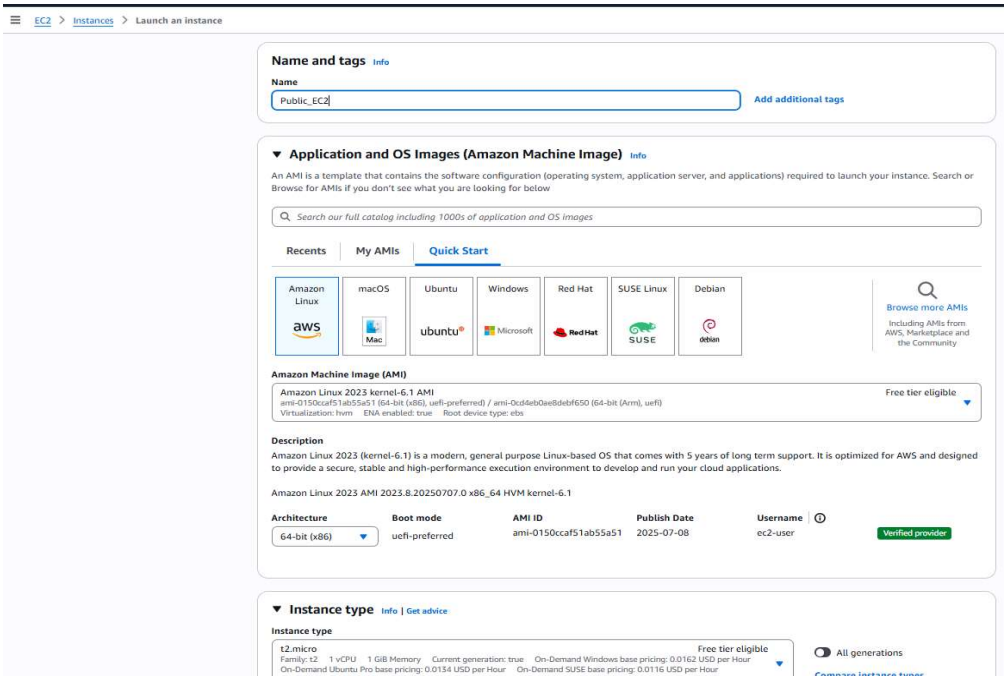
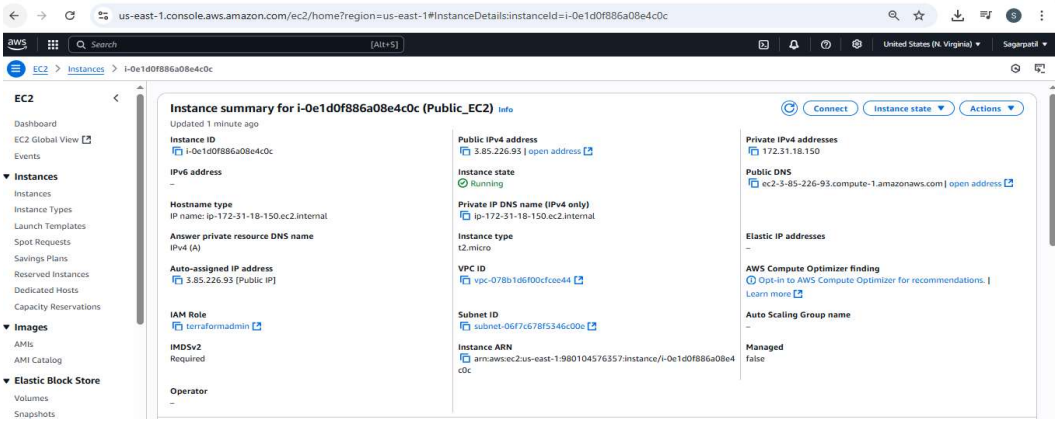
Task : 1

Launch Public_EC2 in Public Subnet

1. **Go to EC2 → Launch Instance**
2. **Choose:**
   - AMI: Ubuntu
   - Type: `t2.small` (Free tier)
   - Network: Your VPC
   - Subnet: Public subnet
   - Auto-assign Public IP: **Enable**
3. **Attach:**
   - Key Pair: Choose the one you created
   - Security Group: The SSH security group created above

Launch the instance





Steps to create s3 bucket and use it as terraform Backend

Create an S3 Bucket for Terraform Backend:

1) Create S3 Bucket :

- Go to S3 Console → https://s3.console.aws.amazon.com/s3/
- Click "Create bucket"
- Enter:
  - Bucket name: **sagar-project-terraform-state-bucket**
  - Region: **us-east-1**
- ✓ Keep Block all public access checked
- (Optional) Enable Versioning
- Click "Create bucket"

2) Create Folder (Prefix)

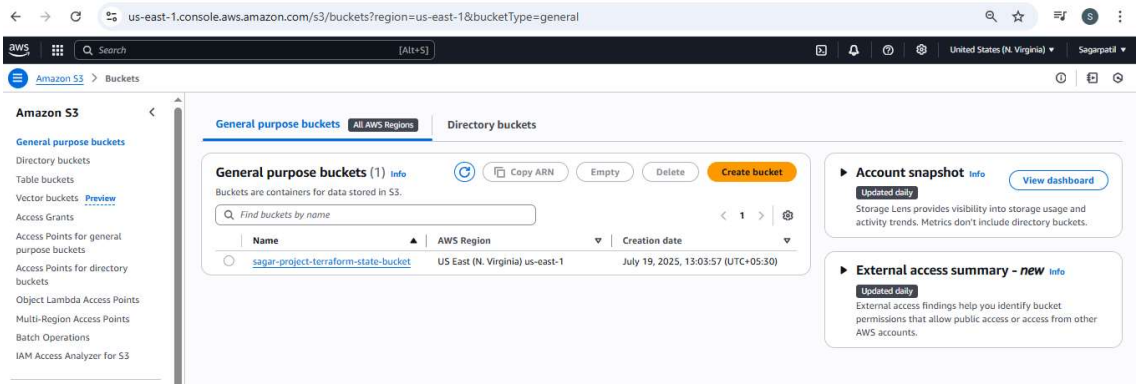
- Inside the bucket, click "Create folder"
- Name it: **project/** (used as key prefix in backend)

3) Add Terraform Backend Configuration In your Terraform project:

- **create: backend.tf**

backend.tf

```
terraform {
 backend "s3" {
  bucket = "sagar-project-terraform-state-bucket"
  key    = "project/state.tfstate"
  region = "us-east-1"
 }
}
```



Step-by-Step Terraform Installation on Ubuntu/Debian

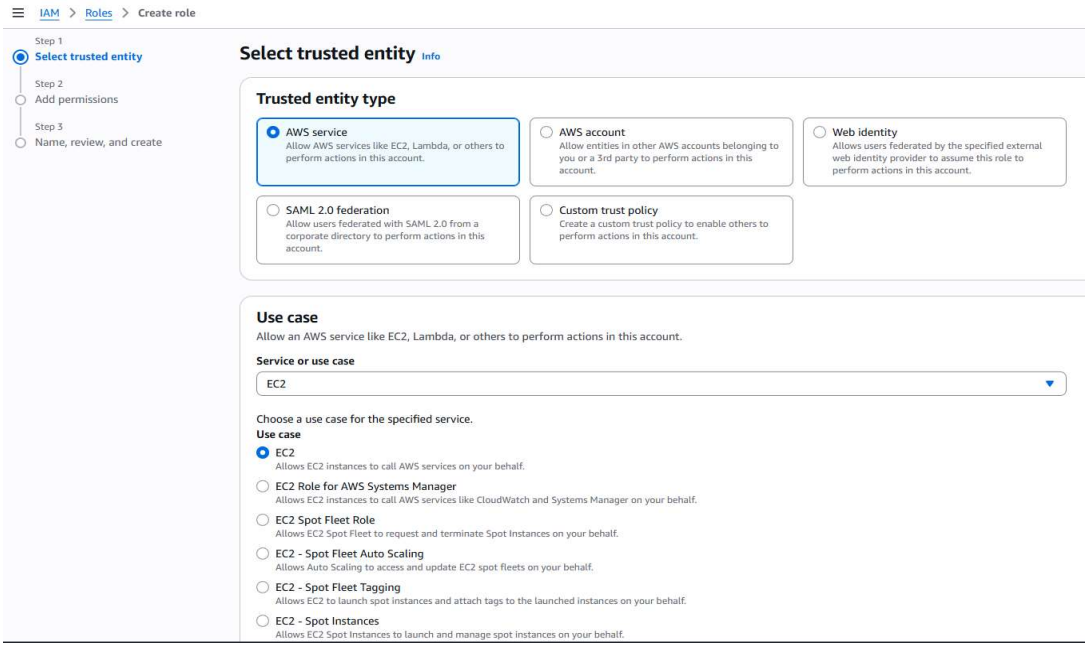
- **wget -O- https://apt.releases.hashicorp.com/gpg | sudo gpg --dearmor -o /usr/share/keyrings/hashicorp-archive-keyring.gpg**
- **echo "deb [signed-by=/usr/share/keyrings/hashicorp-archive-keyring.gpg] https://apt.releases.hashicorp.com $(lsb_release -cs) main" | sudo tee /etc/apt/sources.list.d/hashicorp.list**
- **sudo apt update && sudo apt install terraform**

