CI CD PROJECT

OBJECTIVE:

The primary objective of this project is to establish a robust CI/CD pipeline that automates the process of building, testing, and deploying applications by integrating Git, Jenkins, Maven, SonarQube, Docker Hub,Trivy, ArgoCD and Kubernetes (EKS) , the project aims to achieve the following goals:

1. **Continuous Integration (CI):**
    - Automate the process of code integration, ensuring that new code changes are seamlessly merged with the existing codebase.
    - Perform automated code quality checks and static analysis using SonarQube.
2. **Continuous Deployment (CD):**
    - Automate the deployment of applications to a Kubernetes cluster.
    - Utilize Docker for creating and managing containerized applications, facilitating consistent deployment environments across different stages (development, testing, and production).
    - Implement a streamlined workflow for updating deployment configurations and pushing them to a Git repository for version control.

SUMMARY:

This end-to-end Jenkins pipeline will automate the entire CI/CD process for a Java application, from code checkout to production deployment, using popular devops tools like Git, Jenkins, Maven, SonarQube, Docker Hub, ArgoCD and Kubernetes

This project covers setting up a CI/CD pipeline using.

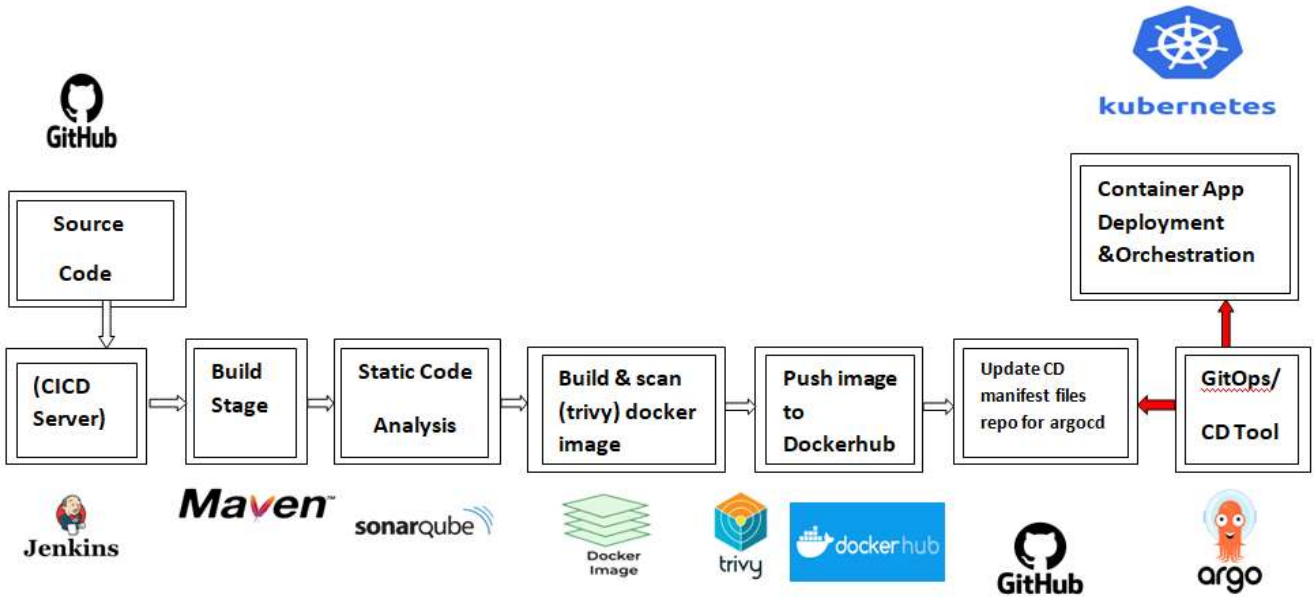
- Installing and configuring Jenkins on a Linux server.
- Setting up Docker, configuring Jenkins to use Docker, and handling permissions.
- Configuring AWS CLI, installing kubectl and eksctl.
- Creating an EKS cluster with eksctl.
- Installing necessary Jenkins plugins and setting up credentials.
- Creating a Jenkins pipeline to:
    - Checkout code from GitHub.
    - Perform a SonarQube scan.
    - Build the project using Maven.

