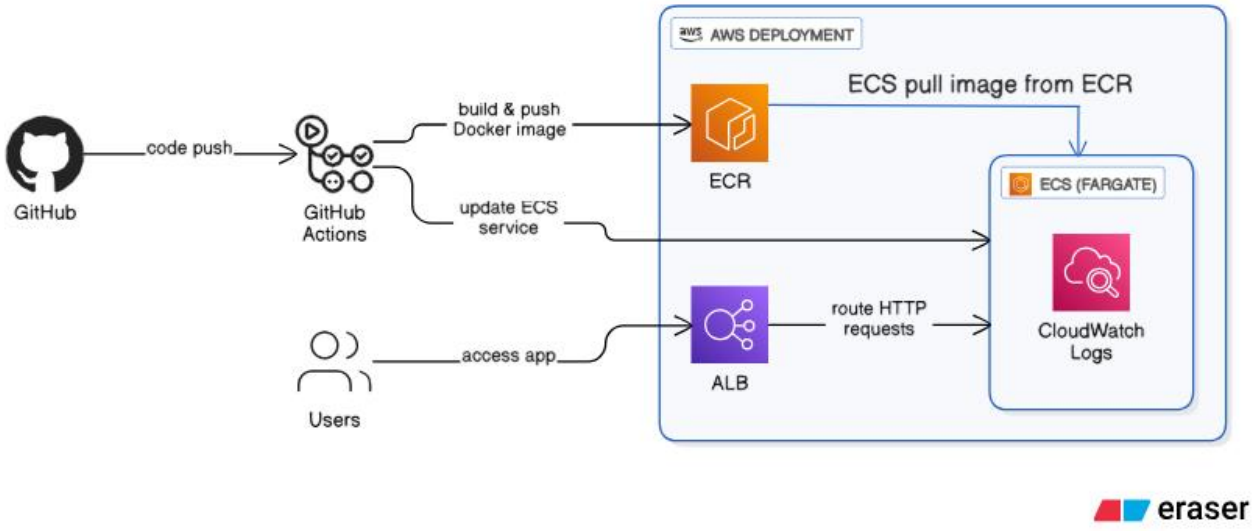
End-to-End Cloud Deployment with AWS ECS, ECR, and GitHub Actions

This guide will walk you through deploying a **Flask containerized app** on **AWS ECS (Fargate)** using **Amazon ECR** for storing Docker images and **Application Load Balancer (ALB)** for traffic distribution.
We will do everything **from scratch** so even a beginner can follow along.

Architectural Diagram:



🔹 Step 1: Prerequisites

Before starting, make sure you have:

- An **AWS account** (free tier works)
- Basic understanding of **Docker** and **Flask app**
- AWS CLI installed (optional but recommended)
- Your app (example: `app.py`) ready

Example Flask app (`app.py`):

```
from flask import Flask
app = Flask(__name__)

@app.route('/')
def home():
    return "Hello from ECS Fargate with ALB!"
@app.route('/health')
def health():
```

```
    return "the container is healthy",200


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

🔹 Step 2: Create Docker Image

1. Create a `Dockerfile` in your project folder:

```
FROM python:3.9-slim
WORKDIR /app
COPY requirements.txt requirements.txt
RUN pip install -r requirements.txt
COPY . .
CMD ["python", "app.py"]
```

8. Build Docker image locally:

```
docker build -t ecs-flask-demo .
```

10. Test locally:

```
 docker run -p 5000:5000 ecs-flask-demo
```

Visit: http://localhost:5000

🔹 Step 3: Push Image to Amazon ECR

Amazon ECR = **Elastic Container Registry** (private Docker repo on AWS).

1. Go to **AWS Console → ECR**
   - Click **Create repository**
   - Name it: `ecs-flask-demo`
   - Visibility: **Private**
   - Click **Create**
2. Authenticate Docker with ECR:

```
aws ecr get-login-password --region us-east-1 | docker login --
username AWS --password-stdin <account_id>.dkr.ecr.us-east-
1.amazonaws.com
```

4. Tag and push image:

```
docker tag ecs-flask-demo:latest <account_id>.dkr.ecr.us-east-
1.amazonaws.com/ecs-flask-demo:latest
docker push <account_id>.dkr.ecr.us-east-1.amazonaws.com/ecs-flask-
demo:latest
```

✅ Now your image is stored in **ECR**.

🔹 Step 4: Create ECS Cluster

Amazon ECS = Elastic Container Service (we use **Fargate** for serverless containers).

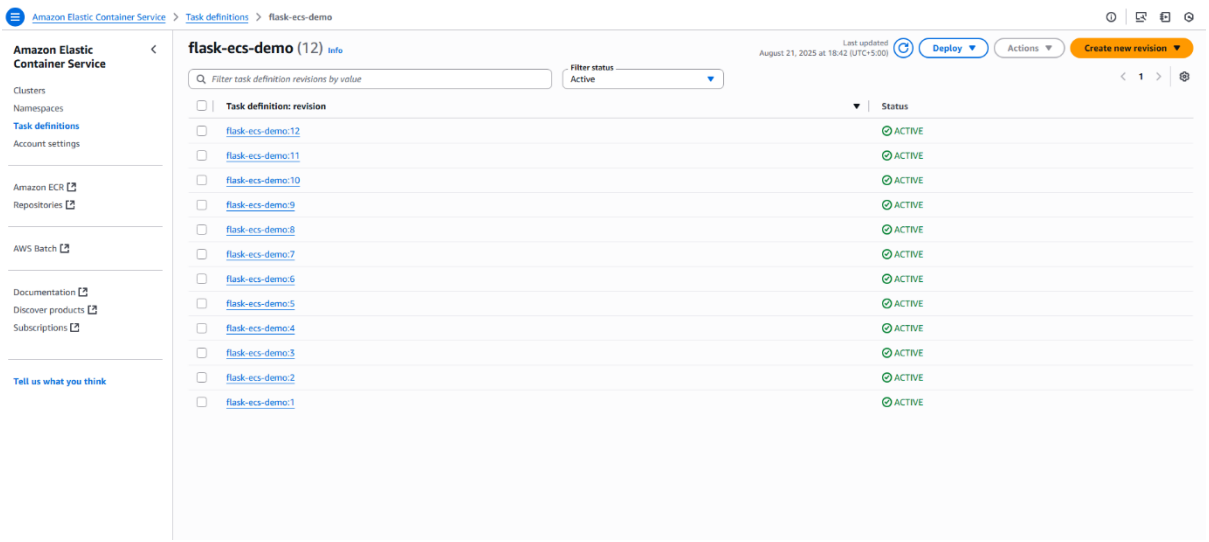
1. Go to **AWS Console → ECS**
2. Click **Create Cluster**
3. Select **Networking only (Fargate)**
4. Name cluster: `ECSClusterDemo`
5. Click **Create**

✅ Cluster is ready.

🔹 Step 5: Create Task Definition

ECS Task = Blueprint of container settings.

1. Go to **ECS → Task Definitions → Create new task definition**
2. Launch type: **Fargate**
3. Task definition name: `ECSTaskDemo`
4. Task role: None (for now)
5. Add container:
    - Name: `ecs-container`
