Project 2

Building a CI/CD Pipeline for a Tech Company

(XYZ Technologies)

Submitted by

Basharul Alam Siddike

CI/CD Pipeline for XYZ technologies on AWS EC2 with Jenkins, Docker, Ansible, Kubernetes, Prometheus, and Grafana

This guide provides a comprehensive setup for creating a CI/CD pipeline using various tools such as Jenkins, Docker, Ansible, Kubernetes, Prometheus, and Grafana, all deployed on an AWS EC2 Ubuntu 24.04 instance.

Prerequisites:

1. **AWS EC2 Ubuntu 24.04 instance**
2. Access to **GitHub** and **DockerHub**
3. Required tools: **Java**, **Maven**, **Git**, **Jenkins**, **Docker**, **Ansible**, **Kubernetes**, **Prometheus**, and **Grafana** pre-installed.

AWS EC2 Setup Guide

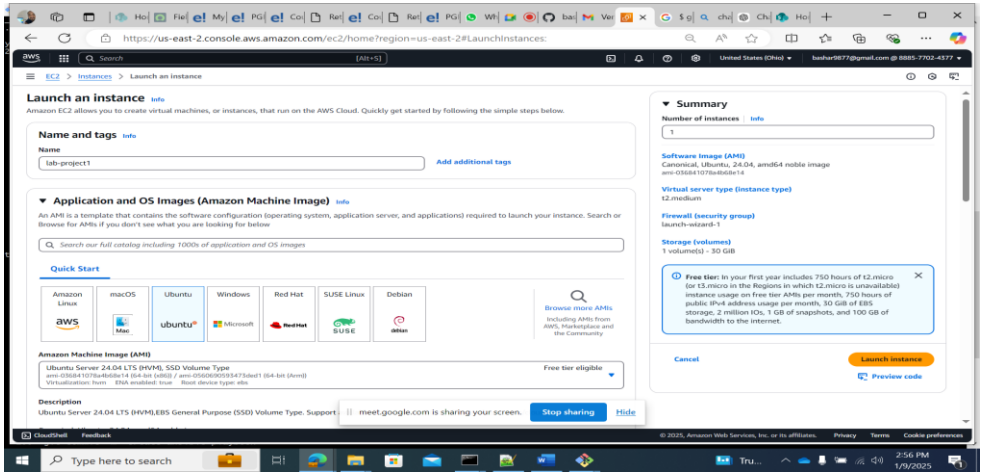
This guide outlines the steps to set up an AWS EC2 instance with necessary tools for continuous integration and deployment using Jenkins, Docker, Ansible, Kubernetes, Prometheus, and Grafana.

1. Setup the AWS EC2 Instance

1.1 Launch an EC2 Instance

- **Log in to your AWS account.**
- **Navigate to the EC2 dashboard and launch a new instance:**
- **Select the AMI:** Choose **Ubuntu Server 24.04 LTS**.
- **Select an instance type:** Use `t2.medium` for testing.
- **Configure security groups:** Allow the following ports:
- **SSH (port 22)**
- **HTTP (port 80)**
- **HTTPS (port 443)**
- **Jenkins (port 8080)**
- **Docker (port 2376)**
- **Grafana (port 3000)**
- **Add an SSH key pair** for connecting to your instance.

Screenshot: Add a screenshot of the EC2 instance configuration.

- 

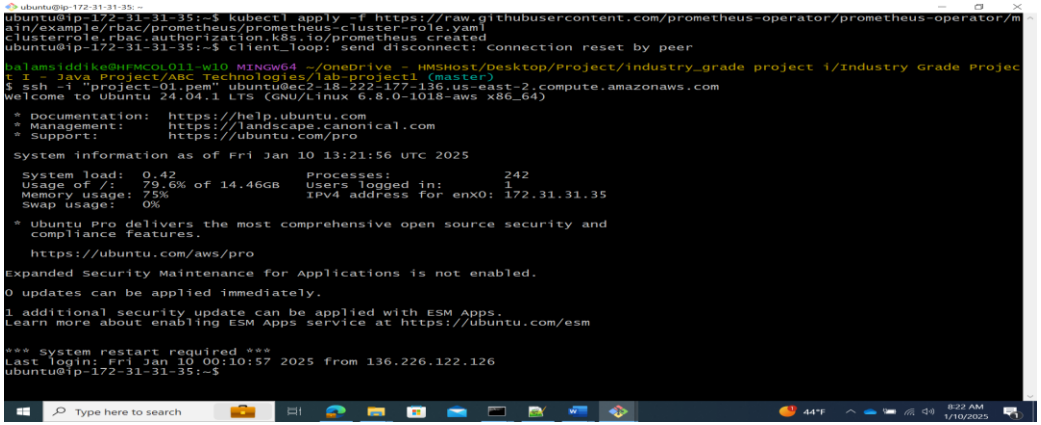
1.2 Connect to the Instance

1. **Open Terminal (Linux/Mac) or Putty (Windows).**
2. **Navigate to the directory where your .pem file is saved.**
3. **Connect using the following command (replace <key-file> and <public-ip>):**

chmod 400 <key-file>.pem

ssh -i <key-file>.pem ubuntu@<public-ip>

Screenshot: Add a screenshot of the terminal connection process.



1.3 Update and Upgrade Packages

sudo apt-get update && sudo apt-get install -y curl unzip git wget gnupg2 apt-transport-https ca-certificates gnupg lsb-release software-properties-common

2. Install Required Tools

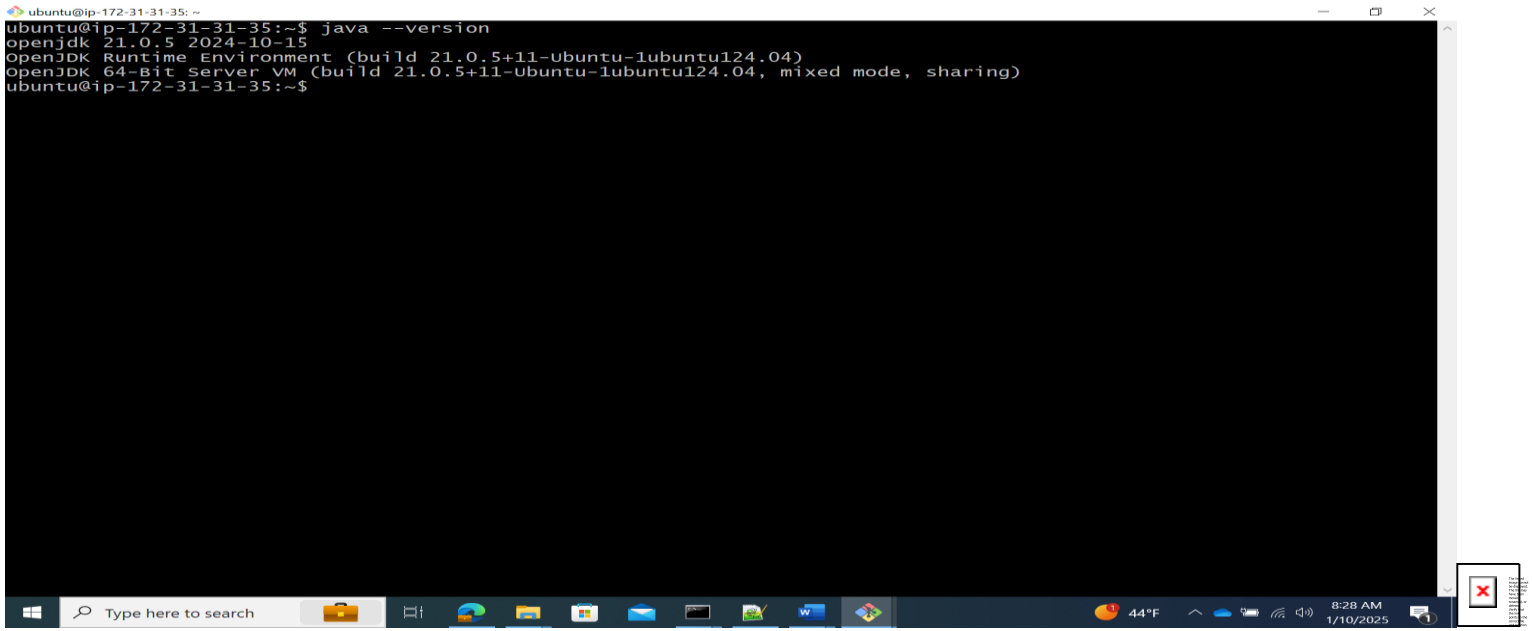
2.1 Install Java

Jenkins requires Java to run.

sudo apt install openjdk-21-jdk -y (updated version)

java -version

Screenshot: Add a screenshot showing Java installation confirmation.

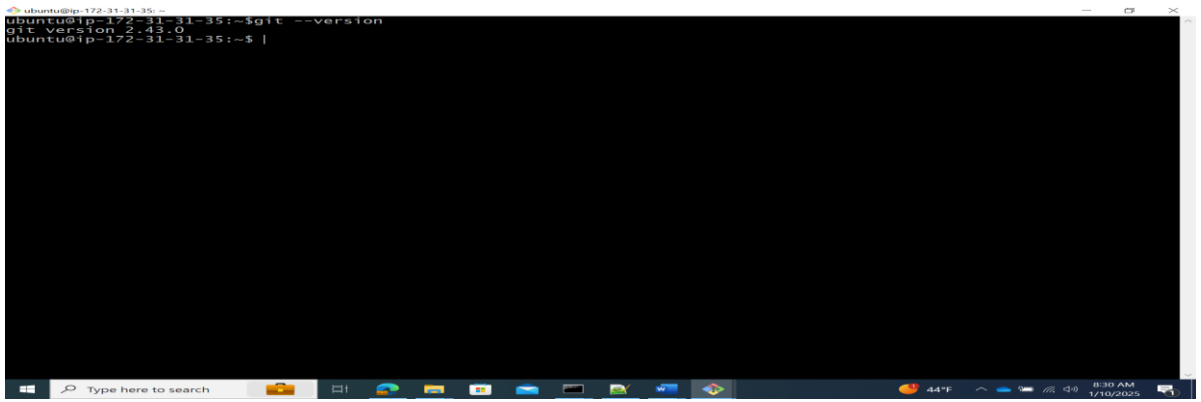


2.2 Install Git

sudo apt-get install git -y

git --version

Screenshot: Add a screenshot showing Git installation confirmation.

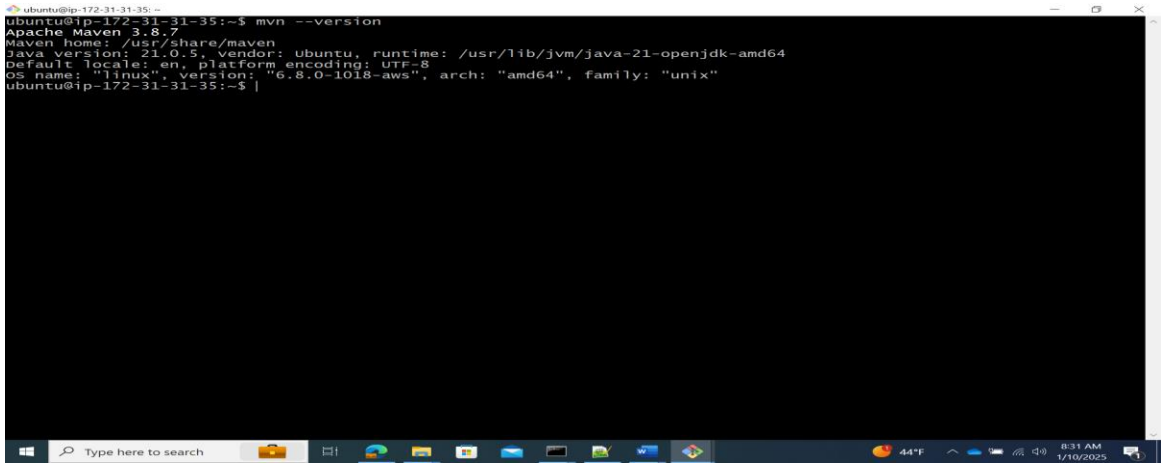


2.3 Install Maven

Maven is used to build Java projects.

```
sudo apt install maven -y
mvn -version
```

Screenshot: Add a screenshot showing Maven installation confirmation.



2.4 Install Docker

Docker will containerize the application.

