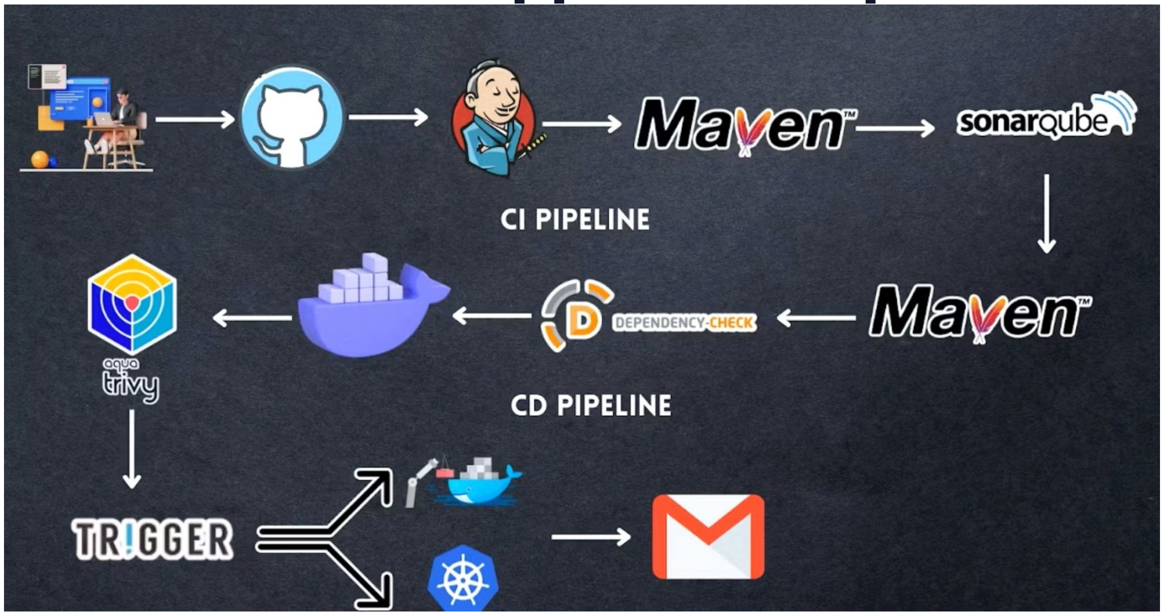
DEVSECOPS Project : Complete CI-CD (3 tier app)-Pet shop



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- CD- HYPERLINK "https://mrcloudbook.hashnode.dev/devsecops-project-complete-ci-cd-3-tier-app-petshop"pet shop HYPERLINK "https://mrcloudbook.hashnode.dev/devsecops-project-complete-ci-cd-3-tier-app-petshop"-pipeline

Hello friends, we will be deploying a Pet shop Java 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.

We will be deploying our application in two ways, one using Docker Container and the other using K8S cluster.

Project Repo: https://github.com/aravikumar55/jpetstore-6.git

Steps:-

Step 1 — Create an Ubuntu(22.04) T2 Large Instance

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

Step 3 — Install Plugins like JDK, SonarQube Scanner, Maven, and OWASP Dependency Check.

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

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Step 7 — Deploy the image using Docker

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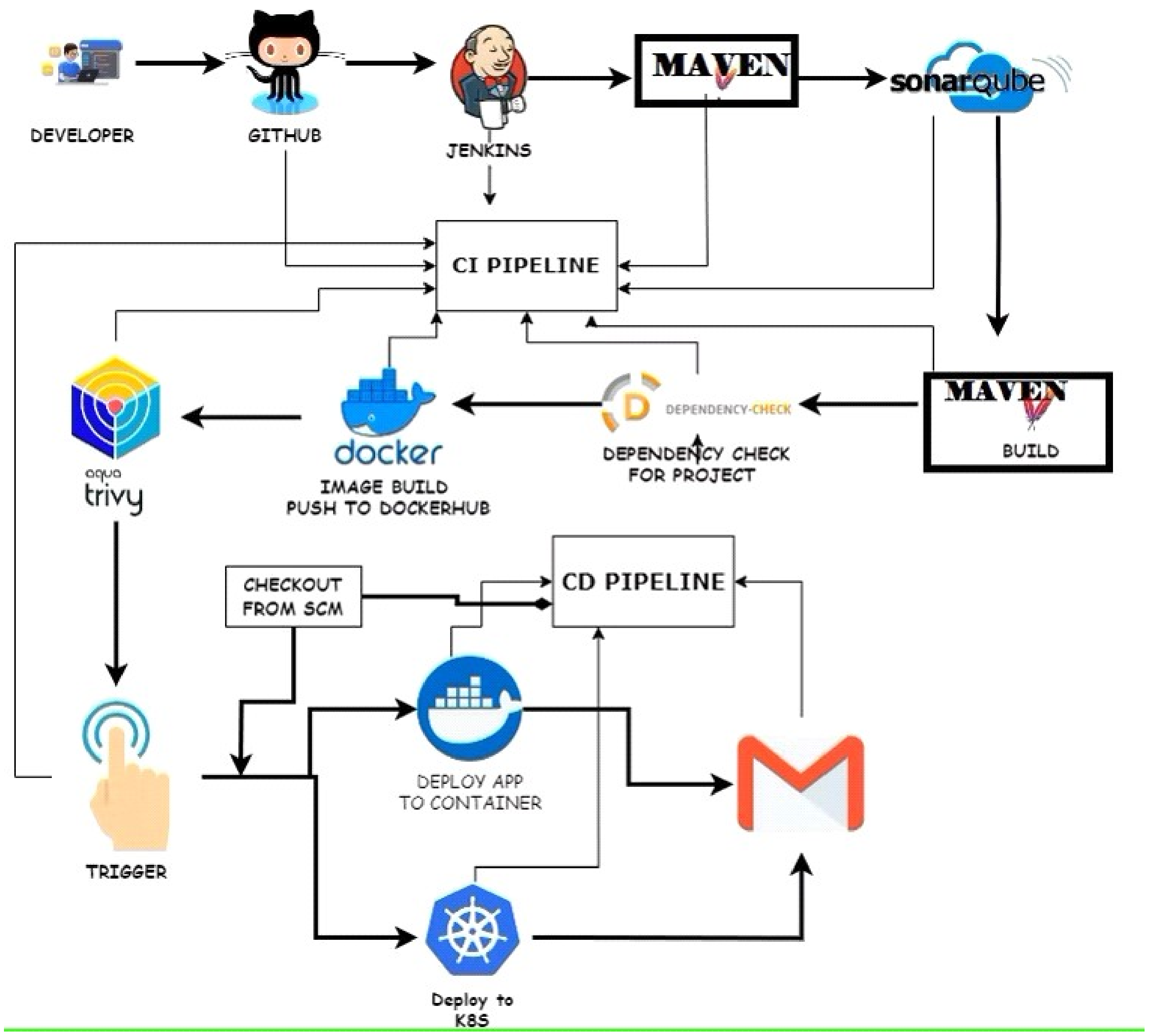
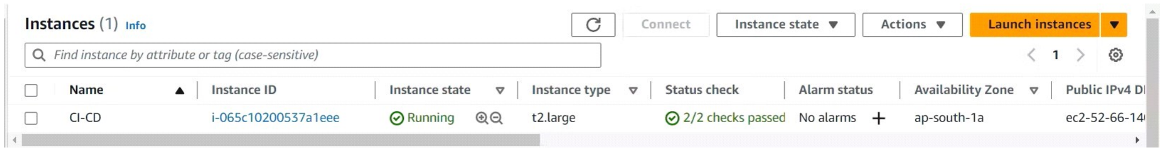
Step 9 — Access the Real-World Application

Step 10 — Terminate the AWS EC2 Instances.



STEP1: Create an Ubuntu (22.04) T2 Large Instance

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 and open all ports (not best case to open all ports but just for learning purposes it's okay).



Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DI
CI-CD	i-065c10200537a1eee	Running	t2.large	2/2 checks passed	No alarms	ap-south-1a	ec2-52-66-14

Step 2 — Install Jenkins, Docker and Trivy

2A — To Install Jenkins

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

```
vi jenkins.sh

#!/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

sudo apt install maven -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    # this will installl Jenkins
```

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.

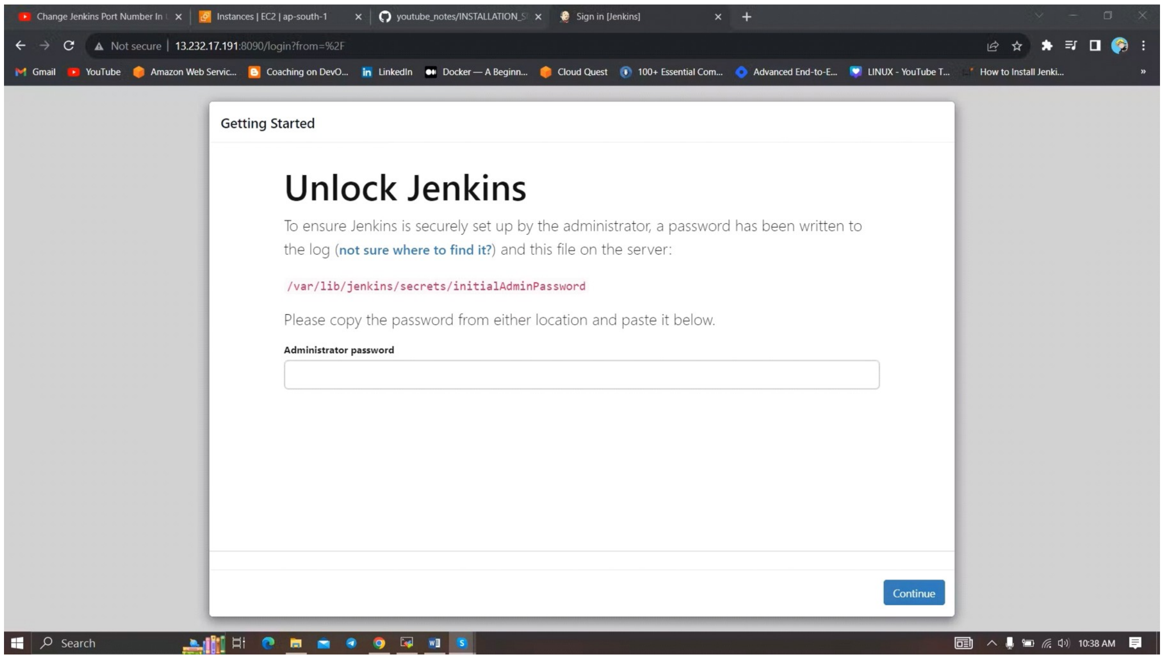
But for this Application case, we are running Jenkins on another port. so change the port to 8090 using the below commands.

```
sudo systemctl stop jenkins

sudo systemctl status jenkins

cd /etc/default

sudo vi jenkins   #chnage port HTTP_PORT=8090 and save and exit

cd /lib/systemd/system

sudo vi jenkins.service  #change Environments="Jenkins_port=8090" save and exit

sudo systemctl daemon-reload

sudo systemctl restart jenkins

sudo systemctl status Jenkins
```