https://www.cherryservers.com/blog/install-terraform-ubuntu

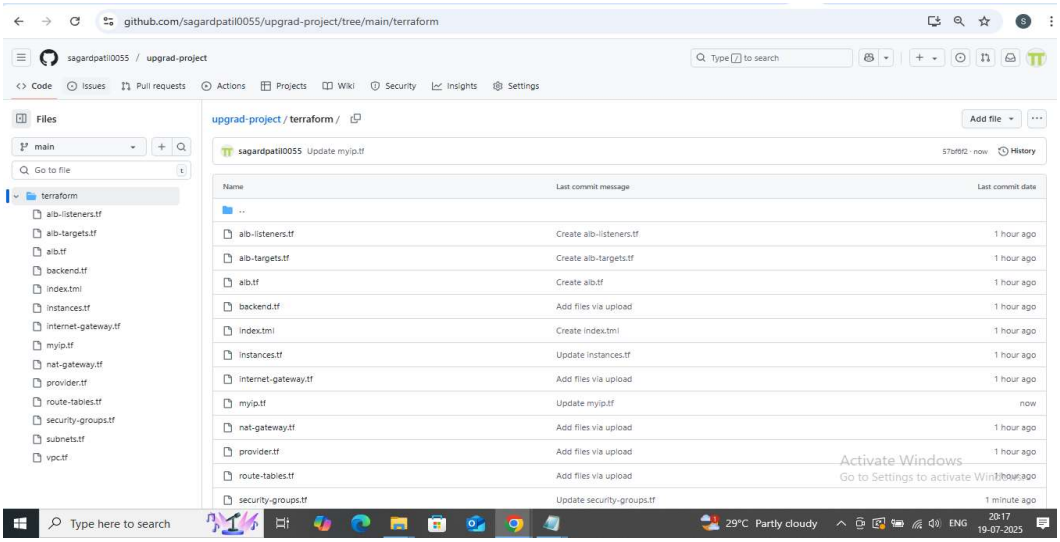
```
ubuntu@ip-172-31-18-150:~$  wget -O- https://apt.releases.hashicorp.com/gpg | sudo gpg --dearmor -o /usr/share/
keyrings/hashicorp-archive-keyring.gpg
--2025-07-16 16:29:23--  https://apt.releases.hashicorp.com/gpg
Resolving apt.releases.hashicorp.com (apt.releases.hashicorp.com)... 18.160.10.45, 18.160.10.71, 18.160.10.69,
...
Connecting to apt.releases.hashicorp.com (apt.releases.hashicorp.com)|18.160.10.45|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 3980 (3.9K) [binary/octet-stream]
Saving to: 'STDOUT'

-                                                                                                   100%[=================
==================================================================================================================
==================================================  ===================================>]   3.89K  --.
-KB/s    in 0s

2025-07-16 16:29:23 (1.07 GB/s) - written to stdout [3980/3980]

ubuntu@ip-172-31-18-150:~$  echo "deb [signed-by=/usr/share/keyrings/hashicorp-archive-keyring.gpg] https://apt
.releases.hashicorp.com $(lsb_release -cs) main" | sudo tee /etc/apt/sources.list.d/hashicorp.list
deb [signed-by=/usr/share/keyrings/hashicorp-archive-keyring.gpg] https://apt.releases.hashicorp.com noble main
ubuntu@ip-172-31-18-150:~$  sudo apt update && sudo apt install terraform
```

Create IAM Role with Admin

1) Go to IAM > Roles > Create role.
2) Select Trusted Entity Type → **"AWS service".**
3) Choose Use case → **EC2.**
4) Click Next.
5) Attach policy:
   - For full admin: **AdministratorAccess**
6) Name the role : **terraformadmin**
7) Click Create Role.



