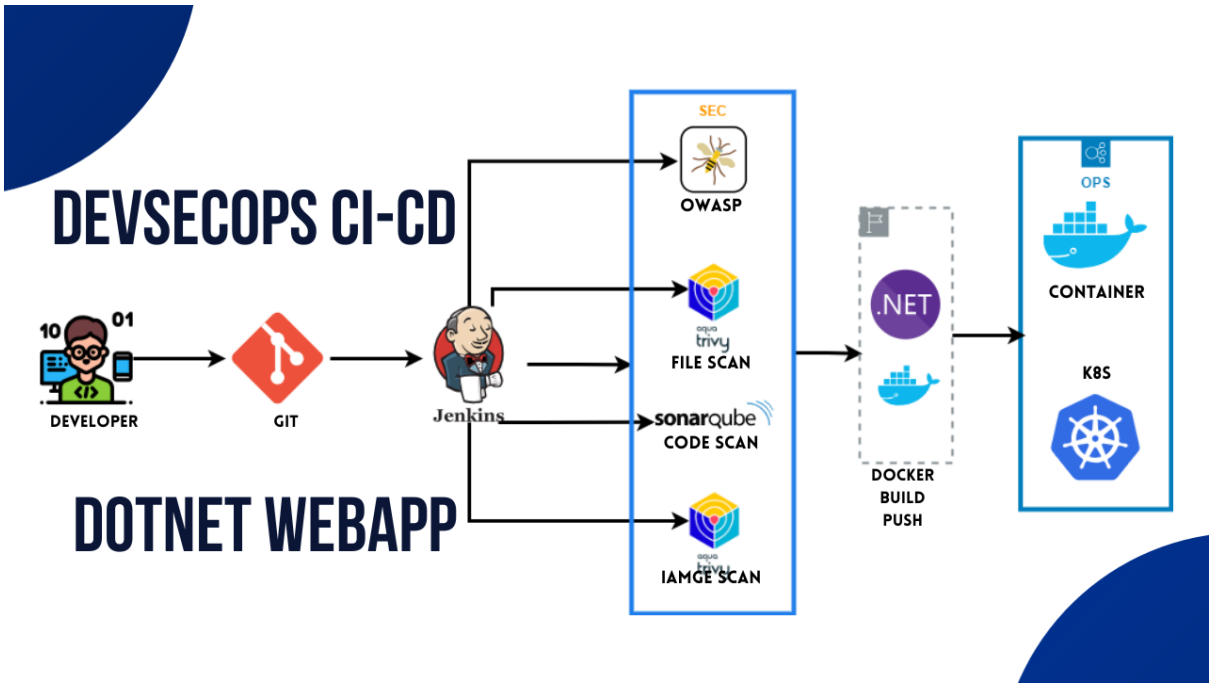
Jenkins CI/CD | DOTNET webapp DevSecOps Project



Hello friends, we will be deploying a .Net-based application. This is an everyday use case scenario used by several organizations. We will be using Jenkins as a CICD tool and deploying our application on a Docker Container and Kubernetes cluster. Hope this detailed blog is useful.

Github: https://github.com/Aj7Ay/DotNet-monitoring.git

Steps:-

Step 1 — Create an Ubuntu T2 Large Instance

Step 2 — Install Jenkins, Docker and Trivy. Create a Sonarqube Container using Docker.

Step 3 — Install Plugins like JDK, Sonarqube Scanner, OWASP Dependency Check,

Step 4 — Create a Pipeline Project in Jenkins using a Declarative Pipeline

Step 5 — Configure Sonar Server in Manage Jenkins

Step 6 — we have to install and make the package

Step 7 — Docker Image Build and Push

Step 8 — Deploy the image using Docker

Step 9 — Access the Real World Application

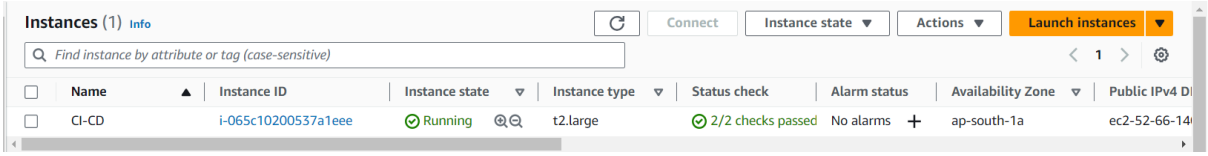
Step 10 — Kubernetes setup

Step 11 — Terminate the AWS EC2 Instance

Now, let's get started and dig deeper into each of these steps:-

Step 1 — Launch an AWS T2 Large Instance.

Use the image as Ubuntu. You can create a new key pair or use an existing one. Enable HTTP and HTTPS settings in the Security Group.



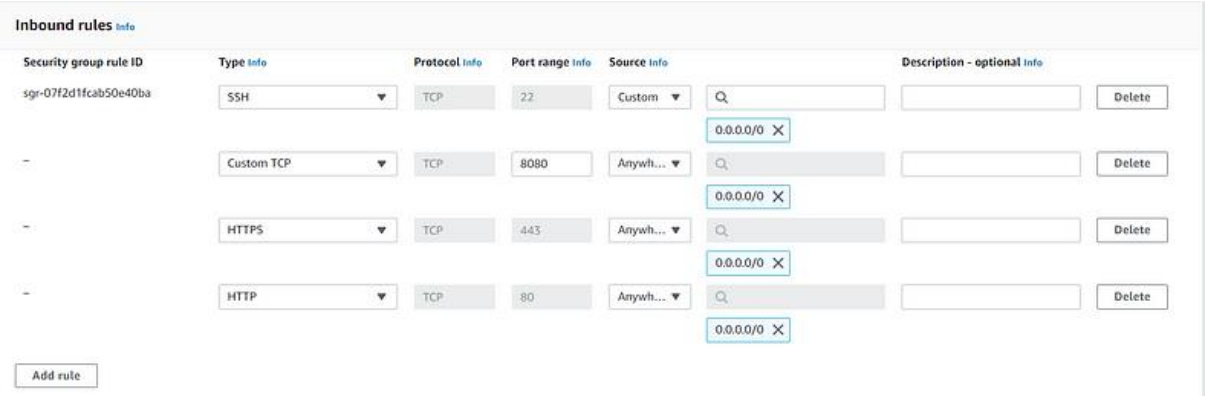
Step 2 — Install Jenkins, Docker and Trivy

2A — To Install Jenkins

Connect to your console, and enter these commands to Install Jenkins

```
sudo vi jenkins.sh

#enter the below code

#!/bin/bash

sudo apt update -y

#sudo apt upgrade -y

wget -O - https://packages.adoptium.net/artifactory/api/gpg/key/public | tee
/etc/apt/keyrings/adoptium.asc

echo "deb [signed-by=/etc/apt/keyrings/adoptium.asc]
https://packages.adoptium.net/artifactory/deb $(awk -F= '/^VERSION_CODENAME/{print$2}'
/etc/os-release) main" | tee /etc/apt/sources.list.d/adoptium.list

sudo apt update -y

sudo apt install temurin-17-jdk -y

/usr/bin/java --version

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

sudo apt-get update -y

sudo apt-get install jenkins -y

sudo systemctl start jenkins

sudo systemctl status jenkins

sudo chmod 777 jenkins.sh

./jenkins.sh
```

Once Jenkins is installed, you will need to go to your AWS EC2 Security Group and open Inbound Port 8080, since Jenkins works on Port 8080.