Now, grab your Public IP Address

<EC2 Public IP Address:8090>

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



Getting Started

Unlock Jenkins

To ensure Jenkins is securely set up by the administrator, a password has been written to the log (not sure where to find it?) and this file on the server:

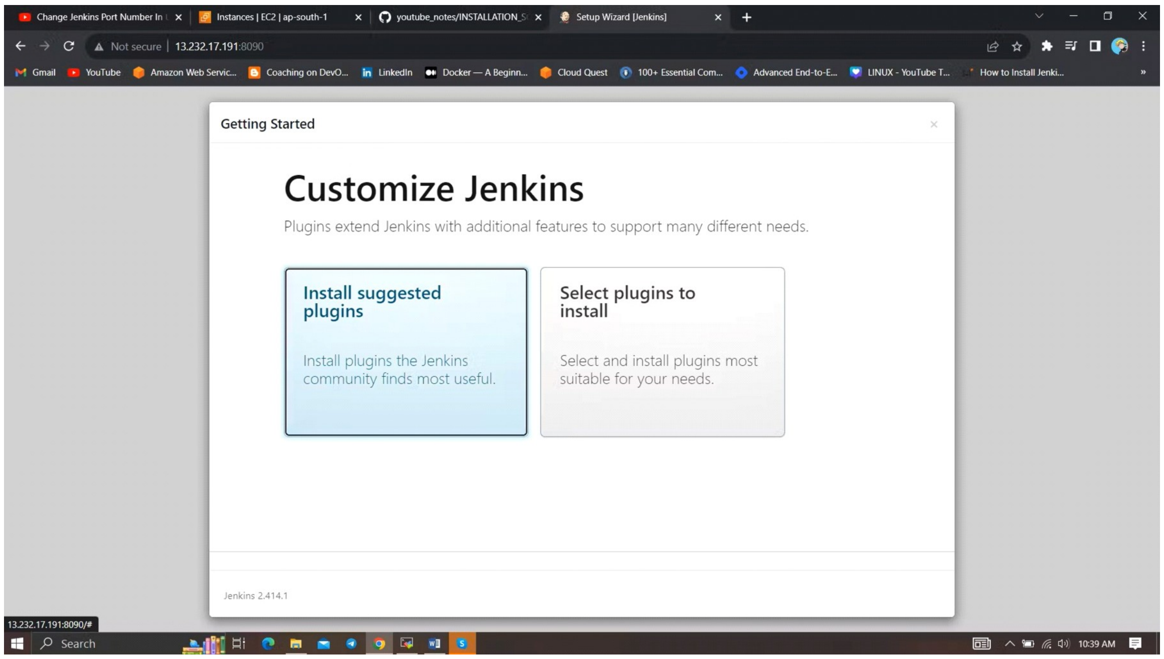
```
/var/lib/jenkins/secrets/initialAdminPassword
```

Please copy the password from either location and paste it below.

Administrator password

Continue

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



Getting Started

Customize Jenkins

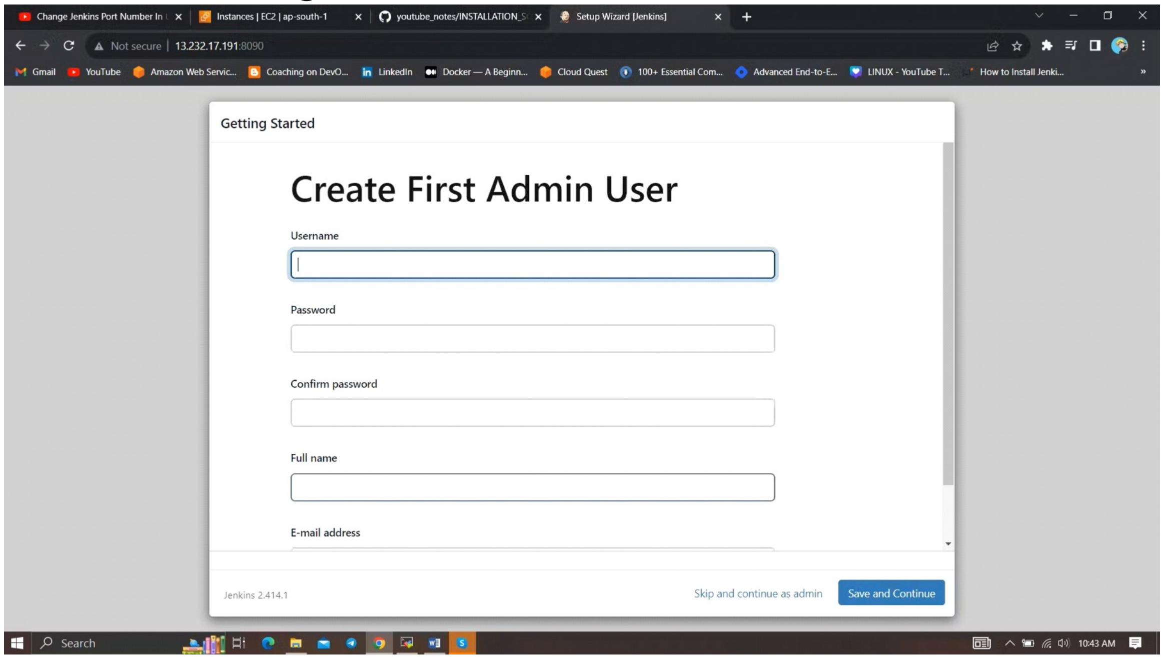
Plugins extend Jenkins with additional features to support many different needs.

Install suggested plugins
Install plugins the Jenkins community finds most useful.

Select plugins to install
Select and install plugins most suitable for your needs.

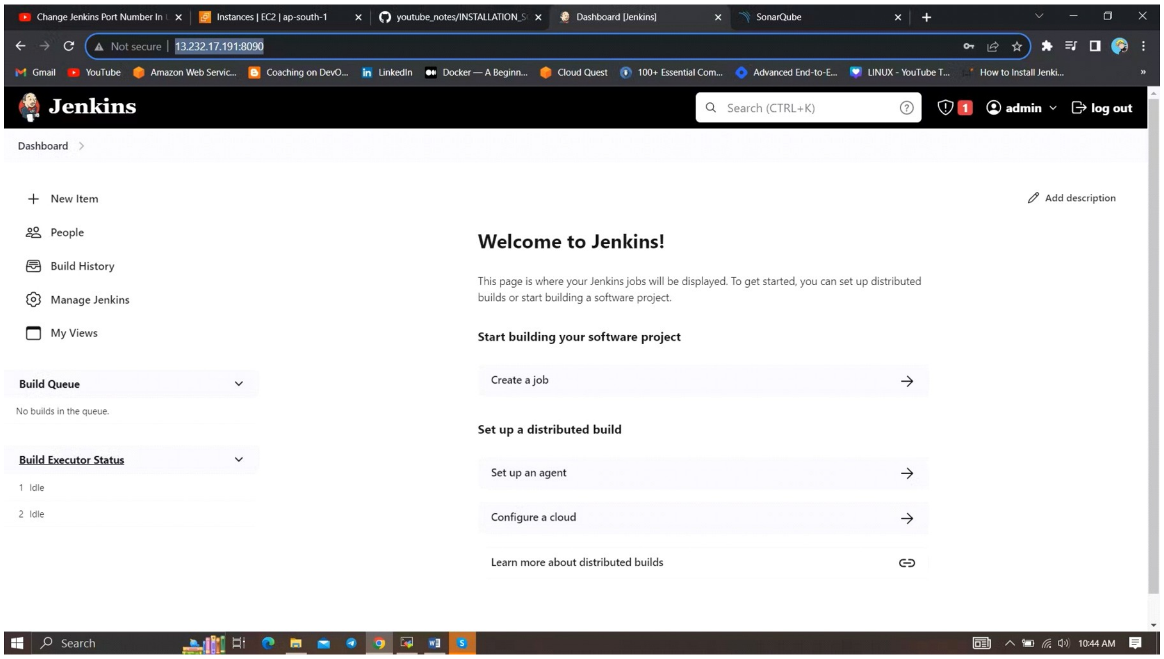
Jenkins 2.414.1

Jenkins will now get installed and install all the libraries.



Create a user click on save and continue.

Jenkins Getting Started Screen.


Jenkins
Search (CTRL+K)
admin
log out
Dashboard
New Item
People
Build History
Manage Jenkins
My Views
Build Queue
No builds in the queue.
Build Executor Status
1 Idle
2 Idle
Add description
Welcome to Jenkins!
This page is where your Jenkins jobs will be displayed. To get started, you can set up distributed builds or start building a software project.
Start building your software project
Create a job
Set up a distributed build
Set up an agent
Configure a cloud
Learn more about distributed builds

2B — Install Docker

sudo apt-get update

sudo apt-get install docker.io -y

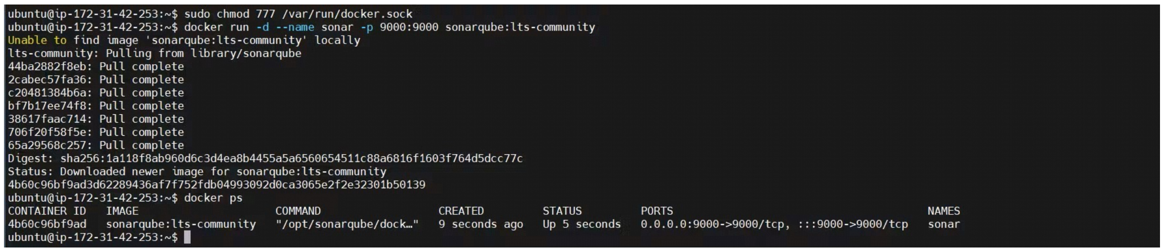
sudo usermod -aG docker $USER   #my case is ubuntu

newgrp docker

sudo chmod 777 /var/run/docker.sock

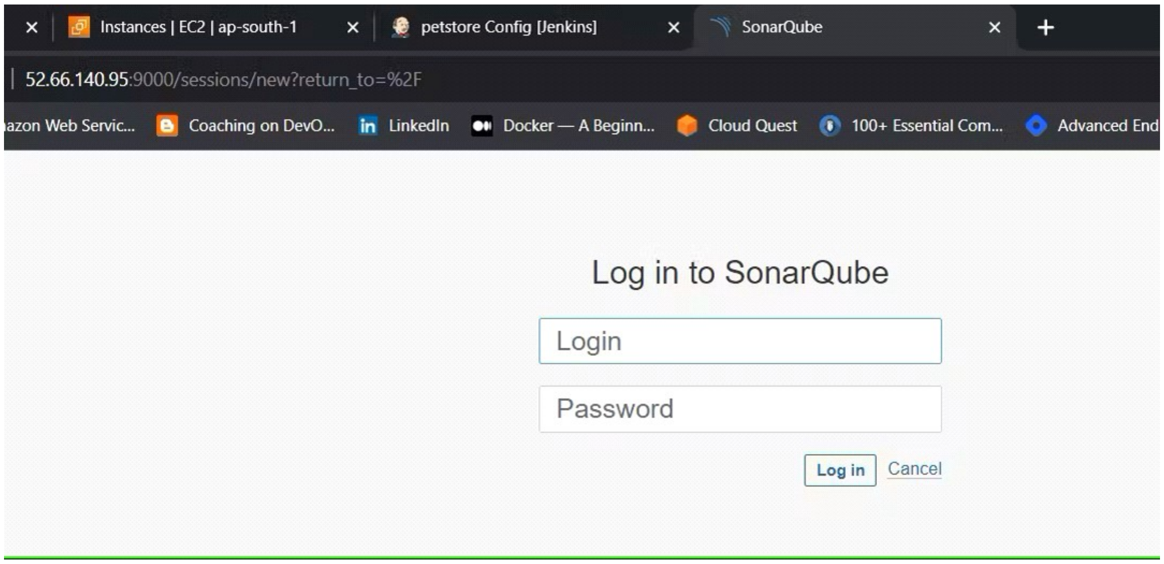
After the docker installation, we create a sonarqube container (Remember added 9000 ports in the security group