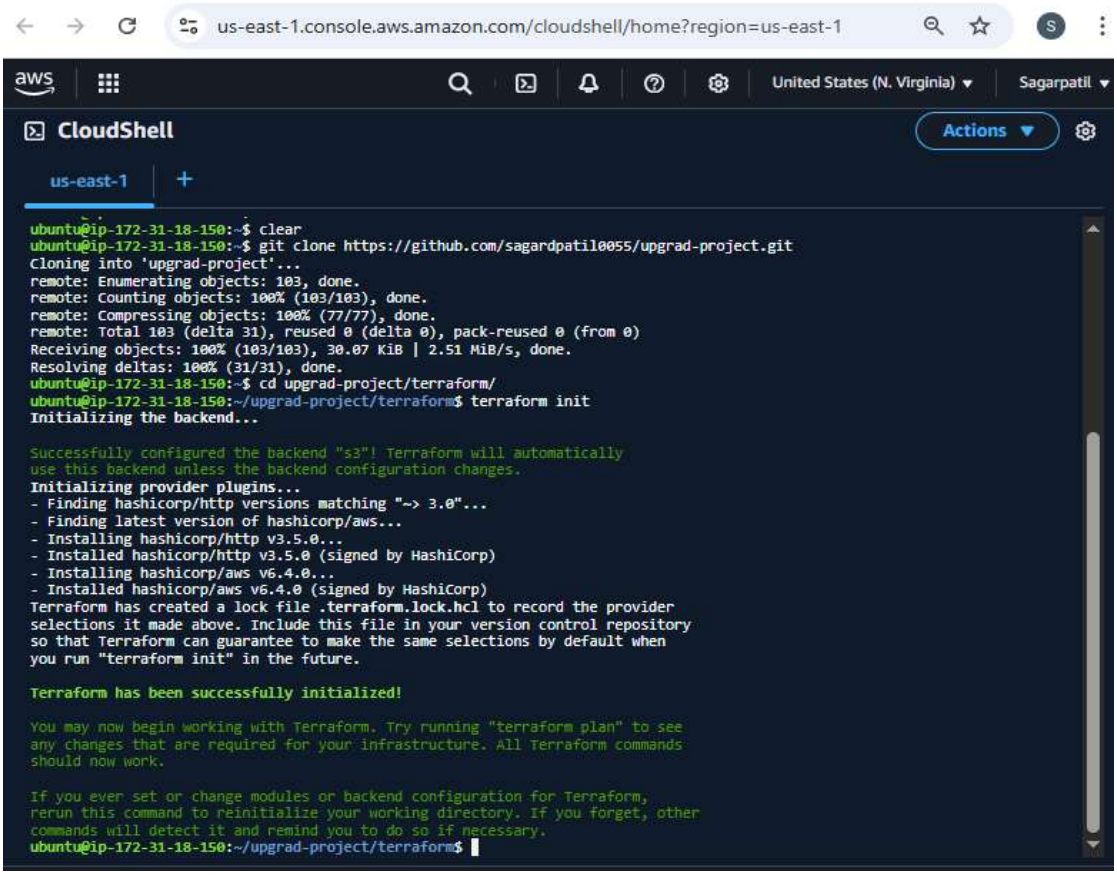
👉 Create Infrastructure using terraform

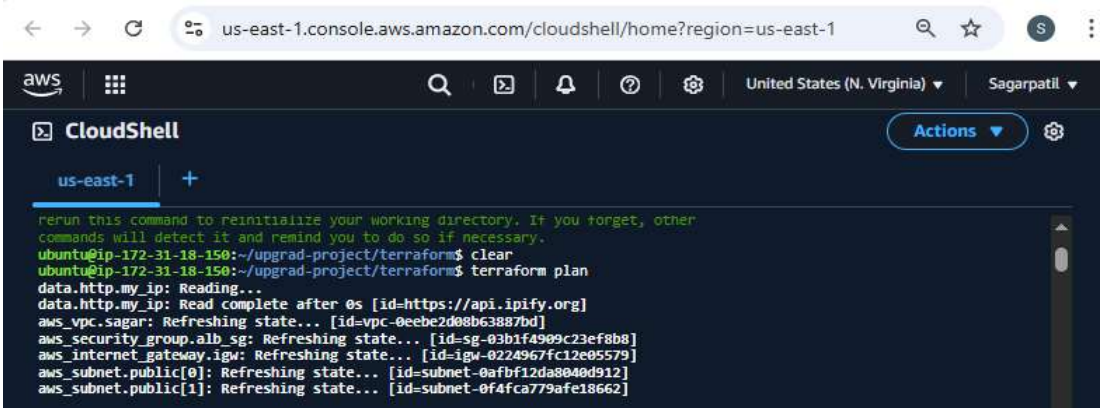


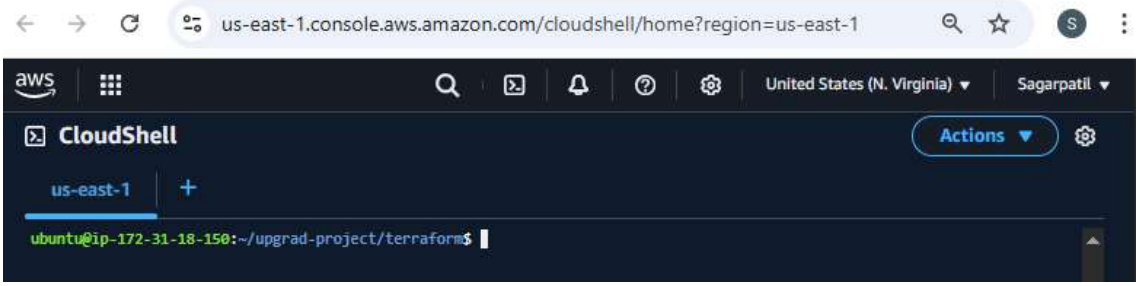
git clone https://github.com/sagardpatil0055/upgrad-project.git

cd upgrad-project/terraform

terraform init
terraform plan
terraform apply


us-east-1.console.aws.amazon.com/cloudshell/home?region=us-east-1
United States (N. Virginia)
Sagarpatil
CloudShell
Actions
us-east-1
ubuntu@ip-172-31-18-150:~$ clear
ubuntu@ip-172-31-18-150:~$ git clone https://github.com/sagardpatil0055/upgrad-project.git
Cloning into 'upgrad-project'...
remote: Enumerating objects: 103, done.
remote: Counting objects: 100% (103/103), done.
remote: Compressing objects: 100% (77/77), done.
remote: Total 103 (delta 31), reused 0 (delta 0), pack-reused 0 (from 0)
Receiving objects: 100% (103/103), 30.07 KiB | 2.51 MiB/s, done.
Resolving deltas: 100% (31/31), done.
ubuntu@ip-172-31-18-150:~$ cd upgrad-project/terraform/
ubuntu@ip-172-31-18-150:~/upgrad-project/terraform$ terraform init
Initializing the backend...
Successfully configured the backend "s3"! Terraform will automatically
use this backend unless the backend configuration changes.
Initializing provider plugins...
- Finding hashicorp/http versions matching "~> 3.0"...
- Finding latest version of hashicorp/aws...
- Installing hashicorp/http v3.5.0...
- Installed hashicorp/http v3.5.0 (signed by HashiCorp)
- Installing hashicorp/aws v6.4.0...
- Installed hashicorp/aws v6.4.0 (signed by HashiCorp)
Terraform has created a lock file .terraform.lock.hcl to record the provider
selections it made above. Include this file in your version control repository
so that Terraform can guarantee to make the same selections by default when
you run "terraform init" in the future.
Terraform has been successfully initialized!
You may now begin working with Terraform. Try running "terraform plan" to see
any changes that are required for your infrastructure. All Terraform commands
should now work.
If you ever set or change modules or backend configuration for Terraform,
rerun this command to reinitialize your working directory. If you forget, other
commands will detect it and remind you to do so if necessary.
ubuntu@ip-172-31-18-150:~/upgrad-project/terraform$


us-east-1.console.aws.amazon.com/cloudshell/home?region=us-east-1
United States (N. Virginia)
Sagarpatil
CloudShell
Actions
us-east-1
rerun this command to reinitialize your working directory. If you forget, other
commands will detect it and remind you to do so if necessary.
ubuntu@ip-172-31-18-150:~/upgrad-project/terraform$ clear
ubuntu@ip-172-31-18-150:~/upgrad-project/terraform$ terraform plan
data.http.my_ip: Reading...
data.http.my_ip: Read complete after 0s [id=https://api.ipify.org]
aws_vpc.sagar: Refreshing state... [id=vpc-0eebe2d08b63887bd]
aws_security_group.alb_sg: Refreshing state... [id=sg-03b1f4909c23ef8b8]
aws_internet_gateway.igw: Refreshing state... [id=igw-0224967fc12e05579]
aws_subnet.public[0]: Refreshing state... [id=subnet-0afbf12da8040d912]
aws_subnet.public[1]: Refreshing state... [id=subnet-0f4fca779afe18662]


us-east-1.console.aws.amazon.com/cloudshell/home?region=us-east-1
United States (N. Virginia)
Sagarpatil
CloudShell
Actions
us-east-1
ubuntu@ip-172-31-18-150:~/upgrad-project/terraform$

Task : 2

Install Ansible on Bastion Machin & create inventory.yaml and playbook.yaml

- SSH → bastion machine → run Below Commands

```
git clone https://github.com/sagardpatil0055/upgrad-project.git

cd upgrad-project/ansible

sh install_ansible.sh
```

```
ubuntu@ip-10-0-1-247:~$ git clone https://github.com/sagardpatil0055/upgrad-project.git
Cloning into 'upgrad-project'...
remote: Enumerating objects: 171, done.
remote: Counting objects: 100% (171/171), done.
remote: Compressing objects: 100% (144/144), done.
remote: Total 171 (delta 52), reused 0 (delta 0), pack-reused 0 (from 0)
Receiving objects: 100% (171/171), 49.77 KiB | 3.83 MiB/s, done.
Resolving deltas: 100% (52/52), done.
ubuntu@ip-10-0-1-247:~$ cd upgrad-project/ansible
ubuntu@ip-10-0-1-247:~/upgrad-project/ansible$ sh install_ansible.sh
```

```
ubuntu@ip-10-0-4-115:~$ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
```

```
ubuntu@ip-10-0-3-146:~$ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
```

Install Jenkins on jenkins machine

- SSH = bastion → SSH = jenkins → run the below commands

```
sudo apt update

sudo apt install openjdk-21-jdk -y

java -version
```

```
ubuntu@ip-10-0-4-115: ~
ubuntu@ip-10-0-4-115:~$ ubuntu@ip-10-0-4-115:~$
ubuntu@ip-10-0-4-115:~$ java -version
openjdk version "21.0.7" 2025-04-15
OpenJDK Runtime Environment (build 21.0.7+6-Ubuntu-0ubuntu124.04)
OpenJDK 64-Bit Server VM (build 21.0.7+6-Ubuntu-0ubuntu124.04, mixed mode, sharing)
ubuntu@ip-10-0-4-115:~$
```

- Install → Jenkins

sudo wget -O /usr/share/keyrings/jenkins-keyring.asc https://pkg.jenkins.io/debian-stable/jenkins.io-2023.key

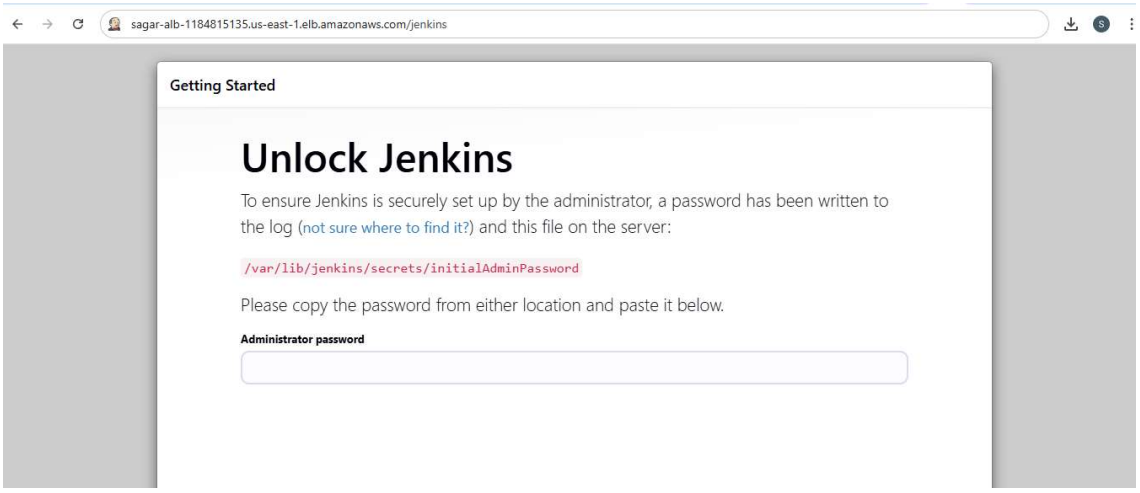
**echo "deb [signed-by=/usr/share/keyrings/jenkins-keyring.asc]" https://pkg.jenkins.io/debian-stable binary/ | sudo tee **

