Capstone Final Project Report

Project Title: Event Dash Board

Cloud-Native Deployment and Monitoring of a Microservices Application using AWS EKS, CI/CD, Terraform, and Route 53

GitHub Repository:

🔗 https://github.com/sujeetsrahate/Capstone-Final-z

Table of Contents

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1. Introduction

The goal of this capstone project was to design and deploy a full-stack cloud-native microservices application using AWS managed services and Infrastructure as Code (IaC) tools. This project integrates EKS, Terraform, AWS CodePipeline, Route 53, and CloudWatch to provide a scalable, highly available, and observable solution.

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2. Objective

To implement a complete DevOps workflow with multi-region disaster recovery, monitoring, and CI/CD capabilities by:

- Deploying Java Spring Boot & ReactJS applications.
- Automating infrastructure using CloudFormation and Terraform.
- Implementing automated pipelines using CodePipeline.
- Configuring Route 53 for disaster recovery.
- Setting up CloudWatch for monitoring and logging.

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3. Tools and Technologies Used

- **AWS Services**: EKS, EC2, RDS, CloudWatch, Route 53, CodePipeline, S3, IAM
- **IaC**: Terraform, AWS CloudFormation
- **CI/CD**: AWS CodePipeline, CodeBuild
- **Containerization**: Docker
- **Monitoring**: CloudWatch
- **Languages**: Java (Spring Boot), ReactJS, YAML, HCL

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4. Architecture Overview

The project implements a **three-tier microservice architecture**:

- **Frontend**: ReactJS
- **Backend**: Spring Boot + MySQL (RDS)
- **Infrastructure**: Provisioned across regions using CloudFormation and Terraform
- **Pipeline**: Source -> Build -> Deploy stages in AWS CodePipeline

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5. Phase 1: Deploy High-Level Application on EKS

The initial phase involves deploying the application on Amazon EKS. Components:

- EKS Cluster creation (via AWS CLI)

- Kubernetes manifests for:
    - Spring Boot deployment & service
    - MySQL deployment & persistent volume
    - ReactJS frontend deployment & service
    - Ingress controller

Manifests used:

- springboot-deploy.yaml
- mysql-deploy.yaml
- react-event-deploy.yaml
- ingress.yaml

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6. Phase 2: CI/CD Pipeline with CodePipeline

This phase integrates CI/CD via AWS CodePipeline.

Key Files:

- buildspec.yaml
  Specifies how CodeBuild builds the project and pushes Docker images to ECR.

Pipeline Flow:

1. Code push to GitHub
2. CodeBuild builds and pushes to ECR
3. Deploys to EKS using kubectl

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7. Phase 3: Multi-Region Infra via CloudFormation & Terraform

This phase establishes high availability and disaster recovery.

- CloudFormation stacks create VPC, subnets, security groups, etc.
- Terraform modules provision additional resources and EKS nodes.

Repositories:

- CloudFormation.yaml
- Infra-terraform.tf

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8. Terraform Infra Structure

Additional infrastructure is provisioned using Terraform:

- VPC and subnets
- EKS cluster and worker node groups
- Route tables and gateways
- S3 and IAM roles

GitHub Repo: sujeetsrahate/terraform_infra

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9. Phase 4: Route 53 Restructuring (Disaster Recovery)

Route 53 is configured with:

- **Primary hosted zone** for active region
- **Secondary failover policy** for standby region
- Health checks on application endpoints
- Weighted routing policies for zero-downtime switch

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10. Phase 5: Monitoring with CloudWatch

CloudWatch is configured to:

- Collect logs from EKS using FluentBit
- Visualize metrics like CPU/Memory usage
- Trigger alarms for unhealthy pods or services
- Store logs from Spring Boot backend and application frontend

Importance:

- Ensures observability
- Enables root cause analysis
- Supports performance tuning

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11. SonarQube Integration

SonarQube was added as a quality gate in the CI/CD pipeline.

- Scans for bugs, vulnerabilities, and code smells
- Improves maintainability and security
- Integrated in CodeBuild using Dockerized scanner

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12. Challenges Faced

- Managing VPC peering across regions
- IAM role policies during automated provisioning
- Synchronizing Terraform and CloudFormation resources
- Kubernetes networking in multi-region setup
- Log ingestion and visibility in CloudWatch

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13. Future Scope

- Use AWS Backup to automate RDS backups
- Integrate Prometheus & Grafana for advanced monitoring
- Add more microservices for horizontal scaling
- Integrate with GitHub Actions or Jenkins for hybrid CI/CD

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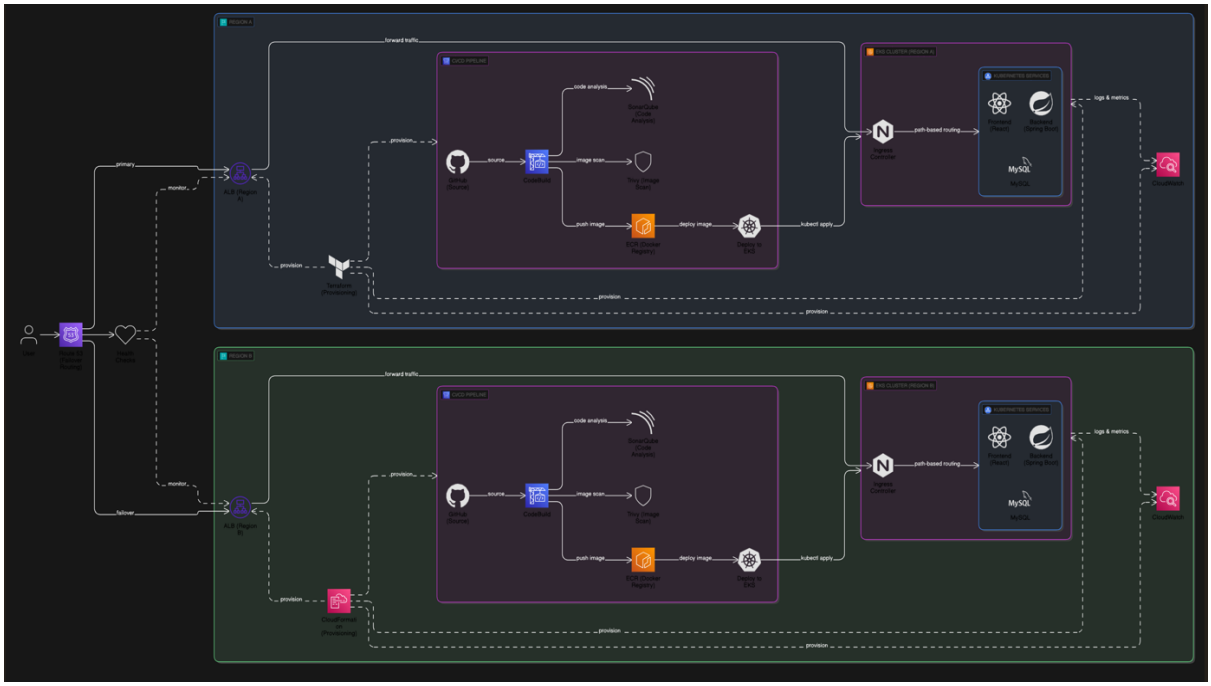
14. Conclusion

