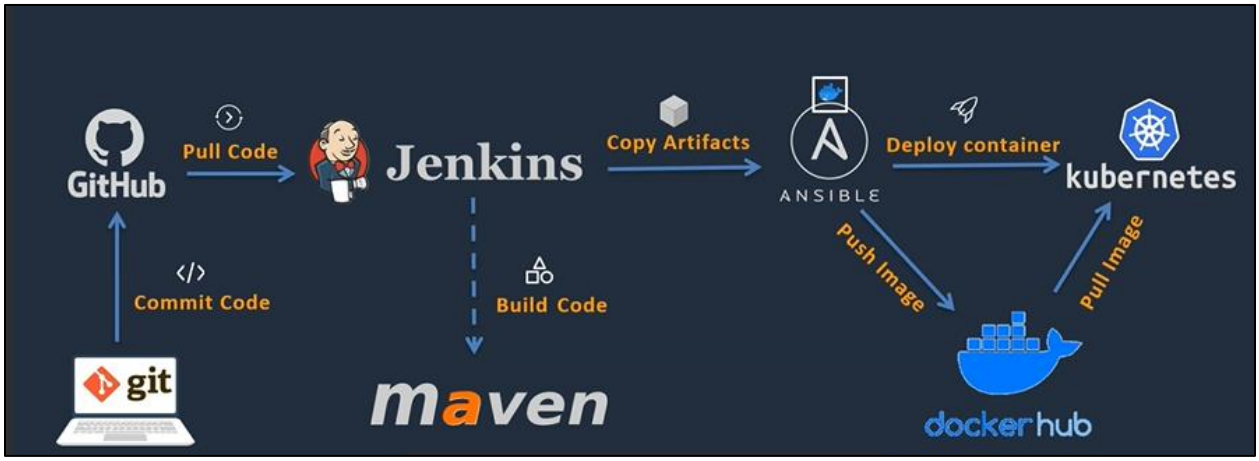
DevOps Project 1

Overview

This project involved setting up a Continuous Integration (CI) and Continuous Deployment (CD) pipeline to automate the deployment process of our applications.

Project Details



In this project, our objective is to establish a CI/CD pipeline to streamline the deployment process. Whenever alterations are made to the source code, they are promptly committed to our GitHub repository.

Subsequently, Jenkins is configured to fetch the code, utilize Maven for building, resulting in the generation of artifacts in the form of a .war file. These artifacts are then forwarded to the Ansible Server.

Concurrently, an Ansible playbook is executed to construct an image incorporating the artifacts, which is then committed to the Docker Hub repository.

Furthermore, we've implemented a CD job that can be initiated through Jenkins. This job triggers an Ansible Playbook, orchestrating the deployment and service files on our Kubernetes cluster.

Setup Jenkins Server

- Setup a Linux EC2 Instance.
- Install JAVA.
- Install Jenkins.
- Access Web UI on port 8080.

Steps to follow:

Create a 2 AWS EC2 Instance.

Commands:

sudo yum update -y
sudo yum upgrade -y
sudo nano /etc/hostname --- #change the hostname to Jenkins master.
sudo init 6 --- #To restart the machine

Command to Install Java:
yum install java-17 -y

Command to Install Jenkins:

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
sudo yum install fontconfig java-17-openjdk
sudo yum install jenkins
sudo systemctl daemon-reload

jenkins --version
systemctl start jenkins --#To start the Jenkins

--# Now Jenkins is set up. Copy the Public key of the Jenkins Master and run on the browser.
Ex - 3.110.42.120:8080

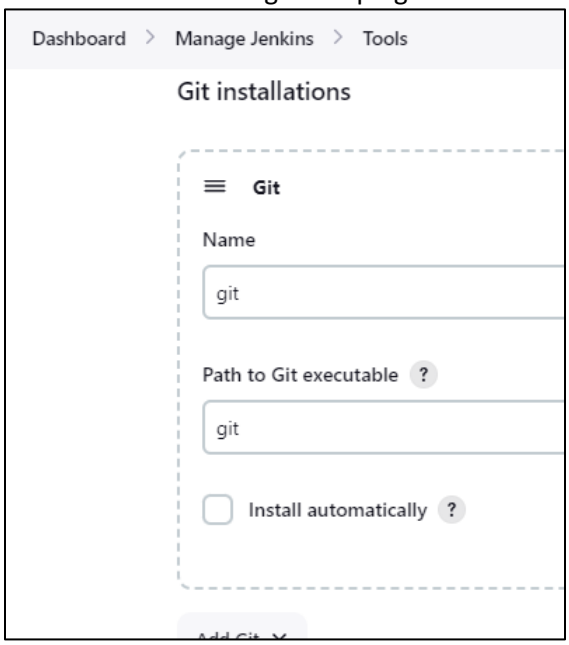
cat /var/lib/jenkins/secrets/initialAdminPassword --#Get the password.