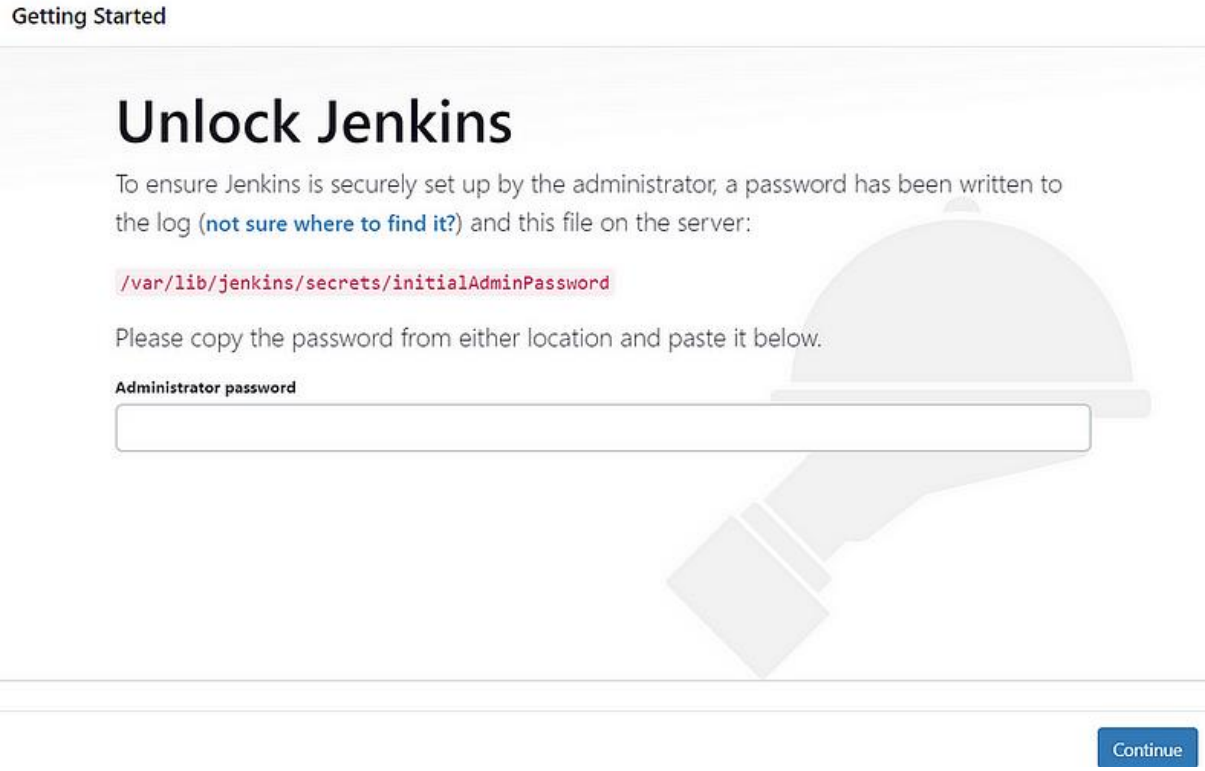


Now, grab your Public IP Address

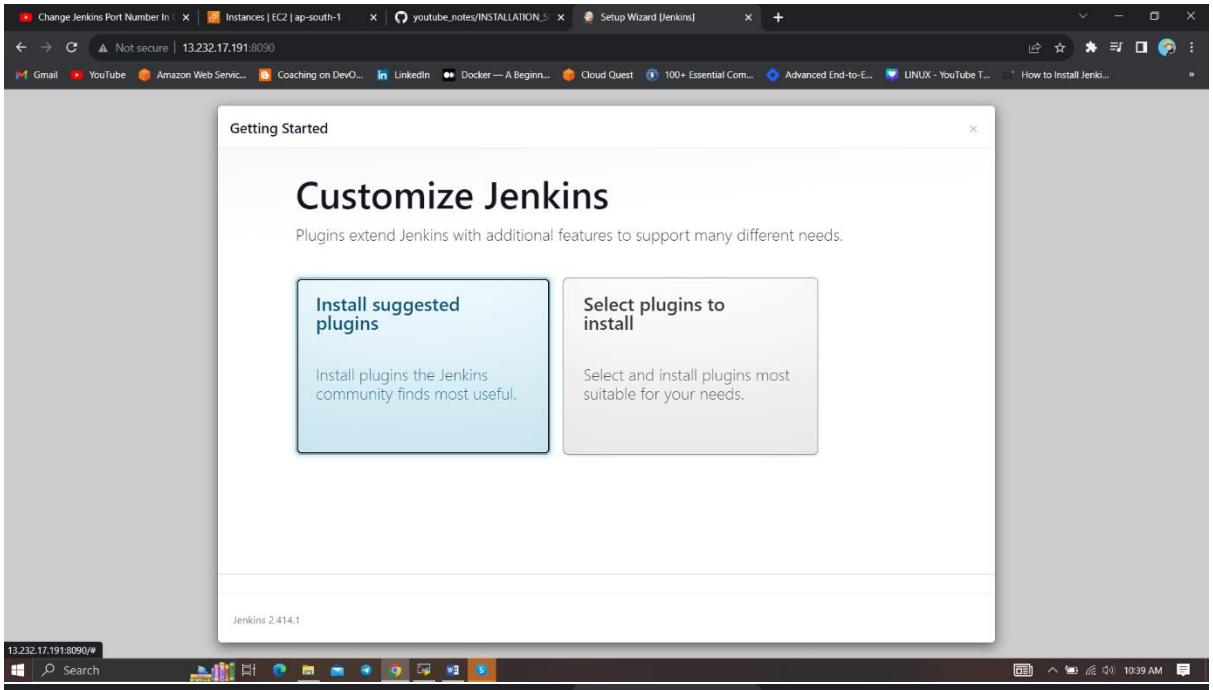
EC2 Public IP Address:8080

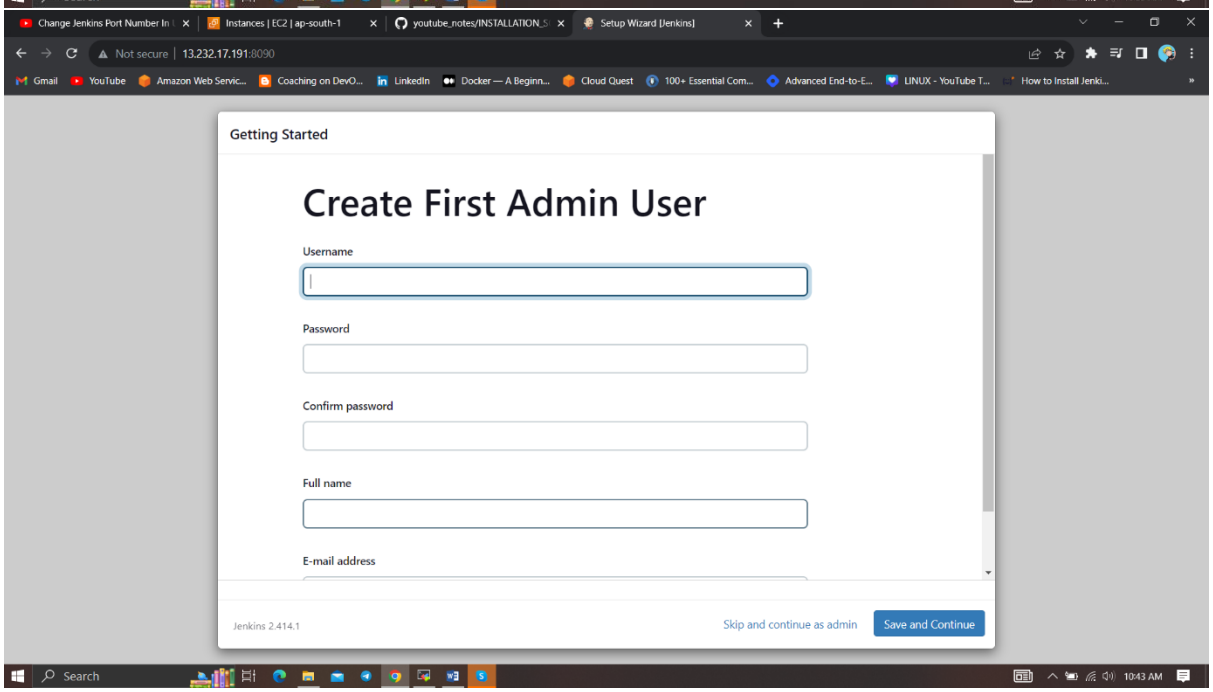
sudo cat /var/lib/jenkins/secrets/initialAdminPassword

Unlock Jenkins using an administrative password and install the required plugins.

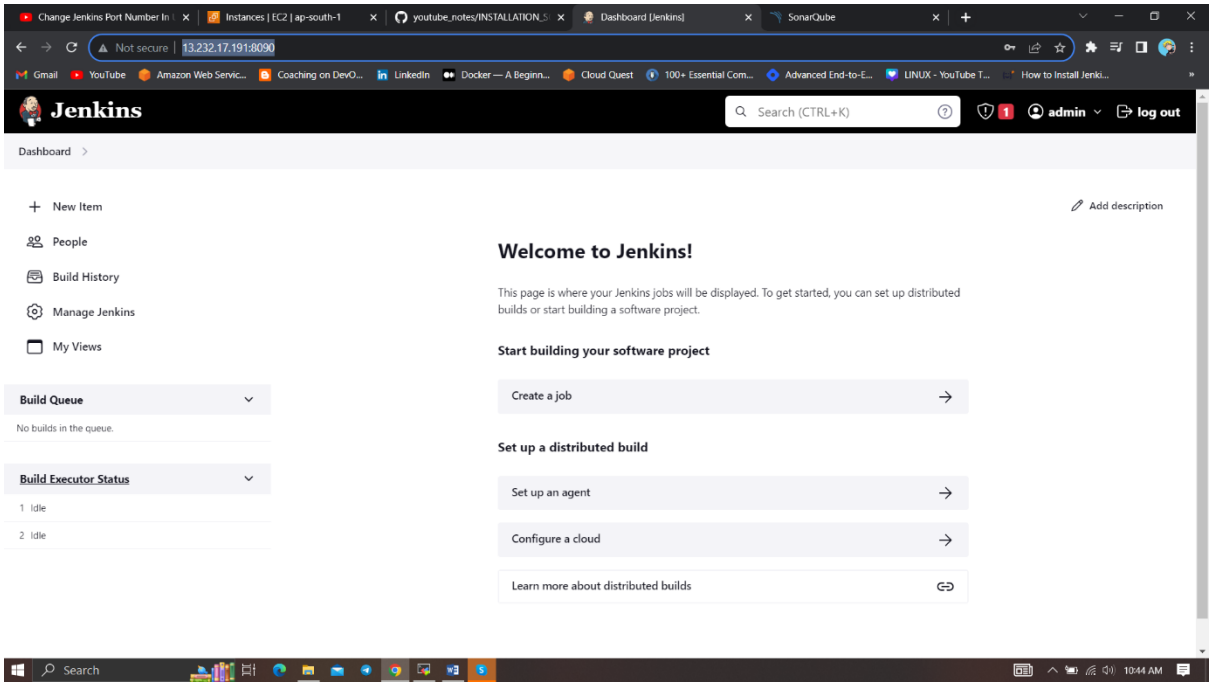


Jenkins will now get installed and install all the libraries.





Jenkins Getting Started Screen



2B — Install Docker

sudo apt-get update

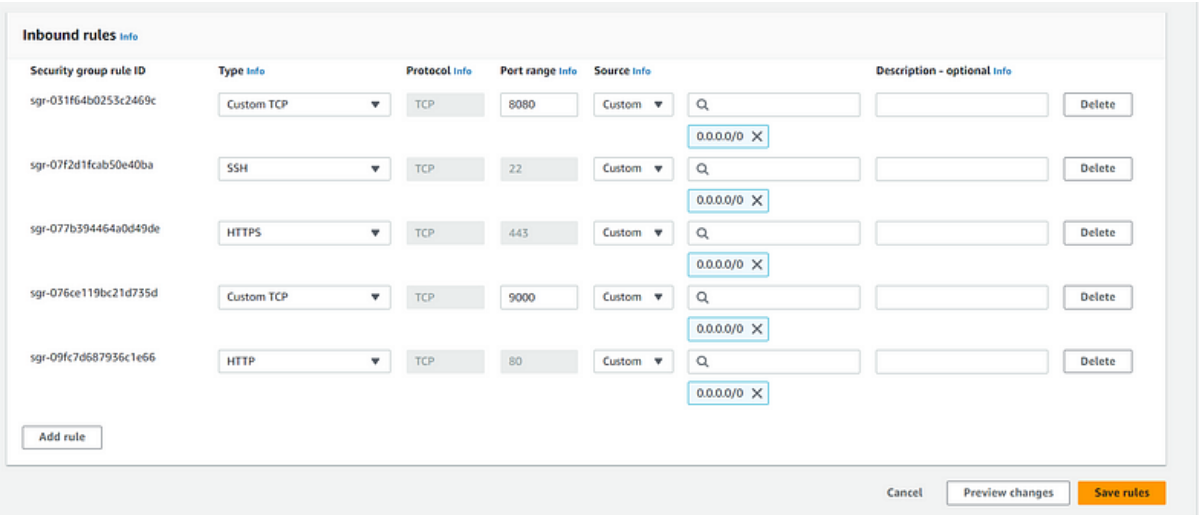
sudo apt-get install docker.io -y

sudo usermod -aG docker $USER

sudo chmod 777 /var/run/docker.sock

sudo docker ps

After the docker installation, we create a sonarqube container (Remember added 9000 port in the security group)