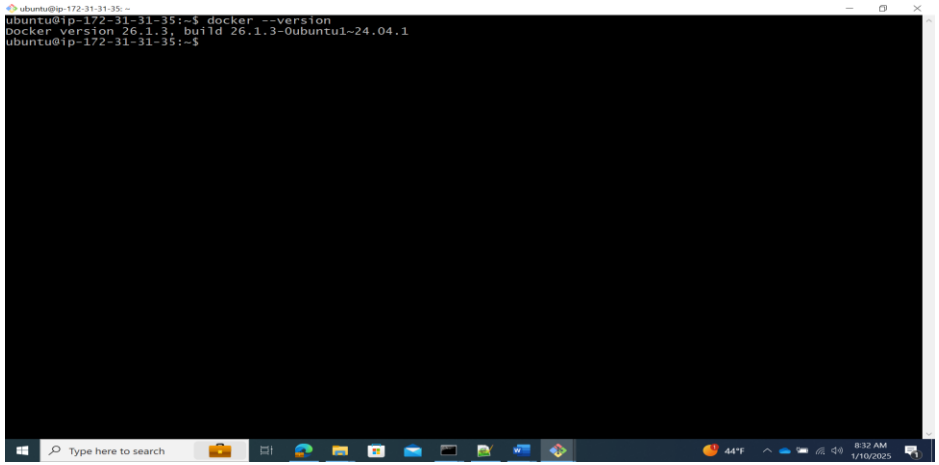
```
sudo apt-get install docker.io -y
sudo systemctl start docker
sudo systemctl enable docker
sudo chmod 666 /var/run/docker.sock
docker --version
```

1. **Add your user to the Docker group:**

```
#sudo groupadd docker
sudo usermod -aG docker $USER
```

1. **Log out and re-login** for the group changes to take effect.

Screenshot: Add a screenshot showing Docker installation confirmation.



2.5 Install Jenkins

Jenkins automates builds and deployments.

```
# Add Jenkins key and repository
curl -fsSL https://pkg.jenkins.io/debian-stable/jenkins.io-2023.key | sudo tee /usr/share/keyrings/jenkins-keyring.asc > /dev/null
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
```

 # Install Jenkins

```
sudo apt-get update
sudo apt-get install jenkins -y
sudo systemctl start jenkins
sudo systemctl enable Jenkins
```

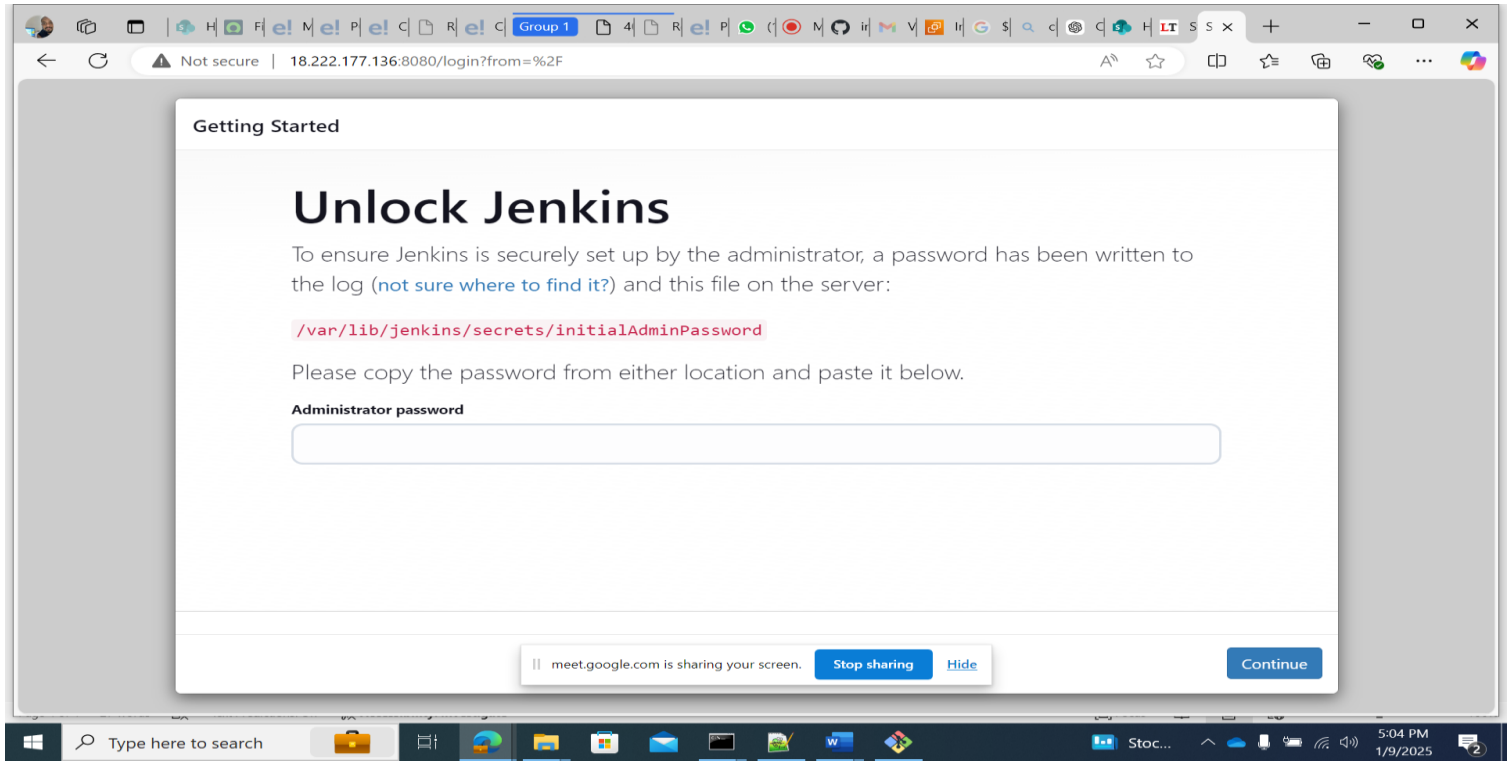
Permissions and Jenkins Docker Setup:

```
sudo usermod -aG docker jenkins
echo "jenkins ALL=(ALL) NOPASSWD: ALL" | sudo tee -a /etc/sudoers > /dev/null
```

1. **Visit Jenkins** on `http://<EC2_PUBLIC_IP>:8080`
2. **Get the initial password to unlock Jenkins:**

```
sudo cat /var/lib/jenkins/secrets/initialAdminPassword
```

Screenshot: Add a screenshot of Jenkins setup and initial password retrieval.



2.6 Install Ansible

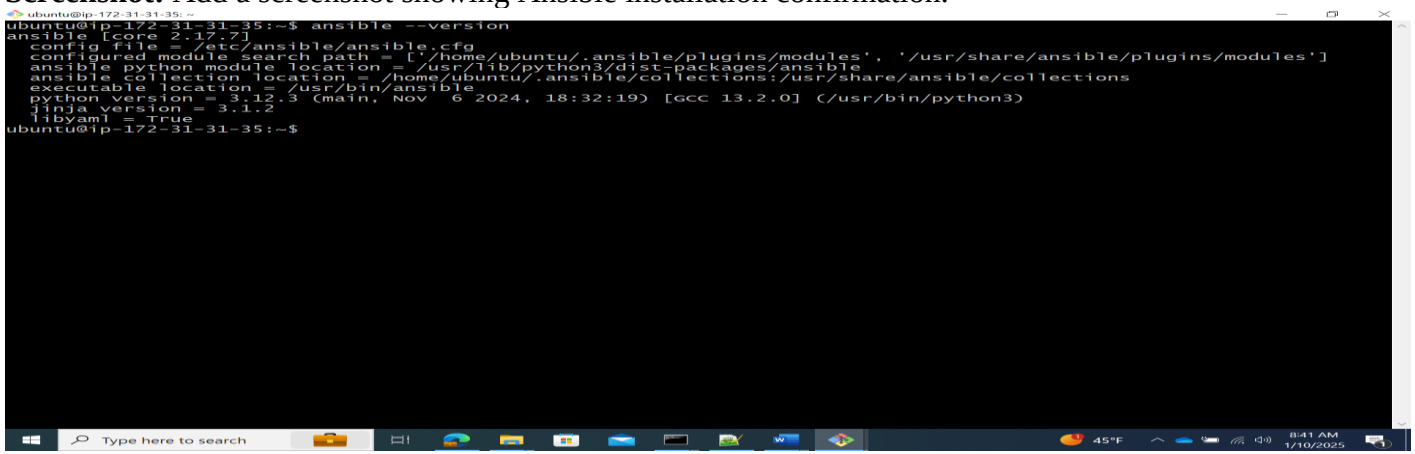
Ansible will automate the deployment process.

```
sudo apt update && sudo apt upgrade -y
sudo apt install software-properties-common -y

# Add Ansible PPA and install Ansible
sudo add-apt-repository ppa:ansible/ansible -y
sudo apt update
sudo apt install ansible -y

# Create Ansible hosts file
mkdir ~/ansible
sudo tee ~/ansible/hosts > /dev/null <<EOL
[localhost]
localhost ansible_connection=local

[k8s]
localhost ansible_connection=local
EOL

# Create Ansible configuration file
sudo tee ~/ansible/ansible.cfg > /dev/null <<EOL
[defaults]
inventory = ./inventory

[privilege_escalation]
become = true
EOL
```

 # Verify Ansible installation

```
ansible –version
```

Screenshot: Add a screenshot showing Ansible installation confirmation.




```
# Install the community.docker collection
ansible-galaxy collection install community.docker kubernetes.core --force
# Install boto3 and botocore (Python libraries for AWS)
sudo apt-get update
sudo apt-get install build-essential libssl-dev libffi-dev python3-dev

sudo apt install python3-pip python3.12-venv -y

# Create a Virtual Environment
sudo -u ubuntu python3 -m venv /home/ubuntu/k8s-ansible-venv
source /home/ubuntu/k8s-ansible-venv/bin/activate

pip3 install boto3 botocore docker dockerpty kubernetes

pip show kubernetes
pip show docker
deactivate
```

2.7 Add Remote Hosts to Inventory

Edit the **`~/ansible/hosts`** file to include your remote servers:

```
[webservers]
remote-server-ip ansible_user=ubuntu ansible_ssh_private_key_file=~/.ssh/your-key.pem
```

2.8 Install Kubernetes Tools

Install kubectl *and* minikube*:*

```
# Install kubectl
curl -LO "https://dl.k8s.io/release/$(curl -L -s https://dl.k8s.io/release/stable.txt)/bin/linux/amd64/kubectl"
chmod +x kubectl
sudo mv kubectl /usr/local/bin/

# Install minikube
curl -LO https://storage.googleapis.com/minikube/releases/latest/minikube-linux-amd64
chmod +x minikube-linux-amd64
sudo cp minikube-linux-amd64 /usr/local/bin/minikube

# Start minikube
minikube start

# Set permissions for Kubernetes config
chmod -R 777 /home/ubuntu/.kube/config
chmod -R 777 /home/ubuntu/.minikube/ca.crt
chmod -R 777 /home/ubuntu/.minikube/profiles/minikube/client.crt
chmod -R 777 /home/ubuntu/.minikube/profiles/minikube/client.key

# Set environment path for Kubernetes config
export KUBECONFIG_PATH='/home/ubuntu/.kube/config'
```

The Jenkins user, ensuring that Jenkins has the necessary permissions and access to the Kubernetes cluster

Set permissions for Kubernetes config

```
sudo chown jenkins:jenkins ~/.kube/config
sudo chmod 600 ~/.kube/config
```

Create Kubernetes Directory for Jenkins

```
sudo mkdir -p /var/lib/jenkins/.kube
sudo cp /home/ubuntu/.kube/config /var/lib/jenkins/.kube/
sudo -u jenkins bash -c "echo 'export KUBECONFIG=var/lib/jenkins/.kube/config' >> ~/.bashrc"
sudo -u jenkins bash -c "source ~/.bashrc"
sudo chown -R jenkins:jenkins /var/lib/jenkins/.kube
```