Command to Install Git:

yum install git -y
git init --#To create the git repository
ls -a --# You will see the repository with .git

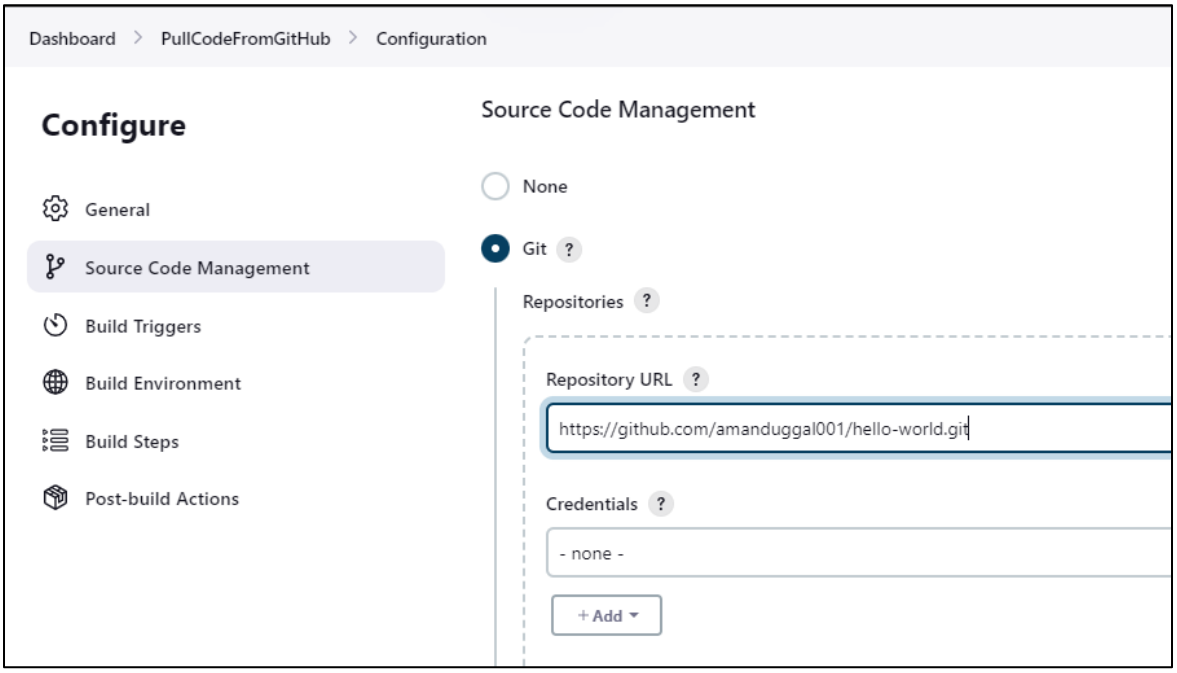
On Jenkins GUI -

Install the GitHub integration plugin.



Run Jenkins job to pull code from GitHub.

- Create a Job in Jenkins GUI.
- Add the Git Hub Repository - https://github.com/amanduggal001/hello-world.git



Console Output

```
Started by user Aman Duggal
Running as SYSTEM
Building in workspace /var/lib/jenkins/workspace/PullCodeFromGitHub
The recommended git tool is: NONE
No credentials specified
 > git rev-parse --resolve-git-dir /var/lib/jenkins/workspace/PullCodeFromGitHub/.git # timeout=10
Fetching changes from the remote Git repository
 > git config remote.origin.url https://github.com/amanduggal001/hello-world.git # timeout=10
Fetching upstream changes from https://github.com/amanduggal001/hello-world.git
 > git --version # timeout=10
 > git --version # 'git version 2.40.1'
 > git fetch --tags --force --progress -- https://github.com/amanduggal001/hello-world.git
+refs/heads/*:refs/remotes/origin/* # timeout=10
 > git rev-parse refs/remotes/origin/master^{commit} # timeout=10
Checking out Revision aacc9fa39ba3ca8f46cfd0019f35ce4511287375 (refs/remotes/origin/master)
 > git config core.sparsecheckout # timeout=10
 > git checkout -f aacc9fa39ba3ca8f46cfd0019f35ce4511287375 # timeout=10
Commit message: "updated pom.xml file"
 > git rev-list --no-walk aacc9fa39ba3ca8f46cfd0019f35ce4511287375 # timeout=10
Finished: SUCCESS
```