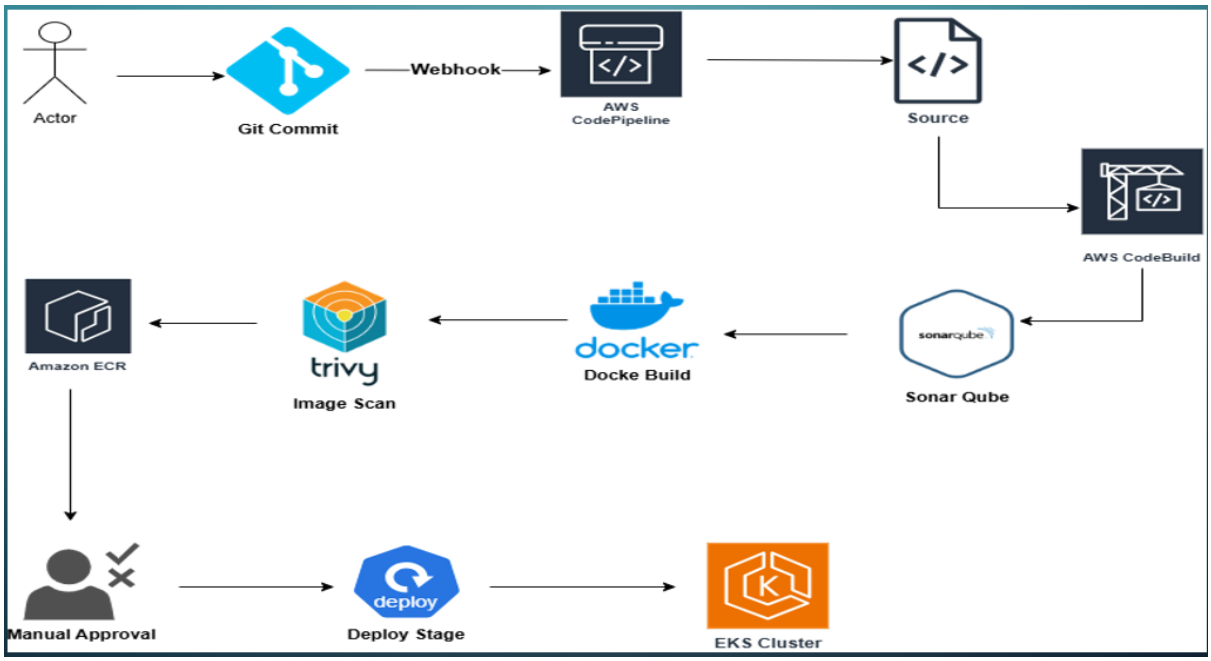
This capstone project successfully delivered a multi-region, production-grade cloud-native application using industry-standard DevOps tools and AWS services. All core objectives including CI/CD, container orchestration, disaster recovery, and monitoring were achieved.

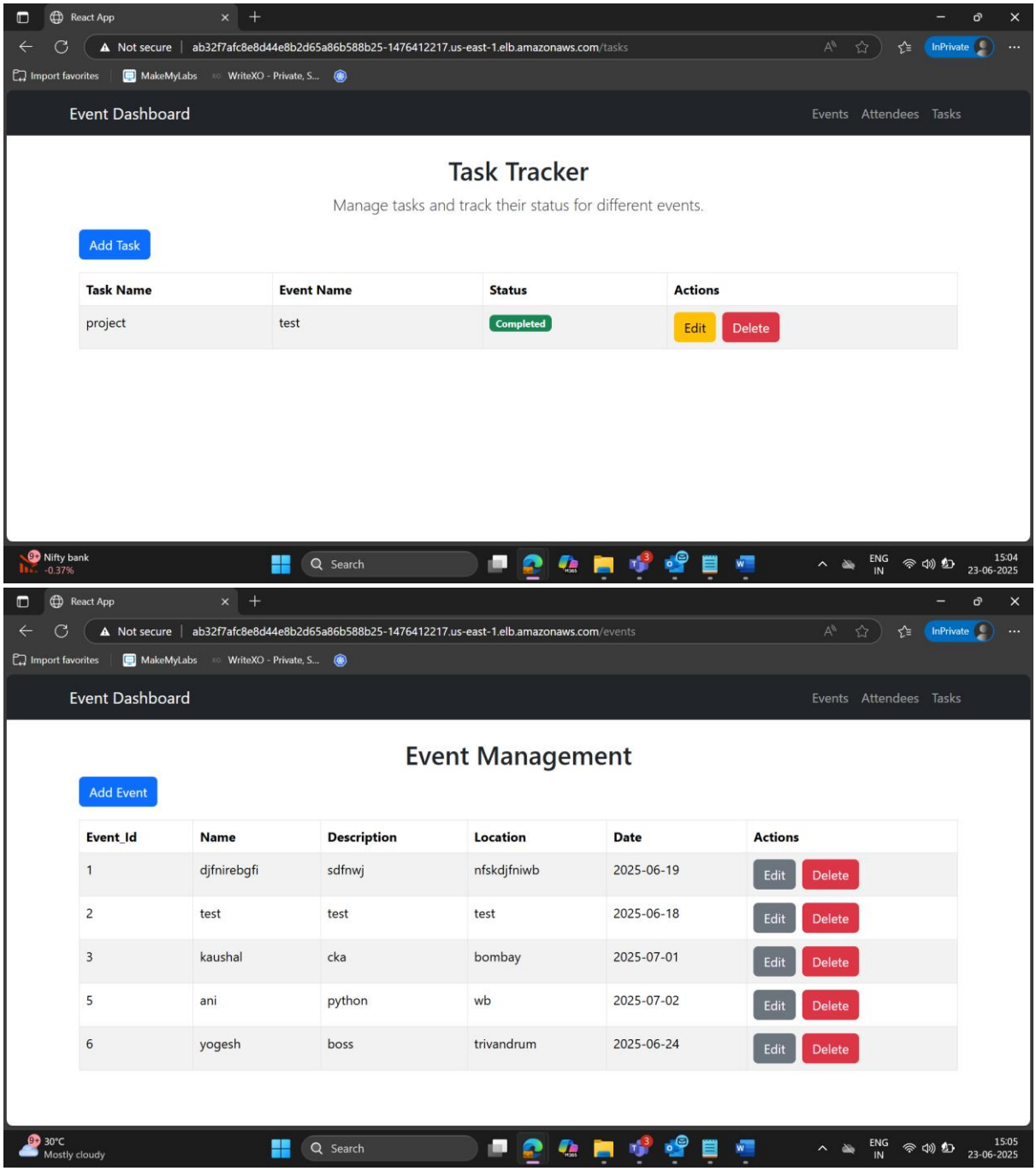
Capstone Project:

GitHub Repository: sujeetsrahate/Capstone-Final-z

Phase 1: Deploy high level application on EKS Cluster

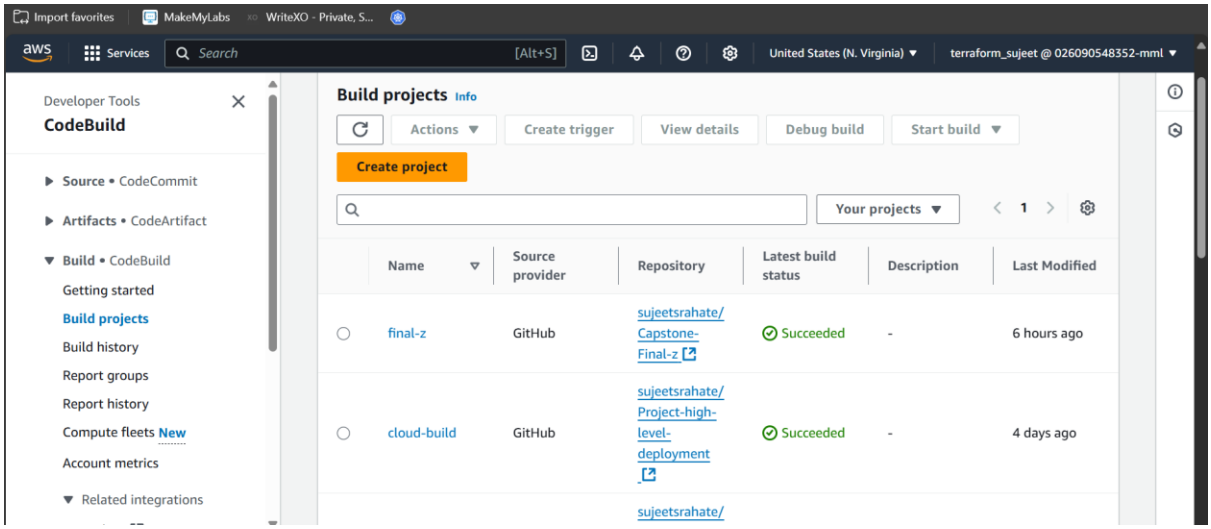


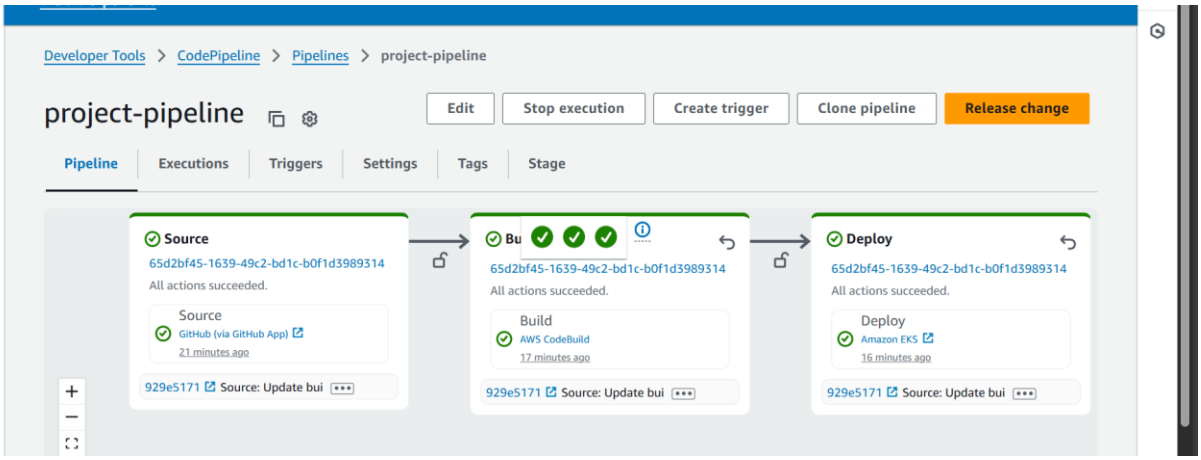

Actor
Git Commit
Webhook
AWS CodePipeline
Source
AWS CodeBuild
Sonar Qube
Docke Build
Image Scan
Amazon ECR
Manual Approval
Deploy Stage
EKS Cluster



Phase 2: deploy Application Through pipeline

Git Repo(buildspec.yaml): [Capstone-Final-z/buildspec.yaml at main · sujeetsrahate/Capstone-Final-z]