/etc/apt/sources.list.d/jenkins.list > /dev/null

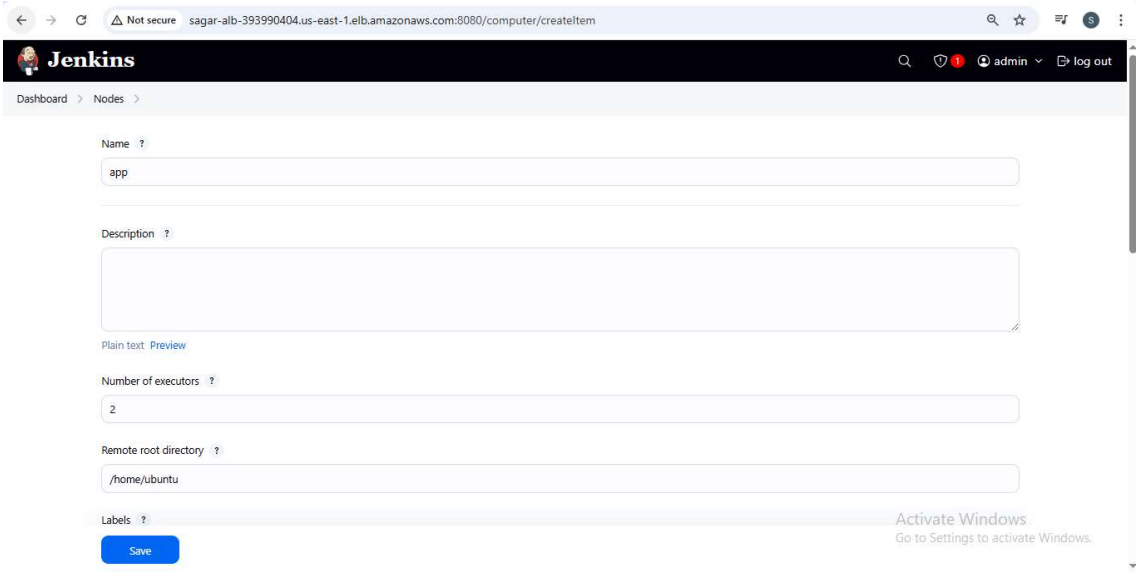
sudo apt update

sudo apt install jenkins -y

```
ubuntu@ip-10-0-4-115: ~
/jenkins.list > /dev/null
tee: ' /etc/apt/sources.list.d/jenkins.list': No such file or directory
ubuntu@ip-10-0-4-115:~$ echo "deb [signed-by=/usr/share/keyrings/jenkins-keyring.asc]" https://pkg.jenkins.io/debian-stable binary/ | sudo tee \
> /etc/apt/sources.list.d/jenkins.list > /dev/null
ubuntu@ip-10-0-4-115:~$ sudo wget -O /usr/share/keyrings/jenkins-keyring.asc https://pkg.jenkins.io/debian-stable/jenkins.io-2023.key
--2025-07-19 19:13:44--  https://pkg.jenkins.io/debian-stable/jenkins.io-2023.key
Resolving pkg.jenkins.io (pkg.jenkins.io)... 146.75.34.133, 2a04:4e42:79::645
Connecting to pkg.jenkins.io (pkg.jenkins.io)|146.75.34.133|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 3175 (3.1K) [application/pgp-keys]
Saving to: '/usr/share/keyrings/jenkins-keyring.asc'

/usr/share/keyrings/jenkins-k 100%[=================================================>]   3.10K  --.-KB/s    in 0s

2025-07-19 19:13:44 (41.8 MB/s) - '/usr/share/keyrings/jenkins-keyring.asc' saved [3175/3175]

ubuntu@ip-10-0-4-115:~$ echo "deb [signed-by=/usr/share/keyrings/jenkins-keyring.asc]" https://pkg.jenkins.io/debian-stable binary/ | sudo tee \
> /etc/apt/sources.list.d/jenkins.list > /dev/null
ubuntu@ip-10-0-4-115:~$ sudo apt update
Hit:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports InRelease
Ign:4 https://pkg.jenkins.io/debian-stable binary/ InRelease
Get:5 https://pkg.jenkins.io/debian-stable binary/ Release [2044 B]
Get:6 https://pkg.jenkins.io/debian-stable binary/ Release.gpg [833 B]
Hit:7 http://security.ubuntu.com/ubuntu noble-security InRelease
Get:8 https://pkg.jenkins.io/debian-stable binary/ Packages [29.4 kB]
Fetched 32.3 kB in 1s (42.1 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
84 packages can be upgraded. Run 'apt list --upgradable' to see them.
ubuntu@ip-10-0-4-115:~$ sudo apt install jenkins -y
```



- **Adding → App node**



👉 Create ECR Repository in Console

1) Go to: ***Amazon ECR Console***
2) Click **"Create repository"**
3) **Set:**
   - Repository name: **test-nodeapp-repo**
4) Visibility settings: **Private**

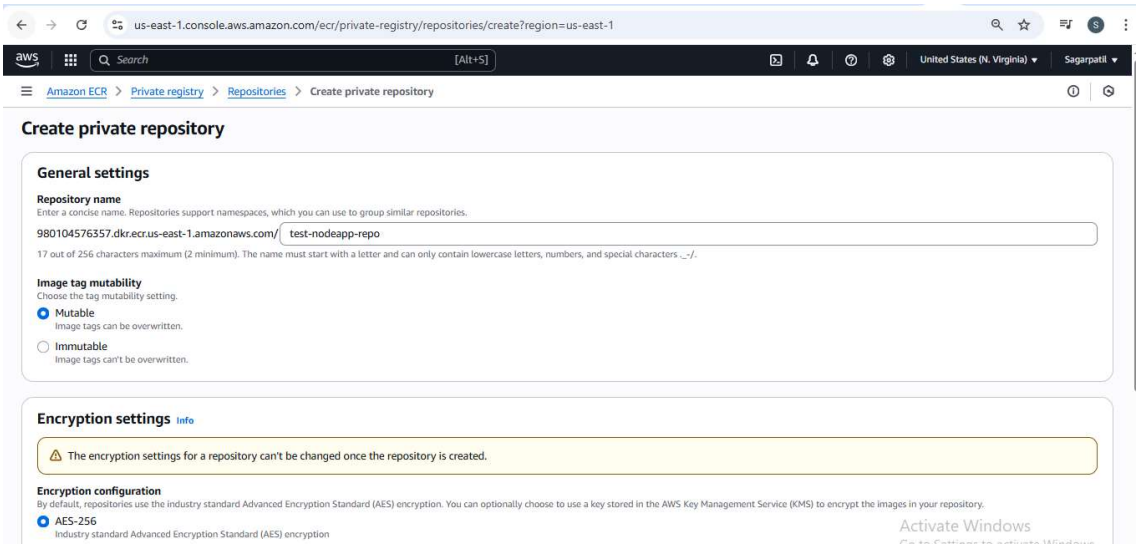
5) Tag immutability: **Mutable (default is fine)**

6) Scan on push: **Enabled**

7) Click **“Create repository”**

8) Note the Repository URI :