Integrate Maven with Jenkins

- Setup Maven on Jenkins Server.
- Setup Environment Variables
  JAVA_HOME, M2, M2_HOME
- Install Maven plugin.
- Configure Maven and Java.

Commands:

cd /opt
wget https://dlcdn.apache.org/maven/maven-3/3.9.6/binaries/apache-maven-3.9.6-bin.tar.gz --#To download the maven.
tar -xzvf apache-maven-3.9.6-bin.tar.gz --#To unzip the tar file.
rm -rf apache-maven-3.9.6-bin.tar.gz --#To remove the tar file.

When you download or clone raw code, it comes in a folder. This folder is inside Jenkins, and it contains all the code, like the POM.xml file and source code.

Next, when we ask Jenkins to build, it uses Maven (mvn) on that folder where the POM.xml file is. Maven reads the POM.xml file and follows the instructions inside. It builds, compiles, and tests the code accordingly.

Now, the question is, can we access Maven (mvn)on the entire terminal so far? To check follow the below steps.

cd /opt
./mvn --version --#You can't access the mvn in/opt folder.
cd /opt/apache-maven-3.9.6/bin
./mvn --version --#You can access the mvn in bin folder.

It means the mvn is accessible only from the particular bin folder not on entire terminal.

Now we need to define a path (Environment Variable), for mvn, so that the Jenkins can call the mvn from their location and start building.

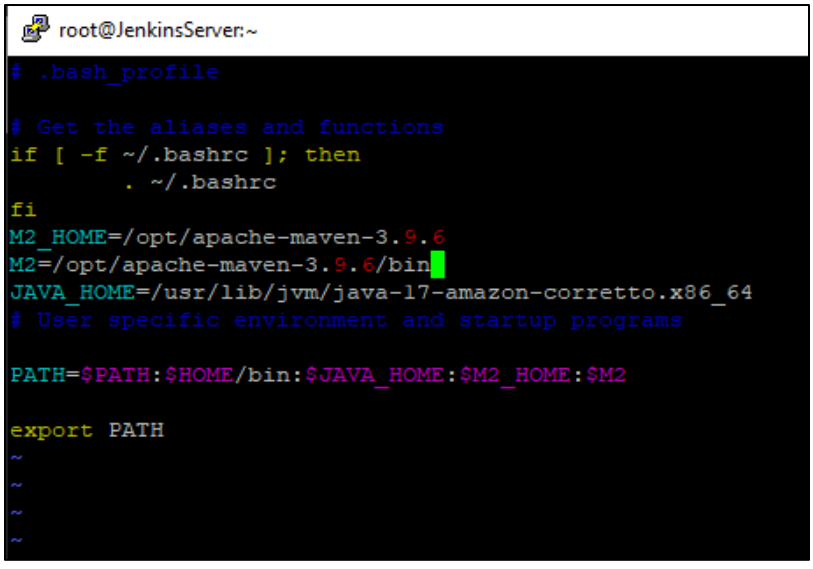
cd ~
vi .bash_profile --#Set the mvn path here

find / -name java-17* --#To find location where the java is installed.

M2_HOME=/opt/apache-maven-3.9.6
M2=/opt/apache-maven-3.9.6/bin
JAVA_HOME=/usr/lib/jvm/java-17-amazon-corretto.x86_64
# User specific environment and startup programs