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:~$
```

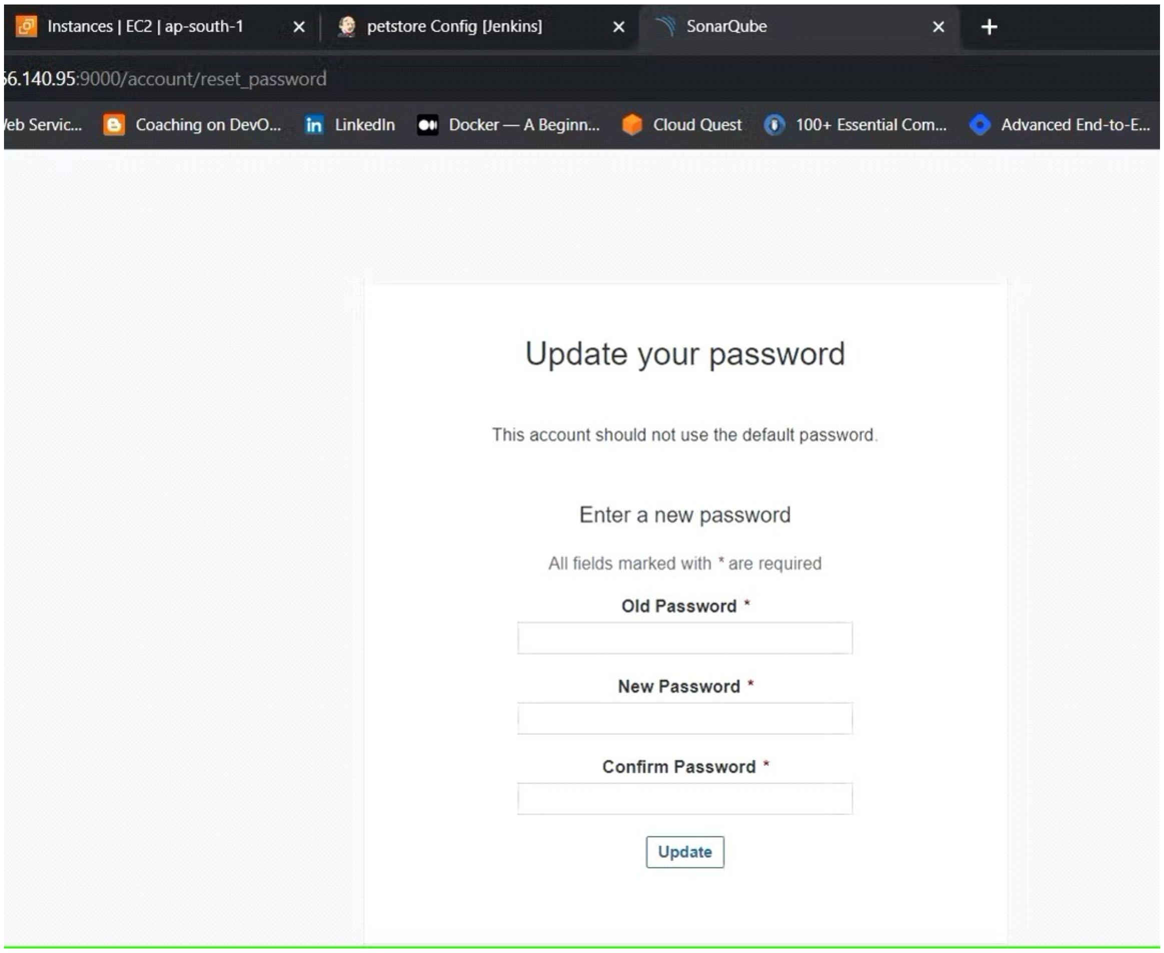
Now our SonarQube is up and running



Enter username and password, click on login and change password

username admin

password admin


Update your password

This account should not use the default password.

Enter a new password

All fields marked with * are required

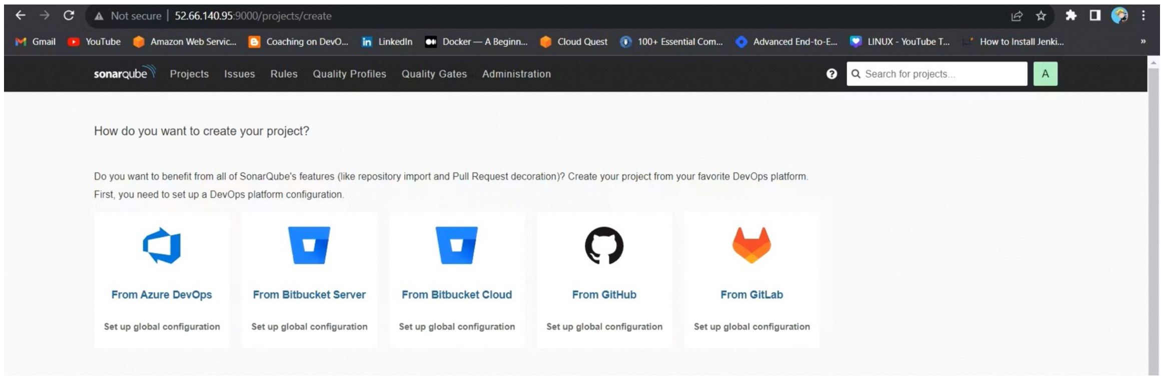
Old Password *

New Password *

Confirm Password *

Update

Update New password, This is Sonar Dashboard.


How do you want to create your project?

Do you want to benefit from all of SonarQube's features (like repository import and Pull Request decoration)? Create your project from your favorite DevOps platform.
First, you need to set up a DevOps platform configuration.

From Azure DevOps
Set up global configuration
From Bitbucket Server
Set up global configuration
From Bitbucket Cloud
Set up global configuration
From GitHub
Set up global configuration
From GitLab
Set up global configuration

2C — Install Trivy

vi trivy.sh

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, Maven, OWASP Dependency Check

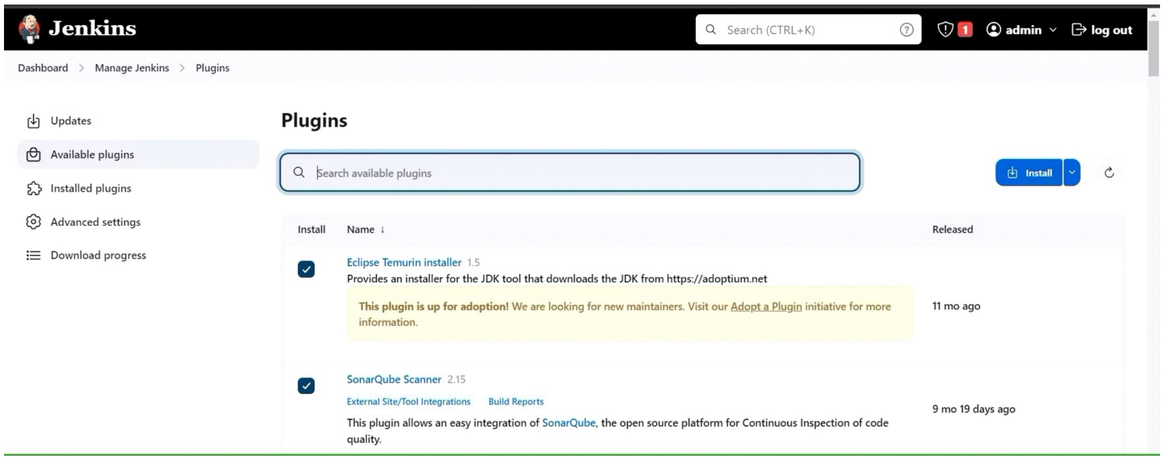
3A — Install Plugin

Goto Manage Jenkins →Plugins → Available Plugins →

Install below plugins

1 → Eclipse Temurin Installer (Install without restart)

2 → SonarQube Scanner (Install without restart)


Jenkins | Search (CTRL+K) | admin | log out

Dashboard > Manage Jenkins > Plugins

Updates
Available plugins
Installed plugins
Advanced settings
Download progress

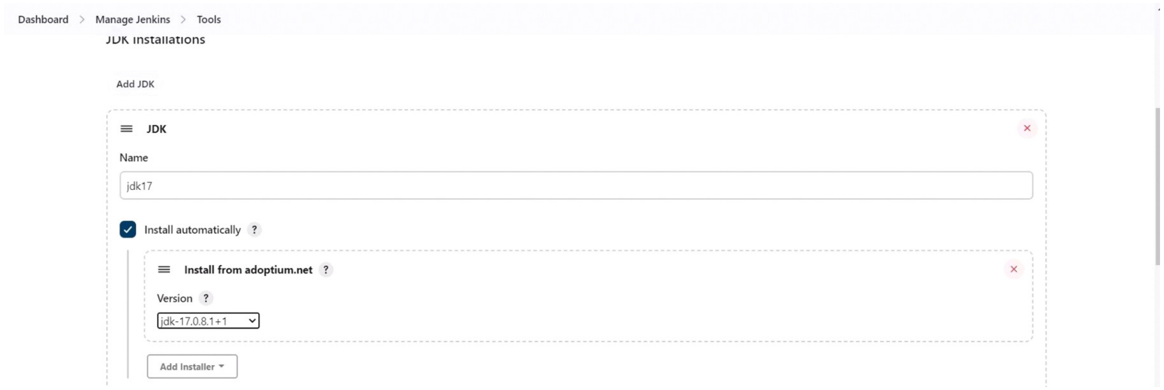
Plugins

Search available plugins | Install

Install	Name ↓	Released
✓	Eclipse Temurin installer 1.5 Provides an installer for the JDK tool that downloads the JDK from https://adoptium.net **This plugin is up for adoption!** We are looking for new maintainers. Visit our Adopt a Plugin initiative for more information.	11 mo ago
✓	SonarQube Scanner 2.15 External Site/Tool Integrations Build Reports This plugin allows an easy integration of SonarQube, the open source platform for Continuous Inspection of code quality.	9 mo 19 days ago

3B — Configure Java and Maven in Global Tool Configuration

Goto Manage Jenkins → Tools → Install JDK(17) and Maven3(3.6.0) → Click on Apply and Save


Dashboard > Manage Jenkins > Tools

JDK installations

Add JDK

JDK

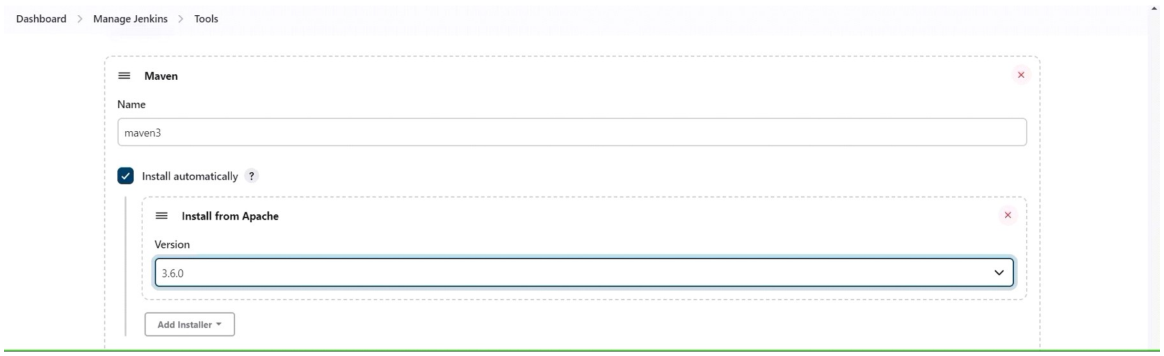
Name: jdk17

✓ Install automatically

Install from adoptium.net

Version: jdk-17.0.8.1+1

Add Installer


Dashboard > Manage Jenkins > Tools

Maven

Name: maven3

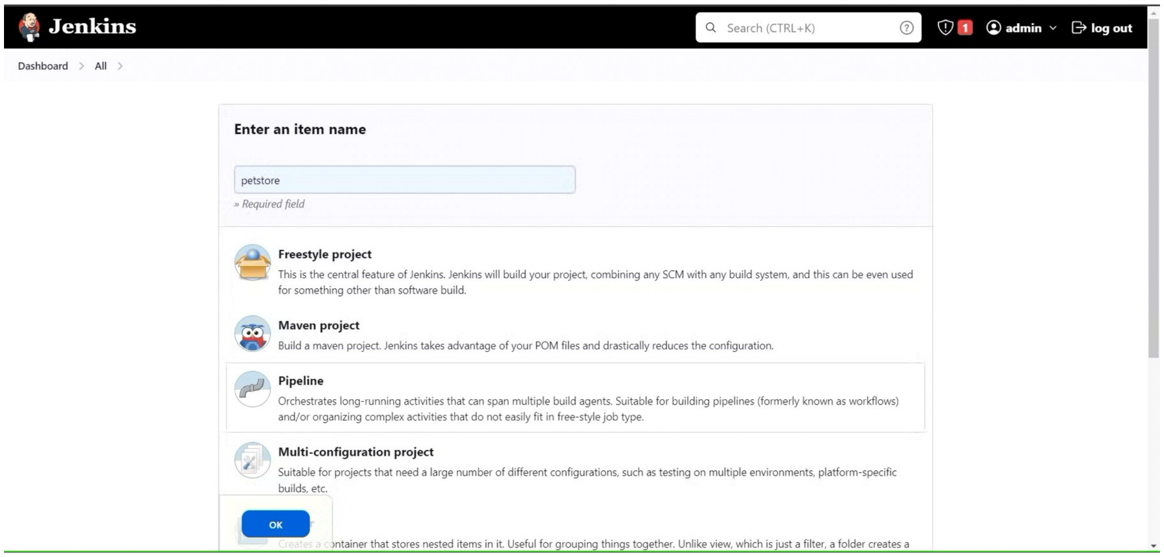
✓ Install automatically

Install from Apache

Version: 3.6.0

Add Installer

3C — Create a Job



Enter an item name

petstore

» Required field

Freestyle project
This is the central feature of Jenkins. Jenkins will build your project, combining any SCM with any build system, and this can be even used for something other than software build.

Maven project
Build a maven project. Jenkins takes advantage of your POM files and drastically reduces the configuration.

Pipeline
Orchestrates long-running activities that can span multiple build agents. Suitable for building pipelines (formerly known as workflows) and/or organizing complex activities that do not easily fit in free-style job type.

Multi-configuration project
Suitable for projects that need a large number of different configurations, such as testing on multiple environments, platform-specific builds, etc.

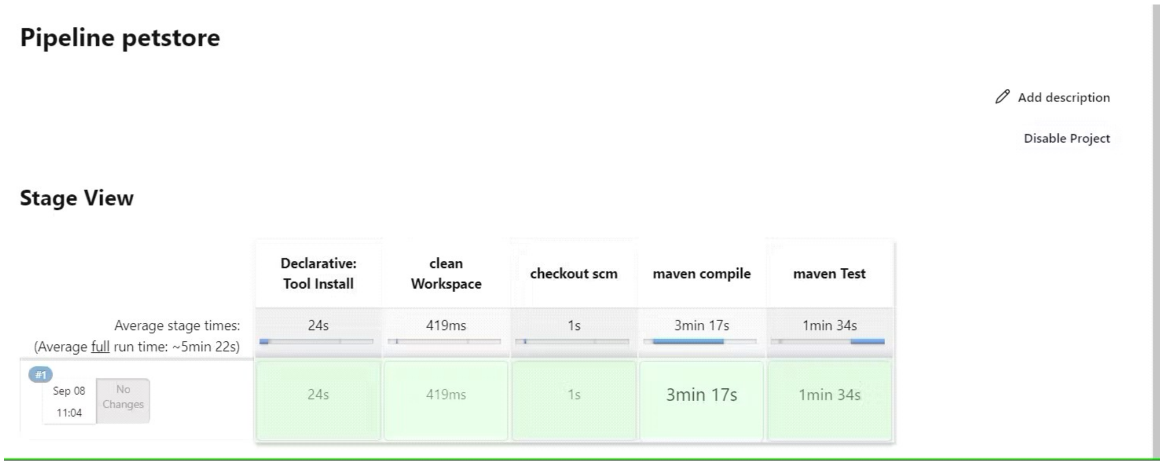
Creates a container that stores nested items in it. Useful for grouping things together. Unlike view, which is just a filter, a folder creates a

Enter this in Pipeline Script,