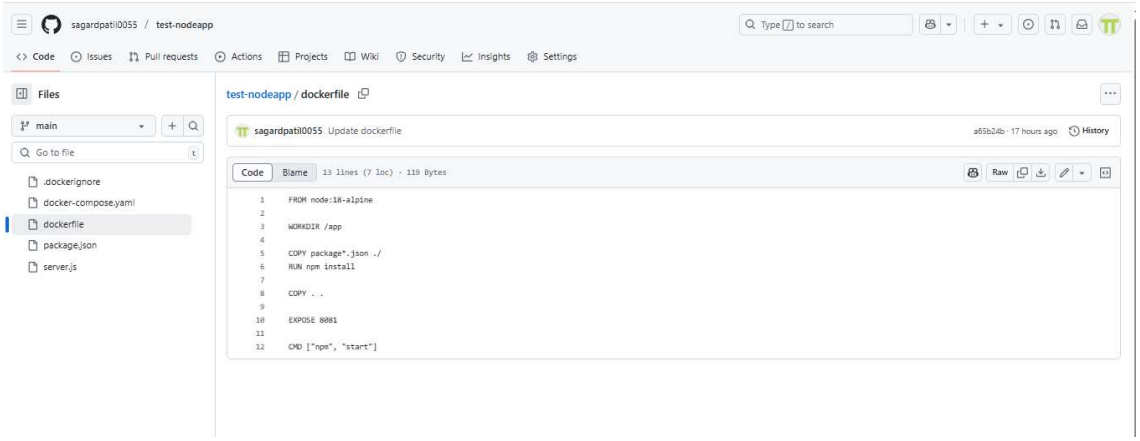
- **980104576357.dkr.ecr.us-east-1.amazonaws.com/test-nodeapp-repo**



Task 3

Create a test-nodeapp project on Github

- **https://github.com/sagardpatil0055/test-nodeapp.git**
- Write a dockerfile to **test-nodeapp**



STEP 1: Testing Docker build & running it on bastion .

- Install docker on bastion
- Check for docker installation on bastion

```
ubuntu@ip-10-0-1-133:~$ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
ubuntu@ip-10-0-1-133:~$
```

git clone https://github.com/sagardpatil0055/test-nodeapp.git

cd test-nodeapp

docker build -t test-nodeapp . # build project

```
ubuntu@ip-10-0-1-133:~/test-nodeapp$ docker build -t test-nodeapp .
[+] Building 0.2s (10/10) FINISHED
 => [internal] load build definition from dockerfile
 => => transferring dockerfile: 156B
 => [internal] load metadata for docker.io/library/node:18-alpine
 => [internal] load .dockerignore
 => => transferring context: 62B
 => [1/5] FROM docker.io/library/node:18-alpine@sha256:8d6421d663b4c28fd3ebc498332f249011d118945588d0a35cb9bc4b8ca09d9e
 => [internal] load build context
 => => transferring context: 163B
 => CACHED [2/5] WORKDIR /app
 => CACHED [3/5] COPY package*.json ./
 => CACHED [4/5] RUN npm install
 => CACHED [5/5] COPY . .
 => exporting to image
 => => exporting layers
 => => writing image sha256:028fdfd46f5084ce542daed0c5aa0ac58b5e6506e7557b6db6a430f4d899b9d0
 => => naming to docker.io/library/test-nodeapp
ubuntu@ip-10-0-1-133:~/test-nodeapp$
```

```
# Run the container

docker run -d -p 8081:8081 --name test-nodeapp test-nodeapp
```

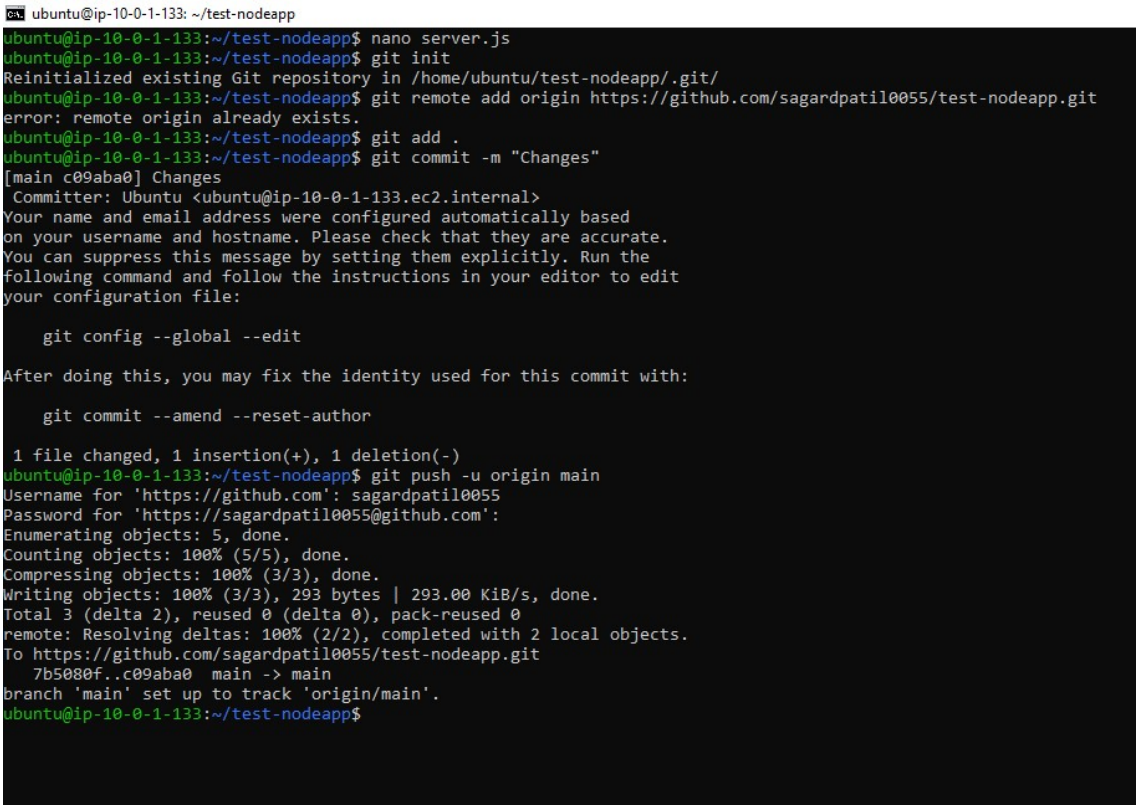
```
ubuntu@ip-10-0-1-133: ~/test-nodeapp
ubuntu@ip-10-0-1-133:~/test-nodeapp$ docker run -d -p 8081:8081 --name test-nodeapp test-nodeapp
2fa566c124277e1e3c9d4842b5ae3b3e0ec75732f6346a4e9e8356d46a75e126
ubuntu@ip-10-0-1-133:~/test-nodeapp$ docker ps
CONTAINER ID   IMAGE          COMMAND                  CREATED         STATUS         PORTS                                                  NAMES
2fa566c12427   test-nodeapp   "docker-entrypoint.s…"   8 seconds ago   Up 7 seconds   0.0.0.0:8081->8081/tcp, [::]:8081->8081/tcp   test-nodeapp
ubuntu@ip-10-0-1-133:~/test-nodeapp$
```

👉 **Output :**

Hello This is Sagar -- Congrats Node app is working

👉 Push the docker file of the node application in the same GitHub repository.

```
git init

git remote add origin https://github.com/sagardpatil0055/test-nodeapp.git

git add .

git commit -m "Add Dockerfile to Dockerize Node.js app"

git branch -M main      # Rename to 'main' to match GitHub default

git push -u origin main                          # Push to 'main' branch
```



👉 STEP 2: Create IAM Role for EC2 ECR Access

Create IAM Role

1) Go to: IAM Console – Roles
2) Click “Create role”

- **Trusted entity type**: AWS service

  Use case: EC2

  Click **Next**

👉 Attach ECR Access Policy

3) Search and select the following managed policy:

- **AmazonEC2ContainerRegistryFullAccess**

4) Click **Next**
5) Role name: **ecr-instance-role**
6) Click **Create role**

👉 STEP 3: Attach IAM Role to Jenkins & App EC2

1) Go to: **EC2 Console**
2) Find your Jenkins and App instances

   For each instance:

   - Select instance → Click **Actions → Security → Modify IAM Role**
   - Select **ecr-instance-role** and click **Update IAM role**

3) Authenticate EC2
   - Done using ansible **playbook .**

4) Use amazon-ecr-credential-helper
   - Install the **ECR Credential Helper** on all agent Done it via Ansible

sudo apt-get update

sudo apt-get install amazon-ecr-credential-helper

👉 Step 4 : Configure Docker to Use Credential Helper Done it via Ansible

Edit or create the file: → `~/.docker/config.json`

Add the following content:

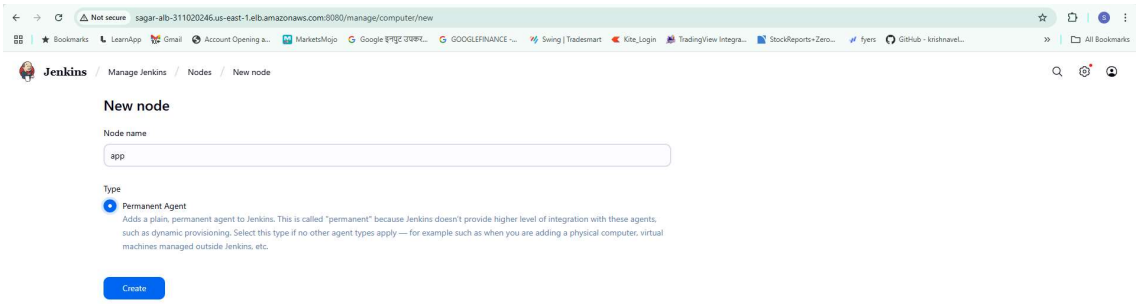
```
{
  "credHelpers": {
    "980104576357.dkr.ecr.us-east-1.amazonaws.com": "ecr-login"
  }
}
```

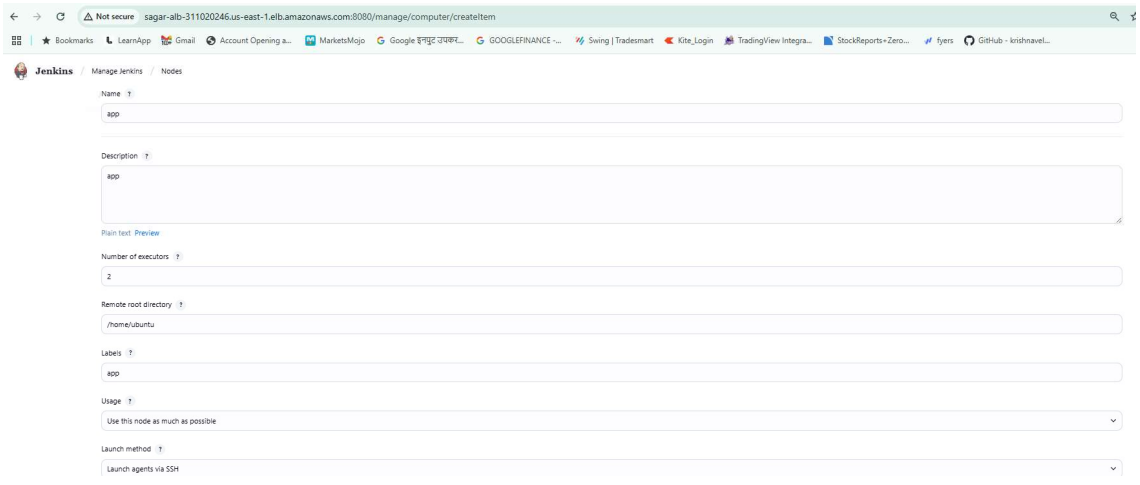
👉 Step 5 : Add Public Key to App EC2

- Done it using **Ansible** copied **project.pem** to app machine .

👉 Step 6: Configured Jenkins CICD for test-nodeapp using Declarative SCM & Jenkinsfile

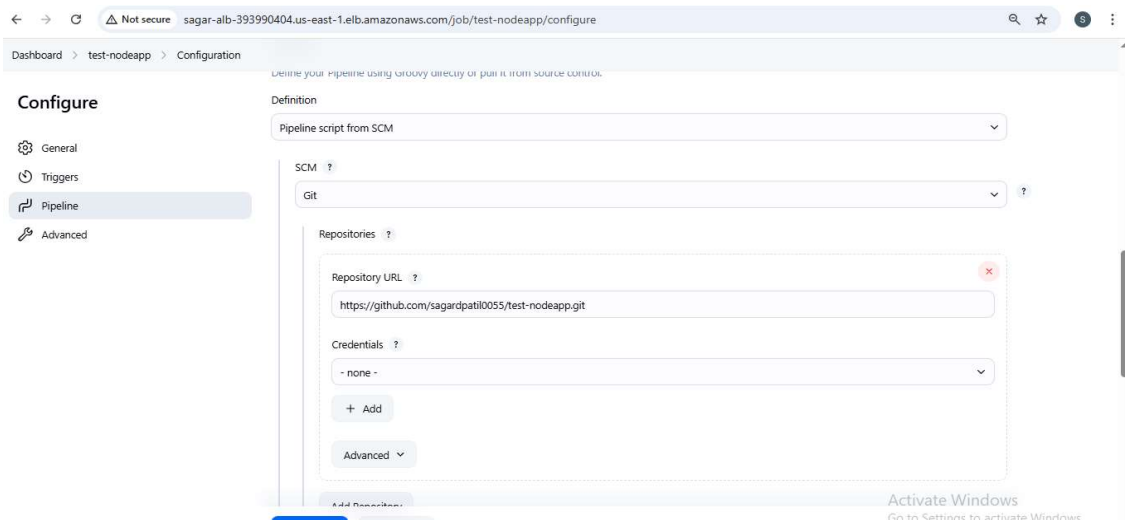
Add node in Jenkins .