PATH=$PATH:$HOME/bin:$JAVA_HOME:$M2_HOME:$M2

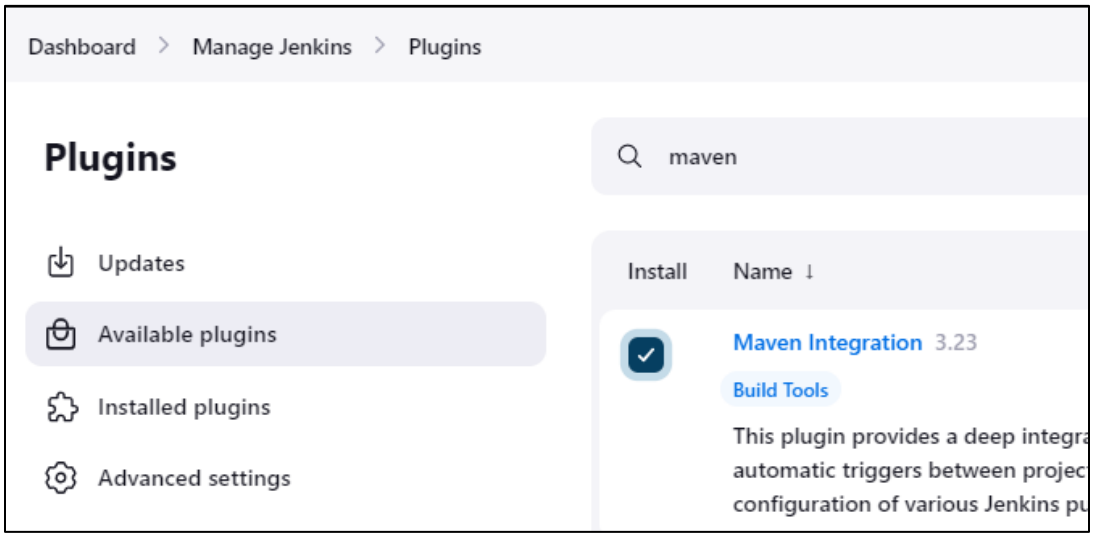
export PATH



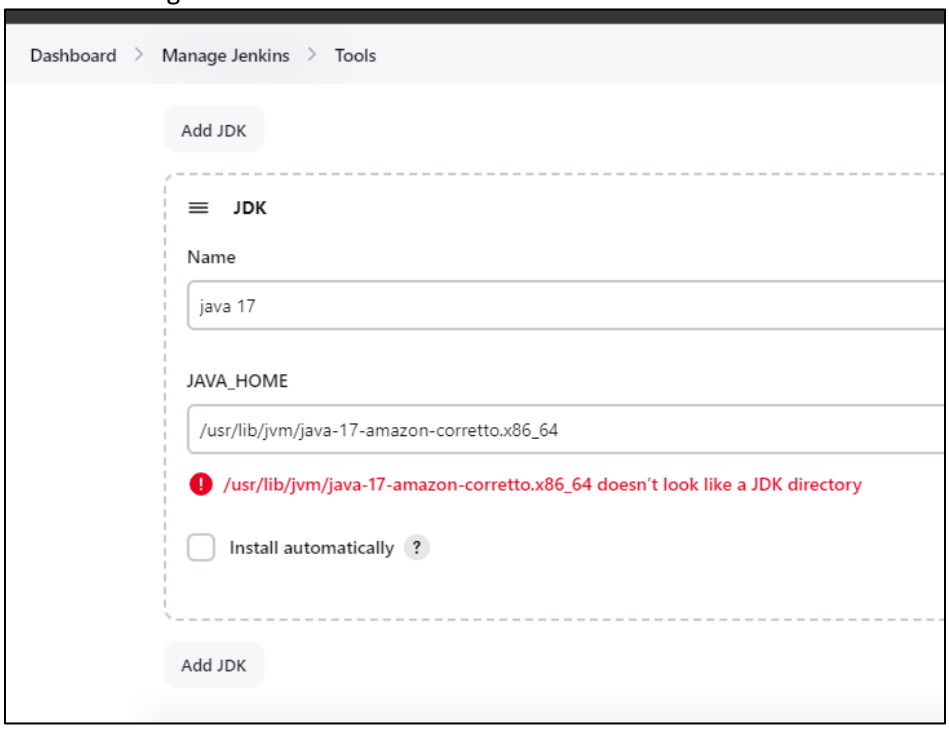
source .bash_profile --#It refresh the .bash_profile, what changes we made in the file. (Source command is used tpo read the file)
Mvn --version --# Validate if the mvn is calling on other folders now.