```
pipeline{
   agent any
   tools {
      jdk 'jdk17'
      maven 'maven3'
   }
   stages{
      stage ('clean Workspace'){
         steps{
            cleanWs()
         }
      }
      stage ('checkout scm') {
         steps {
            git 'https://github.com/Venn1991/jpetstore-6.git'
         }
```

```
        }
        stage ('maven compile') {
           steps {
              sh 'mvn clean compile'
           }
        }
        stage ('maven Test') {
           steps {
              sh 'mvn test'
           }
        }
    }
}
```

The stage view would look like this,



Pipeline petstore

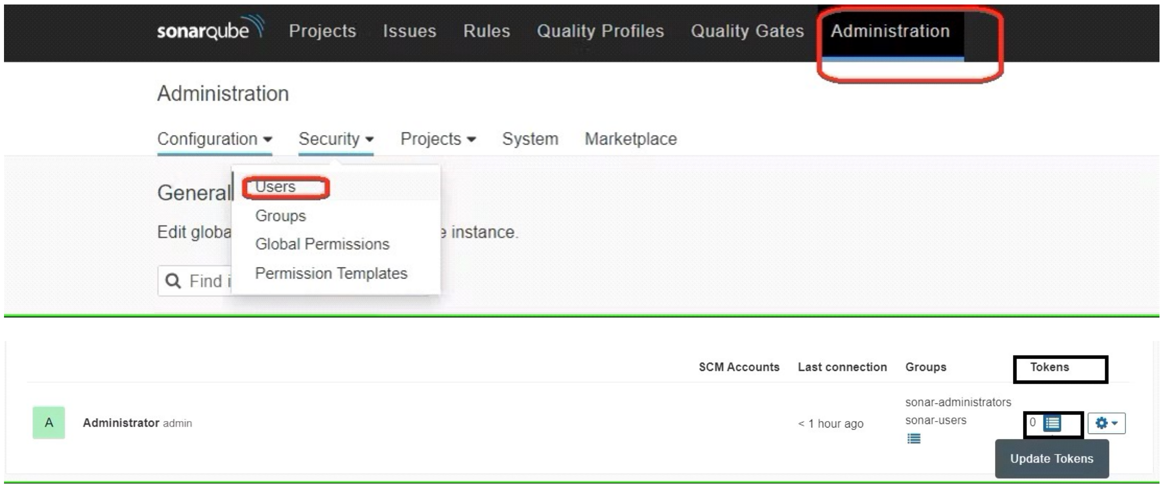
Add description

Disable Project

Stage View

	Declarative: Tool Install	clean Workspace	checkout scm	maven compile	maven Test
Average stage times: (Average full run time: ~5min 22s)	24s	419ms	1s	3min 17s	1min 34s
#1 Sep 08 11:04 No Changes	24s	419ms	1s	3min 17s	1min 34s

Step 4 — Configure Sonar Server in Manage Jenkins



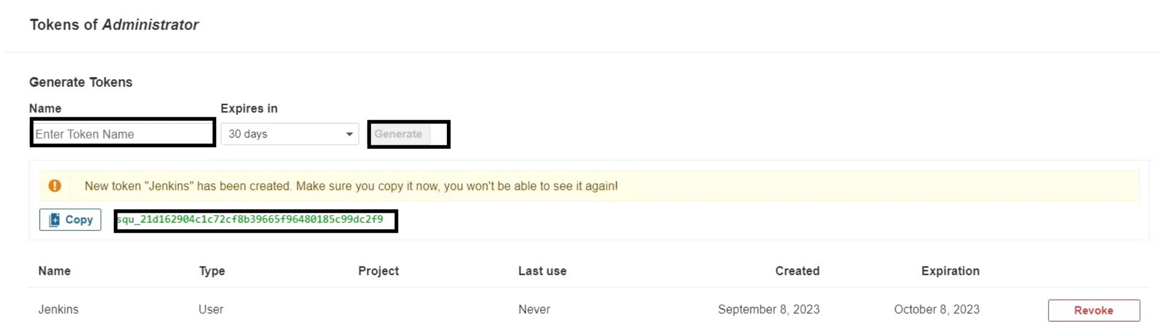
Administration

General

Edit globa… instance.

	SCM Accounts	Last connection	Groups	Tokens
A Administrator admin		< 1 hour ago	sonar-administrators sonar-users	0

Create a token with a name and generate



Tokens of *Administrator*

Generate Tokens

Name	Expires in	
Enter Token Name	30 days	Generate

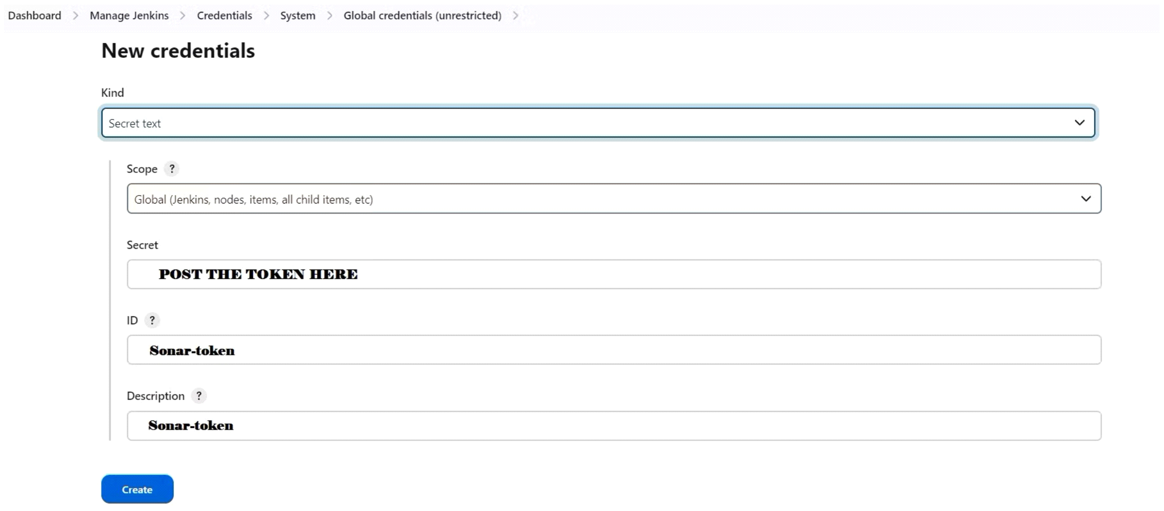
New token "Jenkins" has been created. Make sure you copy it now, you won't be able to see it again!

Copy `squ_21d162904c1c72cf8b39665f96480185c99dc2f9`

Name	Type	Project	Last use	Created	Expiration	
Jenkins	User		Never	September 8, 2023	October 8, 2023	Revoke

copy Token

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


Dashboard > Manage Jenkins > Credentials > System > Global credentials (unrestricted) >

New credentials

Kind: Secret text

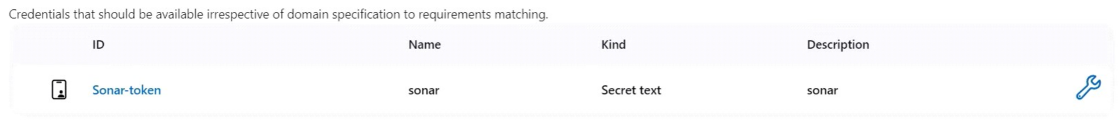
Scope: Global (Jenkins, nodes, items, all child items, etc)

Secret: POST THE TOKEN HERE

ID: Sonar-token

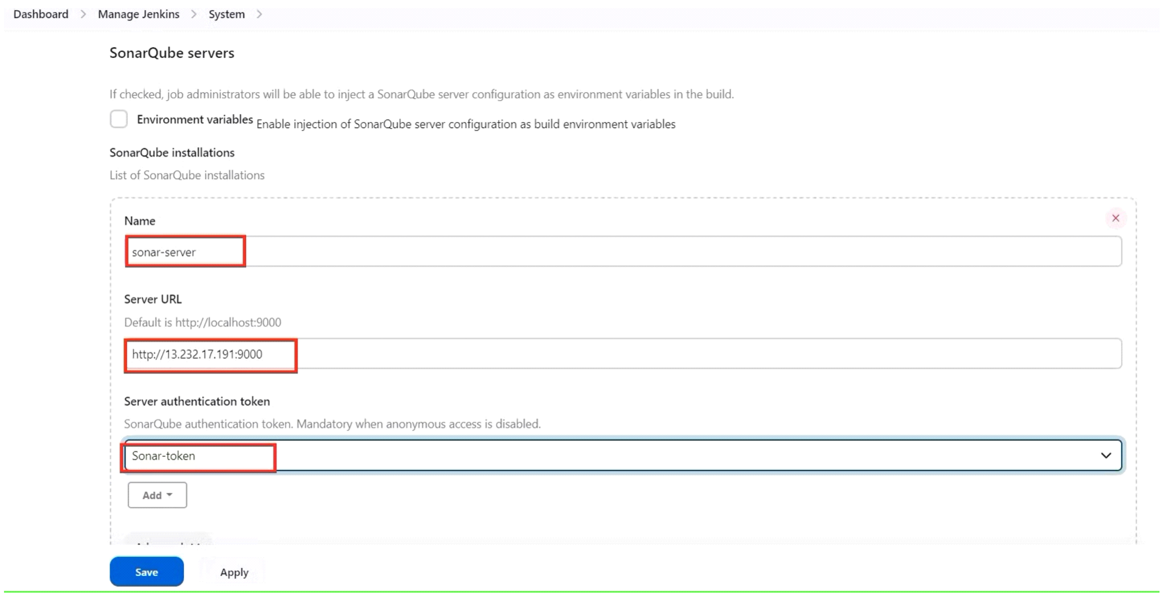
Description: Sonar-token

You will this page once you click on create


Credentials that should be available irrespective of domain specification to requirements matching.

ID	Name	Kind	Description
Sonar-token	sonar	Secret text	sonar

Now, go to Dashboard → Manage Jenkins → System and Add like the below image.


Dashboard > Manage Jenkins > System >

SonarQube servers