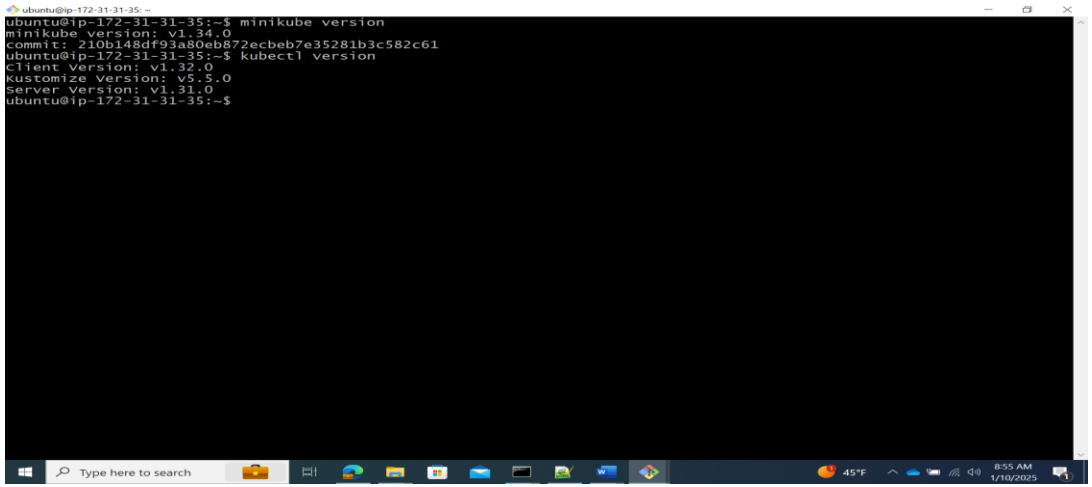
 # Create the Kubernetes configuration directory if it doesn't exist

```
sudo mkdir -p /var/lib/jenkins/.minikube/profiles/minikube
sudo cp -r /home/ubuntu/.minikube/profiles/minikube/* /var/lib/jenkins/.minikube/profiles/minikube/
sudo cp /home/ubuntu/.minikube/ca.crt /var/lib/jenkins/.minikube/
sudo chown -R jenkins:jenkins /var/lib/jenkins/.minikube

# Write the Kubernetes config to /var/lib/jenkins/.kube/config
# Use sed to update the specific lines in the config file
sudo sed -i "s|certificate-authority: .*|certificate-authority: /var/lib/jenkins/.minikube/ca.crt|" /var/lib/jenkins/.kube/config
sudo sed -i "s|client-certificate: .*|client-certificate: /var/lib/jenkins/.minikube/profiles/minikube/client.crt|" /var/lib/jenkins/.kube/config
sudo sed -i "s|client-key: .*|client-key: /var/lib/jenkins/.minikube/profiles/minikube/client.key|" /var/lib/jenkins/.kube/config

#Set the KUBECONFIG Environment Variable
export KUBECONFIG=/home/ubuntu/.kube/config
#View Raw Kubernetes Configuration
kubectl config view --raw > /tmp/kubeconfig
#Install CNI (Calico)
kubectl apply -f https://docs.projectcalico.org/manifests/calico.yaml
#check the cluster status
kubectl get nodes
```

Check kubectl and minikube Version:

$ kubectl version

$ minikube version



3. Build a CI/CD Pipeline

3.1 Clone the GitHub Repository:

Clone the project repository to your EC2 instance:

```
git clone https://github.com/basharul-siddike/lab-project2.git
```

or

If we want to add project to GitHub Repository

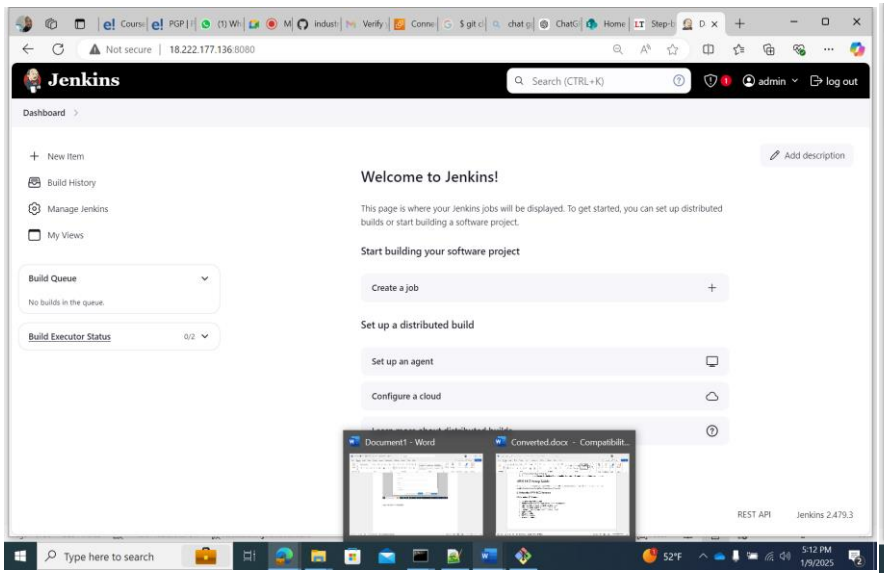
```
git init
git add -A
git commit -m "first commit"
git remote add origin https://github.com/basharul-siddike/lab-project2.git
git push -u origin master
```

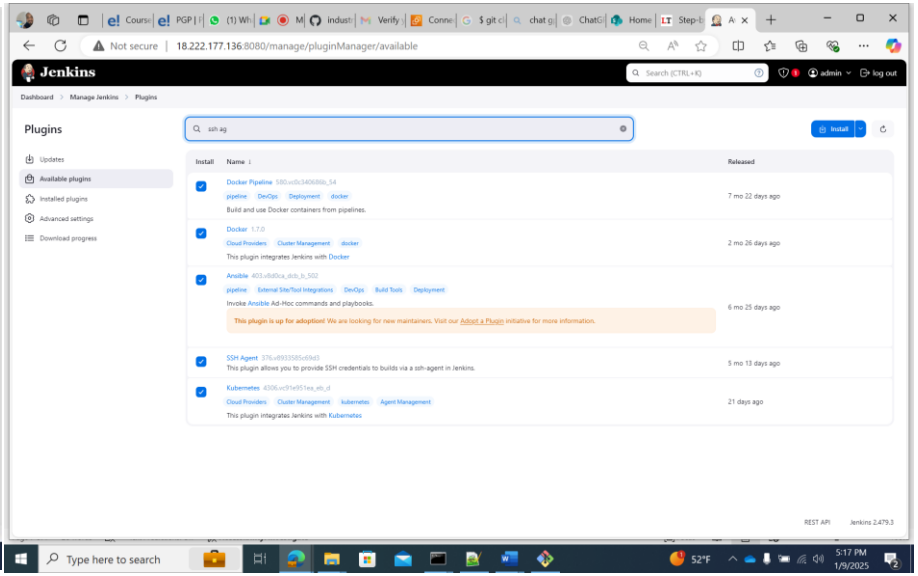
3.2 Create Jenkins Pipeline:

3.2.1. **Login to Jenkins** (`http://<EC2_PUBLIC_IP>:8080`).

3.2.2. Install required plugins:

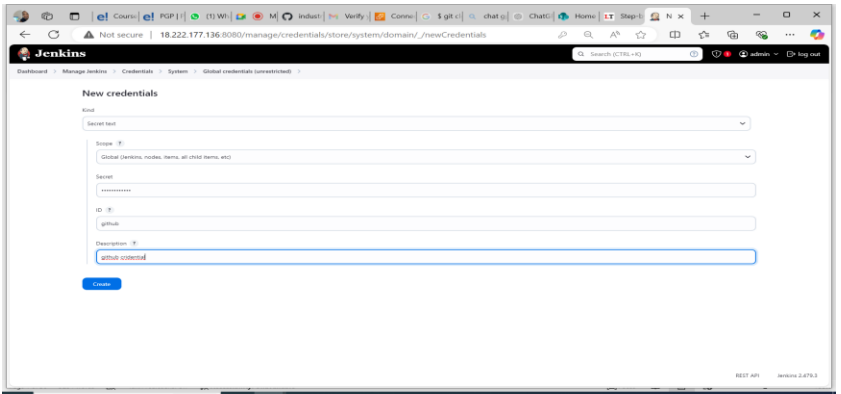
Go to Manage Jenkins > Manage Plugins > Available. and search for - Docker Plugin - Docker Pipeline Plugin - Ansible Plugin - Kubernetes Plugin - SSH Agent Plugin - Restart Jenkins if prompted.





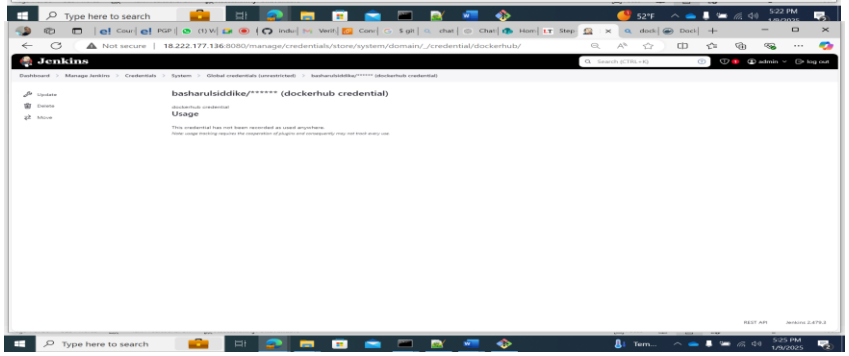
Add GitHub credentials:

- Go to Jenkins Dashboard > Manage Jenkins > Manage Credentials.
- Add a new set of credentials with:
- Secret Text: Your GitHub Personal Access Key.
- ID: Recognizable ID like `github`.



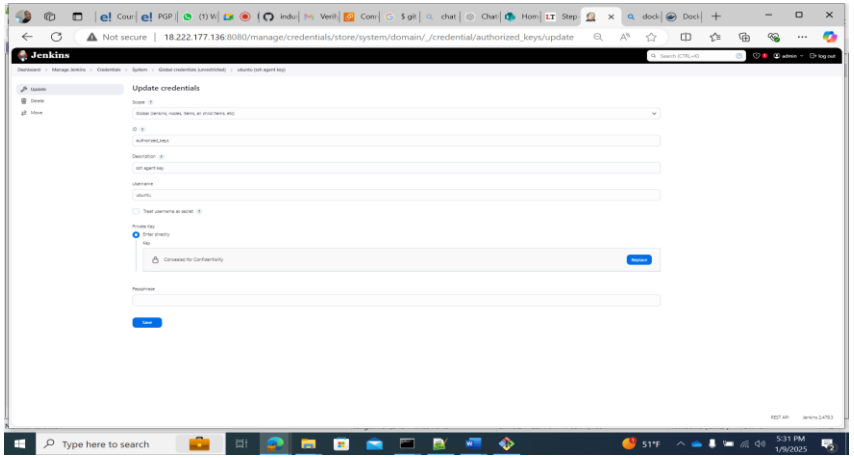
Create Docker Hub Credentials:

- Go to Jenkins Dashboard > Manage Jenkins > Manage Credentials.
- Add a new set of credentials with:
- Username: Your Docker Hub username.
- Password: Your Docker Hub password or access token.
- ID: Recognizable ID like `dockerhub`.



Create SSH Agent Credentials:

- Go to Jenkins Dashboard > Manage Jenkins > Manage Credentials.
- Add a new set of credentials with:
- In the Kind dropdown, select "SSH Username with private key".
- Username: Enter the SSH username that you use to access your Kubernetes master node (e.g., ubuntu, ec2-user, etc.).
- Private Key: Select "Enter directly".
- **Private Key Content**: Paste the content of your **private SSH key** (`.pem` or other SSH private key).
- If you are using a `.pem` file for AWS EC2 instances, open the file in a text editor and copy its content.
- For example, you can use the following command to view and copy the content of the key:
    - `cat /path/to/your-key.pem`
    - **ID**: Recognizable ID like `authorized_keys`.
    - **Description**: (Optional) Add a description for the SSH key for easier identification.



3.3 Create a Job for Each Task:

1. **Compile Job**: Uses Maven to compile the code.
2. **Test Job**: Runs tests.
3. **Package Job**: Packages the code into a .war file.

3.4 Dockerfile Example:

Example *Dockerfile* to deploy the .war to a Tomcat server:

```
FROM iamdevopstrainer/tomcat:base
COPY target/XYZtechnologies-1.0.war /usr/local/tomcat/webapps/
CMD ["catalina.sh", "run"]
```

3.5 Build and Push Docker Image:

```
docker build -t basharulsiddike/xyztechnologies:latest .
docker login
docker push basharulsiddike/xyztechnologies:latest
```

Configure Jenkins to build and push Docker images after packaging.