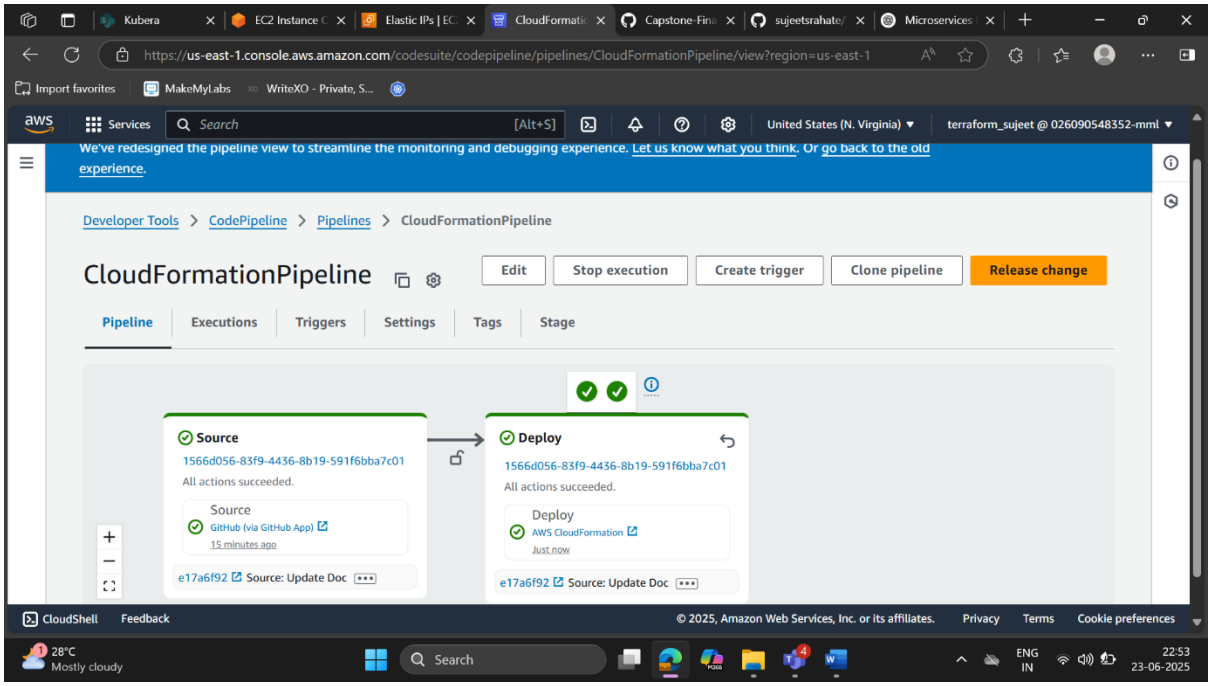


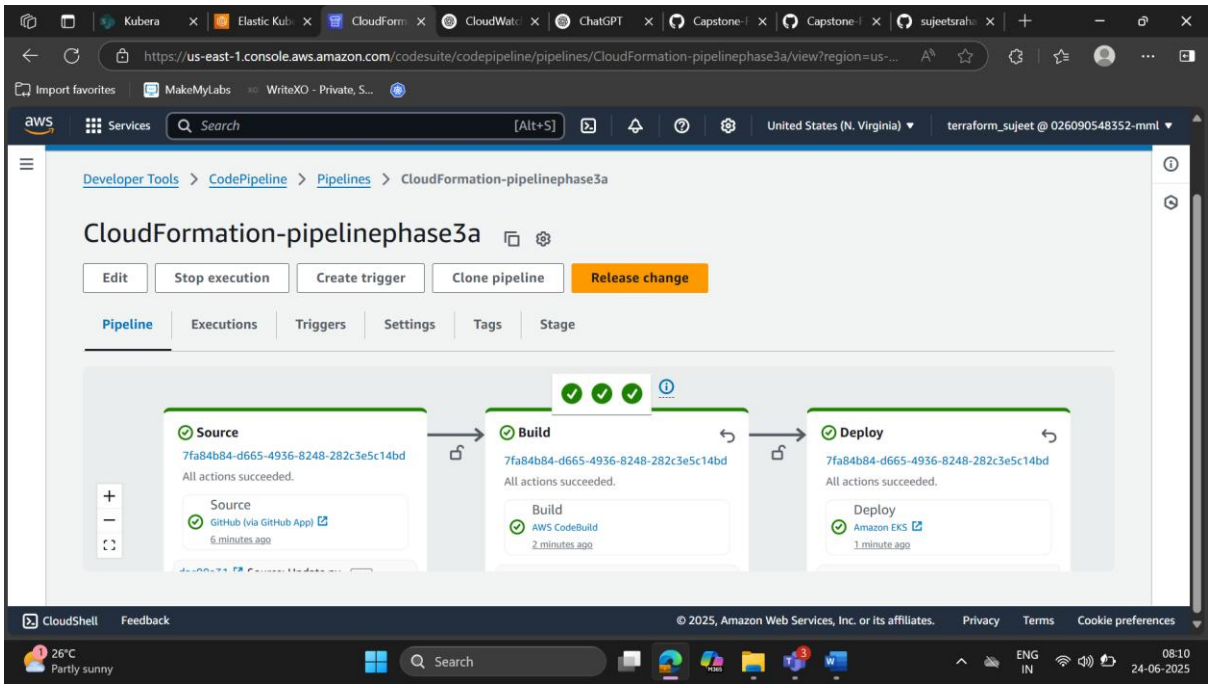


Phase 3: Use AWS Auto pipeline Multi Region of infrastructure with CFT and Terraform.

Git Hub Repo: [Capstone-Final-z/CloudFormation.yaml at main · sujeetsrahate/Capstone-Final-z]

Terraform GitHubRepo: [Capstone-Final-z/Infra-terraform.tf at main · sujeetsrahate/Capstone-Final-z]