    - Image URI: (ECR image URI you copied earlier)
    - Port mappings: **5000**
6. CPU: **256 (.25 vCPU)**
   Memory: **512 MiB**
7. Click **Create**



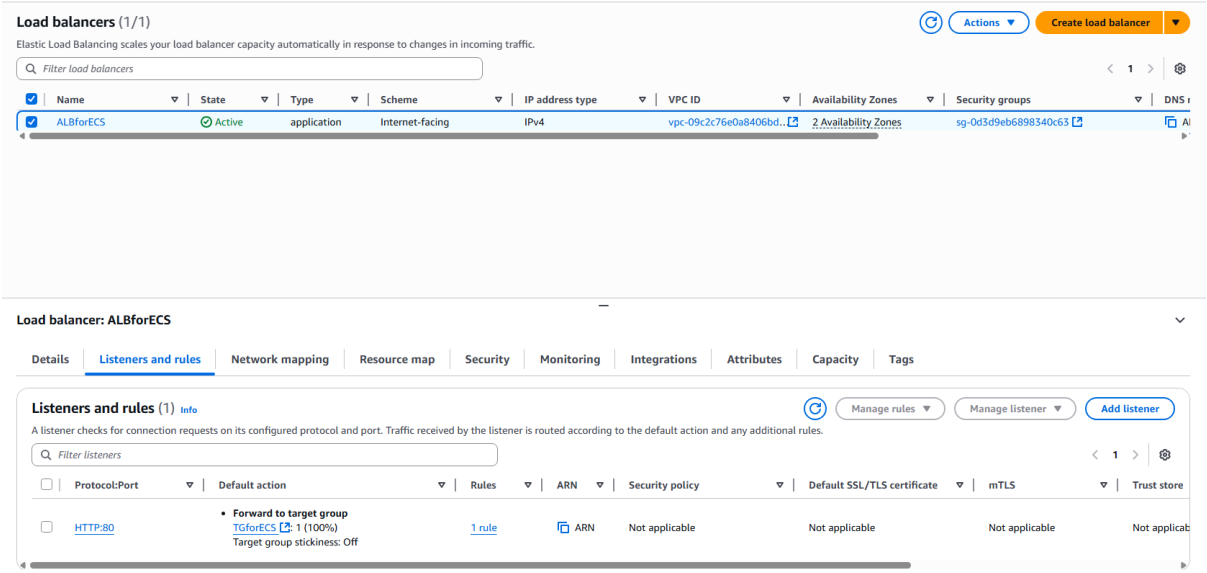
✅ Task definition created.

◆ Step 6: Create Application Load Balancer (ALB)

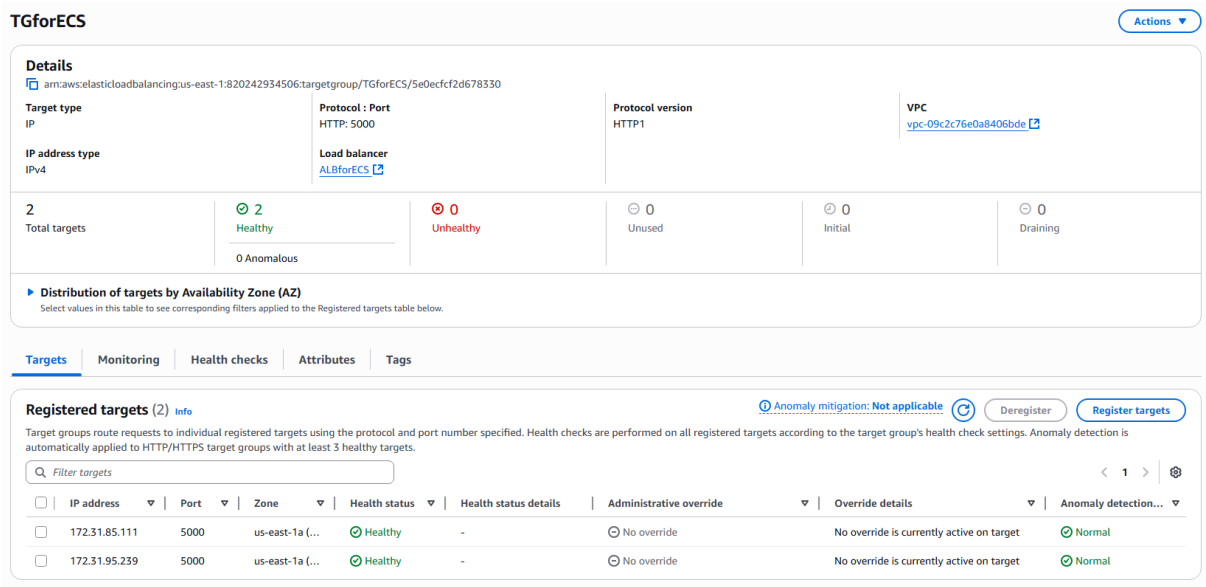
ALB = Distributes traffic to containers.

1. Go to **EC2 → Load Balancers → Create Load Balancer**
2. Select **Application Load Balancer**
3. Name: `ALBforECS`
4. Scheme: **Internet-facing**
5. IP type: IPv4
6. VPC: select default
7. Availability Zones: select at least **2 subnets**
8. Listeners:
    - HTTP :80 → Target group
9. Target Group:
    - Type: **IP**
    - Name: `TGforECS`
    - Protocol: HTTP
    - Port: **5000**
    - Health check path: `/` (important!)
10. Create Load Balancer.

LOAD BALANCER