- Build Docker Image using Docker file,scan the image using trivy and push Docker images to Docker Hub.
- Update deployment configurations and push them to a Git repository.
- Deploy the application to Kubernetes using ArgoCD.

Pre-requisites:

1. Java application code hosted on a Git repository
2. **Server Requirements:**
    - A Linux server for Jenkins , Docker, Sonarqube setup with an instance type **"t2.large"** and a EKS Cluster to deploy container application.
3. **Software Requirements**:
    - Jenkins
    - Docker
    - Maven
    - SonarQube
    - Kubernetes CLI (kubectl) , eksctl for managing EKS clusters
    - EKS Kubernetes cluster
    - Argo CD

FLOW CHART:



1. Jenkins Installation

First, install Jenkins on your Linux system:

```
sudo yum update -y

sudo wget -O /etc/yum.repos.d/jenkins.repo https://pkg.jenkins.io/redhat-stable/jenkins.repo

sudo rpm --import https://pkg.jenkins.io/redhat-stable/jenkins.io-2023.key

sudo yum upgrade -y

sudo dnf install java-17-amazon-corretto -y

sudo yum install jenkins -y

sudo systemctl enable jenkins

sudo systemctl start jenkins
```

2. Docker Installation and Configuration

Install Docker and configure it to work with Jenkins:

```
sudo yum install docker -y

sudo systemctl start docker

sudo usermod -aG docker jenkins

sudo usermod -aG docker ec2-user

sudo systemctl restart docker

sudo chmod 666 /var/run/docker.sock
```

3. AWS CLI Configuration

Configure AWS CLI to interact with AWS services:

```
aws configure

# Enter your AWS

Access Key ID, Secret Access Key, region, and output format when prompted
```

4. Kubectl and Eksctl Installation

Install **kubectl** and **eksctl** to manage Kubernetes clusters:

Kubectl doc: https://kubernetes.io/docs/tasks/tools/install-kubectl-linux/

Eksctl doc: https://docs.aws.amazon.com/emr/latest/EMR-on-EKS-DevelopmentGuide/setting-up-eksctl.html

```
# Install kubectl

curl -LO "https://dl.k8s.io/release/$(curl -L -s https://dl.k8s.io/release/stable.txt)/bin/linux/amd64/kubectl"

curl -LO "https://dl.k8s.io/release/$(curl -L -s https://dl.k8s.io/release/stable.txt)/bin/linux/amd64/kubectl.sha256"

echo "$(cat kubectl.sha256) kubectl" | sha256sum --check

sudo install -o root -g root -m 0755 kubectl /usr/local/bin/kubectl


# Install eksctl

curl --silent --location "https://github.com/weaveworks/eksctl/releases/latest/download/eksctl_$(uname -s)_amd64.tar.gz" | tar xz -C /tmp

sudo mv /tmp/eksctl /usr/local/bin
```

5. Create EKS Cluster

Create an EKS cluster using **eksctl**:

```
eksctl create cluster --name mcappcluster --nodegroup-name mcng --node-type t3.micro --nodes 8 --managed
```