If checked, job administrators will be able to inject a SonarQube server configuration as environment variables in the build.

Environment variables Enable injection of SonarQube server configuration as build environment variables

SonarQube installations

List of SonarQube installations

Name: sonar-server

Server URL: http://13.232.17.191:9000 (Default is http://localhost:9000)

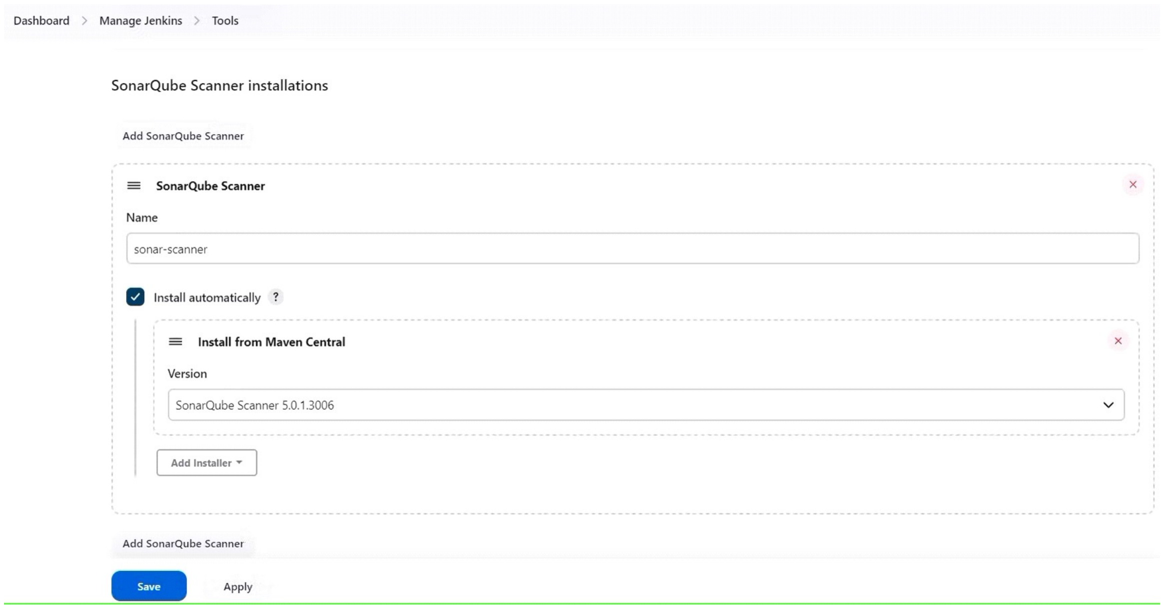
Server authentication token: Sonar-token (SonarQube authentication token. Mandatory when anonymous access is disabled.)

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.



Name: sonar-scanner

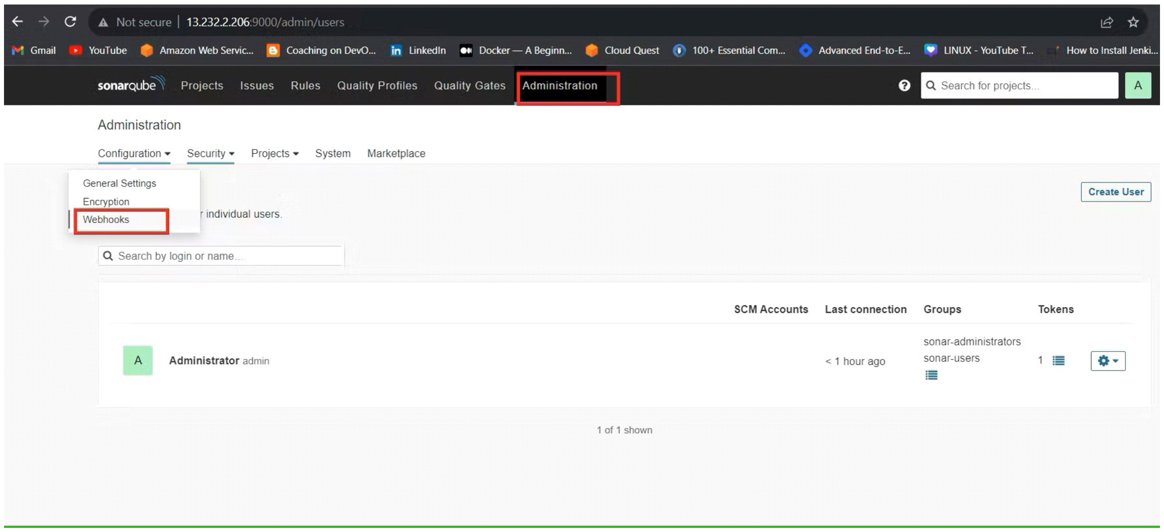
Install automatically ✓

Install from Maven Central

Version: SonarQube Scanner 5.0.1.3006

In the Sonarqube Dashboard add a quality gate also

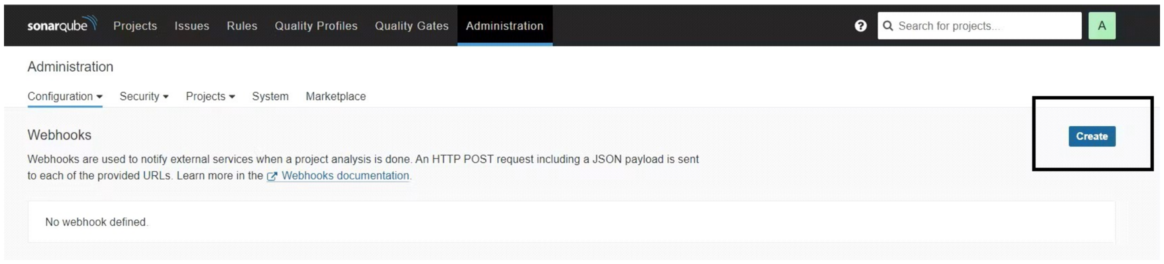
Administration--> Configuration-->Webhooks


Not secure | 13.232.2.206:9000/admin/users
sonarqube Projects Issues Rules Quality Profiles Quality Gates Administration
Search for projects...
Administration
Configuration Security Projects System Marketplace
General Settings
Encryption
Webhooks
Create User
Search by login or name...

	SCM Accounts	Last connection	Groups	Tokens
Administrator admin		< 1 hour ago	sonar-administrators sonar-users	1

1 of 1 shown

Click on Create



Administration

Webhooks

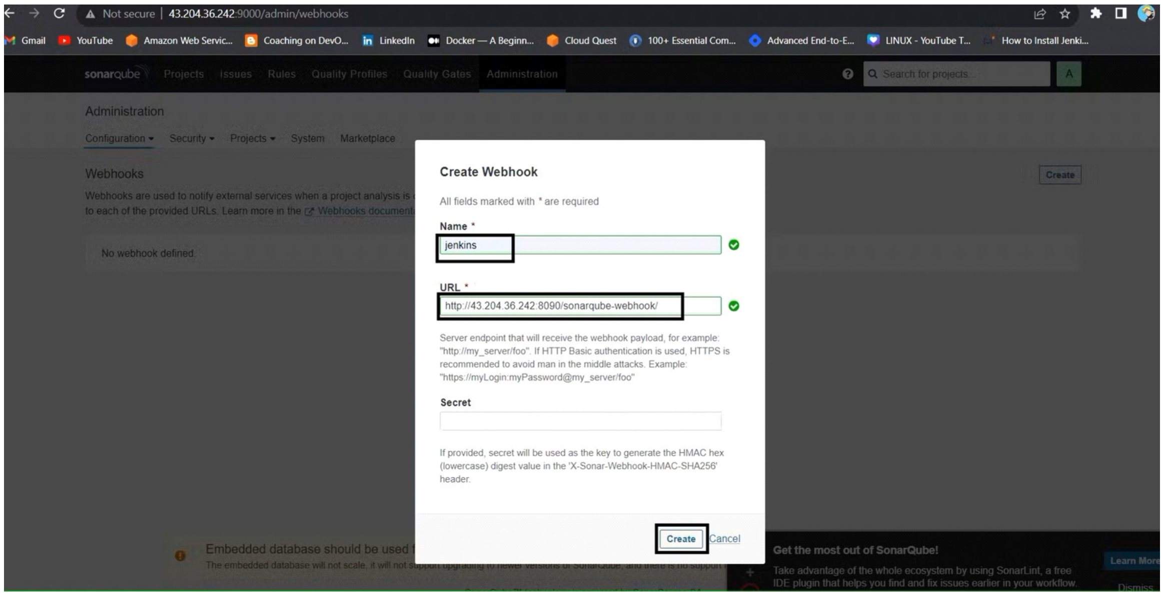
Webhooks are used to notify external services when a project analysis is done. An HTTP POST request including a JSON payload is sent to each of the provided URLs. Learn more in the Webhooks documentation.

No webhook defined.

Add details

#in url section of quality gate

<http://jenkins-public-ip:8090>/sonarqube-webhook/



Create Webhook

All fields marked with * are required

Name *

jenkins

URL *

http://43.204.36.242:8090/sonarqube-webhook/

Server endpoint that will receive the webhook payload, for example: "http://my_server/foo". If HTTP Basic authentication is used, HTTPS is recommended to avoid man in the middle attacks. Example: "https://myLogin:myPassword@my_server/foo"

Secret

If provided, secret will be used as the key to generate the HMAC hex (lowercase) digest value in the 'X-Sonar-Webhook-HMAC-SHA256' header.

Let's go to our Pipeline and add Sonarqube Stage in our Pipeline Script.

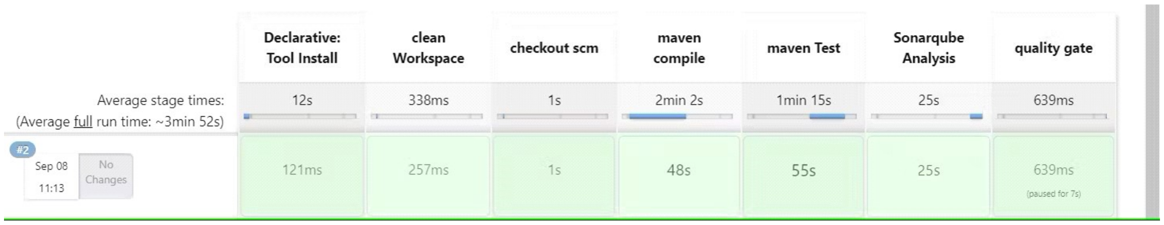
#under tools section add this environment