TARGET GROUP



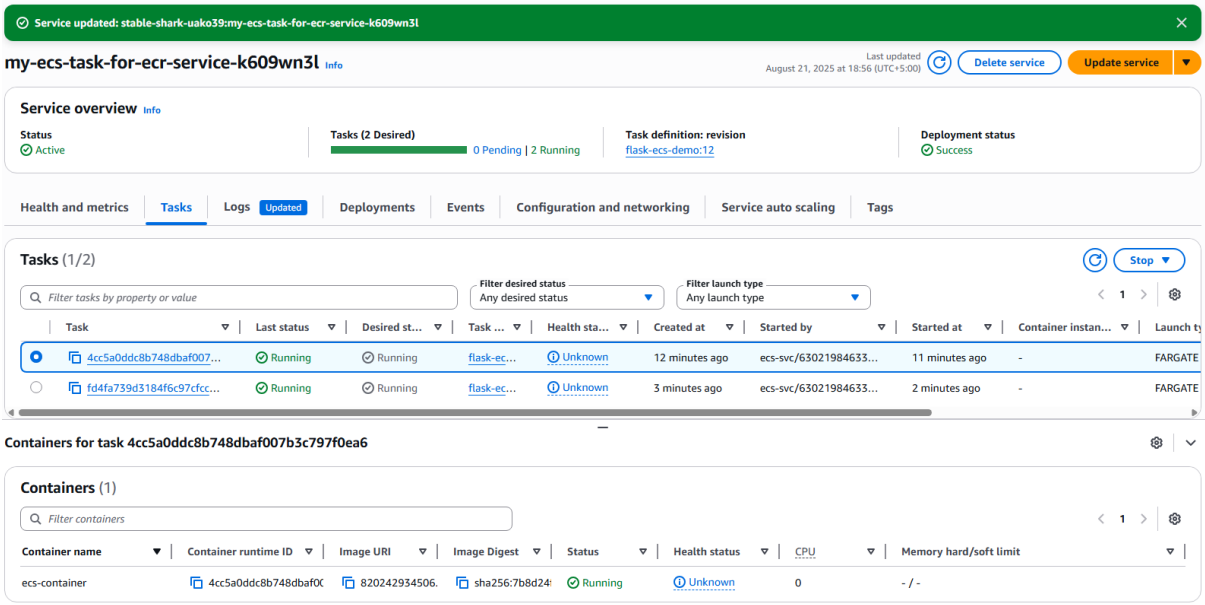
✅ ALB is ready with **Target Group TGforECS**.

🔹 Step 7: Create ECS Service with ALB

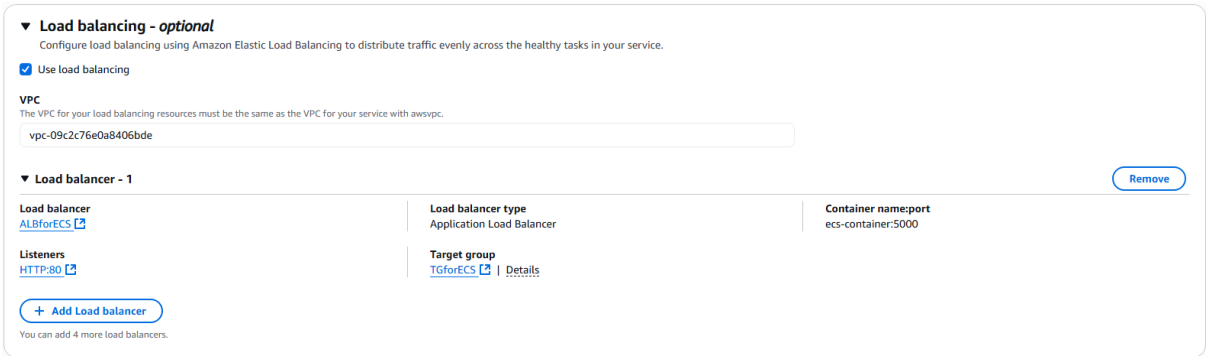
Now deploy containers inside ECS and attach ALB.

1. Go to **ECS → Clusters → ECSClusterDemo**
2. Click **Create Service**
3. Launch type: **Fargate**
4. Task definition: `ECSTaskDemo`
5. Service name: `ECSServiceDemo`
6. Desired tasks: 2 (for scaling)
7. Networking:
    - VPC: Default
    - Subnets: Pick 2
    - Security Group: Allow **HTTP (80) inbound**
8. Load balancing:
    - Select **Application Load Balancer**
    - Listener: HTTP:80
    - Target group: `TGforECS`
9. Click **Create Service**

✅ ECS service is running with **2 tasks**.



Load balancing setup with ECS.

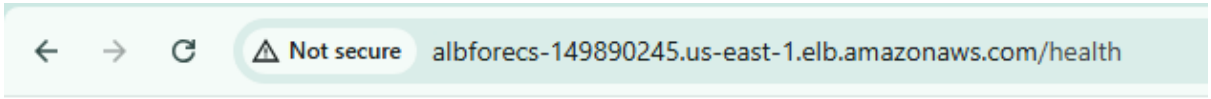


🔹 Step 8: Verify Deployment