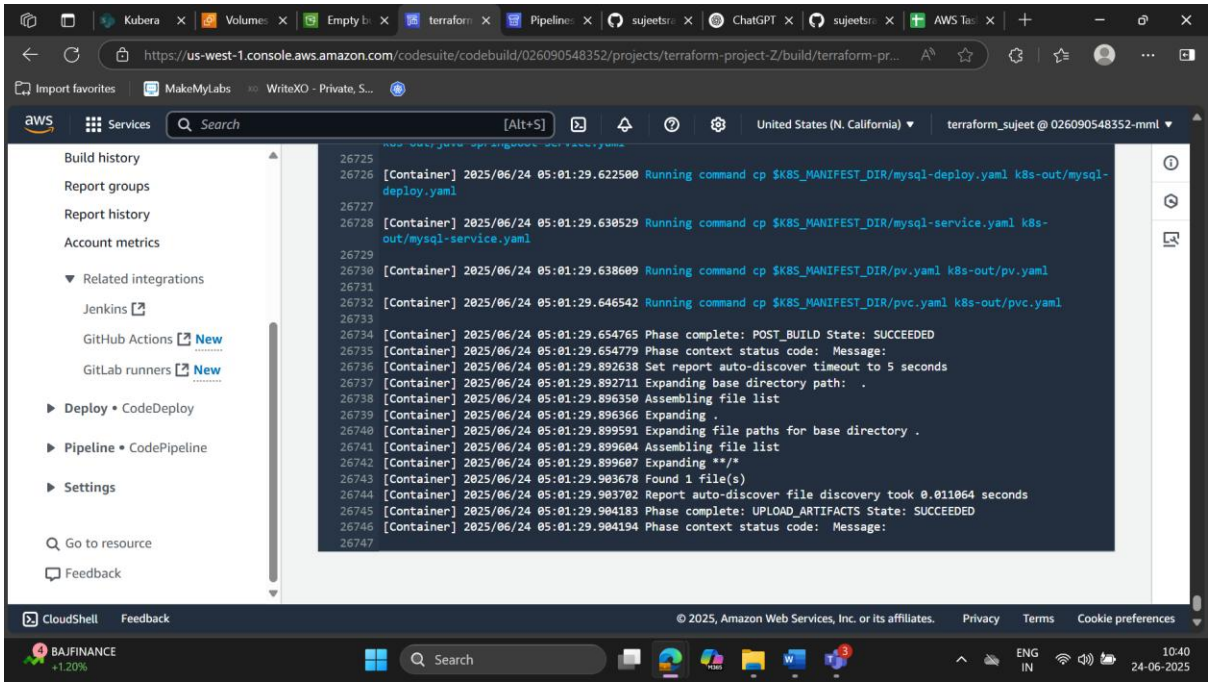


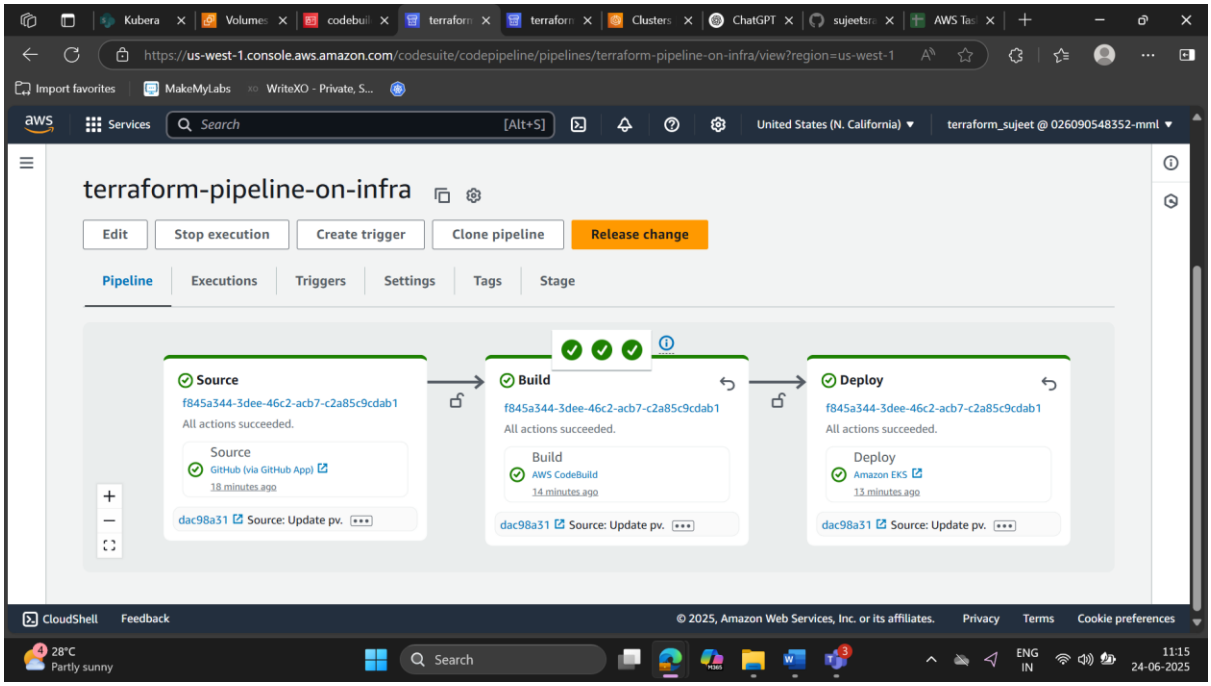


CloudFormation working proper and make the vpc and everything

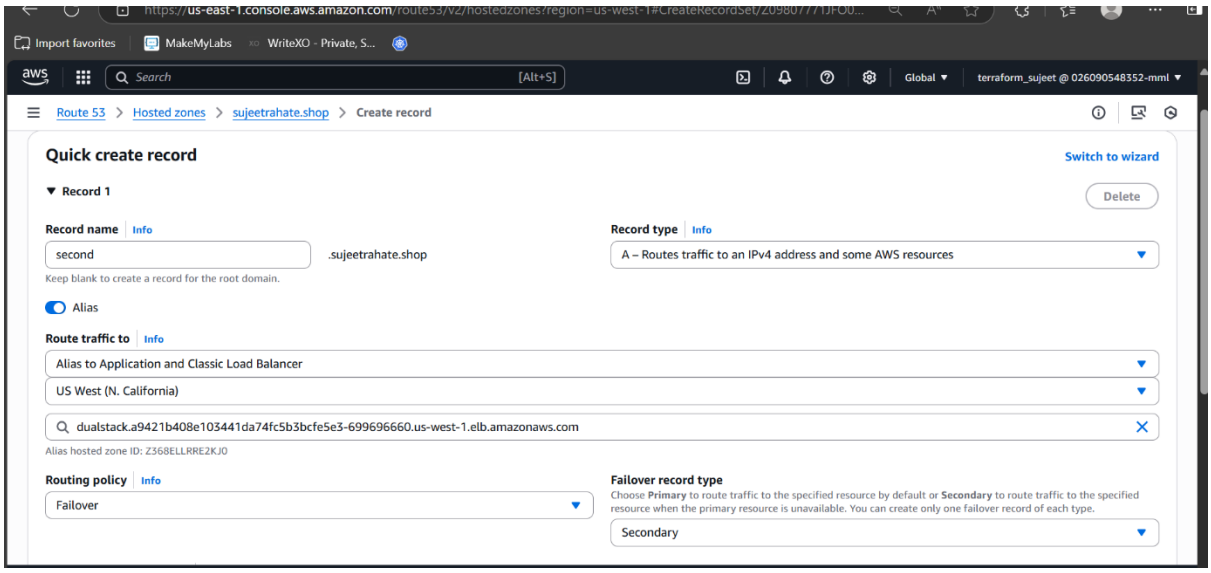
3B: creating Infra Structure through Terraform

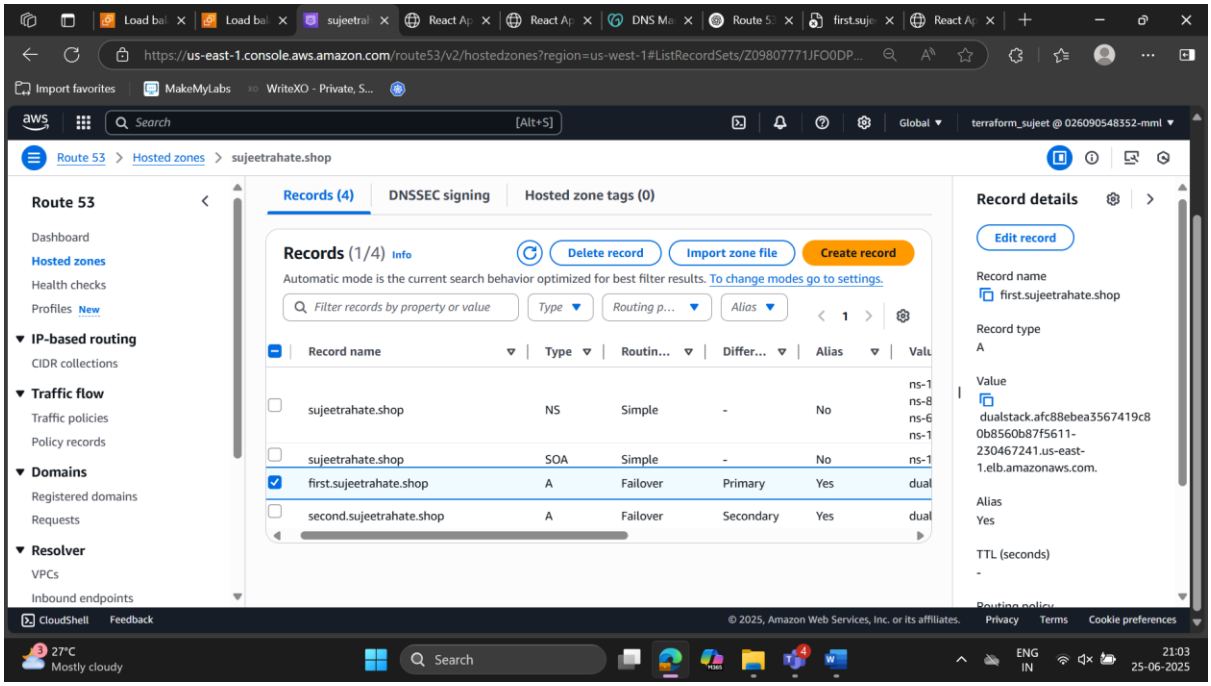
Git Hub Repo : [sujeetsrahate/terraform_infra]

