node-frontend:latest
```

5. Logged in to ECR and pushed images successfully.

Output Screenshot





5.2 AWS ECR (Elastic Container Registry)

- Created two private repositories:
    - **flask-backend**
    - **node-frontend**
- Pushed both container images from EC2 to ECR.

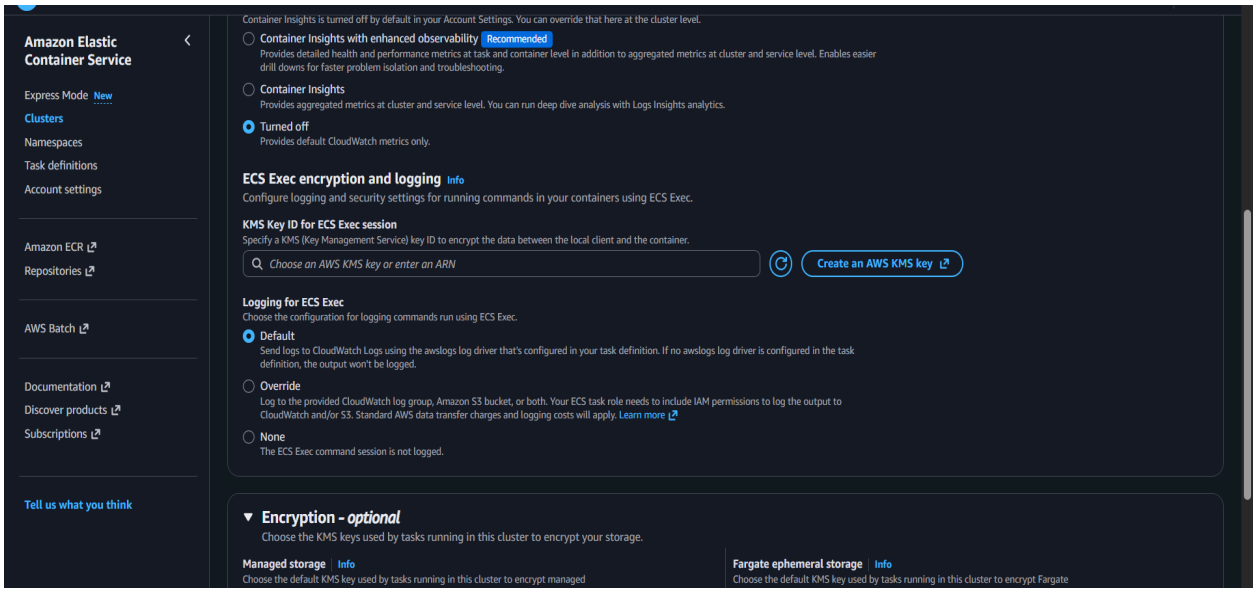
5.3 AWS ECS Cluster Creation

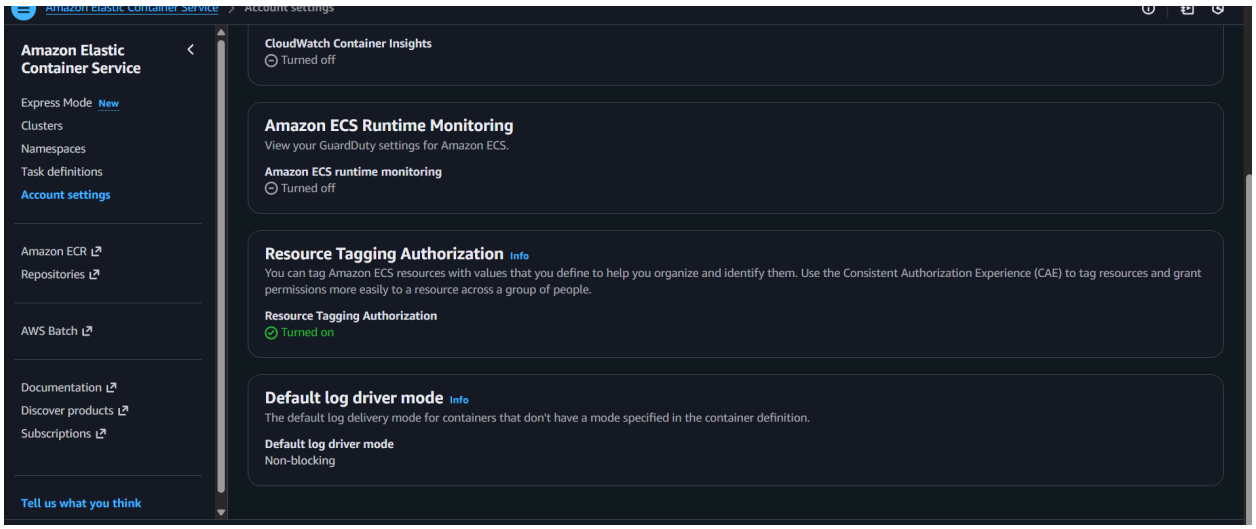
Steps:

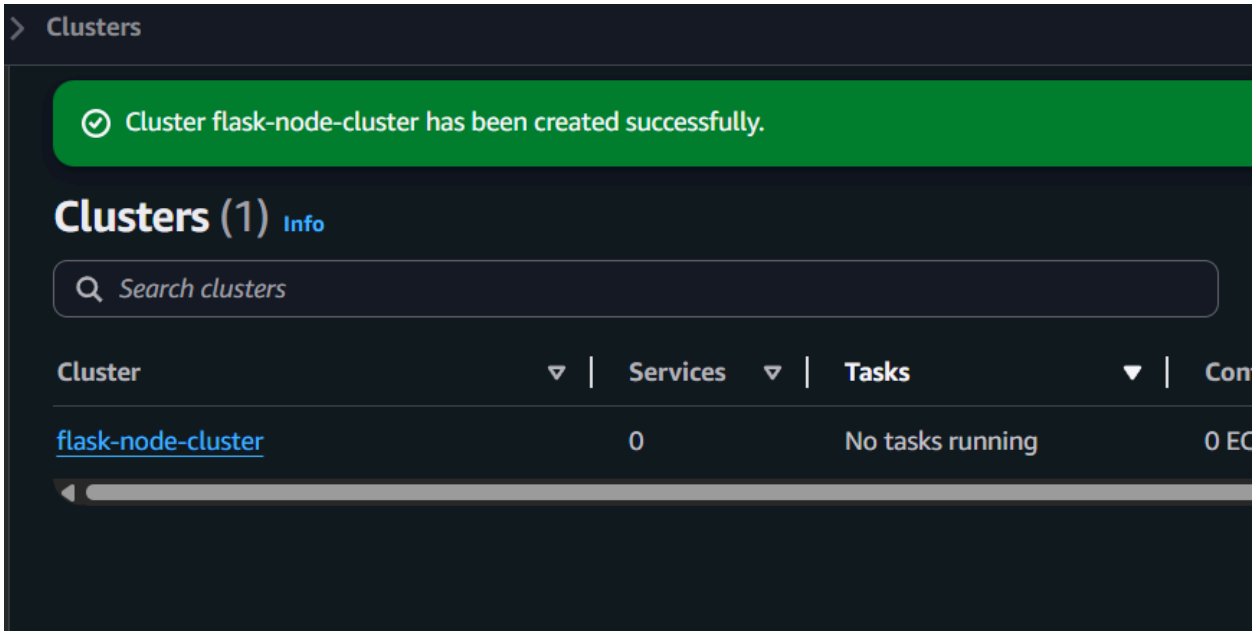