docker run -d --name sonar -p 9000:9000 sonarqube:lts-community

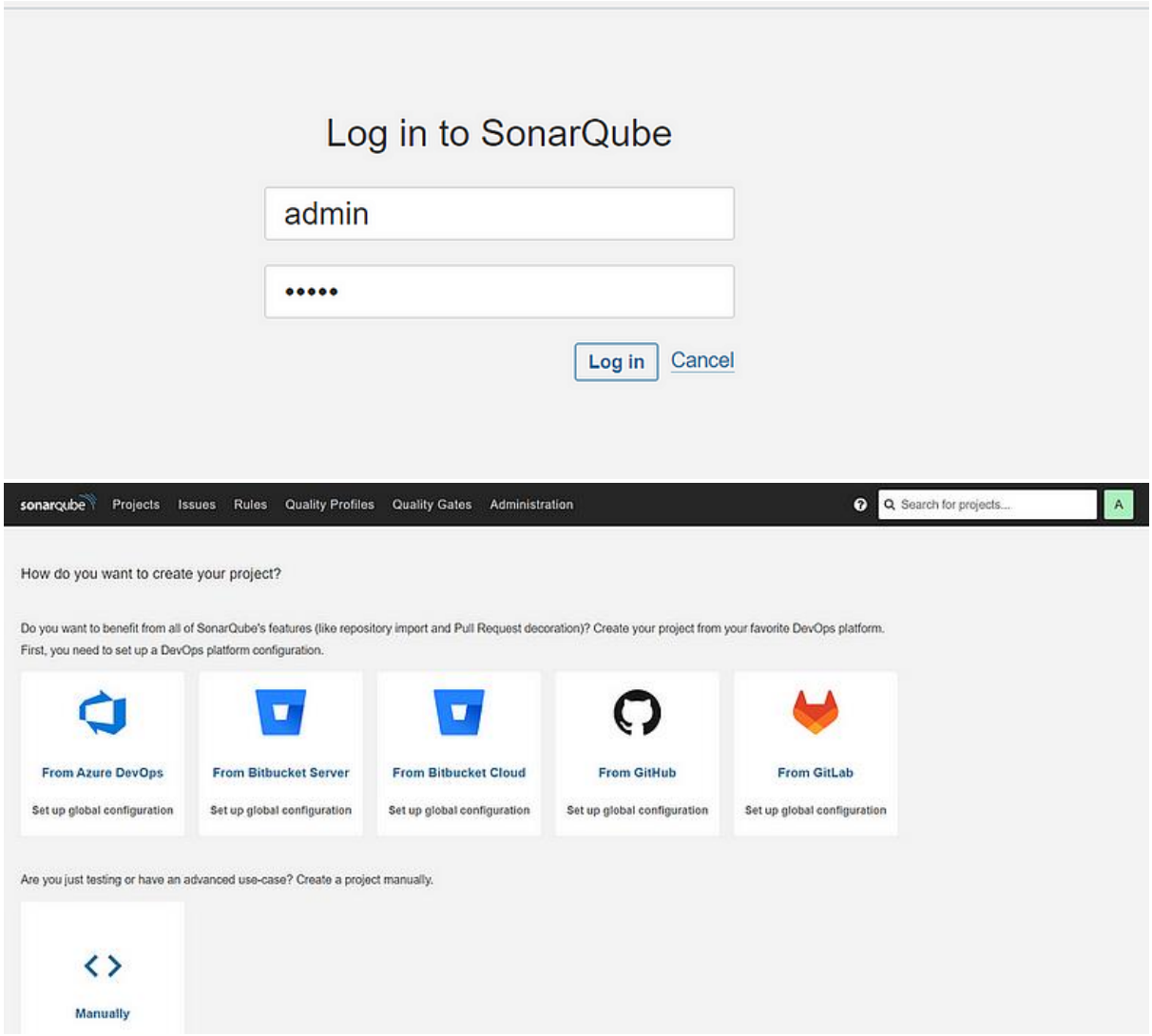
```
ubuntu@ip-172-31-42-253:~$ sudo chmod 777 /var/run/docker.sock
ubuntu@ip-172-31-42-253:~$ docker run -d --name sonar -p 9000:9000 sonarqube:lts-community
Unable to find image 'sonarqube:lts-community' locally
lts-community: Pulling from library/sonarqube
44ba2882f8eb: Pull complete
2cabec57fa36: Pull complete
c20481384b6a: Pull complete
bf7b17ee74f8: Pull complete
38617faac714: Pull complete
706f20f58f5e: Pull complete
65a29568c257: Pull complete
Digest: sha256:1a118f8ab960d6c3d4ea8b4455a5a6560654511c88a6816f1603f764d5dcc77c
Status: Downloaded newer image for sonarqube:lts-community
4b60c96bf9ad3d62289436af7f752fdb04993092d0ca3065e2f2e32301b50139
ubuntu@ip-172-31-42-253:~$ docker ps
CONTAINER ID   IMAGE                    COMMAND                  CREATED         STATUS         PORTS                                          NAMES
4b60c96bf9ad   sonarqube:lts-community  "/opt/sonarqube/dock…"   9 seconds ago   Up 5 seconds   0.0.0.0:9000->9000/tcp, :::9000->9000/tcp   sonar
ubuntu@ip-172-31-42-253:~$
```

Now our sonarqube is up and running

Enter username and password, click on login and change password

username admin

password admin



2C — Install Trivy

sudo apt-get install wget apt-transport-https gnupg lsb-release -y

wget -qO - https://aquasecurity.github.io/trivy-repo/deb/public.key | gpg --dearmor | sudo tee /usr/share/keyrings/trivy.gpg > /dev/null

echo "deb [signed-by=/usr/share/keyrings/trivy.gpg] https://aquasecurity.github.io/trivy-repo/deb $(lsb_release -sc) main" | sudo tee -a /etc/apt/sources.list.d/trivy.list

sudo apt-get update

sudo apt-get install trivy -y

Next, we will log in to Jenkins and start to configure our Pipeline in Jenkins

Step 3 — Install Plugins like JDK, Sonarqube Scanner, OWASP Dependency Check, Docker.

3A — Install Plugin

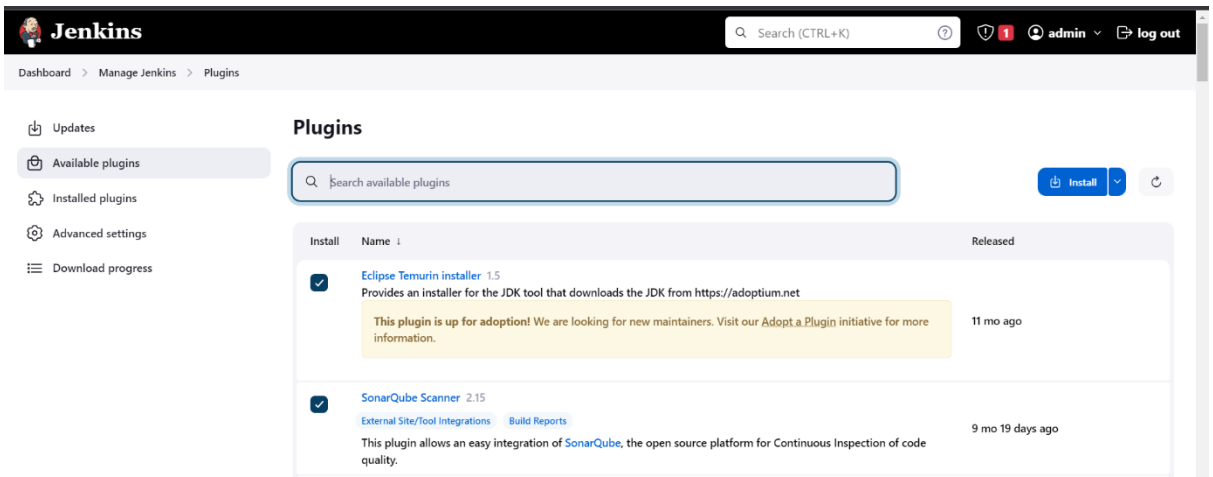
Goto Manage Jenkins →Plugins → Available Plugins →

Install below plugins

1 → Install OWASP ((Install without restart)

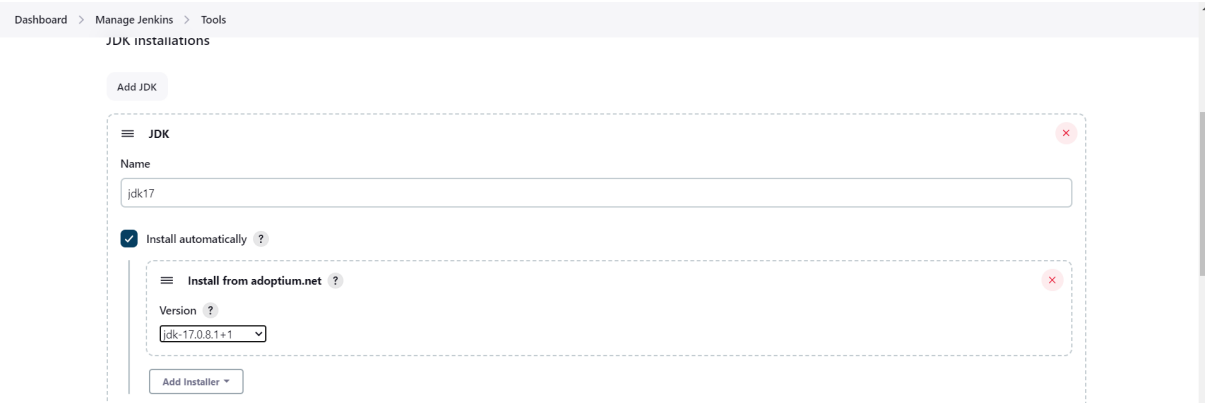
2 → SonarQube Scanner (Install without restart)

3 → 1 → Eclipse Temurin Installer (Install without restart)



3B — Configure Java and Maven in Global Tool Configuration

Goto Manage Jenkins → Tools → Install JDK Click on Apply and Save

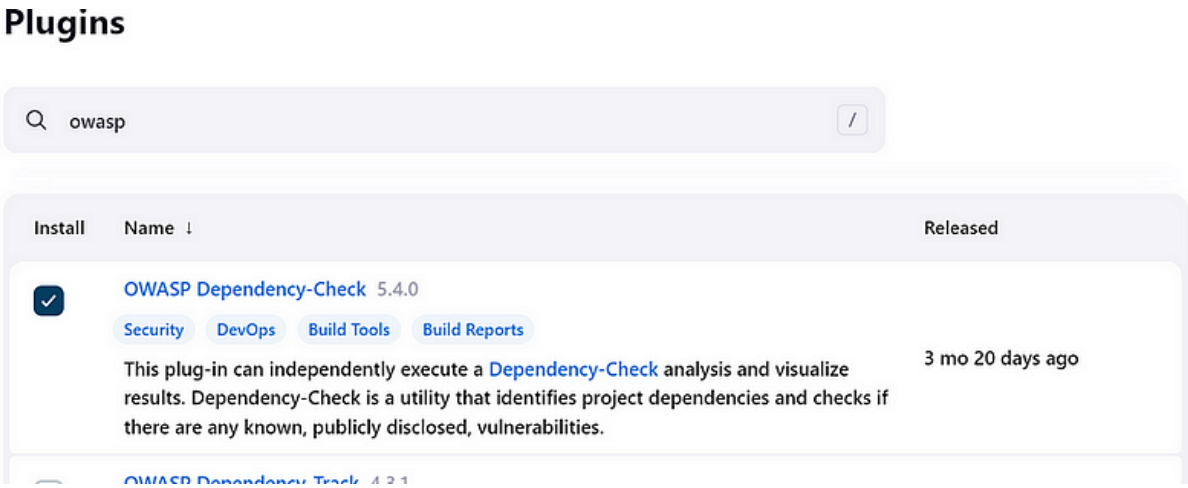


3C — Create a Job

Label it as Dotnet CI-CD, click on Pipeline and OK.

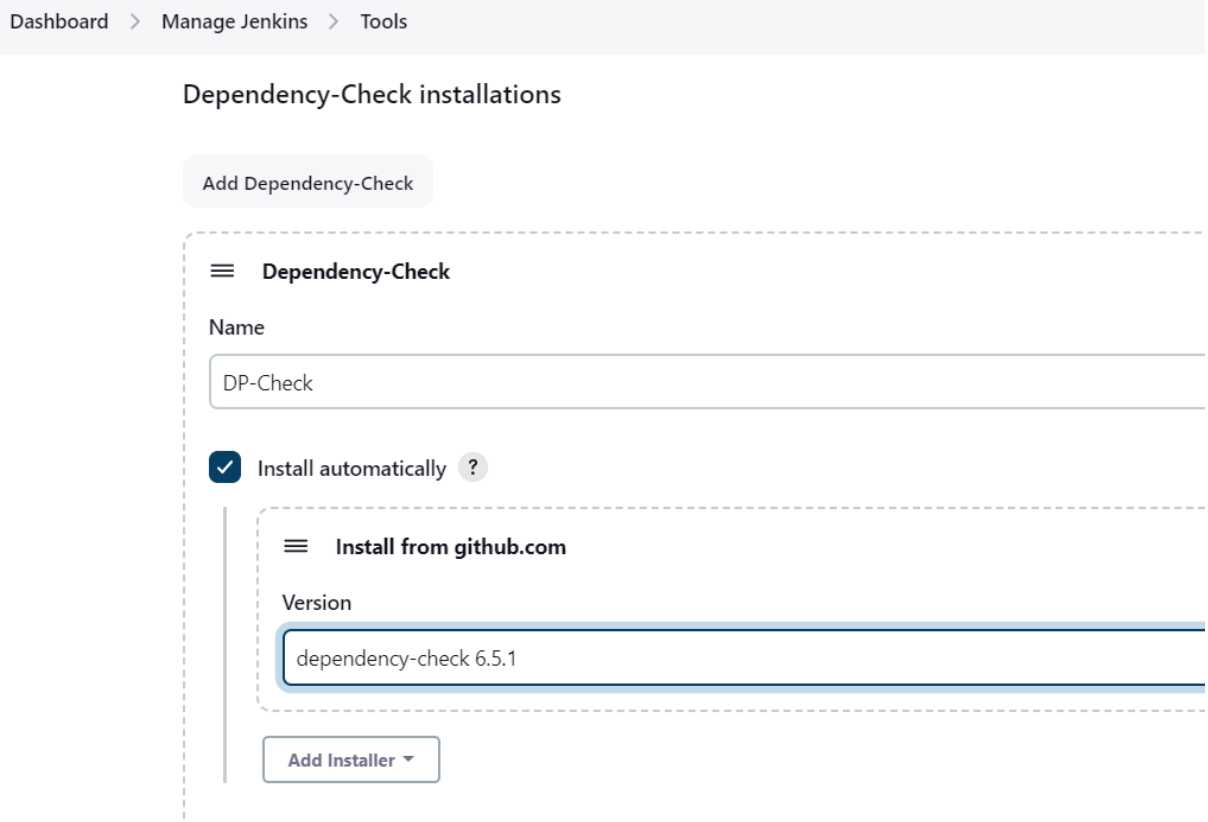
Step 4 — Install OWASP Dependency Check Plugins

GotoDashboard → Manage Jenkins → Plugins → OWASP Dependency-Check. Click on it and install it without restart.