3.6 Write Jenkinsfile:

To automatically deploy your project when you push code to Git (e.g., GitHub) using Jenkins, you need to set up a Jenkins pipeline with a Git webhook. Here's how you can achieve this:

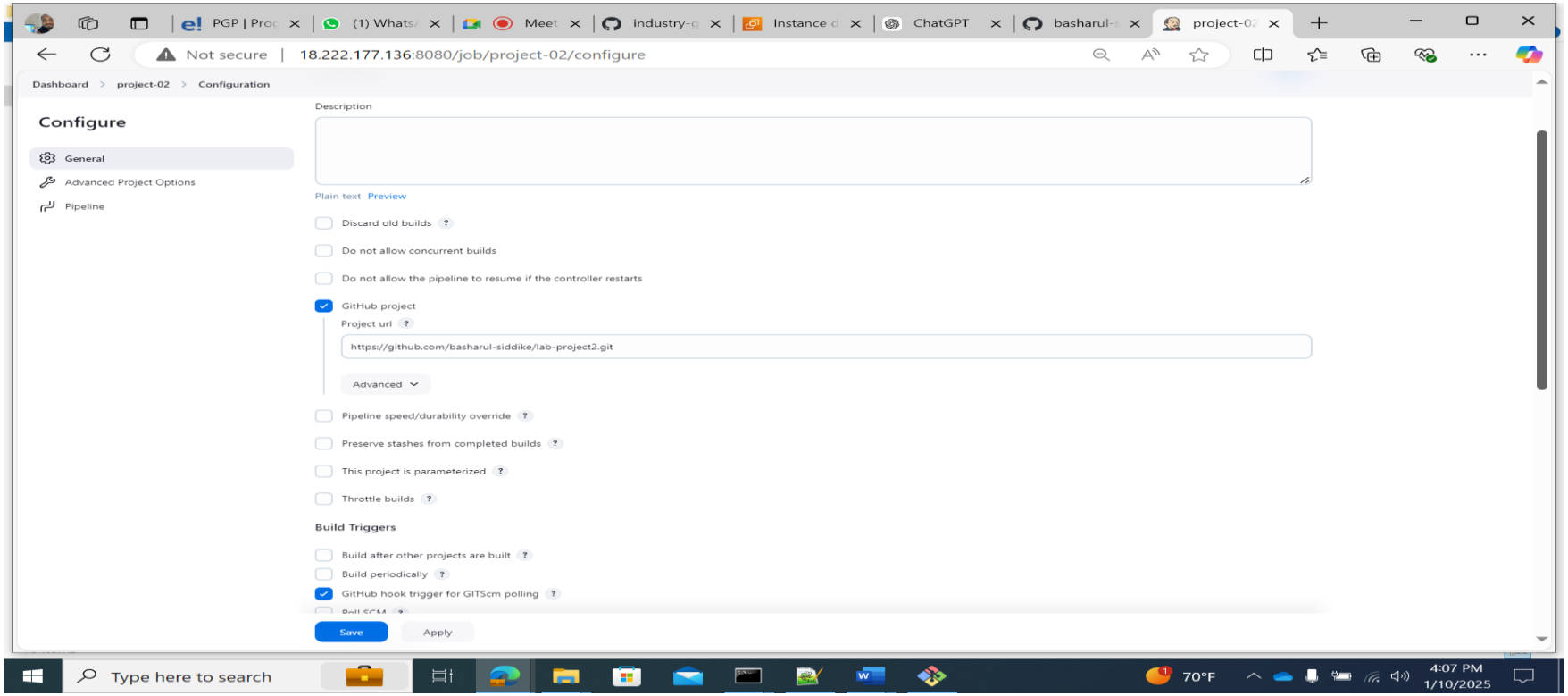
3.6.1. Set up Jenkins

- Install Necessary Plugins: Make sure the following plugins are installed:
    - Git Plugin (for integrating Git with Jenkins)
    - GitHub Integration Plugin (optional if using GitHub)
    - Pipeline Plugin (if you're using Jenkins pipelines)

3.6.2. Create a New Jenkins Job (Freestyle or Pipeline)

- Freestyle Job:
    i. Go to Jenkins dashboard > New Item.

ii. Select "Freestyle project" and provide a name for the job.
iii. Under Source Code Management, select Git and provide the repository URL (e.g., GitHub) and credentials.
iv. Under Build Triggers, select GitHub hook trigger for GITScm polling (if using GitHub) or configure a webhook in GitLab/Bitbucket for similar functionality.
v. Add Build Steps (e.g., run a script to deploy your app, such as docker-compose up, npm run build, or any other deployment commands).
vi. Save and build.



- Pipeline Job:

i. Go to Jenkins dashboard > New Item.
ii. Select Pipeline and provide a name for the job.
iii. Under Pipeline Definition, you can either configure the pipeline directly in the Pipeline Script or use a Jenkinsfile stored in your repository

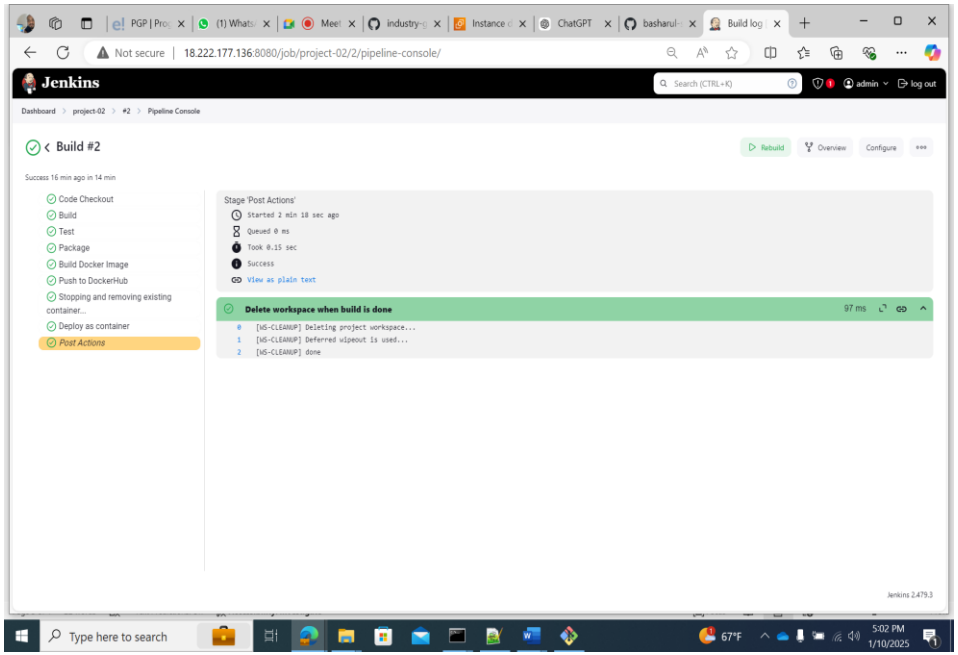
Here’s a basic *Jenkinsfile* for CI/CD:

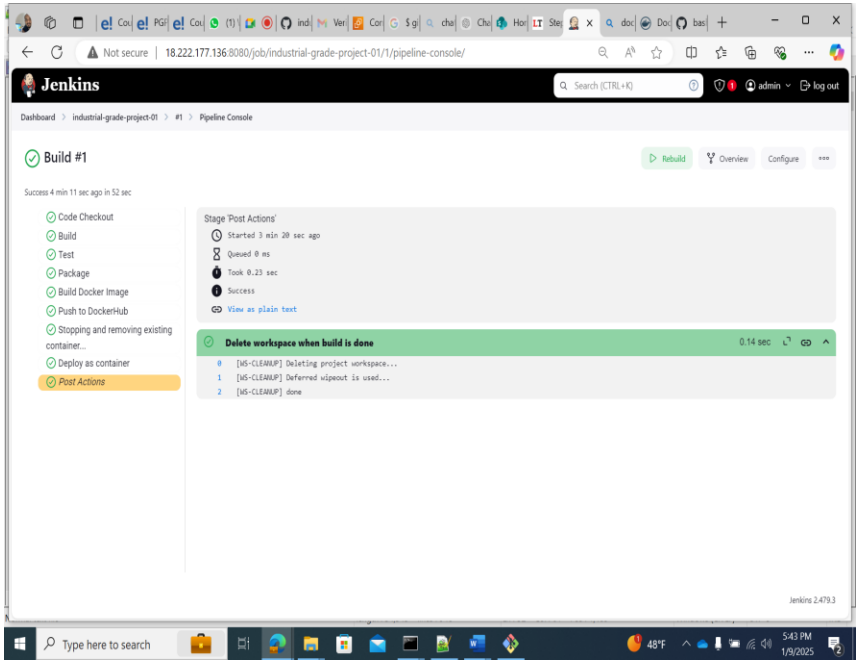
```
pipeline {
  agent any
  environment {
    DOCKER_CREDENTIALS_ID = 'dockerhub' // Jenkins ID for DockerHub credentials
    DOCKER_IMAGE = 'basharulsiddike/xyz-technologies'
    DOCKER_REGISTRY = 'https://index.docker.io/v1/' // For DockerHub
    CONTAINER_NAME = "xyz-technologies"
    DOCKER_TAG = "${BUILD_ID}"  // Use the BUILD_ID as the tag
    CONTAINER_PORT = "9393"  // Use the BUILD_ID as the tag
  }
  stages {
    stage('Code Checkout') {
      steps {
        git branch: 'master', url: 'https://github.com/basharul-siddike/lab-project2.git'
      }
    }

    stage('Build') {
      steps {
        sh 'mvn clean compile'
      }
    }

    stage('Test') {
      steps {
        sh 'mvn test'
      }
    }

    stage('Package') {
      steps {
        sh 'mvn package'
      }
    }
```

```
    stage('Build Docker Image') {
        steps {
            script {
                docker.build("${DOCKER_IMAGE}:${DOCKER_TAG}")
            }
        }
    }

    stage('Push to DockerHub') {
        steps {
            script {
                docker.withRegistry("${DOCKER_REGISTRY}", "${DOCKER_CREDENTIALS_ID}") {
                    docker.image("${DOCKER_IMAGE}:${DOCKER_TAG}").push()
                }
            }
        }
    }
    stage('Stopping and removing existing container...') {
        steps {
            script {
                def containerExists = sh(
                    script: "docker inspect -f '{{.State.Running}}' ${CONTAINER_NAME}",
                    returnStatus: true
                )

                if (containerExists == 0) {
                    echo "Container ${CONTAINER_NAME} exists. Stopping and removing..."
                    sh "docker stop ${CONTAINER_NAME} || true"
                    sh "docker rm ${CONTAINER_NAME}"
                } else {
                    echo "Container ${CONTAINER_NAME} does not exist. No need to stop or remove."
                }
            }
        }
```

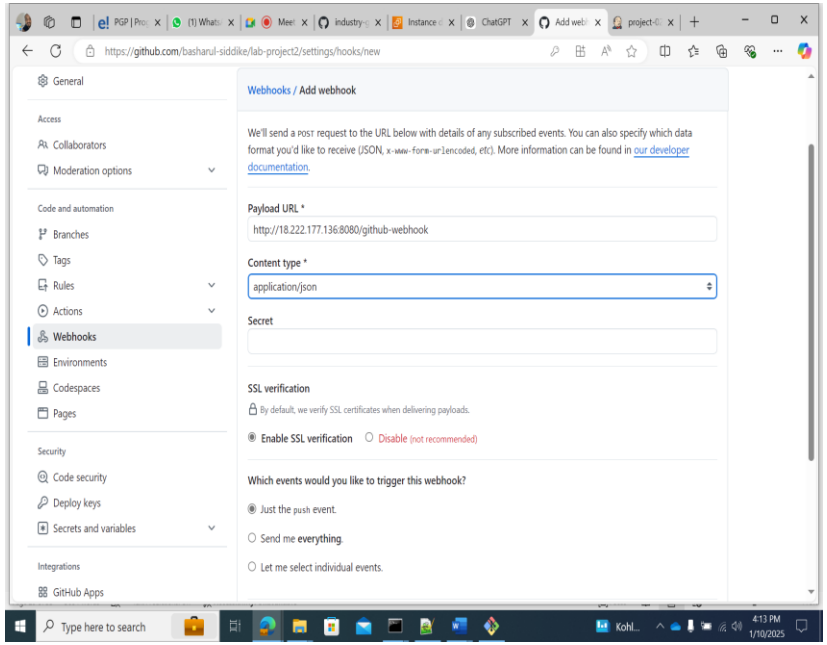
```
    }
    stage('Deploy as container')
                    {
                                steps
                                {
                                        sh 'docker run -d -p ${CONTAINER_PORT}:8080 --name $CONTAINER_NAME ${DOCKER_IMAGE}:${DOCKER_TAG} || {
echo "Failed to start Docker container! Exiting."; exit 1; }'
                                }
                    }

  }
  post {
    always {
        cleanWs()
    }
  }
}
```