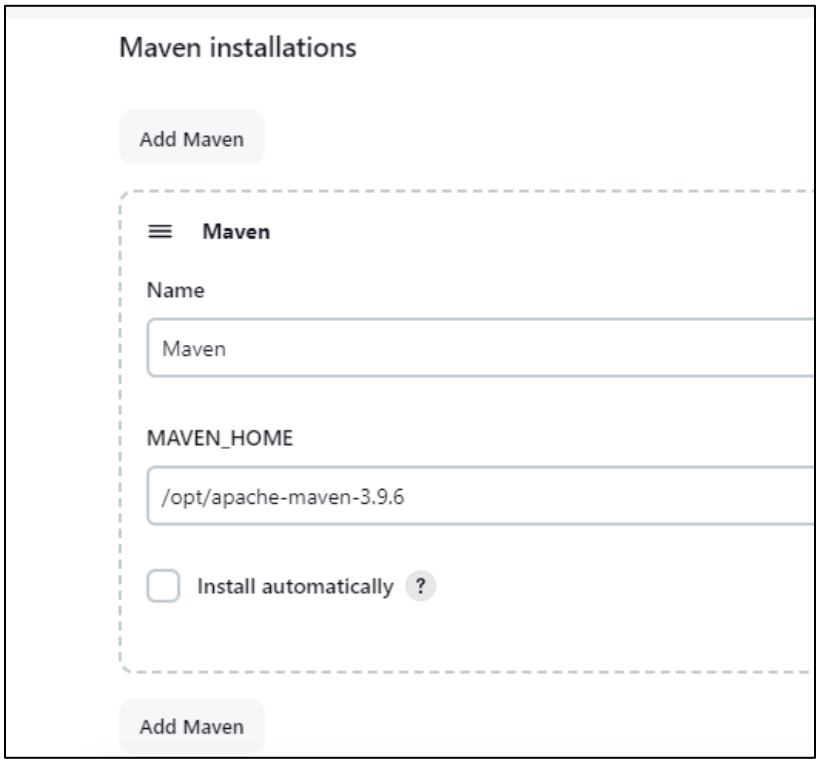
Integrate Git and Maven to Jenkins

- Go to Jenkins UI.
- Manage Jenkins > Plugins > Install Maven Integration.



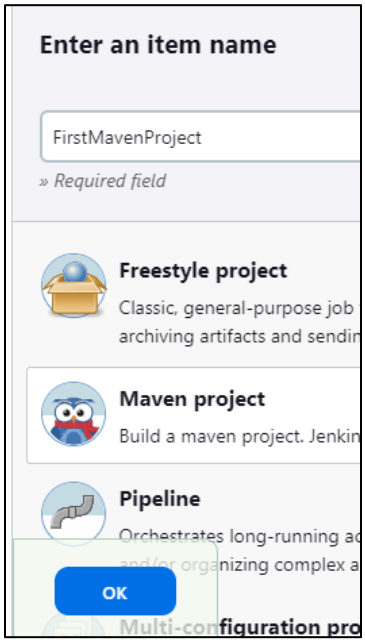
- Manage Jenkins> Tools > Add JDK and Maven Details.