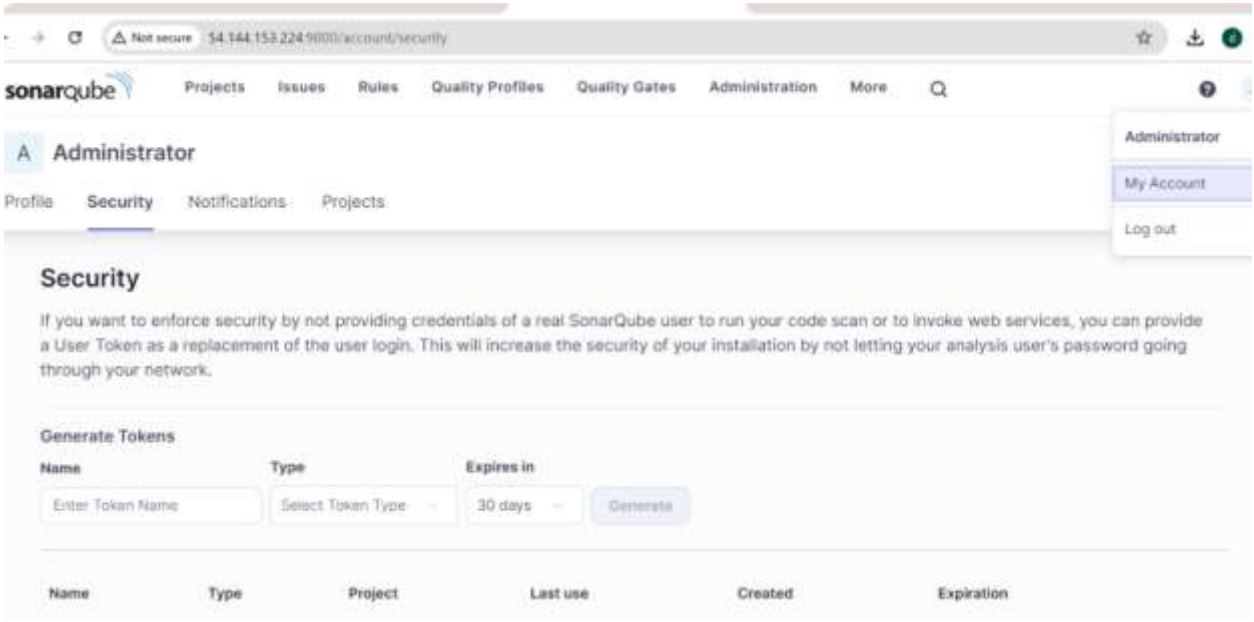
6. Install Required Jenkins Plugins

Install the Docker plugin in Jenkins:

1. Go to Jenkins Dashboard > Manage Jenkins > Manage Plugins > Available.
2. Install the Docker plugin,Pipeline stage view,blue ocean..etc

7. Install and configure Sonarqube as a Docker container

1. Docker run --itd --name sonar -p 9000:9000 sonarqube
2. Check if the SonarQube container is running:
   docker ps
3. Access the SonarQube web interface:
   - Open a web browser and go to http://<your-server-ip>:9000
   - The default login credentials are:
     1. **Username: admin**
     2. **Password: admin**
4. Log in to SonarQube using the default credentials.
   - Change the default password
5. Create Sonar token for Jenkins:
   Sonar Dashboard -> Administration -> MyAccount -> Security -> Create token



8. Generate GitHub Token

Generate a GitHub token for Jenkins to access your GIT repositories:

1. Go to GitHub > Settings > Developer settings > Personal access tokens.
2. Generate a new token with the necessary scopes (e.g., **repo**, **admin:repo_hook**).

9. Create Jenkinsfile for CI/CD Pipeline

Create a **Jenkinsfile** in your repository to define the CI/CD pipeline:

```
pipeline {
    agent any
   // Specify the maven installation to use for this pipeline.
   // 'maven3' refers to a Maven installation configured in Jenkins.

    tools {
        maven 'maven3'
    }

    stages {

        stage('Checkout') {
            steps {
                echo 'Cloning GIT HUB Repo'
                // Clone the specified branch from the GitHub repository
                git branch: 'main', url: 'https://github.com/devopstrainginghub/mindcircuit13.git'
            }
        }

        stage('SonarQube Scan') {
            steps {
                echo 'Scanning project'
                // List directory contents for debugging purposes
                sh 'ls -ltr'
                // Run SonarQube scan with specified SonarQube server and login token
                sh ''' mvn sonar:sonar \\
                    -Dsonar.host.url=http://100.26.227.191:9000 \\
                    -Dsonar.login=squ_19733ad4e43d54992ef61923b91447e2d17a3062'''
            }
        }

        stage('Build Artifact') {
            steps {
                echo 'Build Artifact'
                // Clean and package the project using Maven
                sh 'mvn clean package'
            }
        }

        stage('Build Docker Image') {
```

```
        steps {
            echo 'Build Docker Image'
            // Build the Docker image using the Dockerfile in the project
            // Tag the image with the current build number
            sh 'docker build -t devopshubg333/batch13:${BUILD_NUMBER} .'
        }
    }

    stage('Push to Docker Hub') {
        steps {
            script {
                // Use Dockerhub credentials to access Docker Hub
                withCredentials([string(credentialsId: 'dockerhub', variable: 'dockerhub')]) {
                    sh 'docker login -u devopshubg333 -p ${dockerhub}'
                }
                // Push the Docker image to Docker Hub
                sh 'docker push devopshubg333/batch13:${BUILD_NUMBER}'
                echo 'Pushed to Docker Hub'
            }
        }
    }

    stage('Update Deployment File') {
        environment {
            GIT_REPO_NAME = "mindcircuit13"
            GIT_USER_NAME = "devopstrainninghub"
        }
        steps {
            echo 'Update Deployment File'

            withCredentials([string(credentialsId: 'githubtocken', variable: 'githubtoken')]) {
                sh '''
                    # Configure git user
                    git config user.email "madhuxxxx123@gmail.com"
                    git config user.name "Madhu"
                    # Replace the tag in the deployment YAML file with the current build
number
                    sed -i "s/batch13:.*/batch13:${BUILD_NUMBER}/g"
deploymentfiles/deployment.yml
                    #Stage all changes
```