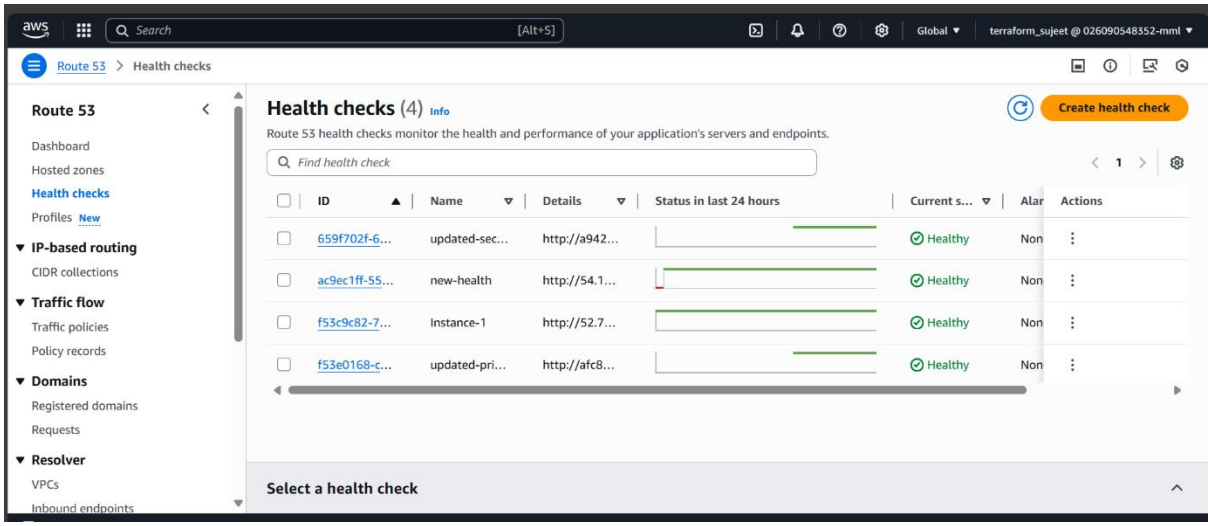




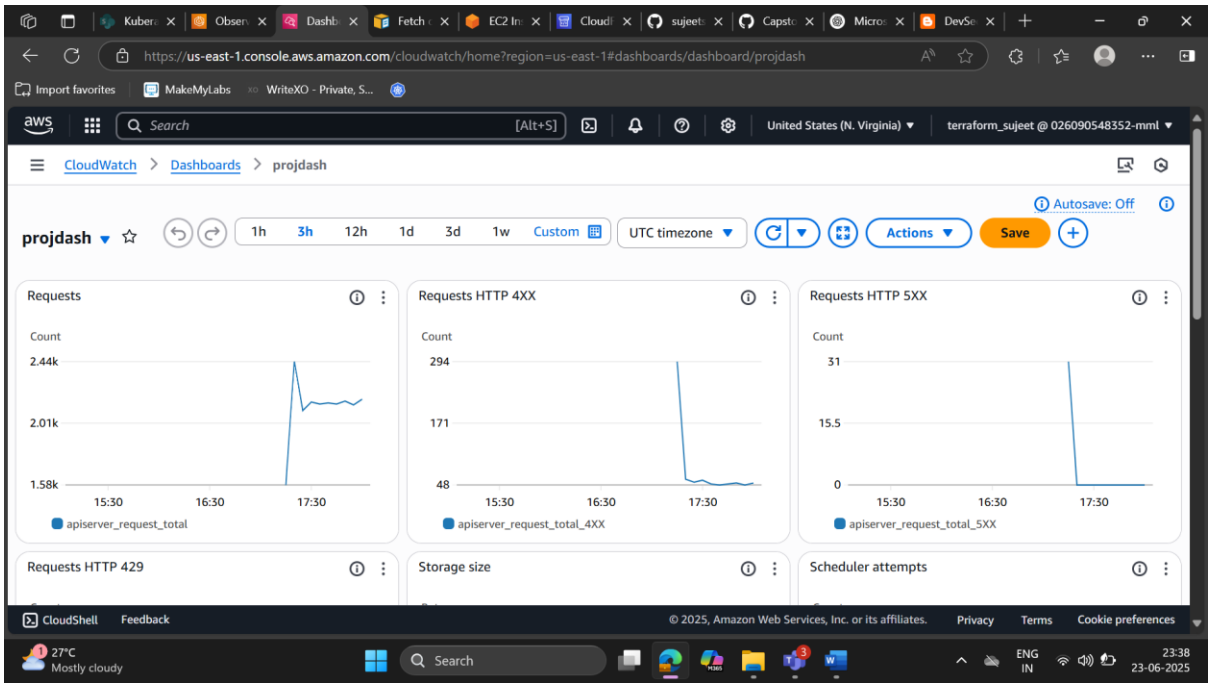
Phase 4: Make Route 53 Restructure. (make disaster strategy)

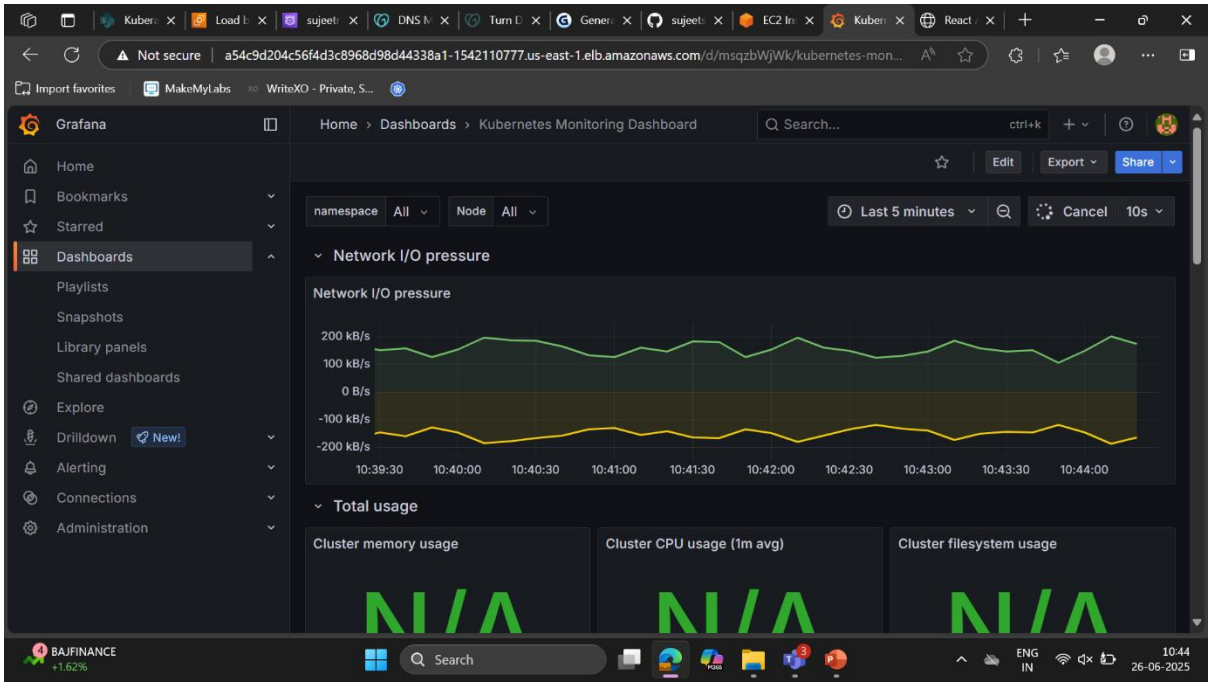

Route 53 > Hosted zones > sujeetrahate.shop > Create record
Quick create record
Switch to wizard
Record 1
Delete
Record name Info
second
.sujeetrahate.shop
Keep blank to create a record for the root domain.
Record type Info
A – Routes traffic to an IPv4 address and some AWS resources
Alias
Route traffic to Info
Alias to Application and Classic Load Balancer
US West (N. California)
dualstack.a9421b408e103441da74fc5b3bcfe5e3-699696660.us-west-1.elb.amazonaws.com
Alias hosted zone ID: Z368ELLRRE2KJ0
Routing policy Info
Failover
Failover record type
Choose Primary to route traffic to the specified resource by default or Secondary to route traffic to the specified resource when the primary resource is unavailable. You can create only one failover record of each type.
Secondary