1. Go to **ECS → Cluster → ECSServiceDemo → Tasks**
   ✅ Check that tasks show **RUNNING**.
2. Go to **EC2 → Target Groups → TGforECS → Targets**
   ✅ Should show **Healthy**.
   If **Unhealthy** → check:
   - Security group allows port 5000
   - Health check path is `/`
   - Container is listening on `0.0.0.0:5000`
3. Copy **ALB DNS name** (from EC2 → Load Balancer → Description).
   - Open in browser:
   - `http://<ALB-DNS-Name>`
   - You should see:
     Hello from ECS Fargate with ALB and Github actions! Or your prompt

Hello from ECS FARGATE with ALB using Github Actions

For /health



the container is healthy

🔹 Step 9: Auto Scaling (Optional)

1. Go to ECS Service → Auto Scaling
2. Add scaling policy:
   - Scale out if CPU > 70%
   - Scale in if CPU < 30%
3. Test by increasing load.

🔹 Step 10: Cleanup (Important to avoid charges)

When done:

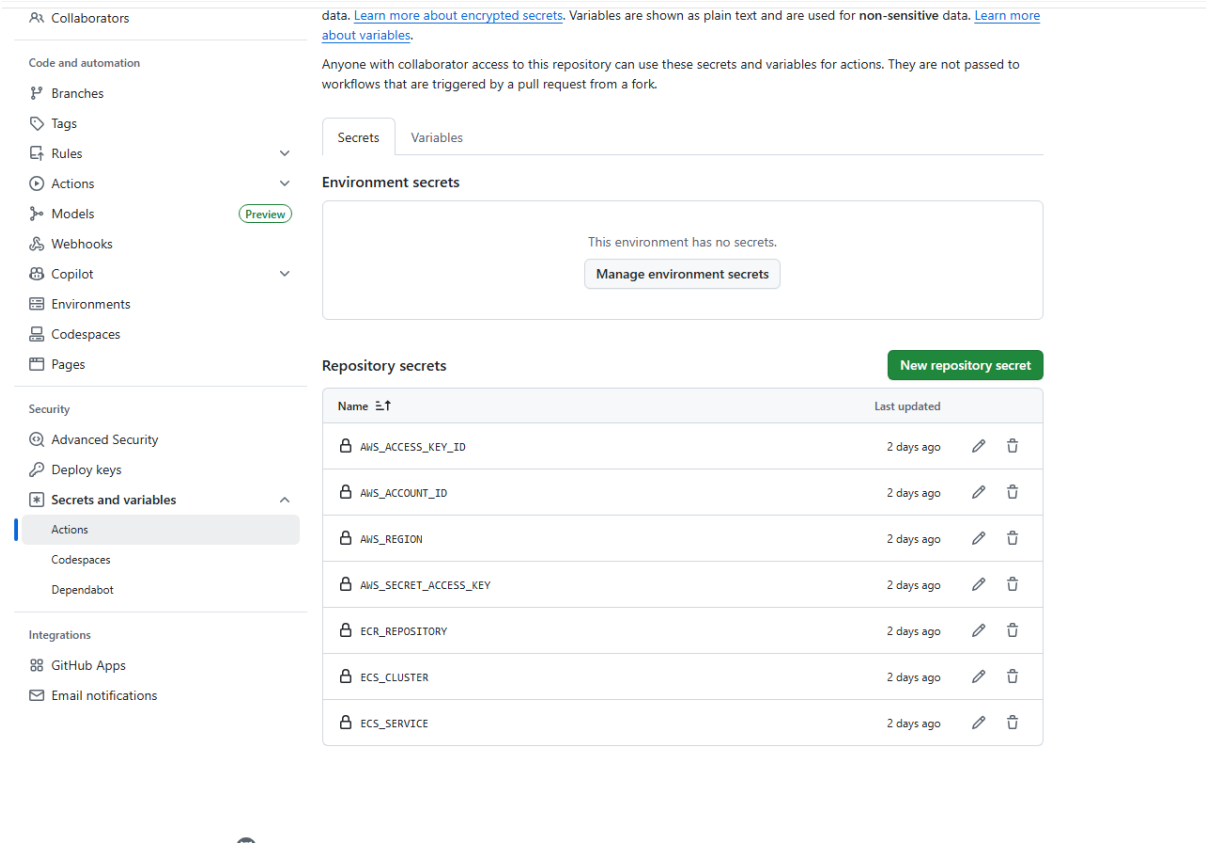
- Delete ECS Service
- Delete Cluster
- Delete ALB + Target Group
- Delete ECR repository
- Delete Security Groups if created manually

Step 11: Automating Deployment with GitHub Actions

Now let's integrate **GitHub Actions** to automate the pipeline.

📌 **Step 11.1 – Create GitHub Repository**

1. Push your project (app.py, Dockerfile, requirements.txt) to GitHub
2. In GitHub → Go to **Settings → Secrets and variables → Actions**
   Add these secrets:
   - AWS_ACCESS_KEY_ID
   - AWS_SECRET_ACCESS_KEY
   - AWS_REGION → us-east-1
   - ECR_REPOSITORY → flask-ecs-demo
   - AWS_ACCOUNT_ID



📌 Step 11.2 – Create GitHub Actions Workflow

In your repo, create:

.github/workflows/deploy.yml

Paste this:

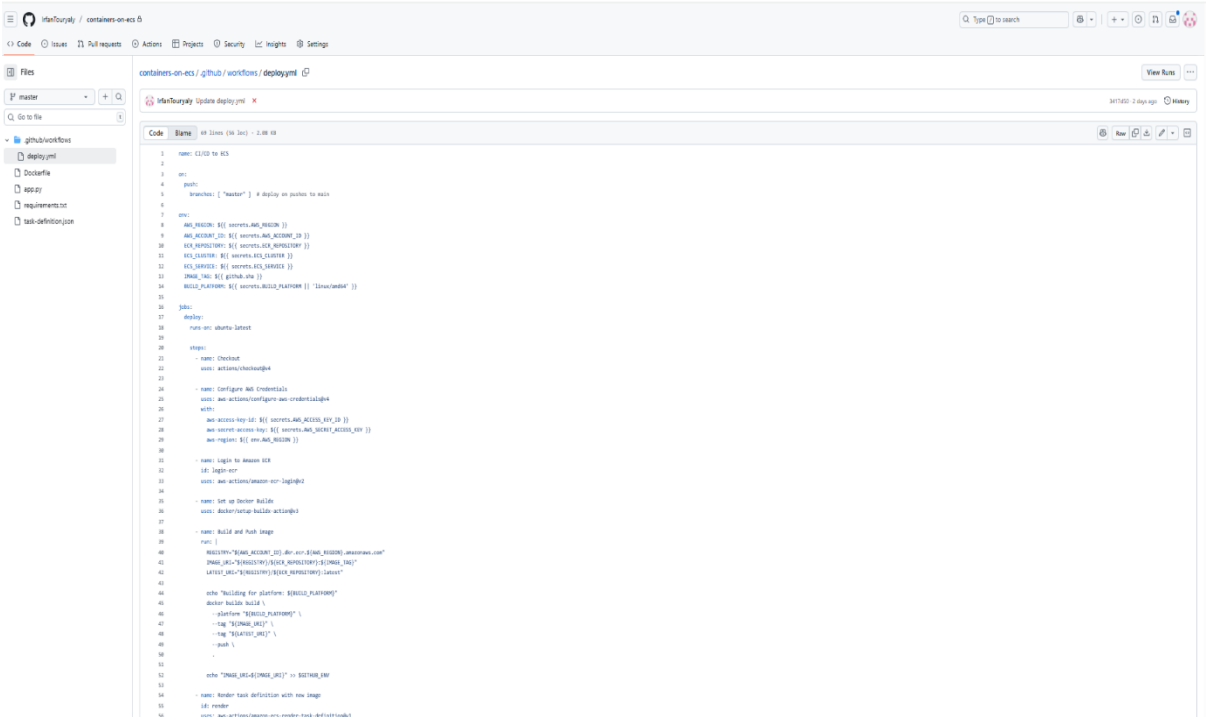
name: CI/CD to ECS

on:

```
  push:
    branches: [ "master" ]  # deploy on pushes to main

env:
  AWS_REGION: ${{ secrets.AWS_REGION }}
  AWS_ACCOUNT_ID: ${{ secrets.AWS_ACCOUNT_ID }}
  ECR_REPOSITORY: ${{ secrets.ECR_REPOSITORY }}
  ECS_CLUSTER: ${{ secrets.ECS_CLUSTER }}
  ECS_SERVICE: ${{ secrets.ECS_SERVICE }}
  IMAGE_TAG: ${{ github.sha }}
  BUILD_PLATFORM: ${{ secrets.BUILD_PLATFORM || 'linux/amd64' }}

jobs:
  deploy:
    runs-on: ubuntu-latest

    steps:
      - name: Checkout
        uses: actions/checkout@v4

      - name: Configure AWS Credentials
        uses: aws-actions/configure-aws-credentials@v4
        with:
```

```
          aws-access-key-id: ${{ secrets.AWS_ACCESS_KEY_ID }}
          aws-secret-access-key: ${{ secrets.AWS_SECRET_ACCESS_KEY }}
          aws-region: ${{ env.AWS_REGION }}

      - name: Login to Amazon ECR
        id: login-ecr
        uses: aws-actions/amazon-ecr-login@v2

      - name: Set up Docker Buildx
        uses: docker/setup-buildx-action@v3

      - name: Build and Push image
        run: |
REGISTRY="${AWS_ACCOUNT_ID}.dkr.ecr.${AWS_REGION}.amazonaws.com"
IMAGE_URI="${REGISTRY}/${ECR_REPOSITORY}:${IMAGE_TAG}"
          LATEST_URI="${REGISTRY}/${ECR_REPOSITORY}:latest"

          echo "Building for platform: ${BUILD_PLATFORM}"
          docker buildx build \
            --platform "${BUILD_PLATFORM}" \
            --tag "${IMAGE_URI}" \
            --tag "${LATEST_URI}" \
```

```
      --push \
      .

    echo "IMAGE_URI=${IMAGE_URI}" >> $GITHUB_ENV

- name: Render task definition with new image
  id: render
  uses: aws-actions/amazon-ecs-render-task-definition@v1
  with:
    task-definition: task-definition.json
    container-name: ecs-container
    image: ${{ env.IMAGE_URI }}