First, we configured the Plugin and next, we had to configure the Tool

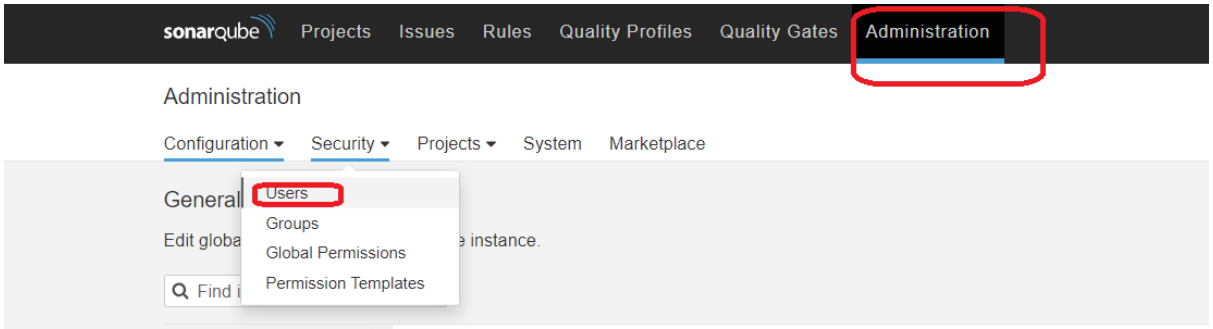
Goto Dashboard → Manage Jenkins → Tools →



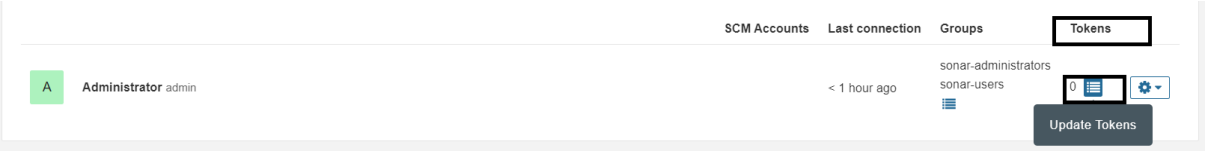
Click on Apply and Save here.

Step 5 — Configure Sonar Server in Manage Jenkins

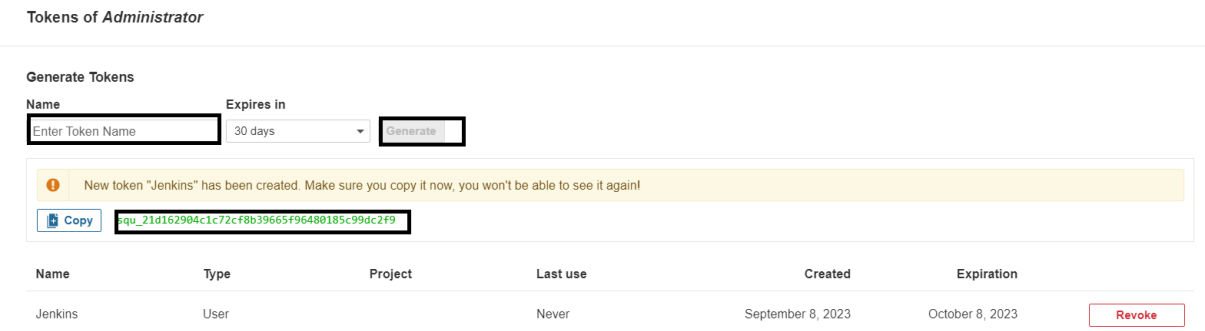
Grab the Public IP Address of your EC2 Instance, Sonarqube works on Port 9000, sp <Public IP>:9000. Goto your Sonarqube Server. Click on Administration → Security → Users → Click on Tokens and Update Token → Give it a name → and click on Generate Token



Click on Update Token

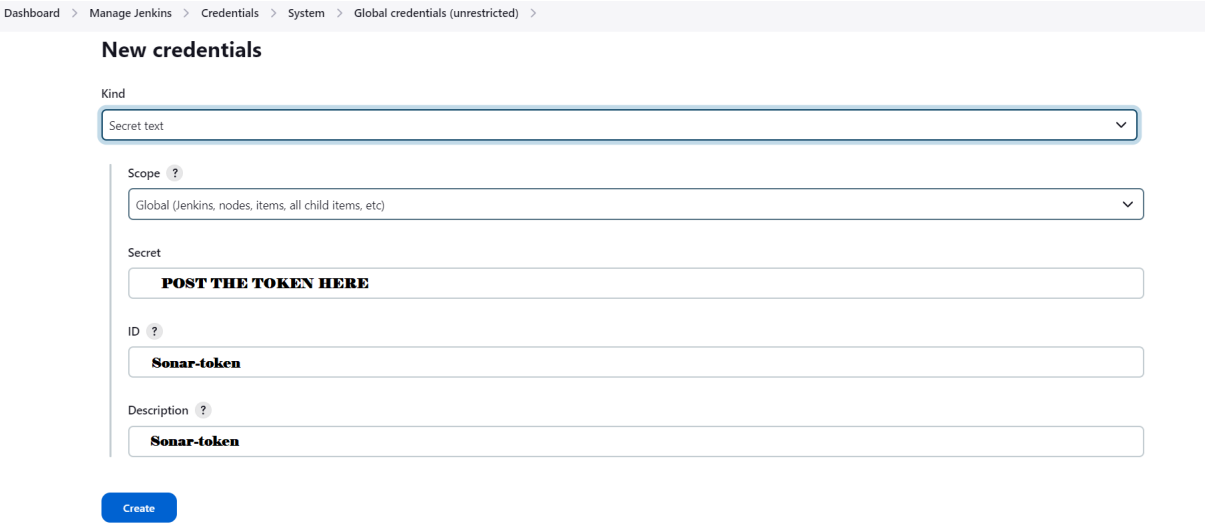


Create a token with a name and generate

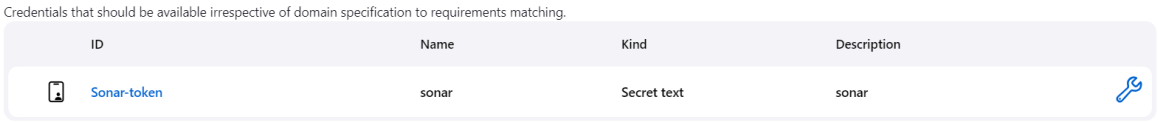


Copy this Token

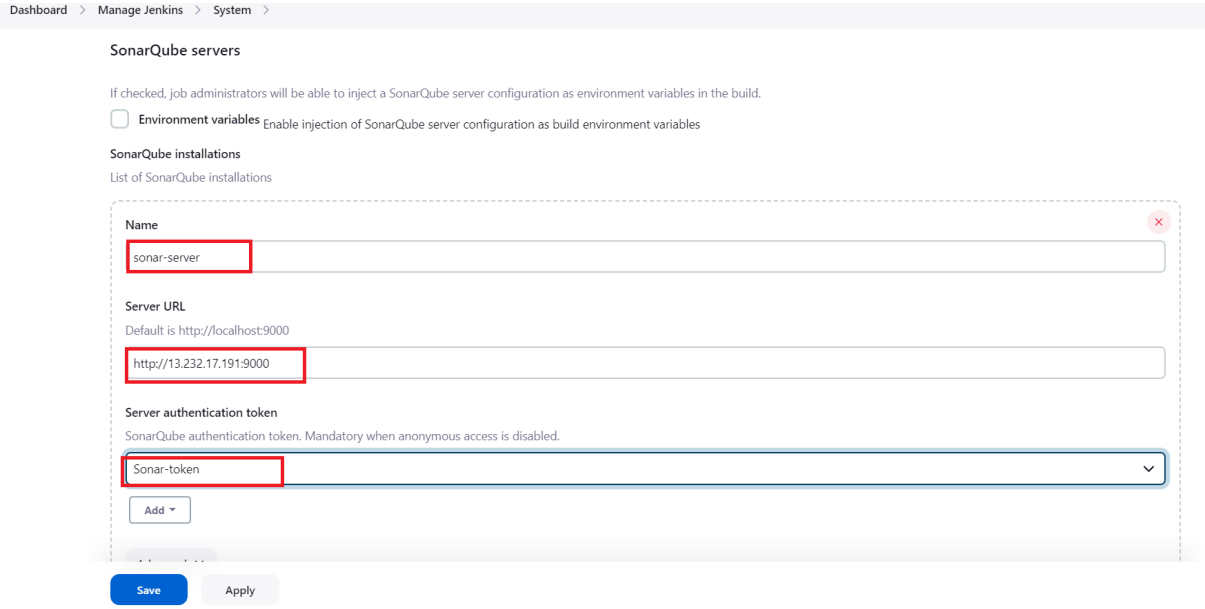
Goto Dashboard → Manage Jenkins → Credentials → Add Secret Text. It should look like this