```
environment {
      SCANNER_HOME=tool 'sonar-scanner'
   }
```

# in stages add this

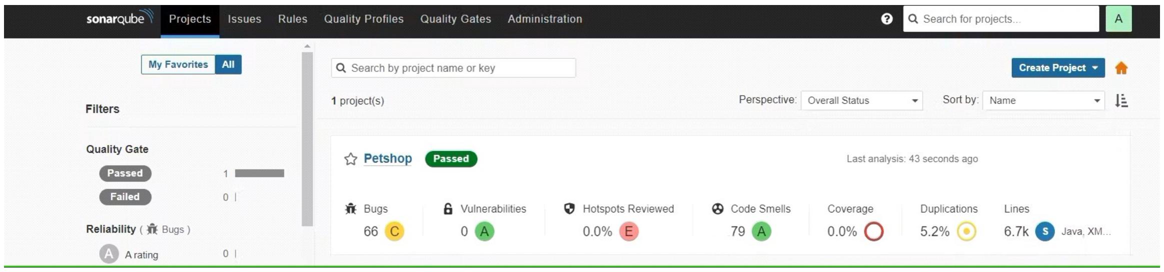
```
stage("Sonarqube Analysis "){
          steps{
            withSonarQubeEnv('sonar-server') {
              sh ''' $SCANNER_HOME/bin/sonar-scanner -Dsonar.projectName=Petshop \
              -Dsonar.java.binaries=. \
              -Dsonar.projectKey=Petshop '''
            }
          }
        }
        stage("quality gate"){
          steps {
            script {
              waitForQualityGate abortPipeline: false, credentialsId: 'Sonar-token'
            }
          }
        }
```

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



	Declarative: Tool Install	clean Workspace	checkout scm	maven compile	maven Test	Sonarqube Analysis	quality gate
Average stage times: (Average full run time: ~3min 52s)	12s	338ms	1s	2min 2s	1min 15s	25s	639ms
#2 Sep 08 11:13 No Changes	121ms	257ms	1s	48s	55s	25s	639ms (paused for 7s)

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



Filters

Quality Gate
Passed 1
Failed 0

Reliability (Bugs)
A rating 0

1 project(s)

Perspective: Overall Status Sort by: Name

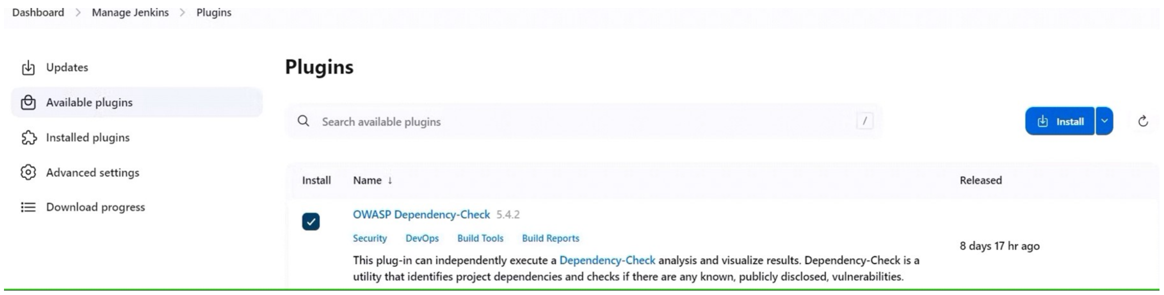
Petshop Passed Last analysis: 43 seconds ago

Bugs	Vulnerabilities	Hotspots Reviewed	Code Smells	Coverage	Duplications	Lines
66 C	0 A	0.0% E	79 A	0.0%	5.2%	6.7k S Java, XM...

You can see the report has been generated and the status shows as passed. You can see that there are 6.7k lines. To see a detailed report, you can go to issues.

Step 5 — Install OWASP Dependency Check Plugins

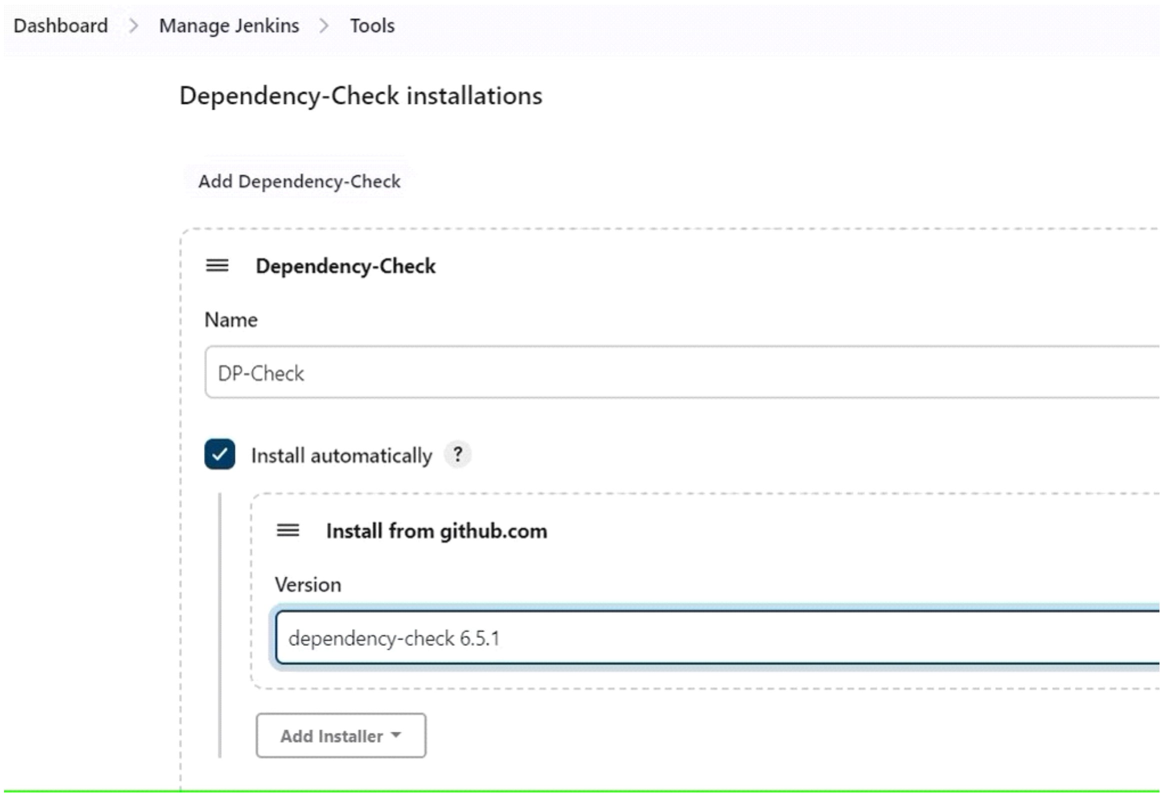
GotoDashboard → Manage Jenkins → Plugins → OWASP Dependency-Check. Click on it and install it without restart.



Install	Name ↓	Released
✓	OWASP Dependency-Check 5.4.2 Security DevOps Build Tools Build Reports This plug-in can independently execute a Dependency-Check analysis and visualize results. Dependency-Check is a utility that identifies project dependencies and checks if there are any known, publicly disclosed, vulnerabilities.	8 days 17 hr ago

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

Goto Dashboard → Manage Jenkins → Tools →


Dashboard > Manage Jenkins > Tools
Dependency-Check installations
Add Dependency-Check
Dependency-Check
Add Installer

Name: DP-Check

[✓] Install automatically

Install from github.com

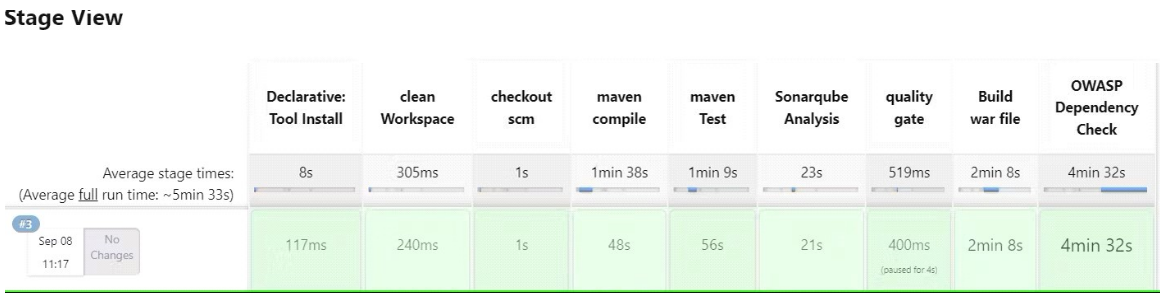
Version: dependency-check 6.5.1

Click on Apply and Save here.

Now go configure → Pipeline and add this stage to your pipeline and build.