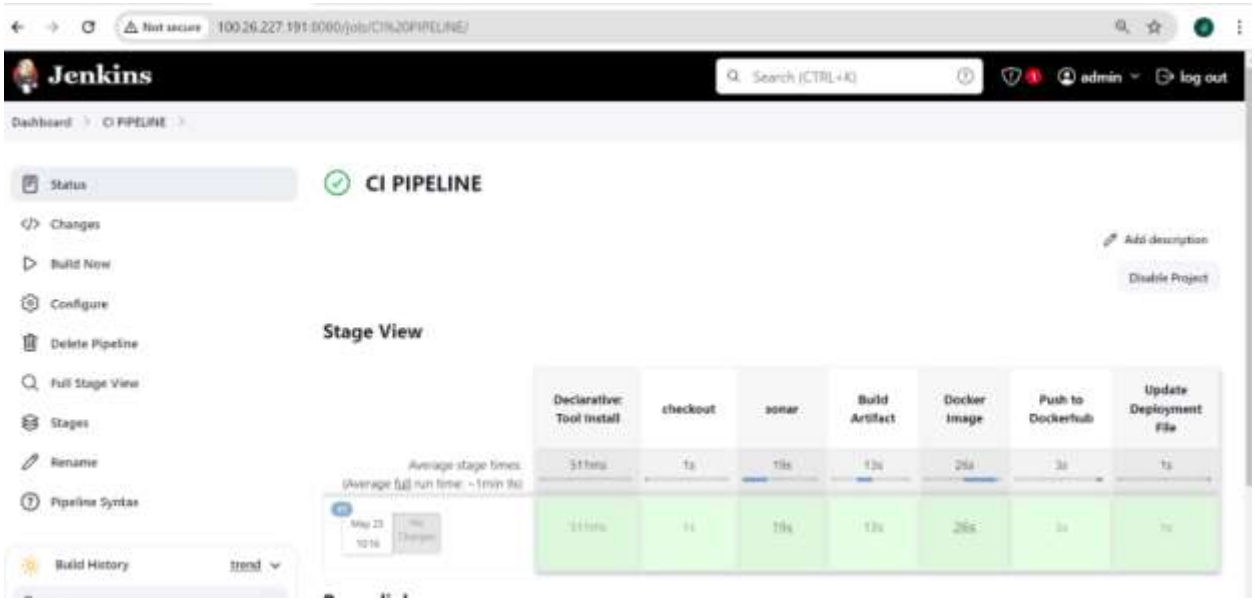
```
                git add .
                # Commit changes with a message containing the build number
                git commit -m "Update deployment image to version ${BUILD_NUMBER}"
                #Push changes to the main branch of the GitHub repository
                git push
https://${githubtoken}@github.com/${GIT_USER_NAME}/${GIT_REPO_NAME}
HEAD:main
            '''
          }
        }
      }

    }
}
```