- name: Deploy to ECS Service
  uses: aws-actions/amazon-ecs-deploy-task-definition@v2
  with:
    task-definition: ${{ steps.render.outputs.task-definition }}
    service: ${{ env.ECS_SERVICE }}
    cluster: ${{ env.ECS_CLUSTER }}
    wait-for-service-stability: true
```



📌 Step 11.3 – Workflow Explanation

- **On push to main branch** → Trigger pipeline
- **Checkout repo** → Pulls your app code
- **AWS credentials** → Authenticate GitHub with AWS
- **Login to ECR** → Enables Docker push
- **Build & Push Image** → Builds new Docker image and pushes to ECR
- **Deploy to ECS** → Forces ECS to pull the new image and redeploy service

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📌 Step 11.4 – Test Deployment

1. Commit & push to main branch
2. GitHub Actions will run
3. ECS Service will redeploy with new Docker image
4. Open ALB DNS URL and confirm update 🎉

Step: Using task-definition.json in GitHub Actions(Step 12)

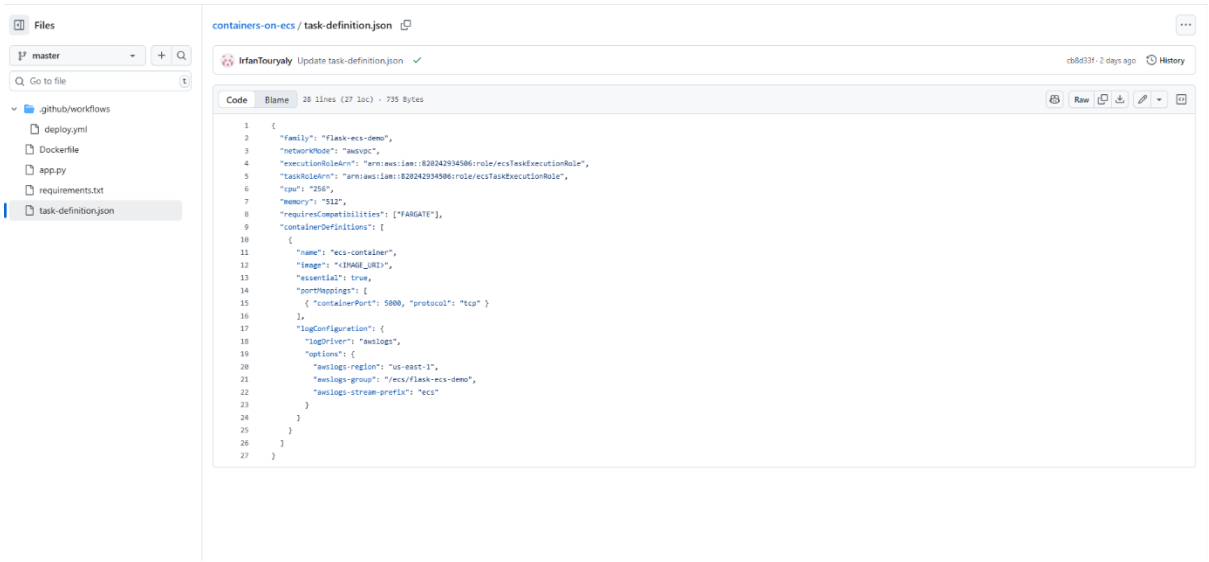
Step 12: Using task-definition.json in GitHub Actions

Create the Task Definition JSON

1. Inside this folder, create a file called:

task-definition.json

3. **Paste this code in Task Definition JSON inside:**



Step 12.1 – Test Deployment

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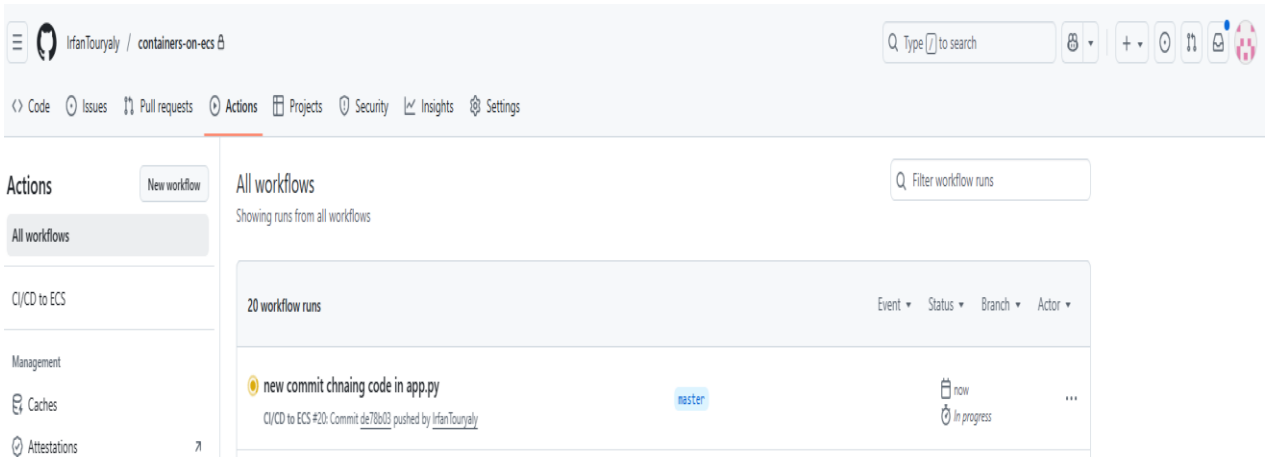

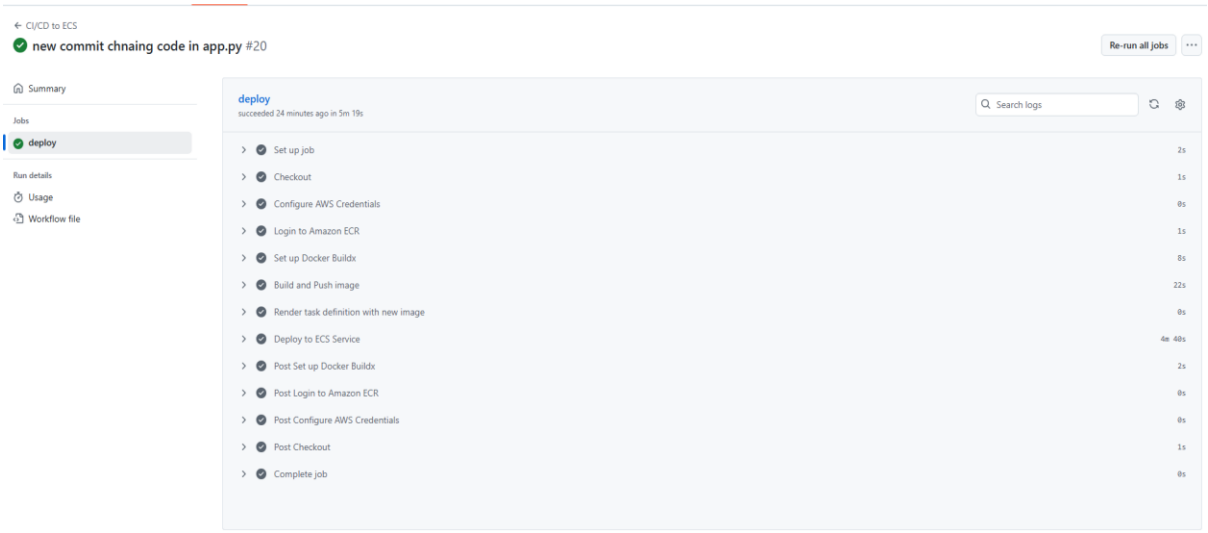

✅ Final Outcome

- Fully automated CI/CD pipeline
- Every push to GitHub main → builds Docker image → pushes to ECR → deploys ECS service with ALB