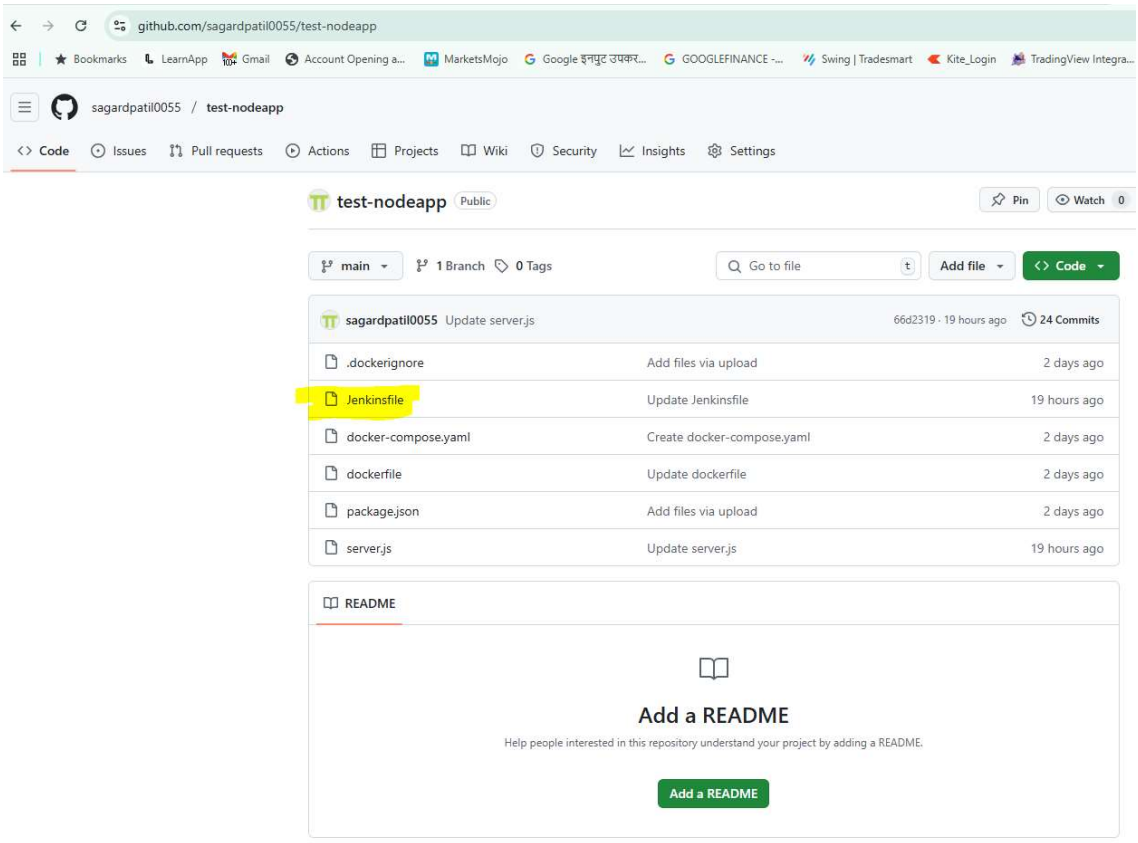


Creating test-nodeapp job

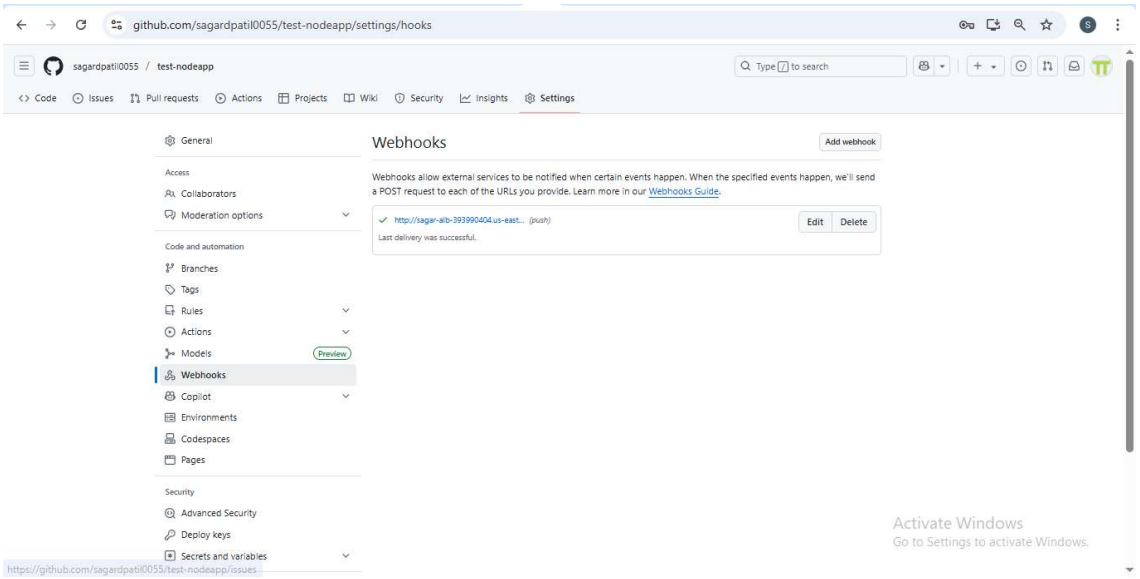
https://github.com/sagardpatil0055/test-nodeapp.git



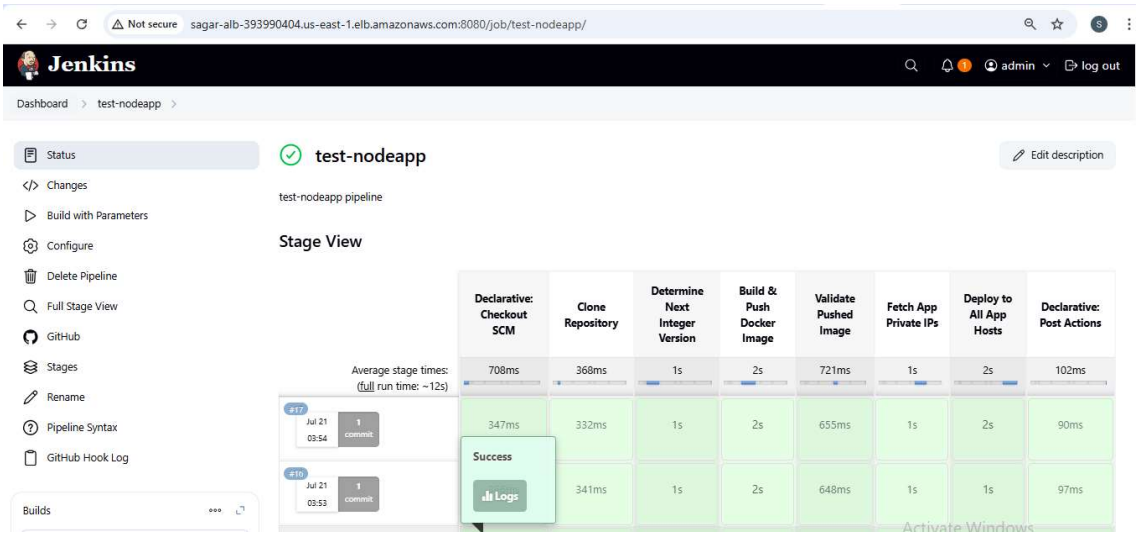
Jenkinsfile location



👉 Webhook url configuration for automation

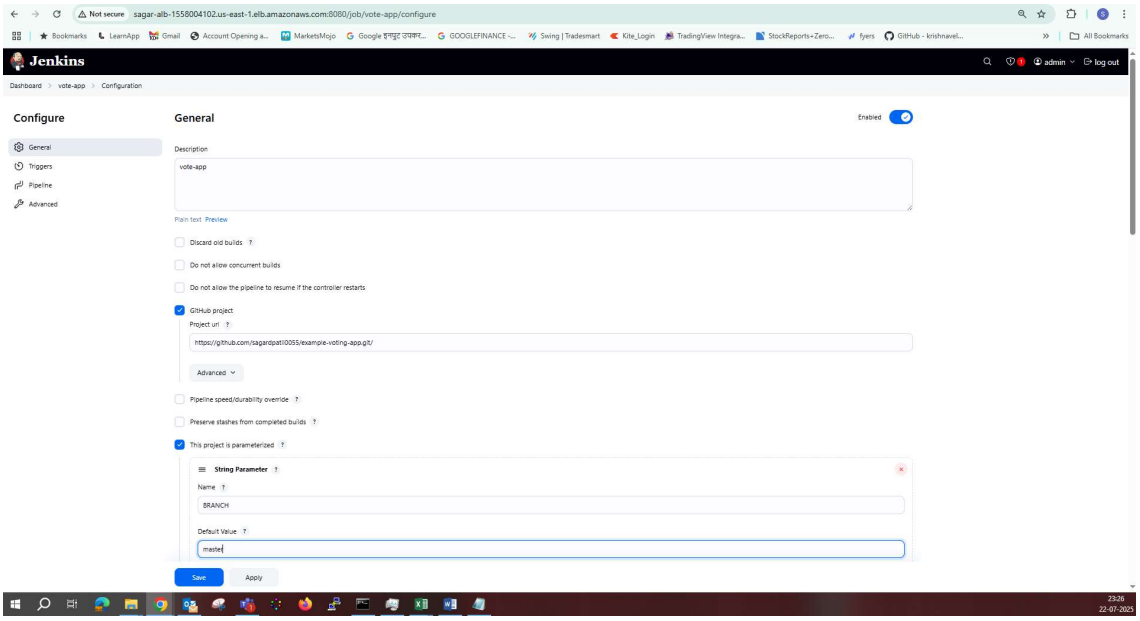


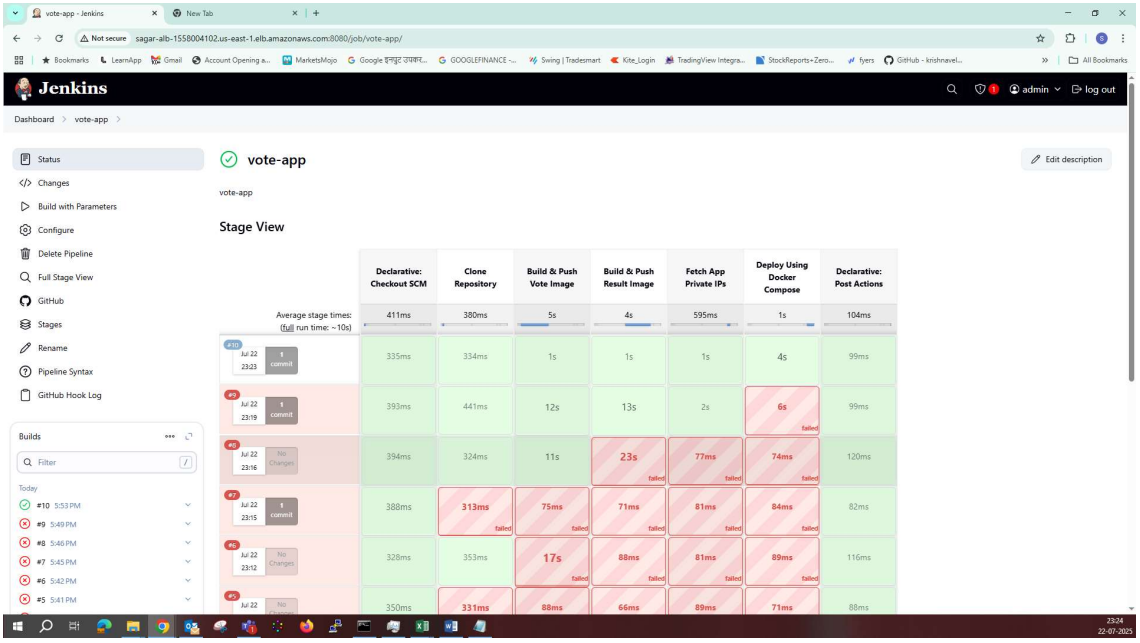
👉 Running CICD for test-nodeapp with webhook