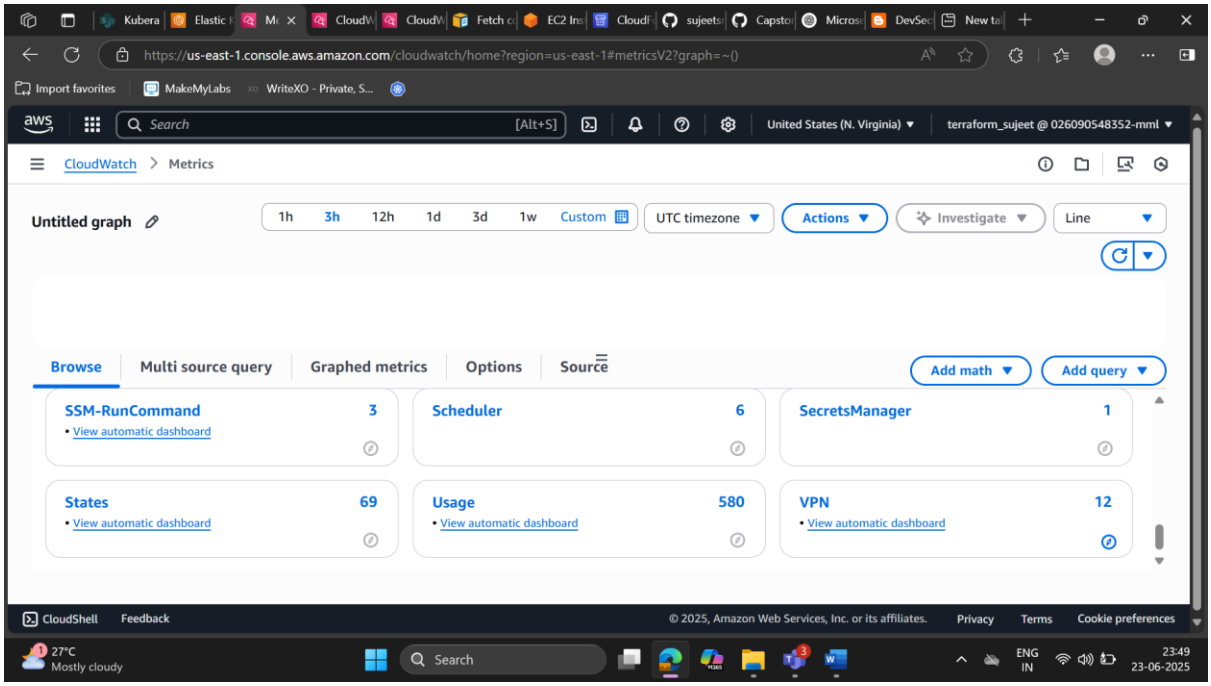

Route 53 > Hosted zones > sujeetrahate.shop
Route 53
Dashboard
Hosted zones
Health checks
Profiles New
IP-based routing
CIDR collections
Traffic flow
Traffic policies
Policy records
Domains
Registered domains
Requests
Resolver
VPCs
Inbound endpoints
Records (4)
DNSSEC signing
Hosted zone tags (0)
Records (1/4) Info
Delete record
Import zone file
Create record
Automatic mode is the current search behavior optimized for best filter results. To change modes go to settings.
Filter records by property or value
Type
Routing p...
Alias
Record name
Type
Routin...
Differ...
Alias
sujeetrahate.shop NS Simple - No
sujeetrahate.shop SOA Simple - No
first.sujeetrahate.shop A Failover Primary Yes
second.sujeetrahate.shop A Failover Secondary Yes
Record details
Edit record
Record name
first.sujeetrahate.shop
Record type
A
Value
dualstack.afc88ebea3567419c80b8560b87f5611-230467241.us-east-1.elb.amazonaws.com.
Alias
Yes
TTL (seconds)
-
CloudShell
Feedback
© 2025, Amazon Web Services, Inc. or its affiliates.
Privacy
Terms
Cookie preferences

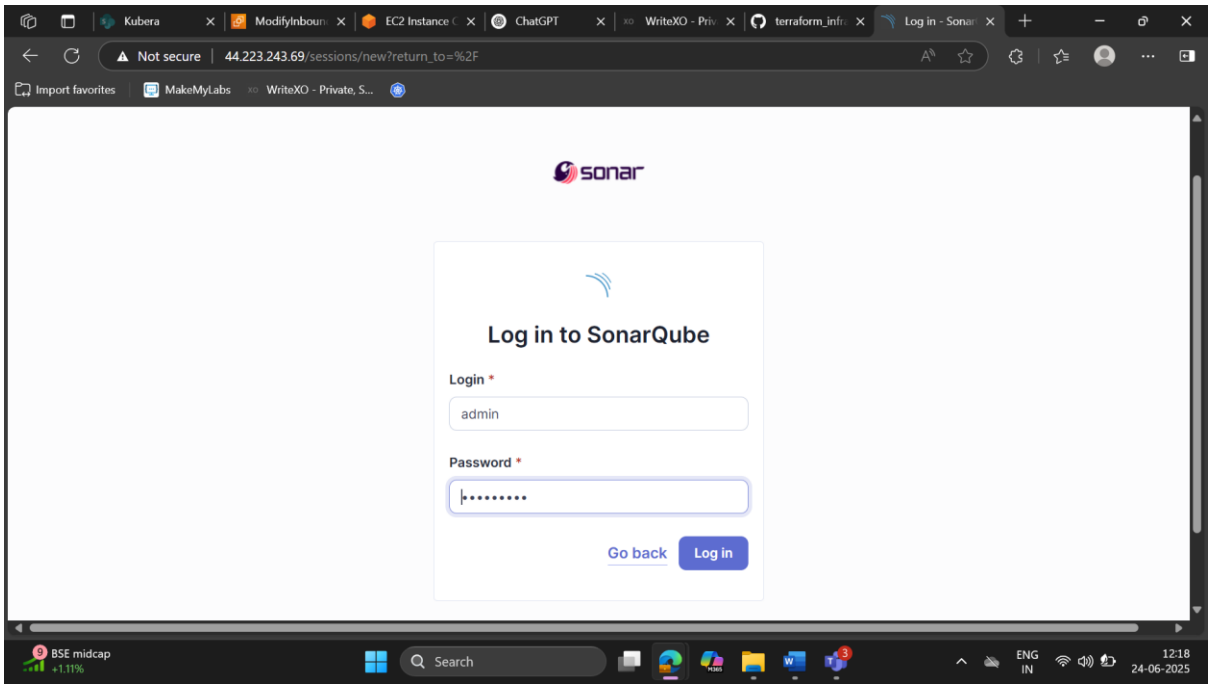

Route 53 > Health checks
Route 53
Dashboard
Hosted zones
Health checks
Profiles New
IP-based routing
CIDR collections
Traffic flow
Traffic policies
Policy records
Domains
Registered domains
Requests
Resolver
VPCs
Inbound endpoints
Health checks (4) Info
Create health check
Route 53 health checks monitor the health and performance of your application's servers and endpoints.
Find health check
ID
Name
Details
Status in last 24 hours
Current s...
Actions
659f702f-6... updated-sec... http://a942... Healthy
ac9ec1ff-55... new-health http://54.1... Healthy
f53c9c82-7... Instance-1 http://52.7... Healthy
f53e0168-c... updated-pri... http://afc8... Healthy
Select a health check