1. Created a new **ECS Cluster** (Networking-only).
2. Created **Task Definitions** for:
    - flask-backend-task
    - node-frontend-task
3. Configured:
    - **Fargate launch type**

- CPU: .25 vCPU
- Memory: 0.5 GB
- Container ports (3000 and 5000)
- Execution role: `ecsTaskExecutionRole`

Output Screenshot





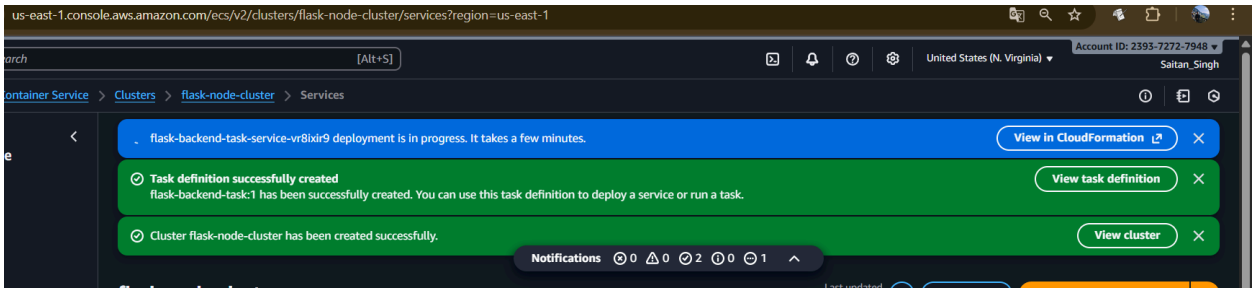


5.4 ECS Service Creation

For each service (frontend + backend):