You will this page once you click on create



Now, go to Dashboard → Manage Jenkins → Configure System

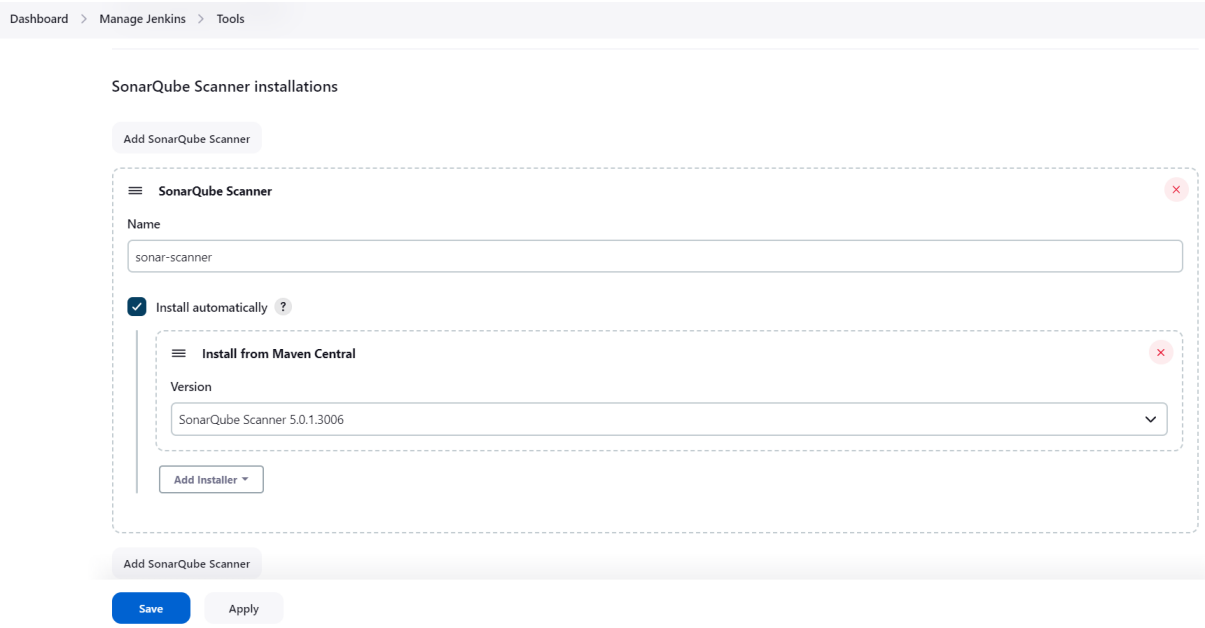


Click on Apply and Save

The Configure System option is used in Jenkins to configure different server

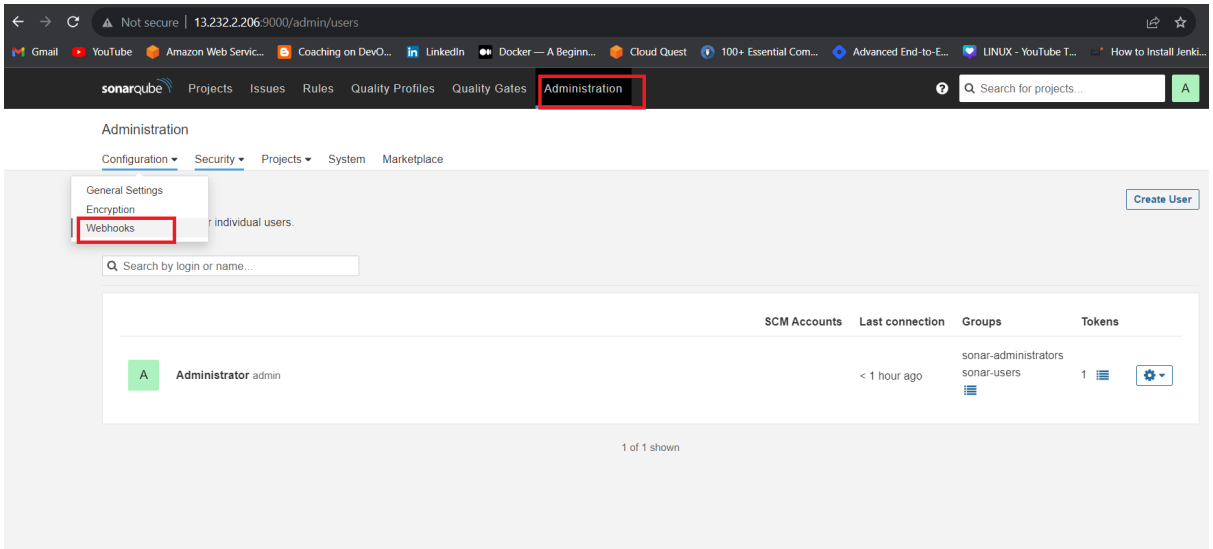
Global Tool Configuration is used to configure different tools that we install using Plugins

We will install a sonar scanner in the tools.

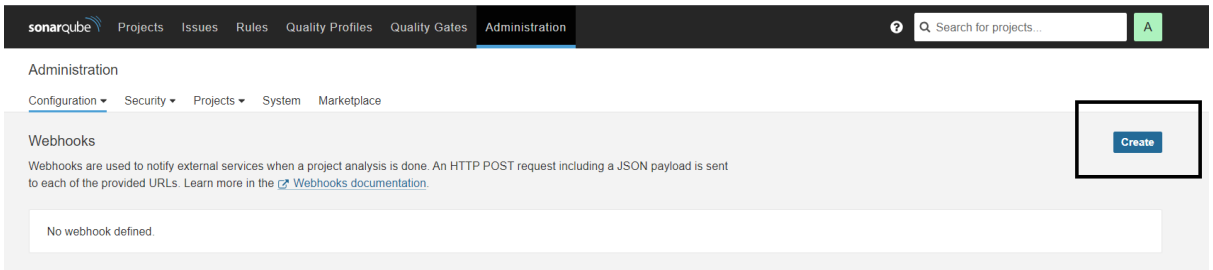


In the Sonarqube Dashboard add a quality gate also

Administration–> Configuration–>Webhooks



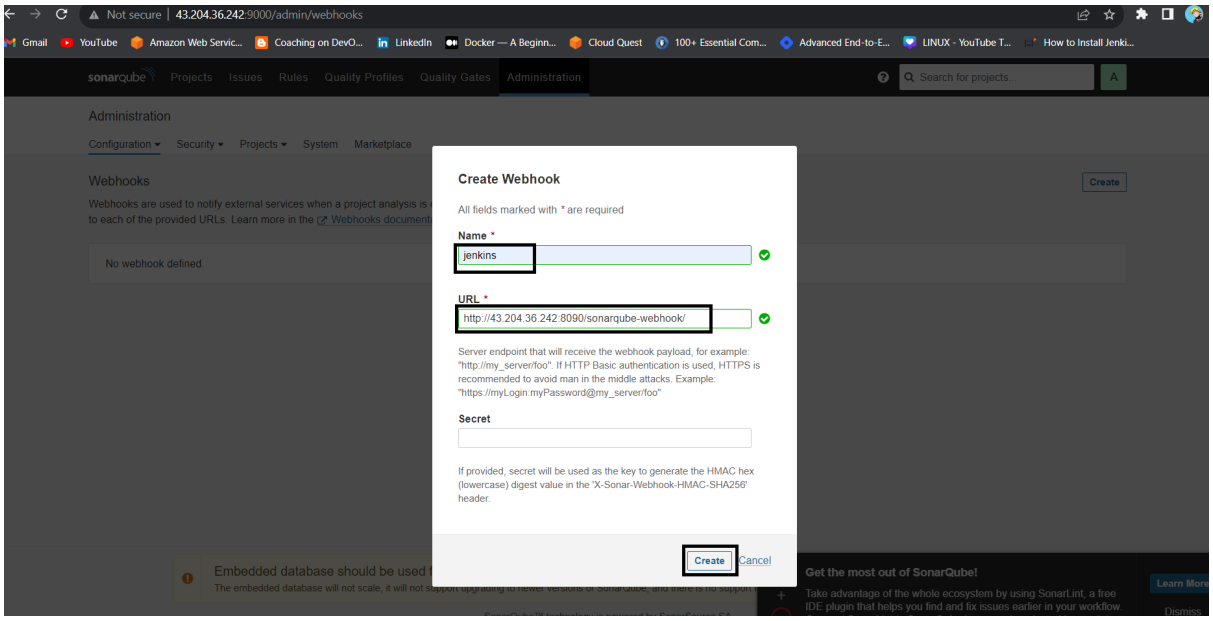
Click on Create



Add details

#in url section of quality gate

http://jenkins-public-ip:8080/sonarqube-webhook/



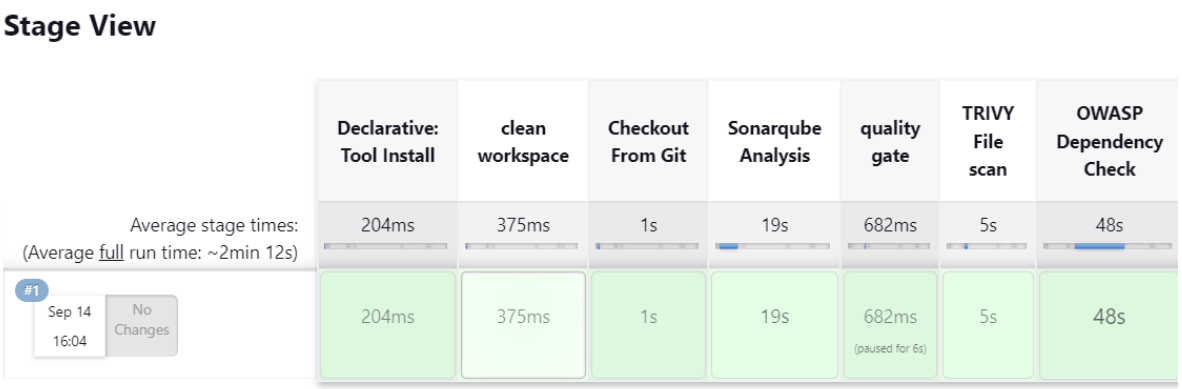
Let’s go to our Pipeline and add the below code Pipeline Script.

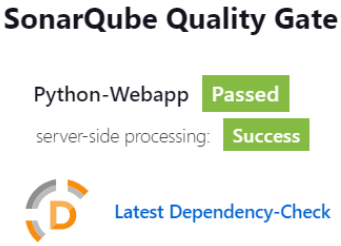
pipeline{

```
agent any
tools{
   jdk 'jdk17'
}
environment {
   SCANNER_HOME=tool 'sonar-scanner'
}
stages {
   stage('clean workspace'){
      steps{
         cleanWs()
      }
   }
   stage('Checkout From Git'){
      steps{
         git branch: 'main', url: 'https://github.com/Aj7Ay/DotNet-monitoring.git'
      }
   }
   stage("Sonarqube Analysis "){
      steps{
         withSonarQubeEnv('sonar-server') {
            sh ''' $SCANNER_HOME/bin/sonar-scanner -Dsonar.projectName=Dotnet-Webapp \
            -Dsonar.projectKey=Dotnet-Webapp '''
         }
      }
   }
   stage("quality gate"){
     steps {
         script {
            waitForQualityGate abortPipeline: false, credentialsId: 'Sonar-token'
         }
```

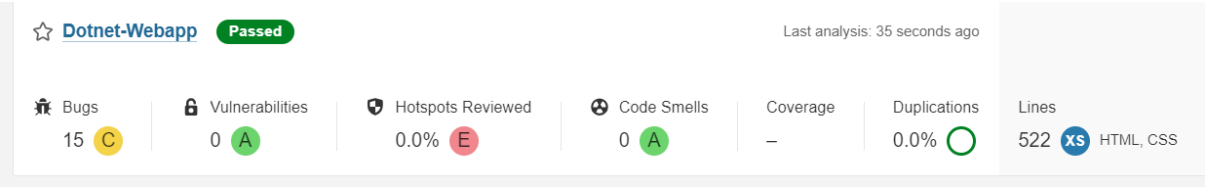
```
        }
    }
    stage("TRIVY File scan"){
        steps{
            sh "trivy fs . > trivy-fs_report.txt"
        }
    }
    stage("OWASP Dependency Check"){
        steps{
            dependencyCheck additionalArguments: '--scan ./ --format XML ', odcInstallation: 'DP-Check'
            dependencyCheckPublisher pattern: '**/dependency-check-report.xml'
        }
    }
```

Click on Build now, you will see the stage view like this





To see the report, you can go to Sonarqube Server and go to Projects.



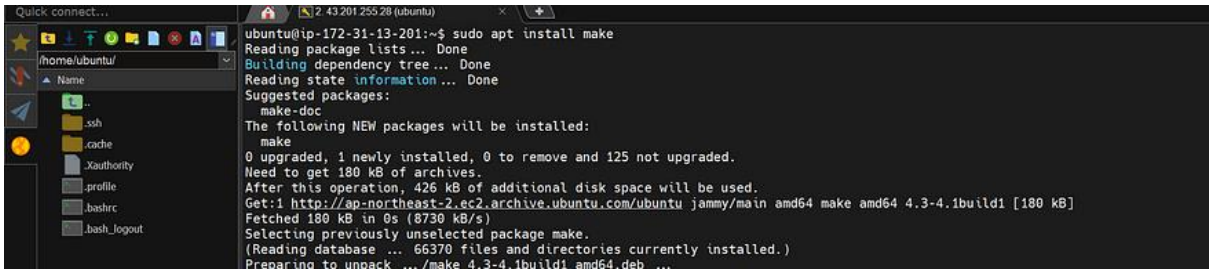
You can see the report has been generated and the status shows as passed. You can see that there are 522 lines. To see a detailed report, you can go to issues.