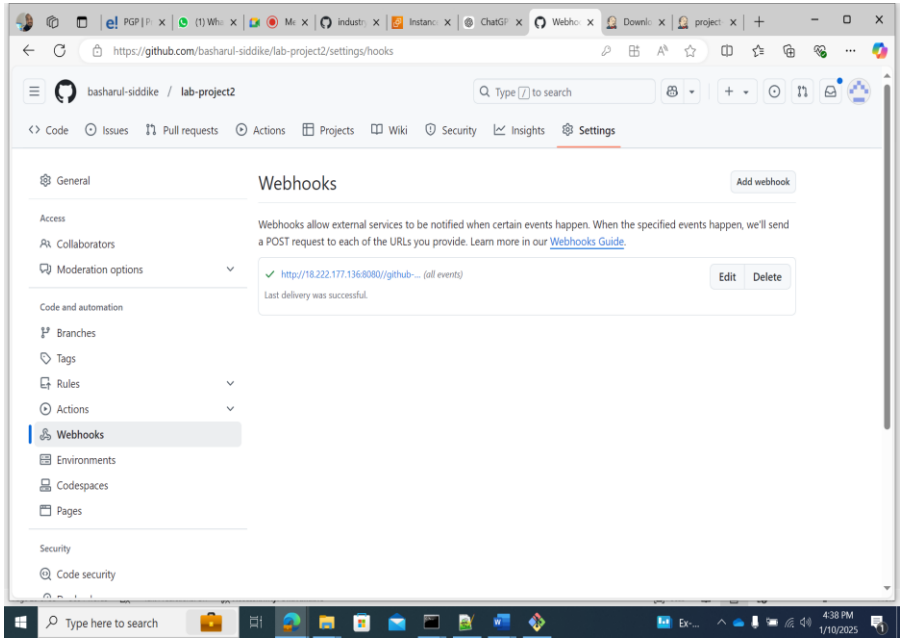
Pipeline Console Pipeline Overview





- GitHub:
    i. Go to your GitHub repository > Settings > Webhooks.
    ii. Click Add webhook.
    iii. In the Payload URL, enter the Jenkins webhook URL. It usually looks like http://your-jenkins-url/github-webhook/.
    iv. Set Content type to application/json.
    v. In Which events would you like to trigger this webhook?, select Just the push event.
    vi. Save the webhook.





3.6.3. Test the Automation

- Push changes to your Git repository.
- The webhook should trigger Jenkins to start the job, and Jenkins should automatically deploy the application based on the defined steps in your pipeline.

This setup will ensure that Jenkins automatically triggers and deploys whenever a push is made to the repository.

3.7 Configure Deployment Using Ansible:

Set environment variables: Before running your Ansible playbook, set your Docker Hub credentials as environment variables in your shell:

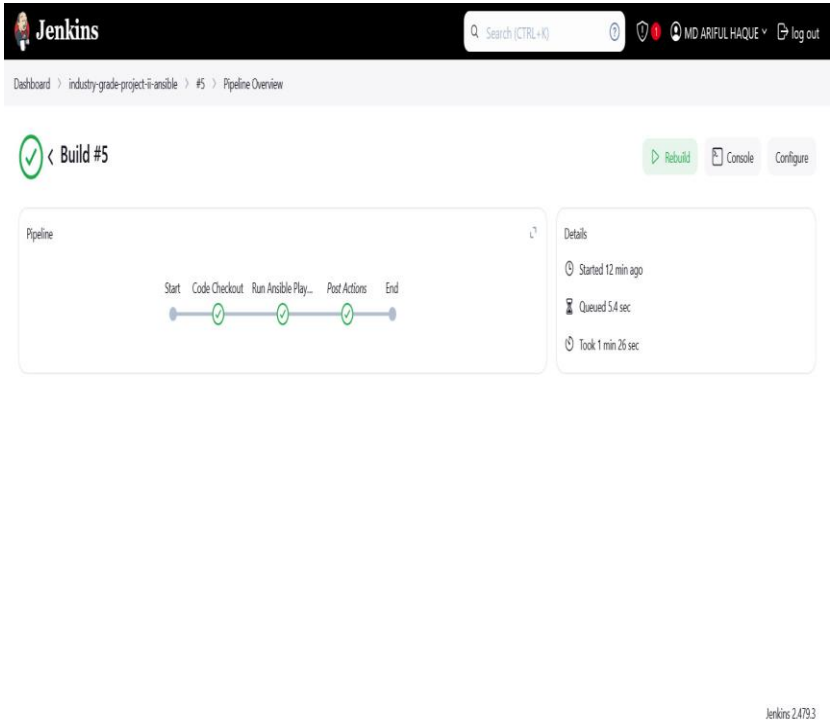
```
export DOCKER_USERNAME='' # your dockerhub username
export DOCKER_PASSWORD='' # your dockerhub password
```

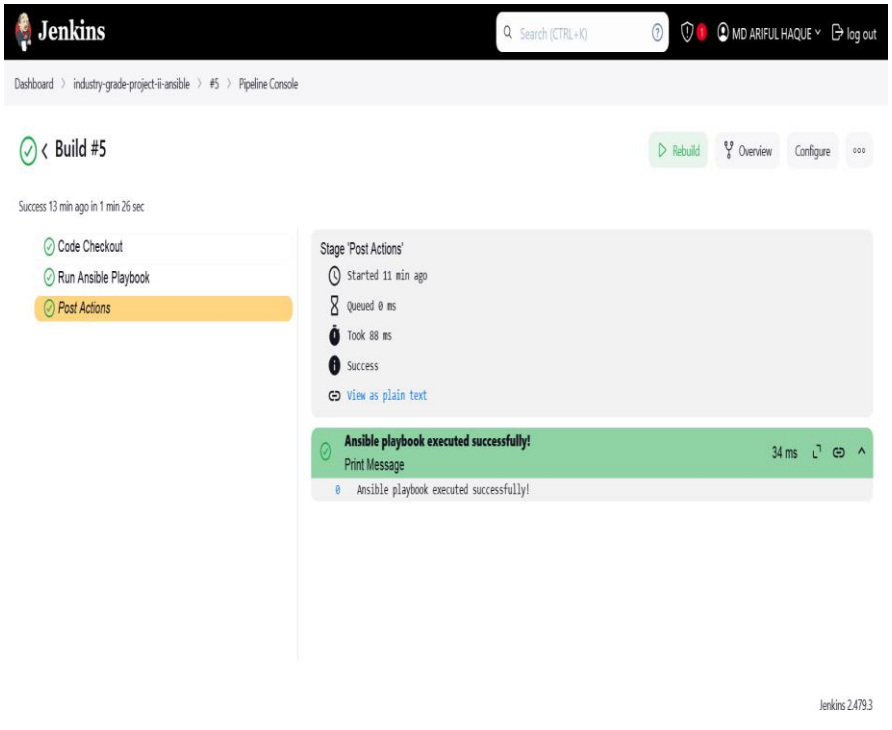
Ansible, Docker and Kubernetes Pipeline CI/CD

```
pipeline {
  agent any
  environment {
    DOCKER_CREDENTIALS_ID = 'dockerhub'
    ANSIBLE_PLAYBOOK = 'playbook.yml' // Path to your Ansible playbook
    // Use the full path instead of ~
    KUBECONFIG = '/var/lib/jenkins/.kube/config'
  }
  stages {
    stage('Code Checkout') {
      steps {
        git branch: 'master', url: 'https://github.com/basharul-siddike/lab-project2.git'
      }
    }
    stage('Run Ansible Playbook') {
      steps {
        script {
          // Use the withCredentials block to inject Docker Hub credentials
          withCredentials([usernamePassword(credentialsId: DOCKER_CREDENTIALS_ID, passwordVariable: 'DOCKER_PASSWORD',
usernameVariable: 'DOCKER_USERNAME')]) {
            withEnv(['KUBECONFIG_PATH=/var/lib/jenkins/.kube/config']) {
              sh 'ansible-playbook -i ~/ansible/inventory.ini playbook.yml --become'
            }
          }
        }
      }
    }
  }
```

```
  post {
    success {
      echo 'Ansible playbook executed successfully!'
    }
    failure {
      echo 'Ansible playbook execution failed.'
    }
  }
}
```

Pipeline Console Pipeline Overview





Create an Ansible playbook for deployment:

```
- hosts: localhost
  become: yes
  become_method: sudo
  become_user: root
  vars:
    ansible_python_interpreter: /home/ubuntu/k8s-ansible-venv/bin/python
    docker_tag: "latest"  # Change this to any tag you want
    container_name: "xyz-technologies-ansible"
    image_name: "mahshamim/xyz-technologies-ansible"
    docker_username: "{{ lookup('env', 'DOCKER_USERNAME') }}"
    docker_password: "{{ lookup('env', 'DOCKER_PASSWORD') }}"
    kubeconfig_path: "{{ lookup('env', 'KUBECONFIG_PATH') }}"
    deployment_file: './k8s_deployments/deployment.yml'
    service_file: './k8s_deployments/service.yaml'
    namespace: "xyz--technologies-ansible" # Add your desired namespace here
    docker_host: "unix:///var/run/docker.sock"
  tasks:
    - name: Debug kubeconfig path
      debug:
        msg: "Kubeconfig path is {{ kubeconfig_path }}"

    - name: Log in to Docker Hub
      command: echo "{{ docker_password }}" | docker login -u "{{ docker_username }}" --password-stdin

    - name: Use Python from virtual environment
      ansible.builtin.command: /home/ubuntu/k8s-ansible-venv/bin/pip install kubernetes packaging

    - name: Check Python Kubernetes module
      ansible.builtin.command: /home/ubuntu/k8s-ansible-venv/bin/python -c "import kubernetes"

    - name: List installed packages
      ansible.builtin.command: /home/ubuntu/k8s-ansible-venv/bin/pip list

    - name: Check if Docker is already installed
```

```
    command: docker --version
    register: docker_installed
    ignore_errors: true

  - name: Install Docker
    apt:
      name: docker.io
      state: present
    when: docker_installed.rc != 0

  - name: Start Docker Service
    service:
      name: docker
      state: started
      enabled: true

  - name: Build WAR file using Maven (if applicable)
    command: mvn clean package
    args:
      chdir: ./
    when: docker_installed.rc == 0  # Run only if Docker is installed

  - name: Build Docker Image
    command: docker build -t {{ image_name }} .

  - name: Stop existing Docker container if running
    docker_container:
      name: "{{ container_name }}"
      state: absent
    ignore_errors: true

  - name: Remove existing Docker container if exists
    docker_container:
      name: "{{ container_name }}"
      state: absent
    ignore_errors: true

  - name: Run Docker Container
    docker_container:
      name: "{{ container_name }}"
      image: "{{ image_name }}"
```

```
      state: started
      published_ports:
        - "9393:8080"

  - name: Log in to Docker Hub
    docker_login:
      username: "{{ docker_username }}"
      password: "{{ docker_password }}"

  - name: Tag Docker image for Docker Hub
    command: docker tag {{ image_name }} "{{ image_name }}:{{ docker_tag }}"

  - name: Push Docker image to Docker Hub
    command: docker push "{{ image_name }}:{{ docker_tag }}"

  - name: Ensure Kubernetes namespace exists
    kubernetes.core.k8s:
      name: "{{ namespace }}"
      state: present
      kubeconfig: "{{ kubeconfig_path }}"
      api_version: v1
      kind: Namespace

  - name: Apply Kubernetes Deployment
    kubernetes.core.k8s:
      state: present
      kubeconfig: "{{ kubeconfig_path }}"
      definition: "{{ lookup('file', deployment_file) }}"
      namespace: "{{ namespace }}"  # Specify the namespace here

  - name: Apply Kubernetes Service
    kubernetes.core.k8s:
      state: present
      kubeconfig: "{{ kubeconfig_path }}"
      definition: "{{ lookup('file', service_file) }}"
      namespace: "{{ namespace }}"  # Specify the namespace here
```