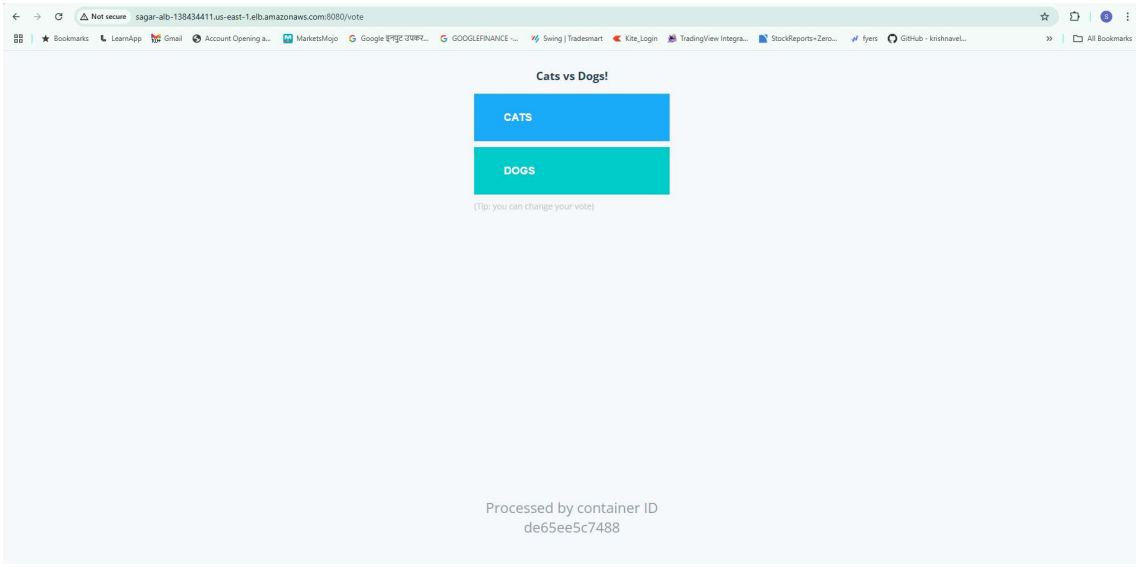
Vote App installation using Jenkins CICD

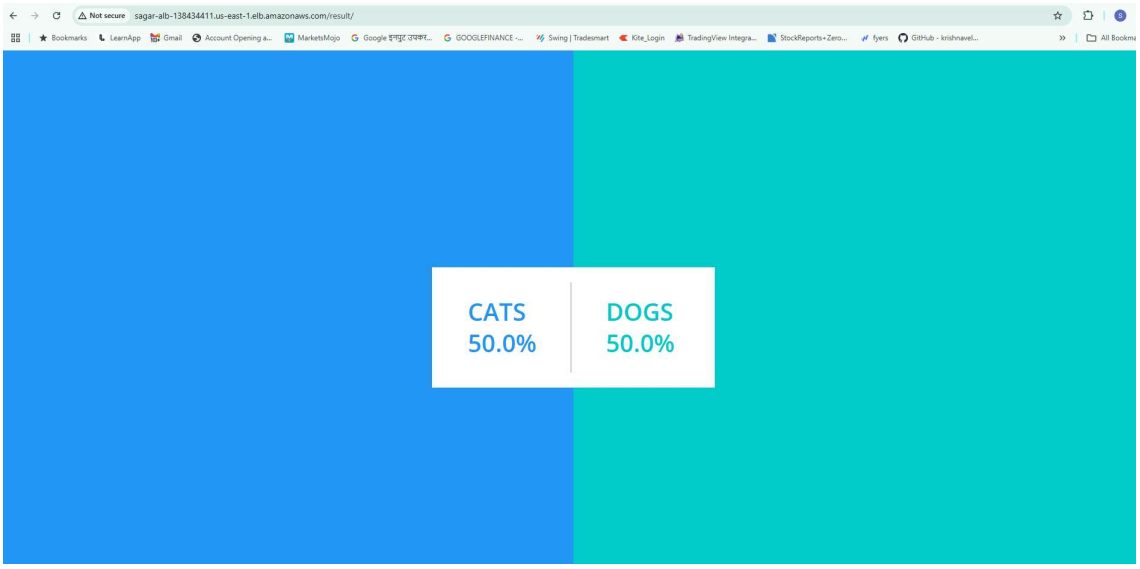
https://github.com/sagardpatil0055/example-voting-app.git



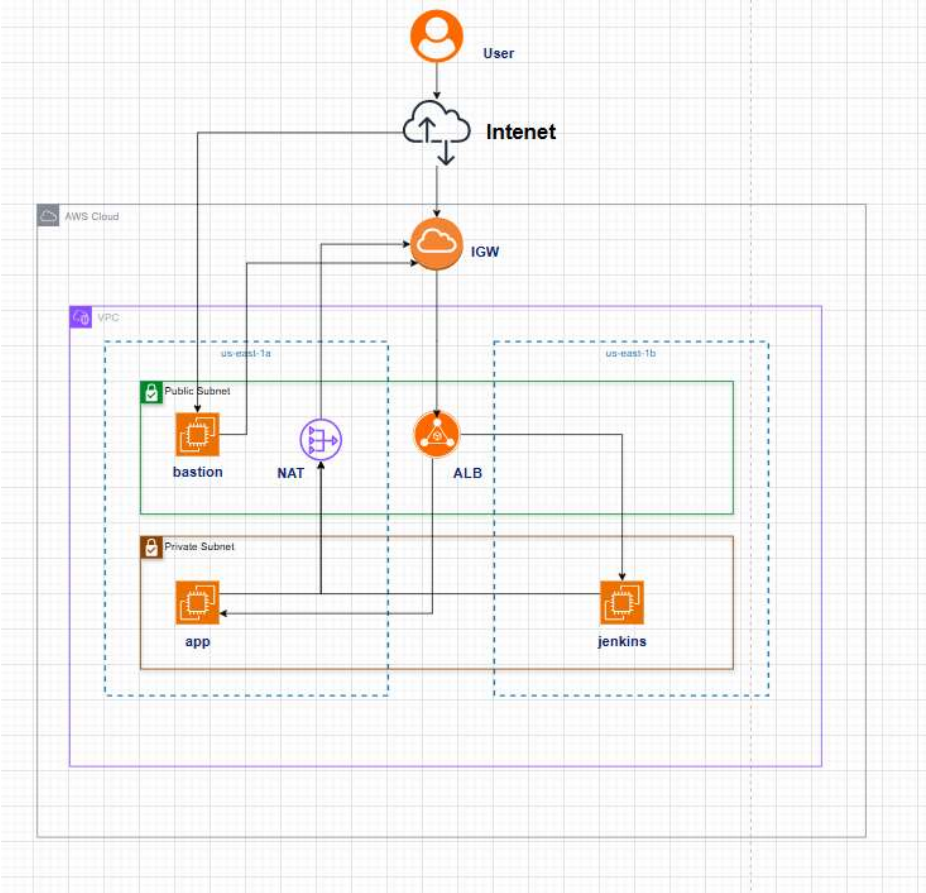


Vote app Output





Three-tier AWS Architecture Diagram .



Full Monthly Cost Estimate :

Resource	Quantity	Unit Price (us-east-1)	Monthly Estimate
EC2 Instances	3 × t2.small	$0.023/hr × 730 hrs	**$50.37**
NAT Gateway	1	$0.045/hr × 730 hrs	**$32.85**
Elastic IP	1 (attached)	Free while attached	**$0.00**
Amazon S3 (backend)	~1 object	~$0.03/GB for backend	**$0.01**
Amazon ECR	~0.9 GB	$0.10/GB	**$0.09**
Security Groups, Subnets, IGW, VPC, Route Tables	Included in AWS	Free	**$0.00**

Total Monthly Estimate: **≈$83.32/Month**

Total Hourly Estimate: **≈ $0.116/hr**