Step 6 — we have to install make package

sudo apt install make

to check version install or not

make -v

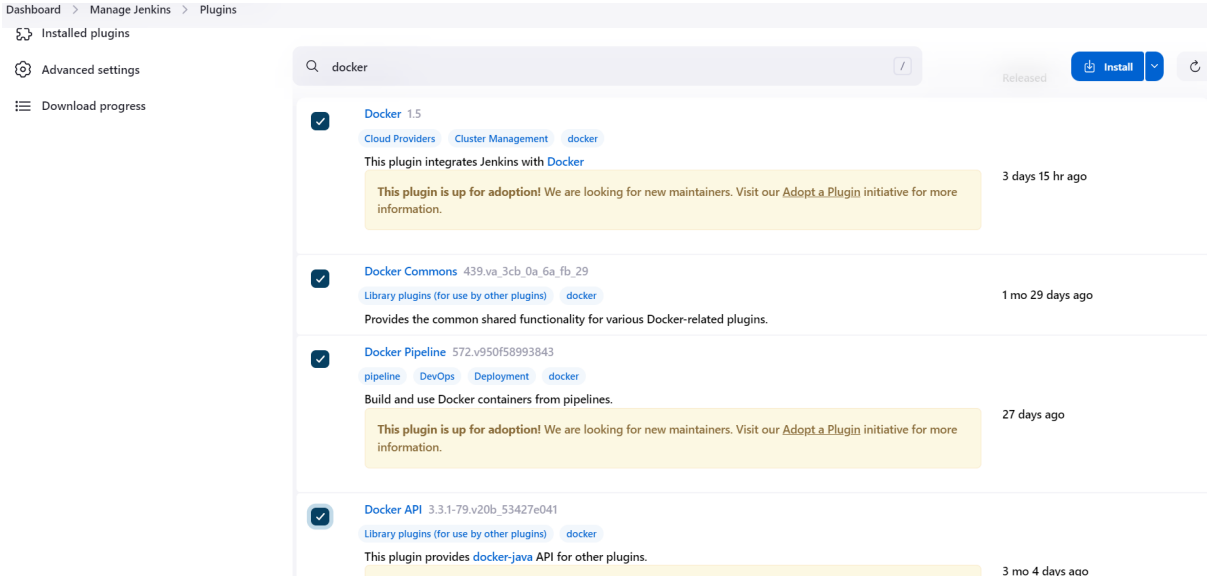


Step 7 — Docker Image Build and Push

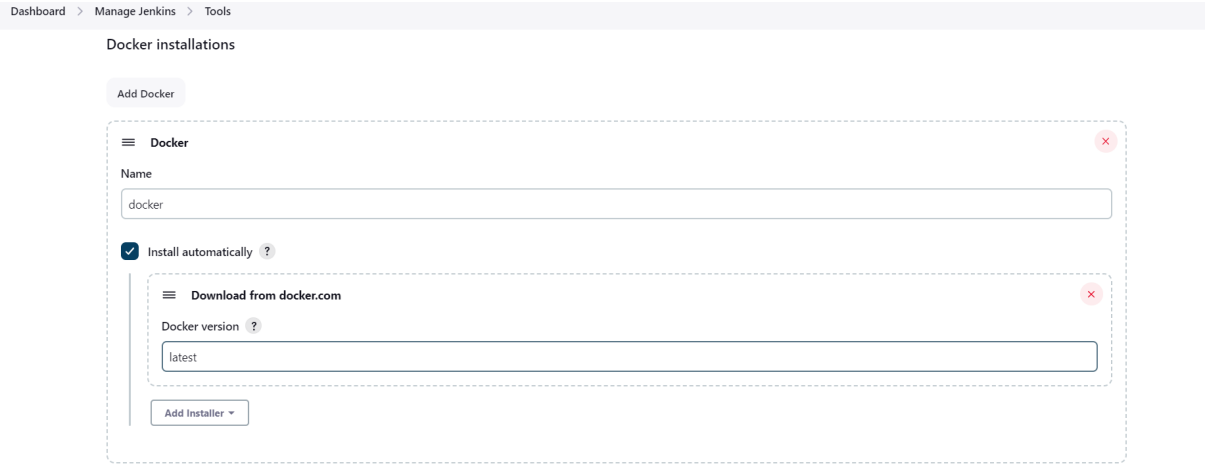
We need to install the Docker tool in our system, Goto Dashboard → Manage Plugins → Available plugins → Search for Docker and install these plugins

- Docker
- Docker Commons
- Docker Pipeline
- Docker API
- docker-build-step

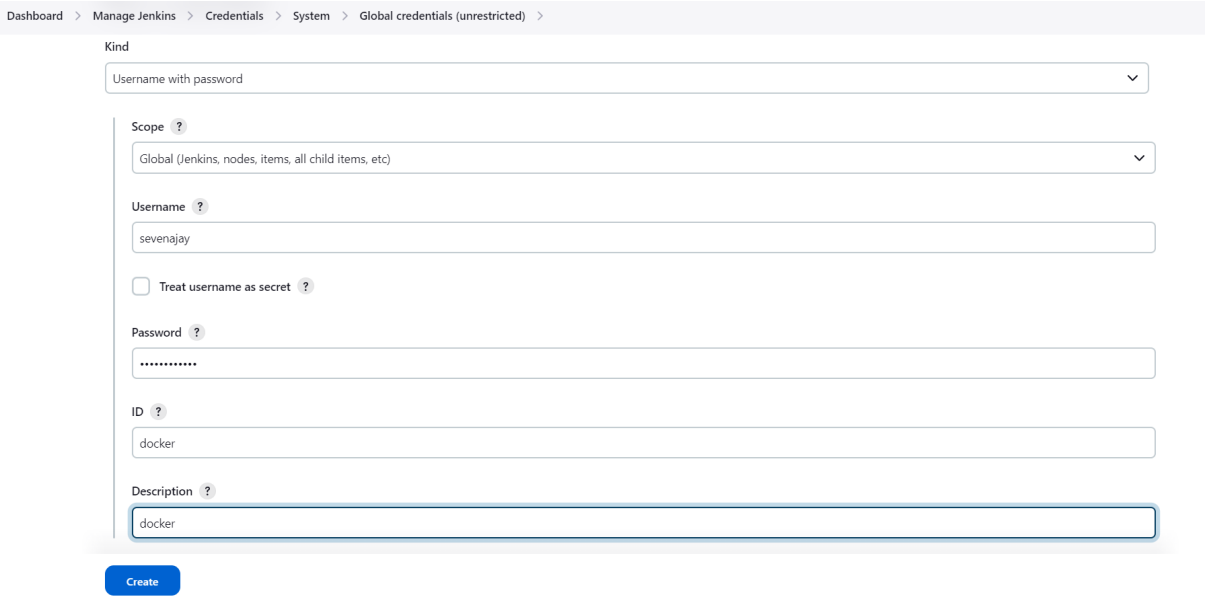
and click on install without restart



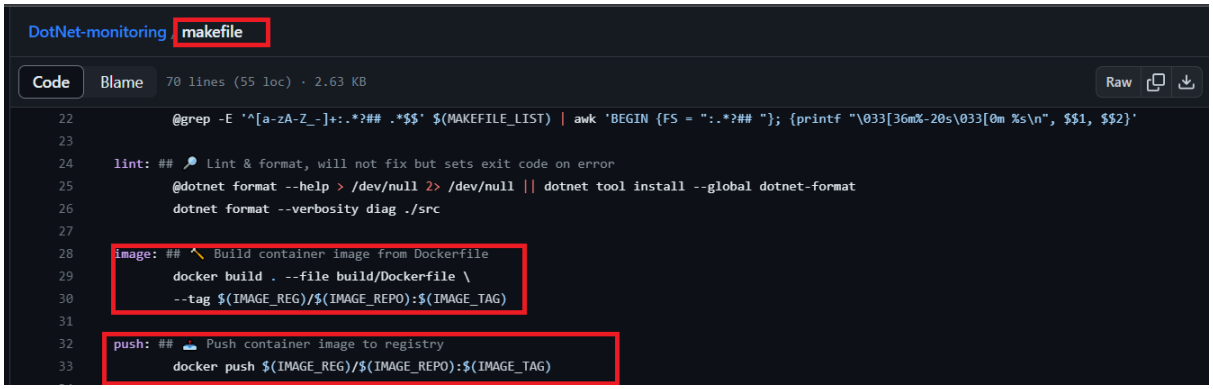
Now, goto Dashboard → Manage Jenkins → Tools →



Add DockerHub Username and Password under Global Credentials



In the makefile, we already defined some conditions to build, tag and push images to dockerhub.



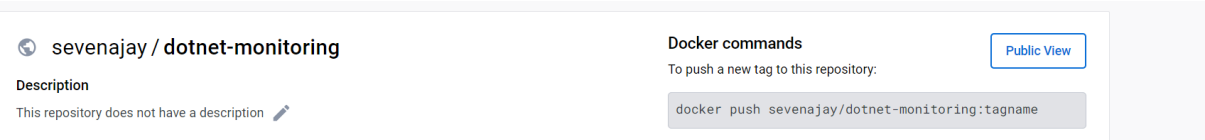
that’s why we are using make image and make a push in the place of docker build -t and docker push

Add this stage to Pipeline Script

```
stage("Docker Build & tag"){
        steps{
```

```
        script{
          withDockerRegistry(credentialsId: 'docker', toolName: 'docker'){
            sh "make image"
          }
        }
      }
    }
    stage("TRIVY"){
      steps{
        sh "trivy image sevenajay/dotnet-monitoring:latest > trivy.txt"
      }
    }
    stage("Docker Push"){
      steps{
        script{
          withDockerRegistry(credentialsId: 'docker', toolName: 'docker'){
            sh "make push"
          }
        }
      }
    }
```

When all stages in docker are successfully created then you will see the result You log in to Dockerhub, and you will see a new image is created



stage view

Declarative: Tool Install	clean workspace	Checkout From Git	Sonarqube Analysis	quality gate	TRIVY File scan	OWASP Dependency Check	Docker Build & tag	TRIVY	Docker Push
204ms	375ms	1s	19s	682ms	5s	48s	24s	3s	15s
204ms	375ms	1s	19s	682ms (paused for 6s)	5s	48s	24s	3s	15s

Step 8 — Deploy the image using Docker

Add this stage to your pipeline syntax

```
stage("Deploy to container"){
        steps{
            sh "docker run -d --name dotnet -p 5000:5000 sevenajay/dotnet-monitoring:latest"
        }
    }
```

You will see the Stage View like this,

Declarative: Tool Install	clean workspace	Checkout From Git	Sonarqube Analysis	quality gate	TRIVY File scan	OWASP Dependency Check	Docker Build & tag	TRIVY	Docker Push	Deploy to container
204ms	375ms	1s	19s	682ms	5s	48s	24s	3s	15s	1s
204ms	375ms	1s	19s	682ms (paused for 6s)	5s	48s	24s	3s	15s	1s

(Add port 5000 to Security Group)