Test the Ansible Playbook:

Run the following command to execute the playbook:

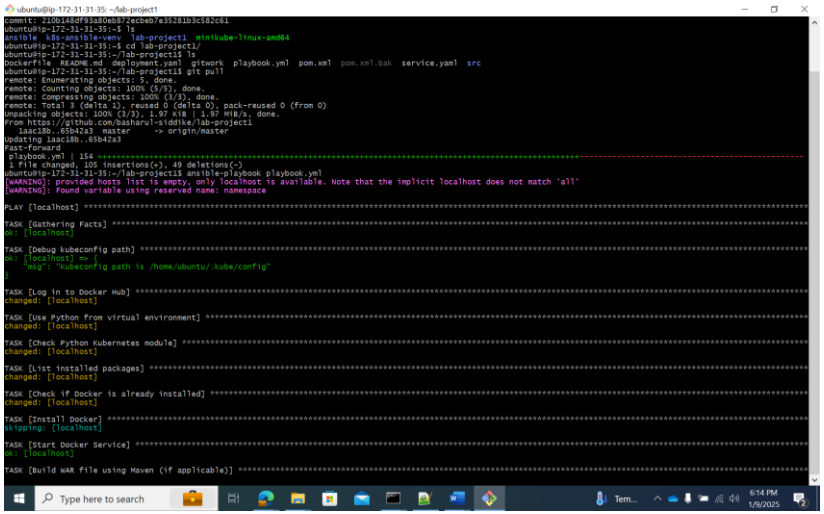
```
ansible-playbook path/to/your/playbook.yml
```

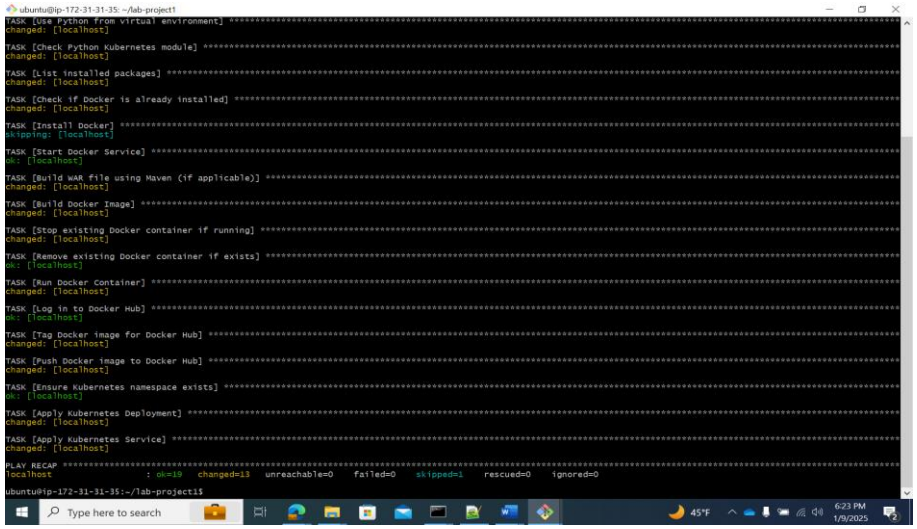
OR

```
ansible-playbook -i inventory.ini path/to/your/playbook.yml --become
```

Ansible Playbook Output

Jenkins Pipeline Run Ansible Playbook





Check Project

<domain or ip>:<port>/XYZtechnologies-1.0/

Welcome to XYZ technologies

This is retail portal

Add Product | View Product

3.8 Deploy Artifacts to Kubernetes

3.8.1. **Kubernetes Deployment Manifest**:

Create a file named `deployment.yml`:

```
apiVersion: apps/v1
kind: Deployment
metadata:
 name: xyz-technologies-deployment
spec:
 replicas: 2
 selector:
  matchLabels:
   app: xyz-technologies
 template:
  metadata:
   labels:
    app: xyz-technologies
  spec:
   containers:
    - name: xyz-technologies
      image: basharulsiddike/xyz-technologies:latest
      ports:
       - containerPort: 8080
```

3.8.2. **Service Manifest**:

Create a file named `service.yaml`:

```
apiVersion: v1
kind: Service
metadata:
  name: xyz-technologies-service
spec:
  type: NodePort
  ports:
    - port: 8080
      targetPort: 8080
      nodePort: 30000
```

```
  selector:
    app: xyz-technologies
```

3.8.3. **Deploy to Kubernetes**:

Run the following commands:

```
kubectl apply -f deployment.yml --validate=false
kubectl apply -f service.yaml --validate=false
```

3.8.4. *Enable Kubernetes Dashboard*

If you haven't already enabled the Kubernetes dashboard, you need to do so by running the following commands on your EC2 instance:

```
minikube addons enable dashboard
minikube addons enable metrics-server
```

3.8.5. *Access the Dashboard*

Start the Kubernetes dashboard using:

```
minikube dashboard --url
```

This command will start the dashboard and give you a URL to access it. However, the URL will only be accessible from the local environment (EC2 instance) by default.

3.8.6. *Port Forwarding to Access Dashboard Remotely*

Since you're using AWS EC2, to access the Kubernetes dashboard from your local machine (laptop or desktop), you need to set up port forwarding. You can use SSH tunneling for that.

From your local machine, run the following command (replace ec2-user with your actual EC2 username and your-ec2-public-ip with your EC2 instanceâ€™s public IP address):

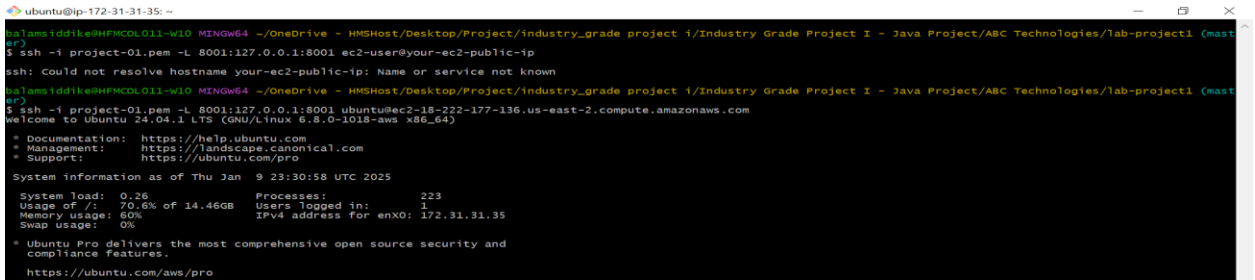
```
ssh -i /path/to/your-key.pem -L 8001:127.0.0.1:8001 ec2-user@your-ec2-public-ip
```

This will forward traffic from your local port 8001 to the same port on the EC2 instance.

3.8.7. *Start the Proxy*

On your EC2 instance, start the kubectl proxy to forward API requests from the browser to the Kubernetes cluster:

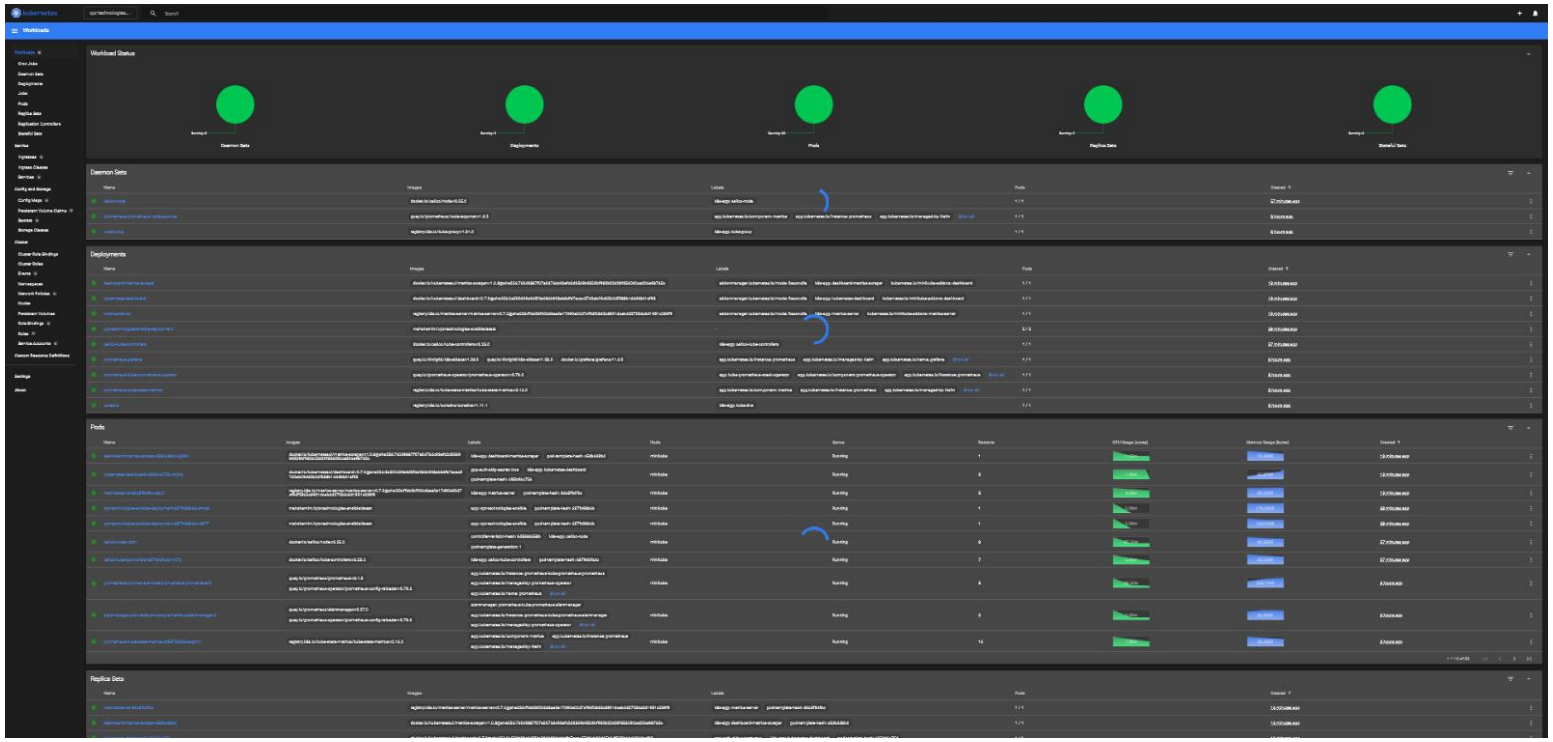
```
kubectl proxy --port=8001
```



3.8.9. *Access the Dashboard from Your Browser*

Now, on your local machine, open the following URL in your web browser:
[Kubernetes dashboard]
This should bring up the Kubernetes dashboard.

Screenshot: Add a screenshot of the Kubernetes dashboard.



3.8.10. *Authentication*

The Kubernetes dashboard may ask for an authentication token. To get the token, you can use this command on the EC2 instance:

```
kubectl -n kubernetes-dashboard create token admin-user
```

Copy the token and use it for logging into the dashboard.

4. Set Up Monitoring with Prometheus and Grafana

Step 1: Install Helm

Helm is required to install and manage Prometheus and Grafana using Helm charts.