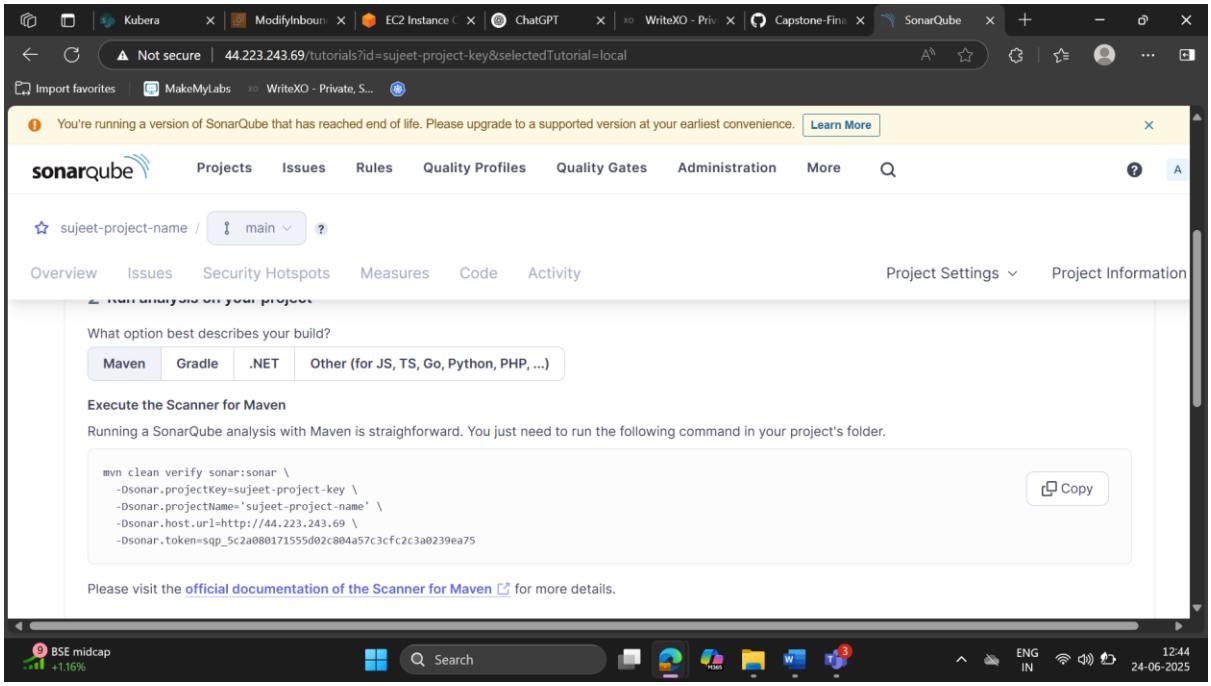
Phase 5: Cloud Watch:






https://us-east-1.console.aws.amazon.com/cloudwatch/home?region=us-east-1#metricsV2?graph=~()
Search
[Alt+S]
United States (N. Virginia)
terraform_sujeet @ 026090548352-mml
CloudWatch
Metrics
Untitled graph
1h
3h
12h
1d
3d
1w
Custom
UTC timezone
Actions
Investigate
Line
Browse
Multi source query
Graphed metrics
Options
Source
Add math
Add query
SSM-RunCommand
3
View automatic dashboard
Scheduler
6
SecretsManager
1
States
69
View automatic dashboard
Usage
580
View automatic dashboard
VPN
12
View automatic dashboard
CloudShell
Feedback
© 2025, Amazon Web Services, Inc. or its affiliates.
Privacy
Terms
Cookie preferences
27°C
Mostly cloudy
Search
ENG
IN
23:49
23-06-2025


Not secure
44.223.243.69/sessions/new?return_to=%2F
sonar
Log in to SonarQube
Login *
admin
Password *
Go back
Log in
BSE midcap
+1.11%
Search
ENG
IN
12:18
24-06-2025



Here are the **important YAML files** from your project repo that are essential for deploying your application on EKS:

---

springboot-deploy.yaml

yaml

CopyEdit

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: springboot-app
spec:
  replicas: 2
  selector:
    matchLabels:
      app: springboot
  template:
    metadata:
      labels:
```

```
      app: springboot
  spec:
    containers:
     - name: springboot
       image: <your-ecr-repo>/springboot-app:latest
       ports:
        - containerPort: 8080
       env:
        - name: SPRING_DATASOURCE_URL
          valueFrom:
            secretKeyRef:
              name: db-secret
              key: datasource_url
```

---

mysql-deploy.yaml

```
yaml
CopyEdit
apiVersion: apps/v1
kind: Deployment
metadata:
 name: mysql
spec:
 selector:
  matchLabels:
   app: mysql
 strategy:
  type: Recreate
 template:
```

```
  metadata:
    labels:
      app: mysql
  spec:
    containers:
      - image: mysql:5.7
        name: mysql
        env:
          - name: MYSQL_ROOT_PASSWORD
            value: rootpassword
          - name: MYSQL_DATABASE
            value: capstone_db
        ports:
          - containerPort: 3306
        volumeMounts:
          - name: mysql-persistent-storage
            mountPath: /var/lib/mysql
    volumes:
      - name: mysql-persistent-storage
        persistentVolumeClaim:
          claimName: mysql-pvc
```

---

react-event-deploy.yaml

yaml

CopyEdit

```
apiVersion: apps/v1
kind: Deployment
metadata:
```

```
  name: react-frontend
spec:
  replicas: 2
  selector:
    matchLabels:
      app: react
  template:
    metadata:
      labels:
        app: react
    spec:
      containers:
        - name: react
          image: <your-ecr-repo>/react-frontend:latest
          ports:
            - containerPort: 3000
```

---

ingress.yaml

```
yaml
CopyEdit
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: capstone-ingress
  annotations:
    nginx.ingress.kubernetes.io/rewrite-target: /
spec:
  rules:
```

```
  - http:
      paths:
       - path: /springboot
         pathType: Prefix
         backend:
          service:
            name: springboot-service
            port:
              number: 8080
       - path: /react
         pathType: Prefix
         backend:
          service:
            name: react-service
            port:
              number: 3000
```

---

mysql-service.yaml

```
yaml
CopyEdit
apiVersion: v1
kind: Service
metadata:
 name: mysql
spec:
 ports:
  - port: 3306
 selector:
```

```
  app: mysql
```

---

java-springboot-service.yaml

yaml

CopyEdit

```
apiVersion: v1
kind: Service
metadata:
 name: springboot-service
spec:
 type: ClusterIP
 selector:
  app: springboot
 ports:
  - port: 8080
    targetPort: 8080
```

---

react-event-service.yaml

yaml

CopyEdit

```
apiVersion: v1
kind: Service
metadata:
 name: react-service
spec:
 type: ClusterIP
 selector:
  app: react
```

```
  ports:
    - port: 3000
      targetPort: 3000
```

---

pv.yaml

```
yaml
CopyEdit
apiVersion: v1
kind: PersistentVolume
metadata:
  name: mysql-pv
spec:
  capacity:
    storage: 1Gi
  accessModes:
    - ReadWriteOnce
  hostPath:
    path: "/mnt/data"
```

---

pvc.yaml

```
yaml
CopyEdit
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: mysql-pvc
spec:
  accessModes:
```

```
  - ReadWriteOnce
 resources:
  requests:
   storage: 1Gi
==================Complete========
```