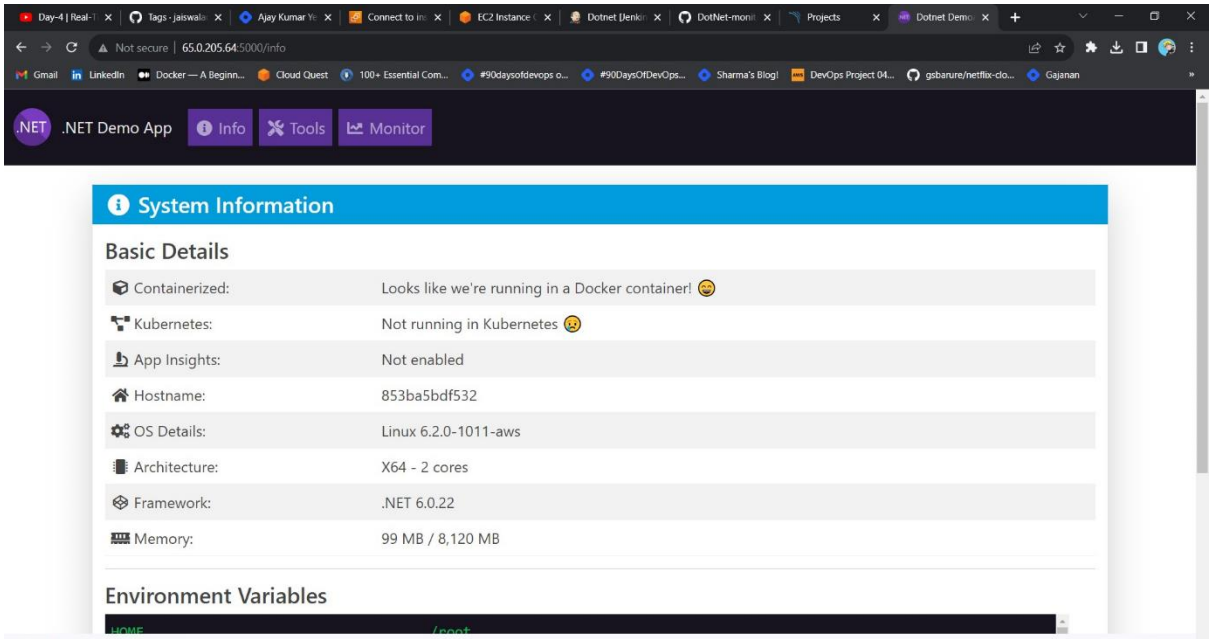
sgr-076ce119bc21d735d	Custom TCP	TCP	9000	Custom	0.0.0.0/0	Delete
sgr-09fc7d687936c1e66	HTTP	TCP	80	Custom	0.0.0.0/0	Delete
-	Custom TCP	TCP	5000	Anywh...	0.0.0.0/0	Delete

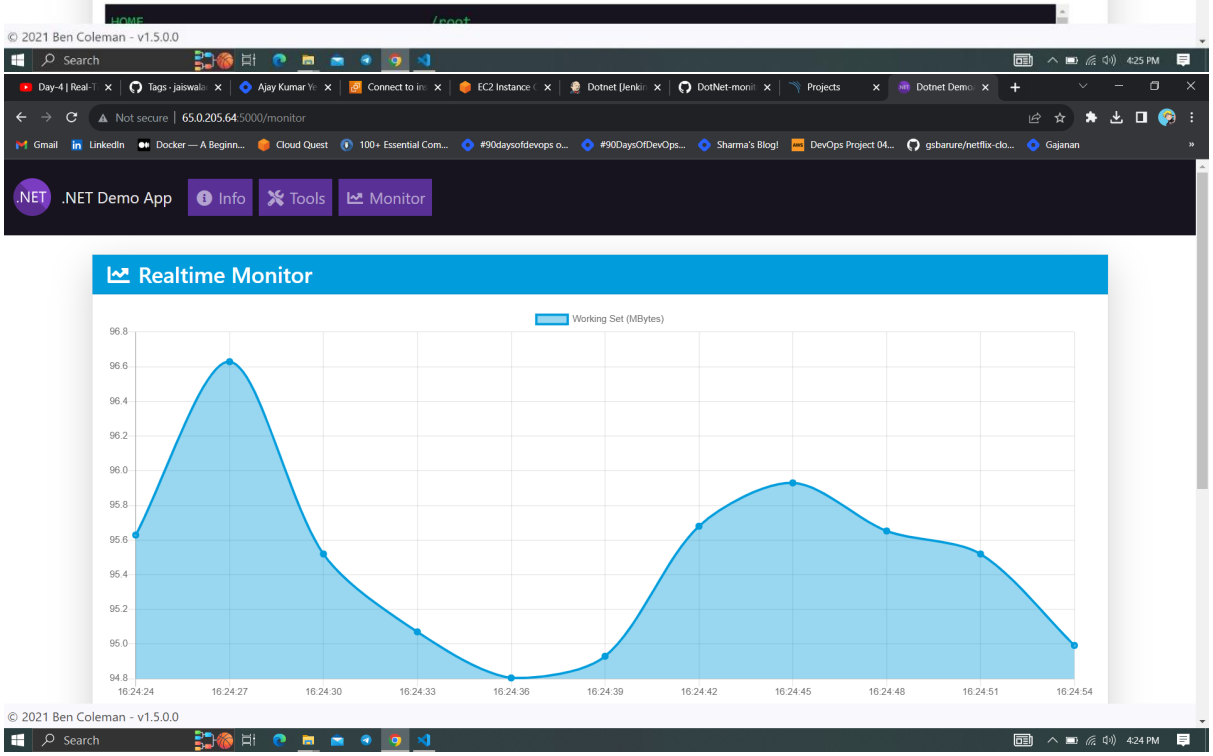
Add rule

And you can access your application on Port 5000. This is a Real World Application that has all Functional Tabs.

<public-ip of jenkins:5000>

Step 9 — Access the Real World Application





Step 10 —Kubernetes setup

Take-Two Ubuntu 20.04 instances one for k8s master and the other one for worker.

Install Kubectl on Jenkins machine also.

Kubectl on Jenkins to be installed

sudo apt update

sudo apt install curl

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

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

Part 1 ———-Master Node————

```
sudo su
hostname master
bash
clear
```

———-Worker Node————

```
sudo su
hostname worker
bash
clear
```

Part 2 ————Both Master & Node ————

```
sudo apt-get update
sudo apt-get install -y docker.io
sudo usermod –aG docker Ubuntu
newgrp docker
sudo chmod 777 /var/run/docker.sock
sudo curl -s https://packages.cloud.google.com/apt/doc/apt-key.gpg | sudo apt-key add -
sudo tee /etc/apt/sources.list.d/kubernetes.list <<EOF
deb https://apt.kubernetes.io/ kubernetes-xenial main
EOF
sudo apt-get update
sudo apt-get install -y kubelet kubeadm kubectl
sudo snap install kube-apiserver
```

Part 3 ————— Master —————

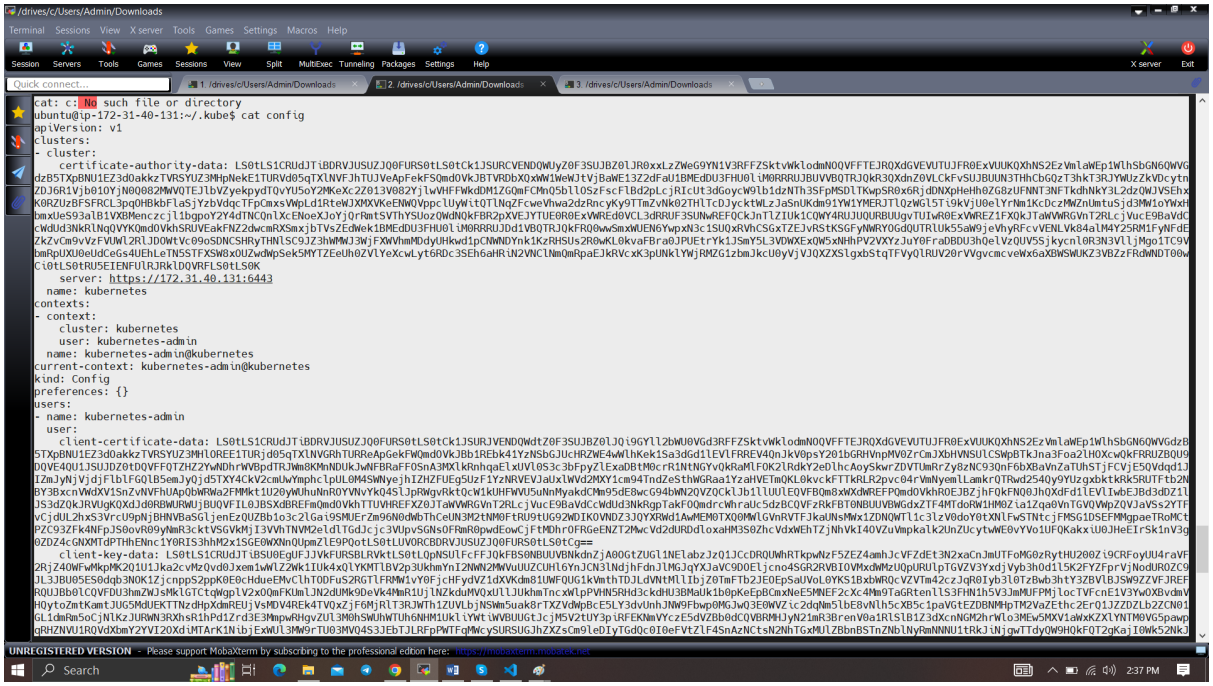
```
sudo kubeadm init --pod-network-cidr=10.244.0.0/16
# in case your in root exit from it and run below commands
mkdir -p $HOME/.kube
sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
sudo chown $(id -u):$(id -g) $HOME/.kube/config
```

kubectl apply -f https://raw.githubusercontent.com/coreos/flannel/master/Documentation/kube-flannel.yml

———-Worker Node————

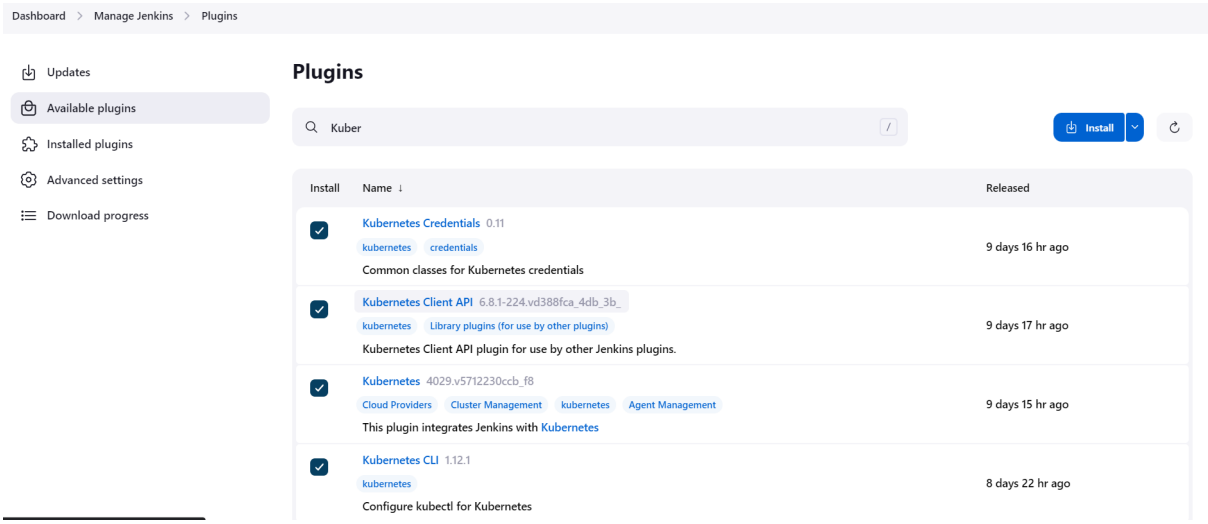
sudo kubeadm join <master-node-ip>:<master-node-port> --token <token> --discovery-token-ca-cert-hash <hash>