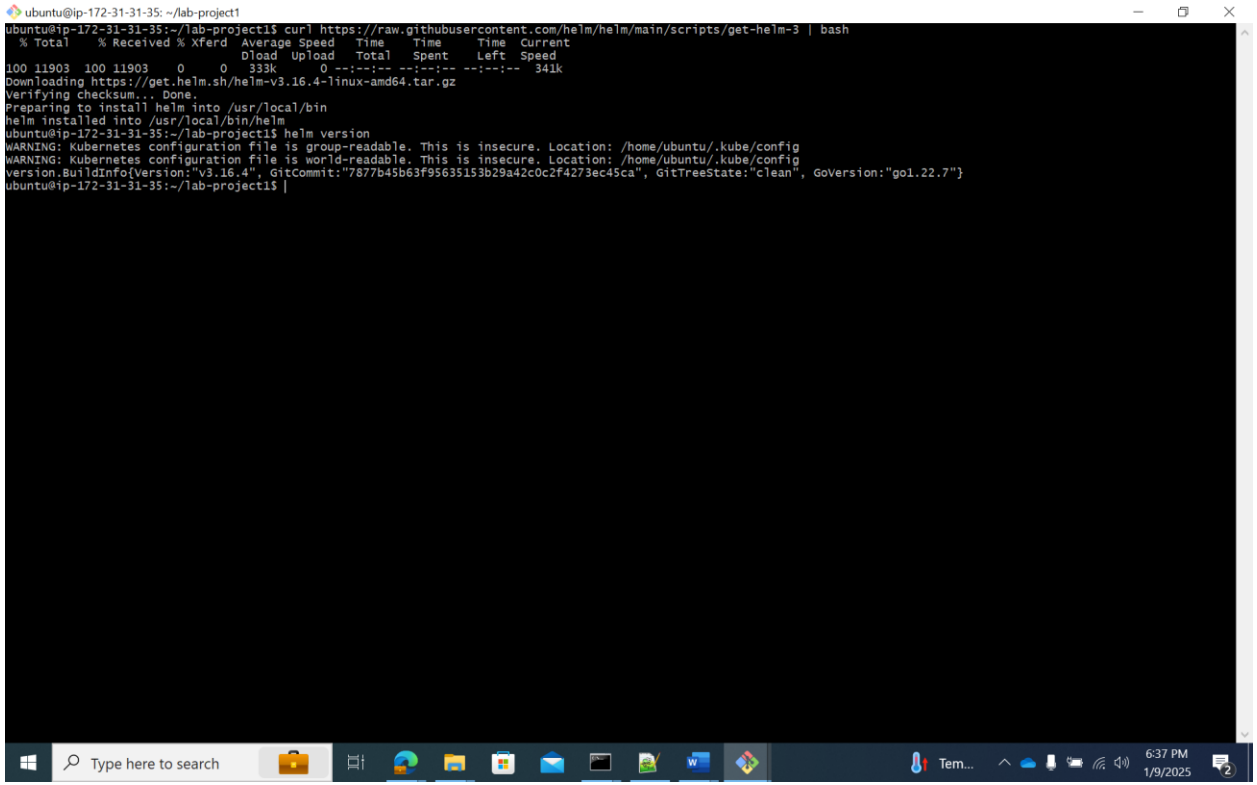
Download and Install Helm:

```
curl https://raw.githubusercontent.com/helm/helm/main/scripts/get-helm-3 | bash
```

Verify Helm Installation:

```
helm version
```

Screenshot: Add a screenshot of the helm installation



Step 2: Add Helm Repositories for Prometheus and Grafana

2.1. **Add Prometheus Helm Chart Repository:**

helm repo add prometheus-community https://prometheus-community.github.io/helm-charts

2.2. **Add Grafana Helm Chart Repository:**

helm repo add grafana https://grafana.github.io/helm-charts

2.3. **Update Helm Repositories:**

helm repo update

Step 3: Deploy Prometheus

3.1. **Create a Kubernetes Namespace for Monitoring:**

kubectl create namespace monitoring

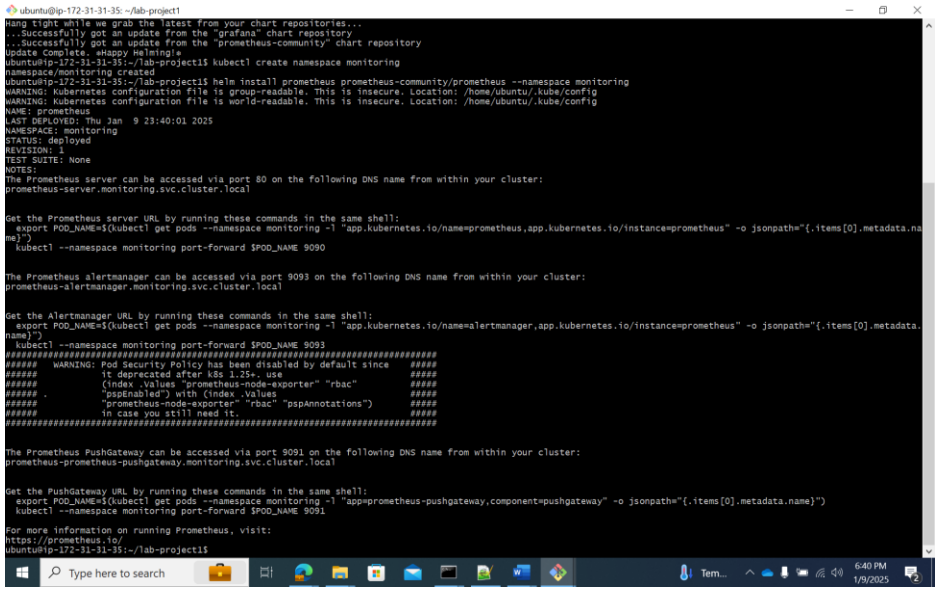
3.2. **Install Prometheus Using Helm:**

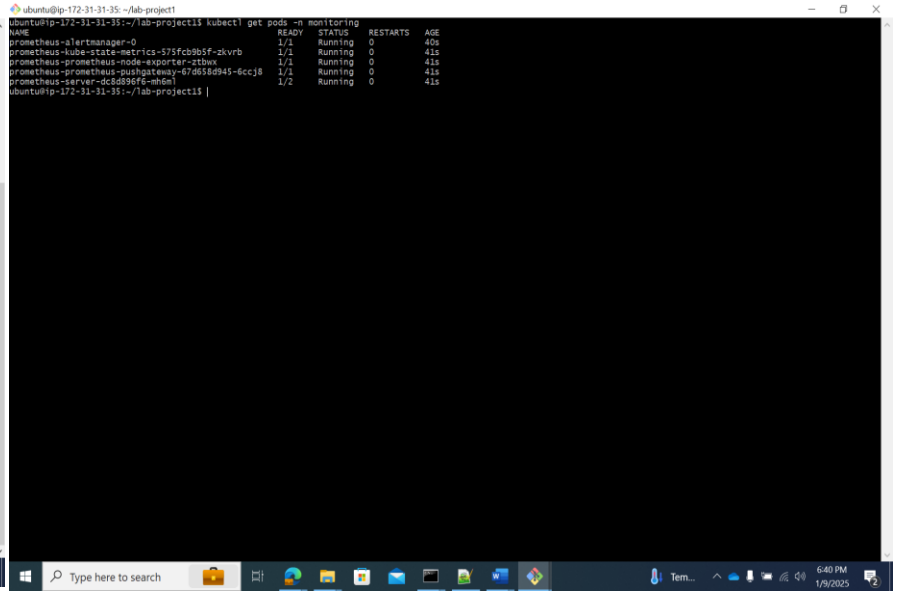
helm install prometheus prometheus-community/prometheus --namespace monitoring

3.3. **Verify Prometheus Installation:**

kubectl get pods -n monitoring

Screenshot: Add a screenshot of the Prometheus





From your local machine, run the following command (replace ec2-user with your actual EC2 username and your-ec2-public-ip with your EC2 instanceâ€™s public IP address):

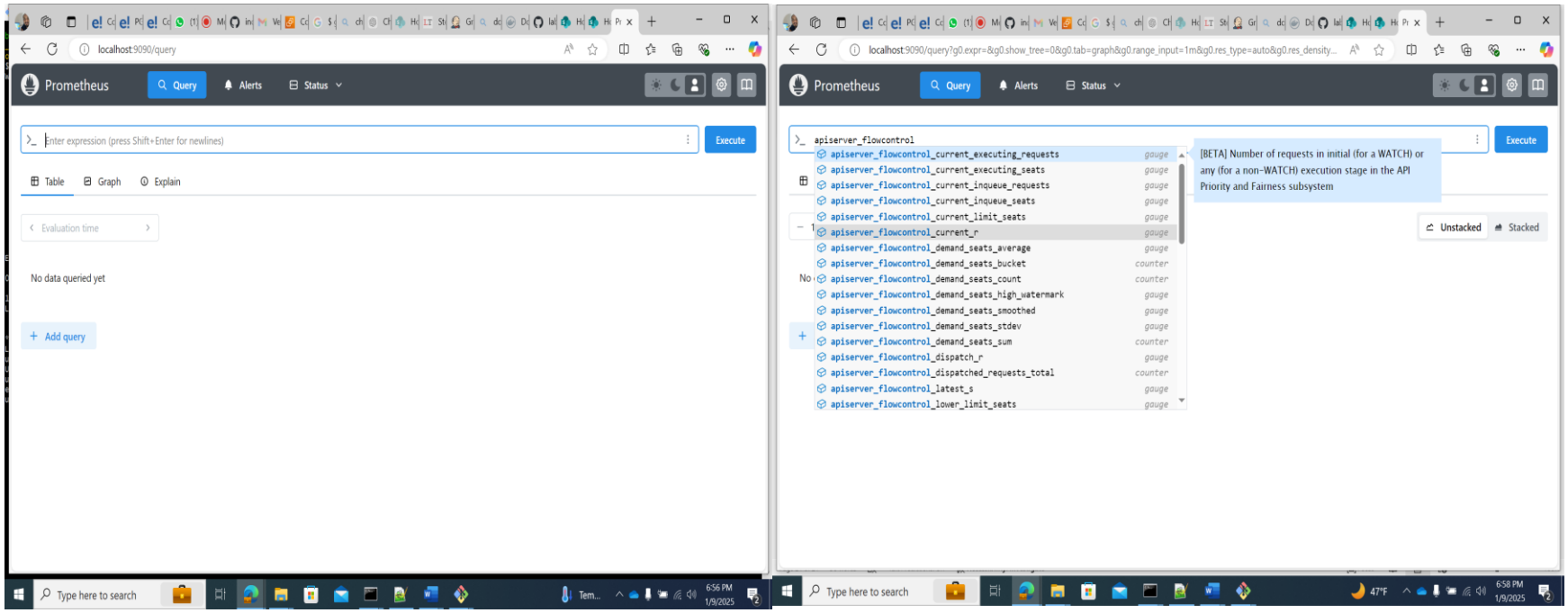
```
ssh -i /path/to/your-key.pem -L 9090:127.0.0.1:9090 ec2-user@your-ec2-public-ip
```

Once the Prometheus pods are running, you can access the Prometheus UI:

```
kubectl port-forward -n monitoring deploy/prometheus-server 9090:9090
```

Access it via your browser at `http://localhost:9090`.

Screenshot: Add a screenshot of the Prometheus dashboard.



Step 4: Deploy Grafana

4.1. **Install Grafana Using Helm:**

```
helm install grafana grafana/grafana --namespace monitoring
```

4.2. **Check the Status of Grafana Pod:**

```
kubectl get pods -n monitoring
```

4.3. **Get Grafana Admin Password:**

```
kubectl get secret --namespace monitoring grafana -o jsonpath="{.data.admin-password}" | base64 --decode ; echo
```

From your local machine, run the following command (replace ec2-user with your actual EC2 username and your-ec2-public-ip with your EC2 instanceâ€™s public IP address):

```
ssh -i /path/to/your-key.pem -L 3000:127.0.0.1:3000 ec2-user@your-ec2-public-ip
```