Explanation of Each Stage

1. **Checkout**
    - Clones the **main** branch of the specified GitHub repository to the Jenkins workspace.
2. **SonarQube Scan**
    - Lists the directory contents to ensure files are in place.
    - Runs a SonarQube scan using Maven to analyze the code for bugs, vulnerabilities, and code smells. The scan results are sent to the specified SonarQube server.
3. **Build Artifact**
    - Cleans the workspace and packages the Maven project, creating a build artifact (typically a JAR or WAR file).
4. **Build Docker Image**
    - Builds a Docker image from the Dockerfile in the project directory.
    - Tags the Docker image with the Jenkins build number for versioning.
    - Trivy is an image scan on the specified image and fail the build if critical issues are found in image.
5. **Push to Docker Hub**
    - Logs into Docker Hub using credentials stored in Jenkins.

- Pushes the Docker image to the Docker Hub repository.

6. **Update Deployment File**
    - Configures git user details for committing changes.
    - Updates the deployment YAML file to use the newly created Docker image with the current build number.
    - Stages, commits, and pushes the updated deployment file back to the GitHub repository, ensuring the Kubernetes cluster can pull the latest image.



10. Kubernetes Deployment and Service Files

1. Installation of argocd:

```
kubectl create namespace argocd

kubectl apply -n argocd -f https://raw.githubusercontent.com/argoproj/argo-cd/stable/manifests/install.yaml
```

2. Edit the Argo CD server service to type **LoadBalancer**:

```
kubectl patch svc argocd-server -n argocd -p '{"spec": {"type": "LoadBalancer"}}'

kubectl get svc argocd-server -n argocd

kubectl -n argocd get secret argocd-initial-admin-secret -o jsonpath="{.data.password}" | base64 -d ; echo
```

Create **deployment.yaml** and **service.yaml** in your repository to define the Kubernetes resources:

deployment.yml:

```
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: mc-app
  labels:
    app: mc-app
spec:
  replicas: 2
  selector:
    matchLabels:
      app: mc-app
  template:
    metadata:
      labels:
        app: mc-app
    spec:
      containers:
      - name: mc-app
        image: devopshubg333/batch13:tag
        ports:
        - containerPort: 8080
```

service.yml:

```
apiVersion: v1
kind: Service
metadata:
  name: mc-app-service
spec:
  type: LoadBalancer
  ports:
  - name: http
    port: 80
    targetPort: 8080
    protocol: TCP
```

```
selector:
  app: mc-app
```

11. ArgoCD Application Configuration

1. **Open the Argo CD UI**:

- Access the Argo CD UI using the **EXTERNAL-IP** (for LoadBalancer)
- Log in with the username **admin** and the password retrieved in the previous step.

2. Create and Sync an Application

- Once logged in, click the **+ New App** button at the top of the Argo CD dashboard.
- Fill out the application details in the "General" section:
- **Application Name**: **my-app** (or your preferred name)
- **Project**: **default**
- **Sync Policy**: Leave as Manual for now (you can change it to Automatic later if desired)

- **Fill out the "Source" section:**
  - **Repository URL**: Enter the URL of the Git repository containing your application manifests. For example, **https://github.com/devopstraininghub/mindcircuit13.git**.
  - **Revision**: Leave as **HEAD** or specify a branch/tag if needed.
  - **Path**: Enter the path within the repository where the Kubernetes manifests are located. For example, **deploymentfiles**.
- **Fill out the "Destination" section:**
  - **Cluster URL**: Leave as **https://kubernetes.default.svc** (this targets the current cluster).
  - **Namespace**: Specify the namespace where you want the application to be deployed. For example, **default**.
  - Click the **Create** button at the bottom of the page.

5. Sync the Application

- After the application is created, it will appear in the Argo CD dashboard with a status of **OutOfSync**.

- To sync the application, click on the application name (**my-app**).
- Click the **Sync** button at the top right of the application details page.
- In the sync dialog, review the resources to be synchronized and click **Synchronize** to start the sync process.
- The status will change to **Healthy** once the sync is complete and the application is successfully deployed.