Copy the config file to Jenkins master or the local file manager and save it

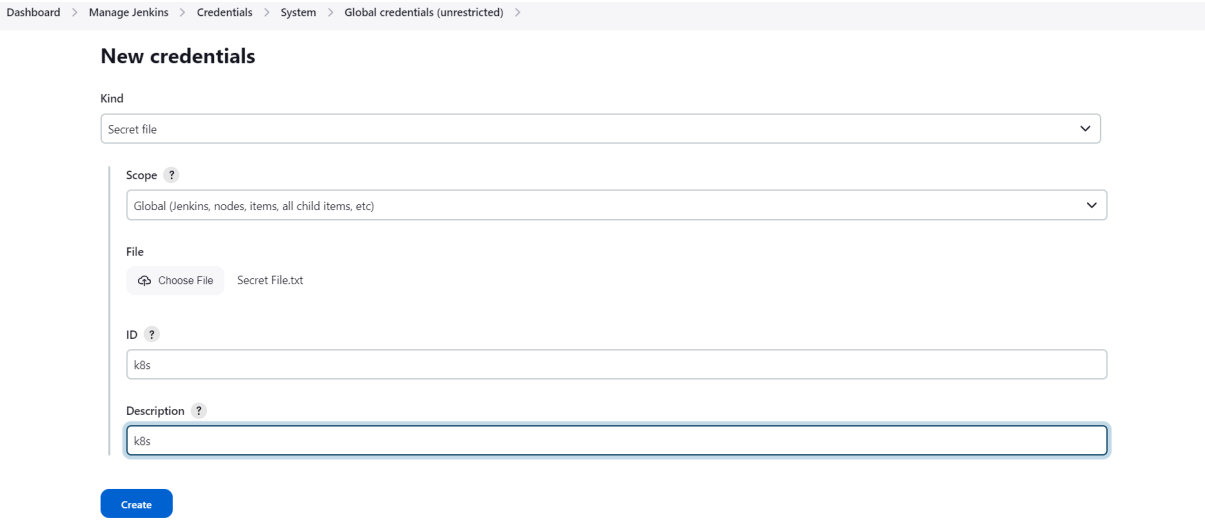


copy it and save it in documents or another folder save it as secret-file.txt

Install Kubernetes Plugin, Once it’s installed successfully



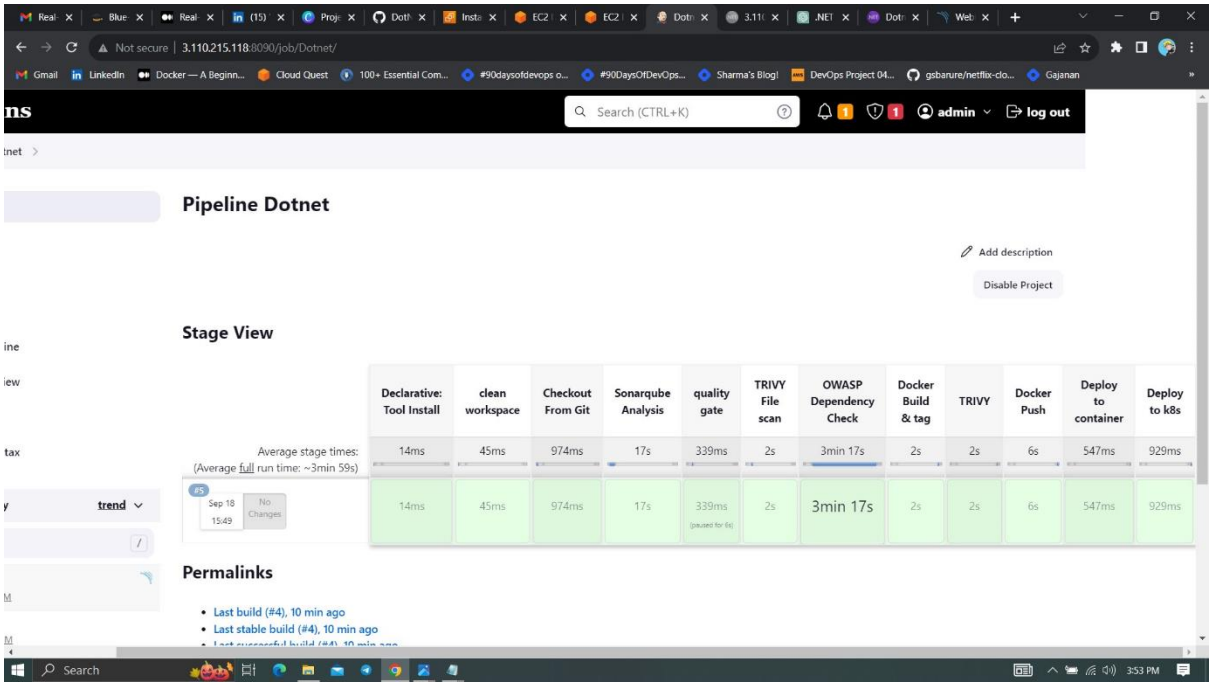
goto manage Jenkins –> manage credentials –> Click on Jenkins global –> add credentials



the final step to deploy on the Kubernetes cluster, add this stage to the pipeline.

```
stage('Deploy to k8s'){
        steps{
          dir('K8S') {
            withKubeConfig(caCertificate: '', clusterName: '', contextName: '', credentialsId: 'k8s',
namespace: '', restrictKubeConfigAccess: false, serverUrl: '') {
             sh 'kubectl apply -f deployment.yaml'
            }
          }
        }
      }
```

Before starting a new build remove Old containers.

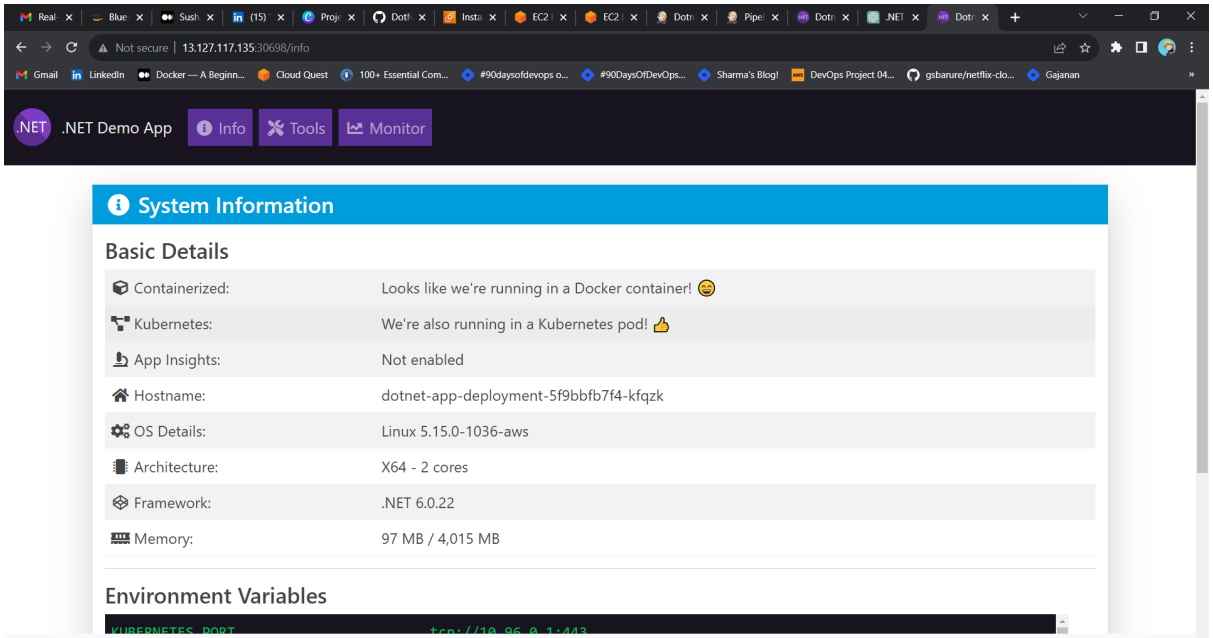


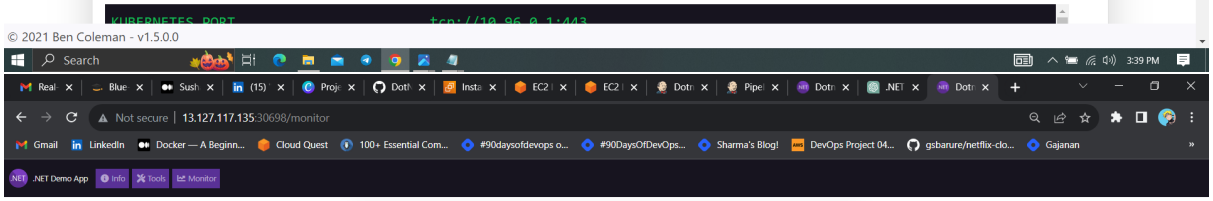
Output

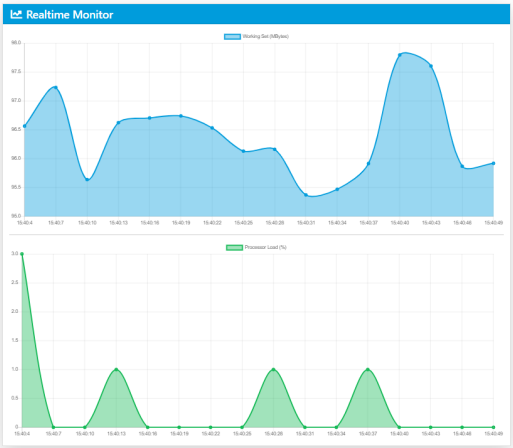
kubectl get svc

#copy service port

<worker-ip:svc port>







Step 11 — Terminate the AWS EC2 Instance

Lastly, do not forget to terminate the AWS EC2 Instance.

complete pipeline

```
pipeline{
   agent any
   tools{
      jdk 'jdk17'
   }
```

```
environment {
    SCANNER_HOME=tool 'sonar-scanner'
}
stages {
    stage('clean workspace'){
        steps{
            cleanWs()
        }
    }
    stage('Checkout From Git'){
        steps{
            git branch: 'main', url: 'https://github.com/Aj7Ay/DotNet-monitoring.git'
        }
    }
    stage("Sonarqube Analysis "){
        steps{
            withSonarQubeEnv('sonar-server') {
                sh ''' $SCANNER_HOME/bin/sonar-scanner -Dsonar.projectName=Dotnet-Webapp \
                -Dsonar.projectKey=Dotnet-Webapp '''
            }
        }
    }
    stage("quality gate"){
       steps {
            script {
                waitForQualityGate abortPipeline: false, credentialsId: 'Sonar-token'
            }
        }
    }
    stage("TRIVY File scan"){
        steps{
```

```
            sh "trivy fs . > trivy-fs_report.txt"
        }
    }
    stage("OWASP Dependency Check"){
        steps{
            dependencyCheck additionalArguments: '--scan ./ --format XML ', odcInstallation: 'DP-
Check'
            dependencyCheckPublisher pattern: '**/dependency-check-report.xml'
        }
    }
    stage("Docker Build & tag"){
        steps{
            script{
                withDockerRegistry(credentialsId: 'docker', toolName: 'docker'){
                    sh "make image"
                }
            }
        }
    }
    stage("TRIVY"){
        steps{
            sh "trivy image sevenajay/dotnet-monitoring:latest > trivy.txt"
        }
    }
    stage("Docker Push"){
        steps{
            script{
                withDockerRegistry(credentialsId: 'docker', toolName: 'docker'){
                    sh "make push"
                }
            }
```

```
        }
    }
    stage("Deploy to container"){
        steps{
            sh "docker run -d --name dotnet -p 5000:5000 sevenajay/dotnet-monitoring:latest"
        }
    }
    stage('Deploy to k8s'){
        steps{
            dir('K8S') {
                withKubeConfig(caCertificate: '', clusterName: '', contextName: '', credentialsId: 'k8s',
namespace: '', restrictKubeConfigAccess: false, serverUrl: '') {
                sh 'kubectl apply -f deployment.yaml'
                }
            }
        }
    }
  }
}
```