1. Selected cluster.
2. Created service using task definition.
3. Configured:
    - VPC
    - Subnets (public)
    - Security group (port 3000 or 5000)
4. Enabled auto-assign public IP.

Output Screenshot

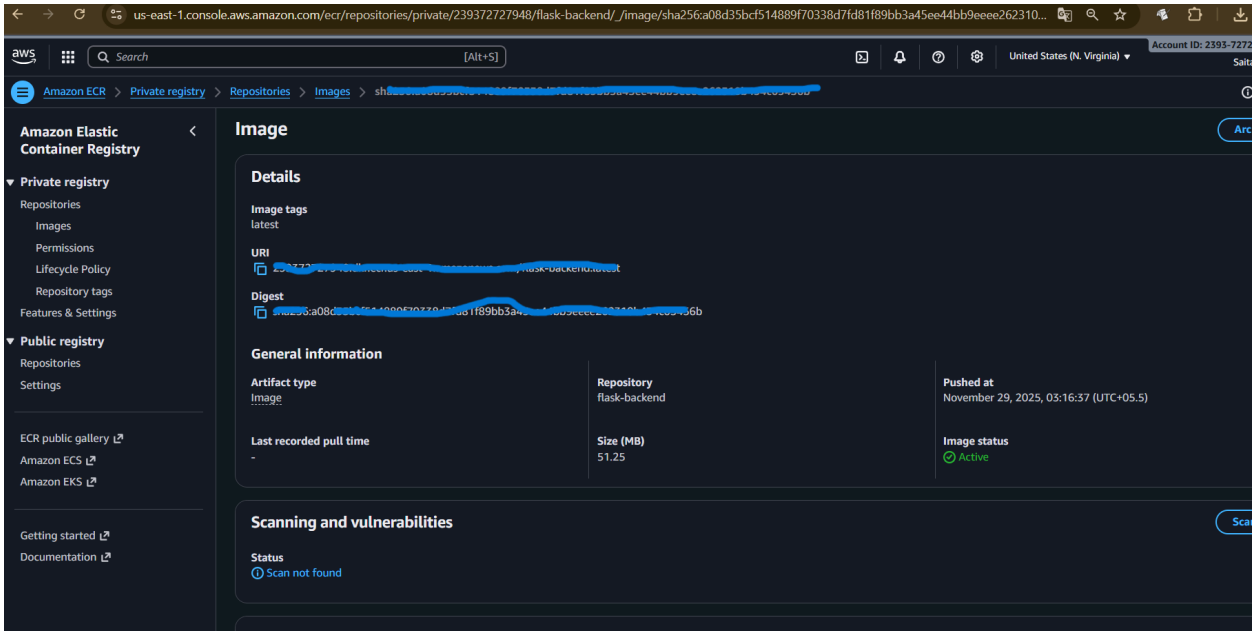


5.5 Successful Deployment

After debugging issues (image not found, role missing, ECR paths incorrect, etc.), the services were successfully deployed.

Both containers are now running inside ECS and reachable via public IP.

Output Screenshot



6. Issues Faced & Resolution

Issue 1: ECR repository not found

Cause: Wrong region in image push command
Fix: Created ECR in correct region & updated docker tag.

Issue 2: ECS service linked role missing

Fix: Deleted problematic role → recreated automatically.

Issue 3: Task stopped due to “CannotPullContainerError”

Fix: Corrected ECR URI & re-pushed image.

Issue 4: Frontend could not reach backend

Fix: Allowed backend’s security group from anywhere OR from frontend service.

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7. Final Outputs

Component	Status
Flask Backend	Deployed Successfully
Express Frontend	Deployed Successfully
EC2 (Single)	Working
EC2 (Separated)	Working
ECR	Images uploaded
ECS Cluster	Running
VPC Networking	Configured
Application	Live and accessible

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8. Conclusion

This assignment gave hands-on experience with:

- Cloud deployment using AWS
- Running applications on EC2
- Designing distributed architecture
- Using Docker for containerization
- Pushing images to Amazon ECR
- Running containers using ECS Fargate
- Handling IAM roles, VPC, subnets, and security groups

By completing all three deployment methods, I learned the full workflow of:

Local development → Dockerization → Cloud deployment → Production hosting

This project strengthened my understanding of DevOps, AWS cloud infrastructure, CI/CD foundations, and container orchestration.