```
stage ('Build war file'){
      steps{
        sh 'mvn clean install -DskipTests=true'
      }
    }
    stage("OWASP Dependency Check"){
      steps{
        dependencyCheck additionalArguments: '--scan ./ --format XML ', odcInstallation: 'DP-Check'
        dependencyCheckPublisher pattern: '**/dependency-check-report.xml'
      }
    }
```

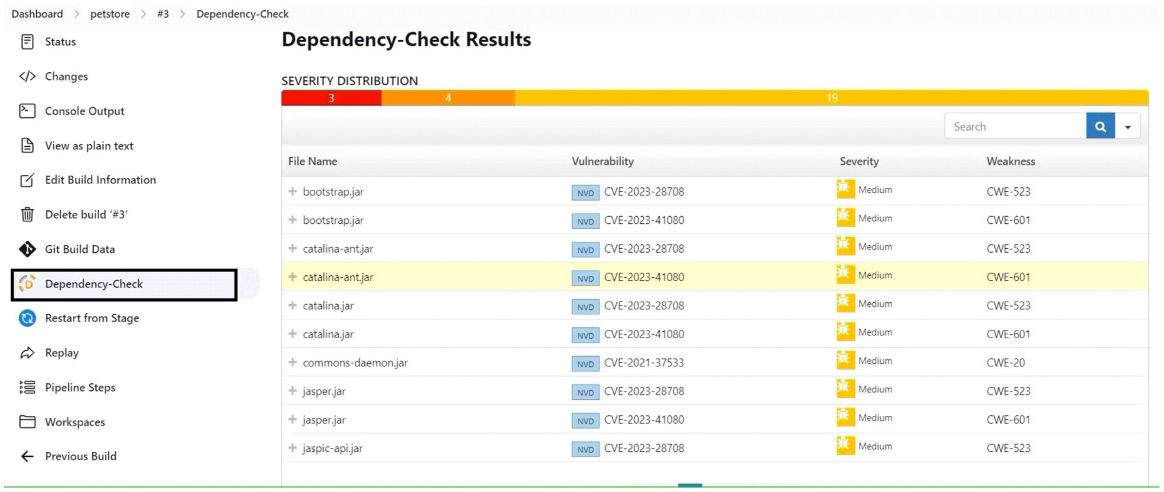
The stage view would look like this,



Stage View

	Declarative: Tool Install	clean Workspace	checkout scm	maven compile	maven Test	Sonarqube Analysis	quality gate	Build war file	OWASP Dependency Check
Average stage times: (Average full run time: ~5min 33s)	8s	305ms	1s	1min 38s	1min 9s	23s	519ms	2min 8s	4min 32s
#3 Sep 08 11:17 No Changes	117ms	240ms	1s	48s	56s	21s	400ms (paused for 4s)	2min 8s	4min 32s

You will see that in status, a graph will also be generated and Vulnerabilities.



Dependency-Check Results

SEVERITY DISTRIBUTION

3 4 19

File Name	Vulnerability	Severity	Weakness
bootstrap.jar	NVD CVE-2023-28708	Medium	CWE-523
bootstrap.jar	NVD CVE-2023-41080	Medium	CWE-601
catalina-ant.jar	NVD CVE-2023-28708	Medium	CWE-523
catalina-ant.jar	NVD CVE-2023-41080	Medium	CWE-601
catalina.jar	NVD CVE-2023-28708	Medium	CWE-523
catalina.jar	NVD CVE-2023-41080	Medium	CWE-601
commons-daemon.jar	NVD CVE-2021-37533	Medium	CWE-20
jasper.jar	NVD CVE-2023-28708	Medium	CWE-523
jasper.jar	NVD CVE-2023-41080	Medium	CWE-601
jaspic-api.jar	NVD CVE-2023-28708	Medium	CWE-523

Step 6 — 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`

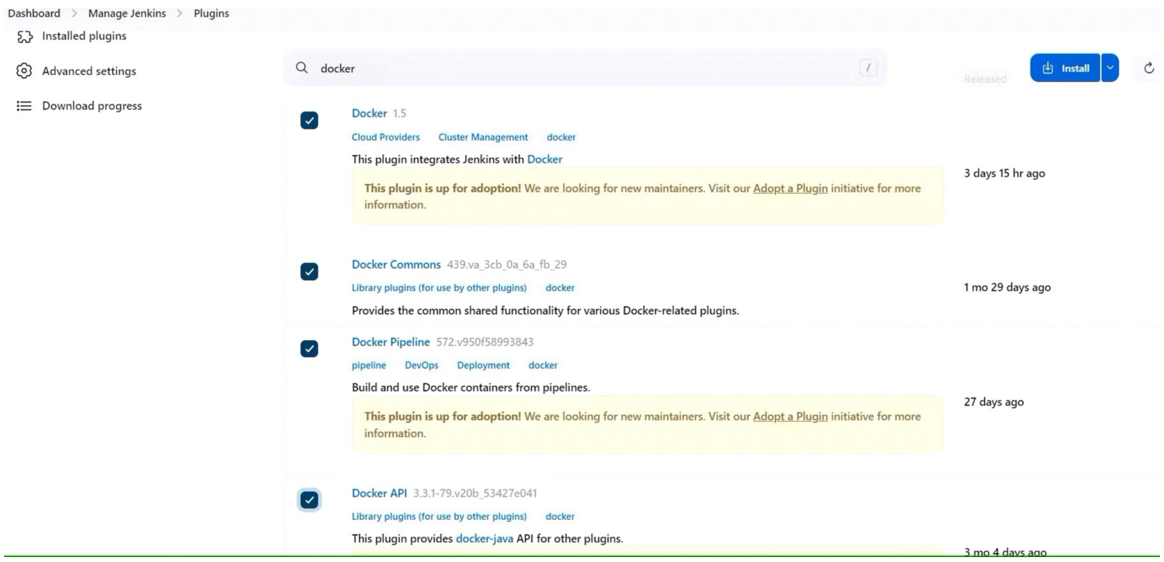
`Docker Commons`

`Docker Pipeline`

`Docker API`

`docker-build-step`

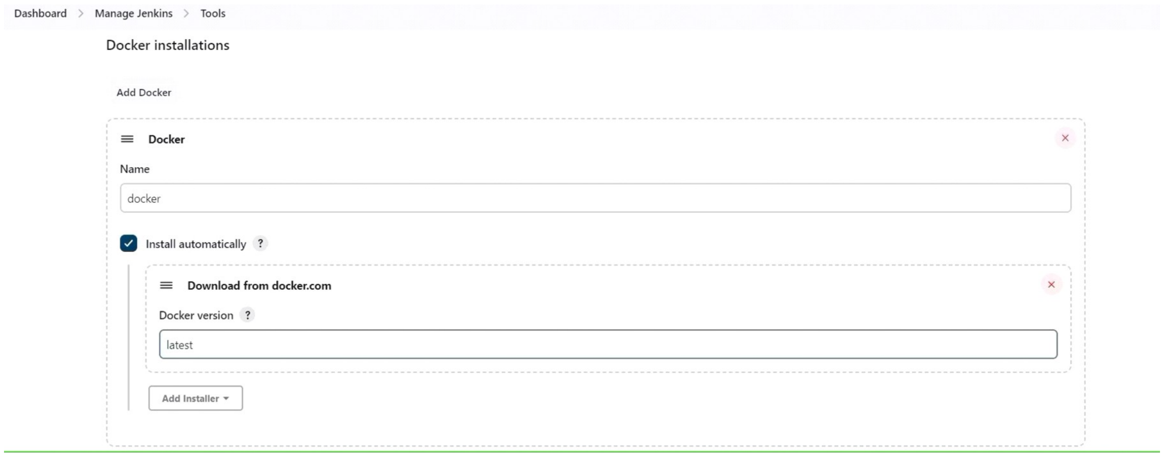
and click on install without restart


Dashboard > Manage Jenkins > Plugins

docker

- [✓] Docker 1.5 — Cloud Providers, Cluster Management, docker — This plugin integrates Jenkins with Docker — **This plugin is up for adoption!** We are looking for new maintainers. Visit our Adopt a Plugin initiative for more information. — 3 days 15 hr ago
- [✓] Docker Commons 439.va_3cb_0a_6a_fb_29 — Library plugins (for use by other plugins), docker — Provides the common shared functionality for various Docker-related plugins. — 1 mo 29 days ago
- [✓] Docker Pipeline 572.v950f58993843 — pipeline, DevOps, Deployment, docker — Build and use Docker containers from pipelines. — **This plugin is up for adoption!** We are looking for new maintainers. Visit our Adopt a Plugin initiative for more information. — 27 days ago
- [✓] Docker API 3.3.1-79.v20b_53427e041 — Library plugins (for use by other plugins), docker — This plugin provides docker-java API for other plugins. — 3 mo 4 days ago

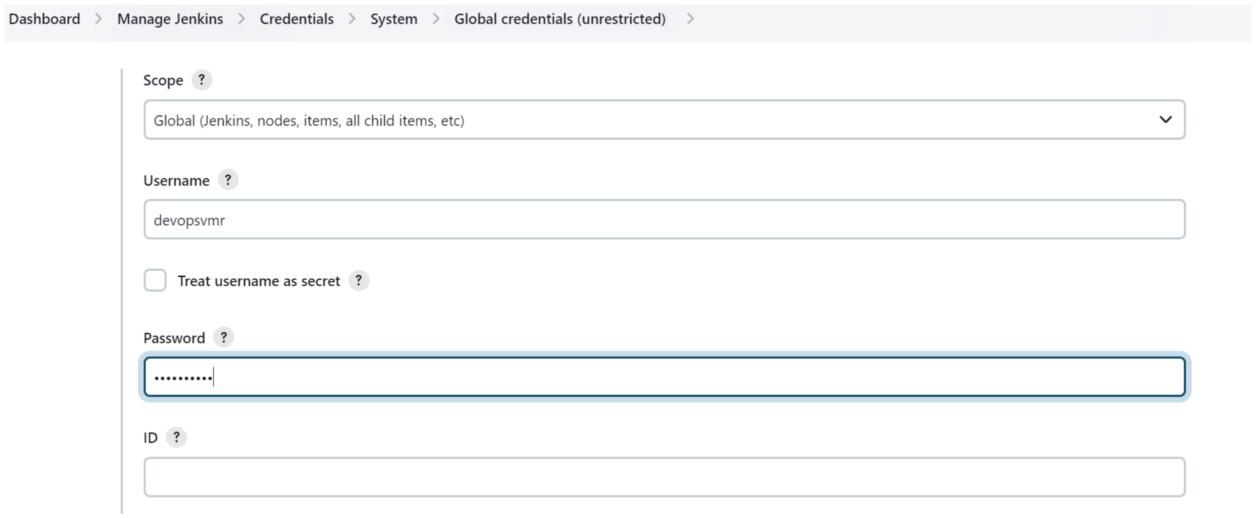
Now, goto Dashboard → Manage Jenkins → Tools →


Dashboard > Manage Jenkins > Tools

Docker installations

Docker
Name: docker
[✓] Install automatically
Download from docker.com
Docker version: latest

Add DockerHub Username and Password under Global Credentials

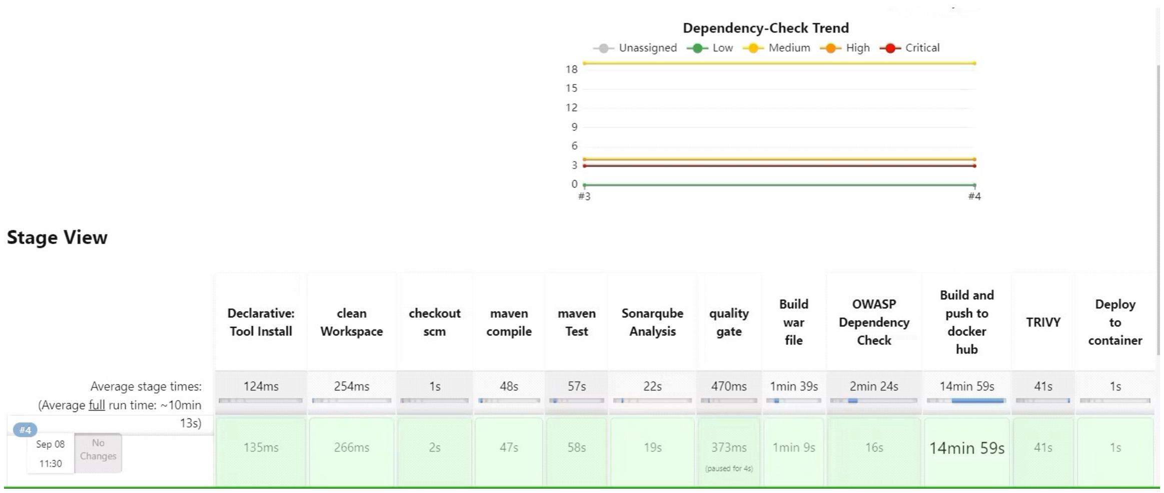

Dashboard > Manage Jenkins > Credentials > System > Global credentials (unrestricted) >

Scope: Global (Jenkins, nodes, items, all child items, etc)
Username: devopsvmr
[ ] Treat username as secret
Password: ••••••••••
ID:

Add this stage to Pipeline Script