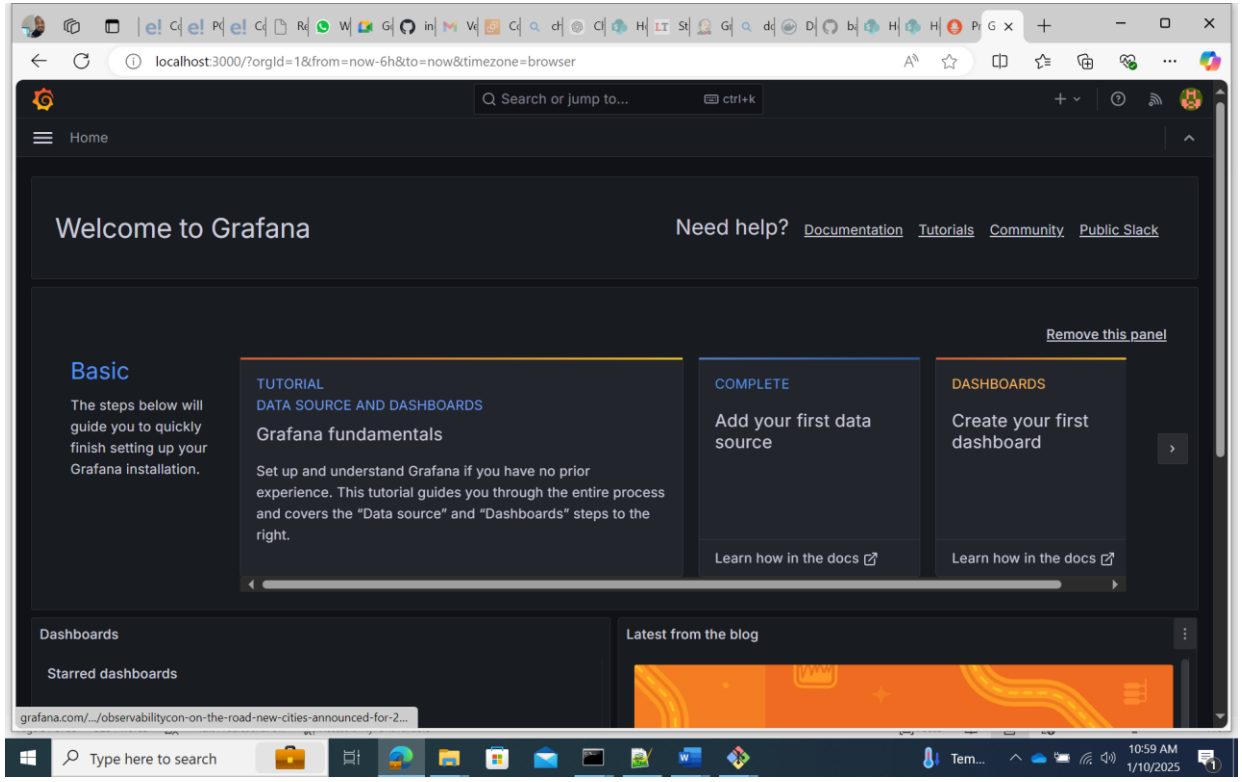
4.4. **Access Grafana UI:** Port-forward the Grafana service:

```
kubectl port-forward -n monitoring service/grafana 3000:80
```

Access Grafana UI in your browser: `http://localhost:3000`

1. Username: `admin`
2. Password: (retrieved from the previous step)

Screenshot: Add a screenshot of the **Grafana** dashboard.

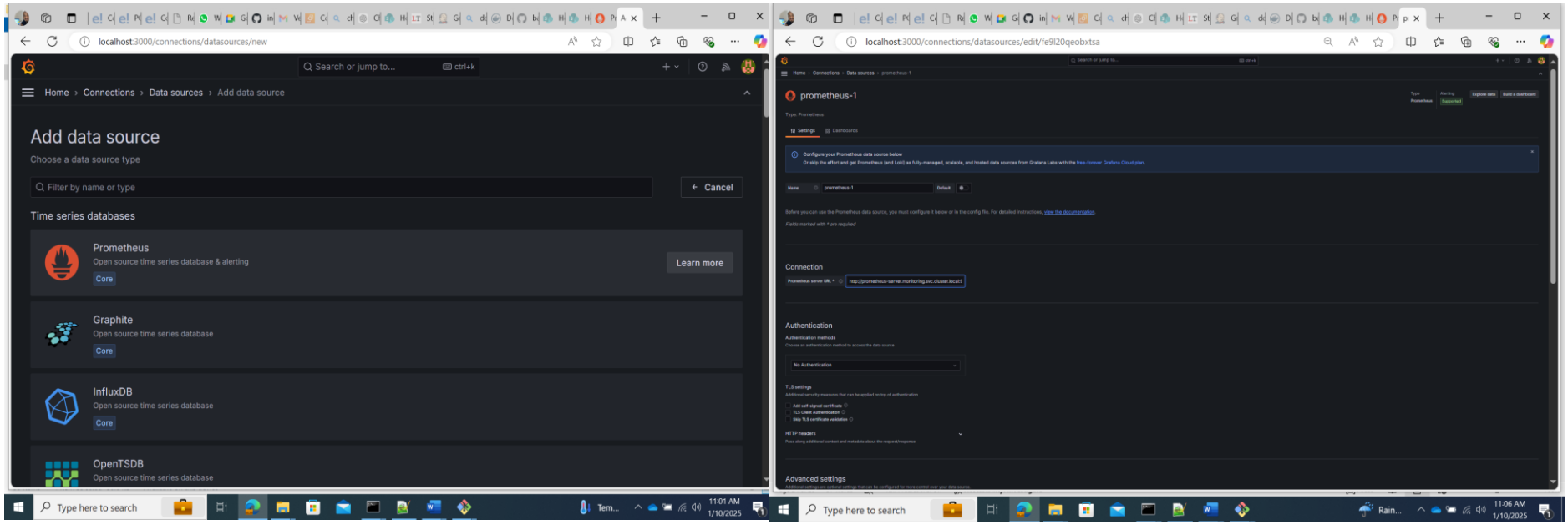


Step 5: Configure Prometheus as a Data Source in Grafana

Once you log in to Grafana, configure Prometheus as the data source:

1. Navigate to **Configuration > Data Sources**.
2. Add Prometheus as the data source.
3. Set the URL to `http://prometheus-server.monitoring.svc.cluster.local:9090`.
4. Save & Test the configuration.

Screenshot: Add a screenshot of the **Grafana** dashboard

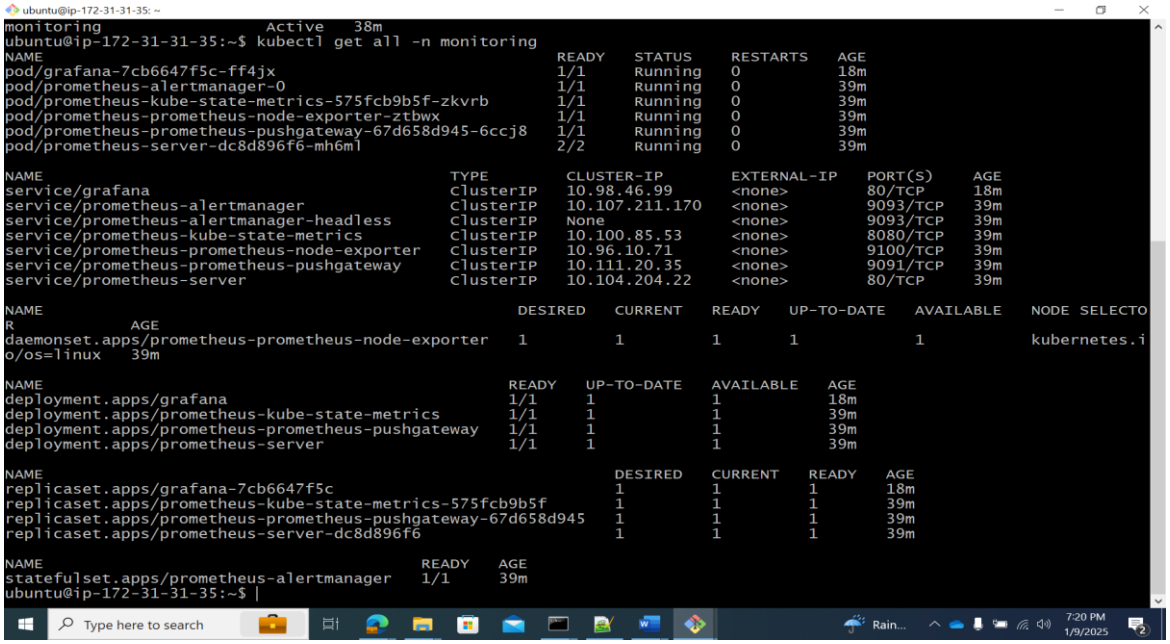


Step 6: Access Prometheus and Grafana from AWS EC2

1. Expose the Prometheus and Grafana services using LoadBalancer or NodePort if you want to access them from your AWS EC2 public IP <`http:// 18.222.177.136`>.

For NodePort, modify the service type:
kubectl edit service grafana -n monitoring
Change `type: ClusterIP` to `type: NodePort` and save.
Check the NodePort assigned using:
kubectl get svc -n monitoring

Screenshot: Add a screenshot of the **Grafana** Monitoring



Access Grafana using `http://<EC2_PUBLIC_IP>:<NodePort>`

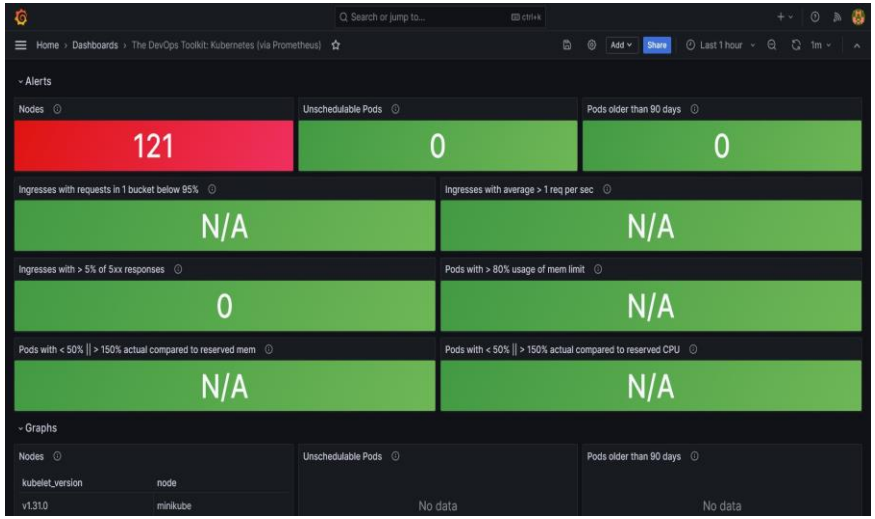
You can do the same for Prometheus.

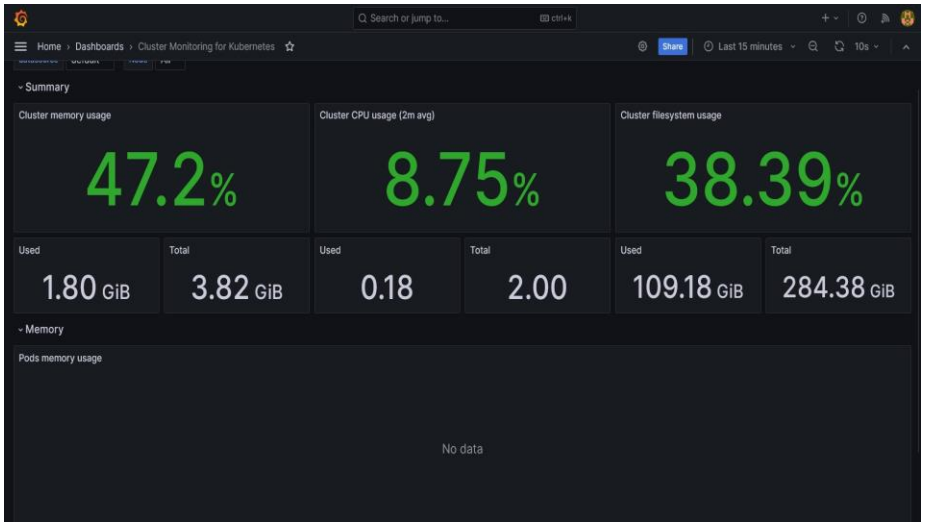
Step 7: Set Up Kubernetes Cluster Permissions for Monitoring

Make sure Prometheus has access to scrape metrics from the Kubernetes cluster. Create a ClusterRole and RoleBinding:

kubectl apply -f https://raw.githubusercontent.com/prometheus-operator/prometheus-operator/main/example/rbac/prometheus/prometheus-cluster-role.yaml

Screenshot: Add a screenshot of the Grafana dashboard.





5. Final Testing and Verification

1. **Run the CI/CD Pipeline**:
2. Trigger the pipeline in Jenkins and observe the logs for each stage.
3. Ensure Docker images are built and pushed to DockerHub.
4. Verify Kubernetes deployments and services are correctly set up.
5. **Access Application and Monitoring Tools**:
6. Visit your application at the LoadBalancer's external IP.
7. Check Prometheus at `http://<EC2_PUBLIC_IP>:9090`.
8. Review your Grafana dashboards to ensure metrics are being collected and displayed.

Conclusion

Our CI/CD pipeline is now set up. This configuration allows us to automate your deployment process using Jenkins, Ansible and Docker, monitor your applications with Prometheus, and visualize performance with Grafana.