```
stage ('Build and push to docker hub'){
      steps{
        script{
          withDockerRegistry(credentialsId: 'docker', toolName: 'docker') {
            sh "docker build -t petshop ."
            sh "docker tag petshop devopsvmr/petshop:latest"
            sh "docker push devopsvmr/petshop:latest"
         }
        }
      }
    }
    stage("TRIVY"){
      steps{
        sh "trivy image devopsvmr/petshop:latest > trivy.txt"
      }
    }
    stage ('Deploy to container'){
      steps{
        sh 'docker run -d --name pet1 -p 8080:8080 devopsvmr/petshop:latest'
      }
    }
```

You will see the output below, with a dependency trend.

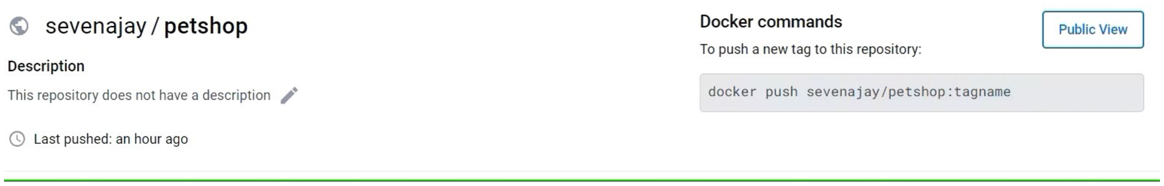


Stage View

	Declarative: Tool Install	clean Workspace	checkout scm	maven compile	maven Test	Sonarqube Analysis	quality gate	Build war file	OWASP Dependency Check	Build and push to docker hub	TRIVY	Deploy to container
Average stage times: (Average full run time: ~10min 13s)	124ms	254ms	1s	48s	57s	22s	470ms	1min 39s	2min 24s	14min 59s	41s	1s
#4 Sep 08 11:30 No Changes	135ms	266ms	2s	47s	58s	19s	373ms (paused for 4s)	1min 9s	16s	14min 59s	41s	1s

Now, when you do

When you log in to Dockerhub, you will see a new image is created



sevenajay / **petshop**

Description

This repository does not have a description

Last pushed: an hour ago

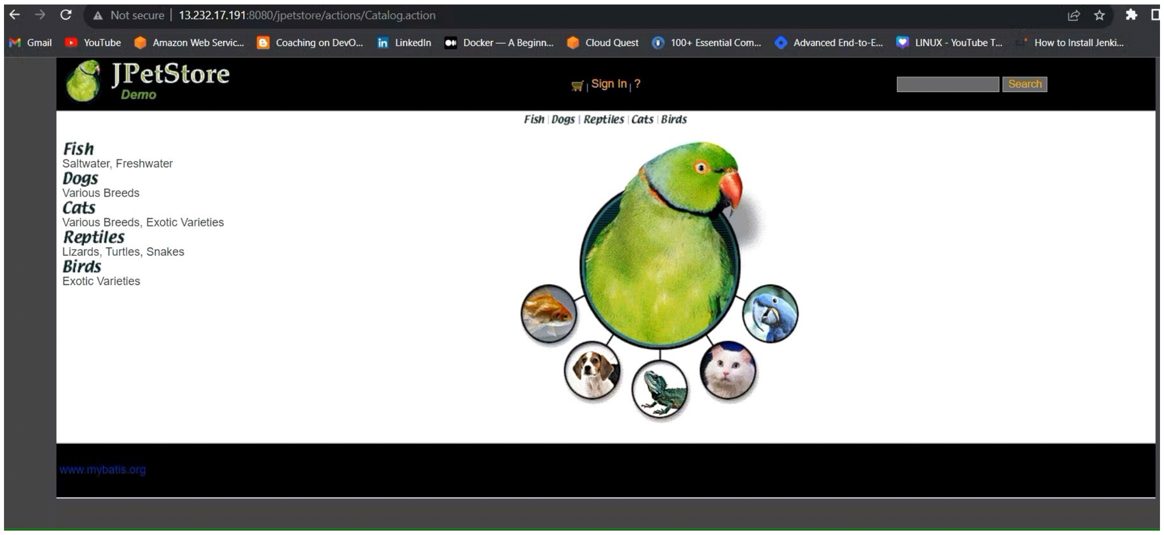
Docker commands

To push a new tag to this repository:

```
docker push sevenajay/petshop:tagname
```

`<Ec2-public-ip:8080/jpetstore>`

You will get this output


Not secure | 13.232.17.191:8080/jpetstore/actions/Catalog.action
Gmail
YouTube
Amazon Web Servic...
Coaching on DevO...
LinkedIn
Docker — A Beginn...
Cloud Quest
100+ Essential Com...
Advanced End-to-E...
LINUX - YouTube T...
How to Install Jenki...
JPetStore Demo
Sign In | ?
Search
Fish | Dogs | Reptiles | Cats | Birds
Fish
Saltwater, Freshwater
Dogs
Various Breeds
Cats
Various Breeds, Exotic Varieties
Reptiles
Lizards, Turtles, Snakes
Birds
Exotic Varieties
www.mybatis.org