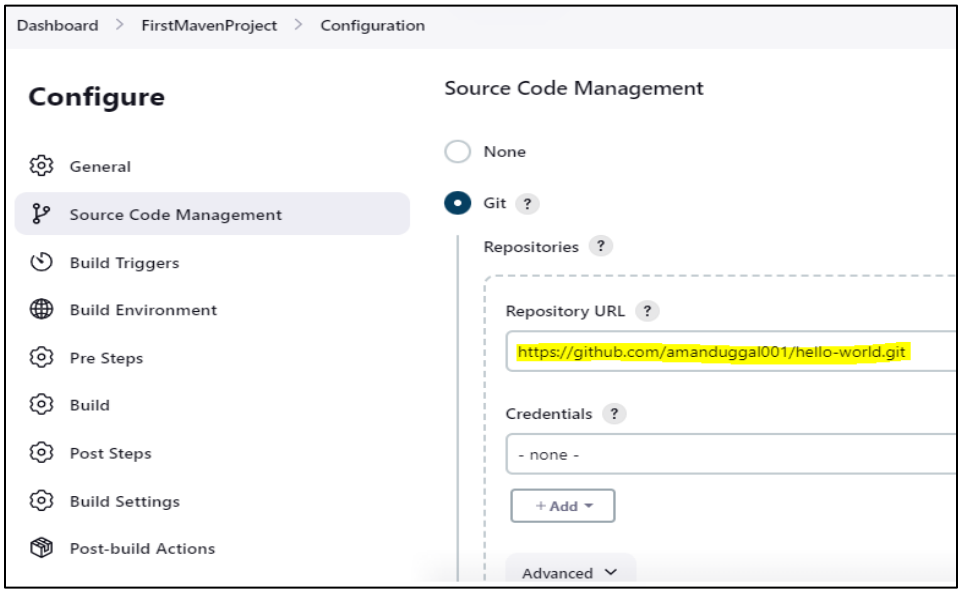


Build a java project using Jenkins

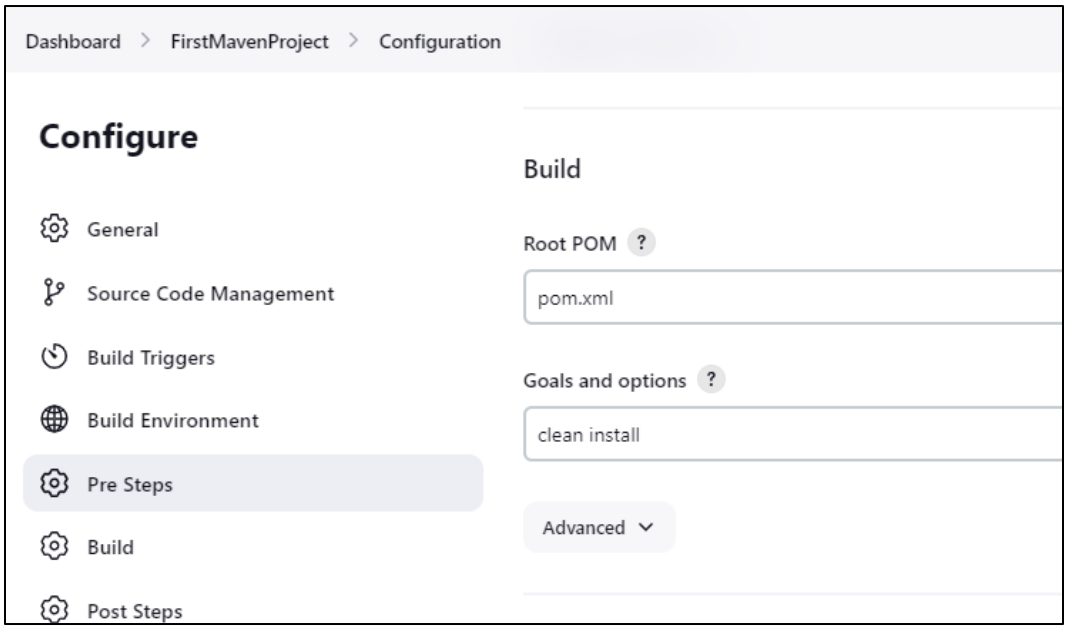
- Go to Jenkins UI > New Item > Create a new Job using Maven Project.



- First Select the Git.



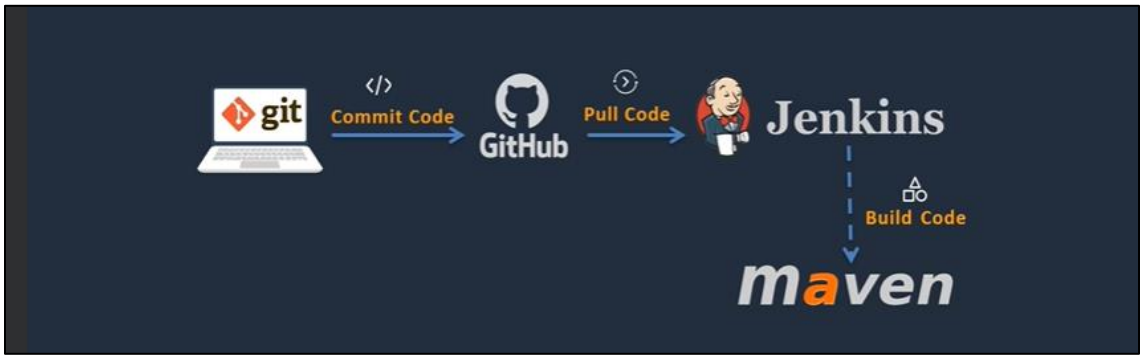
- Enter the command for maven build in the goals and option.
  Clean install --# This command creates the packages and stores in the local repository.



- After build the .war file is created under the below location.

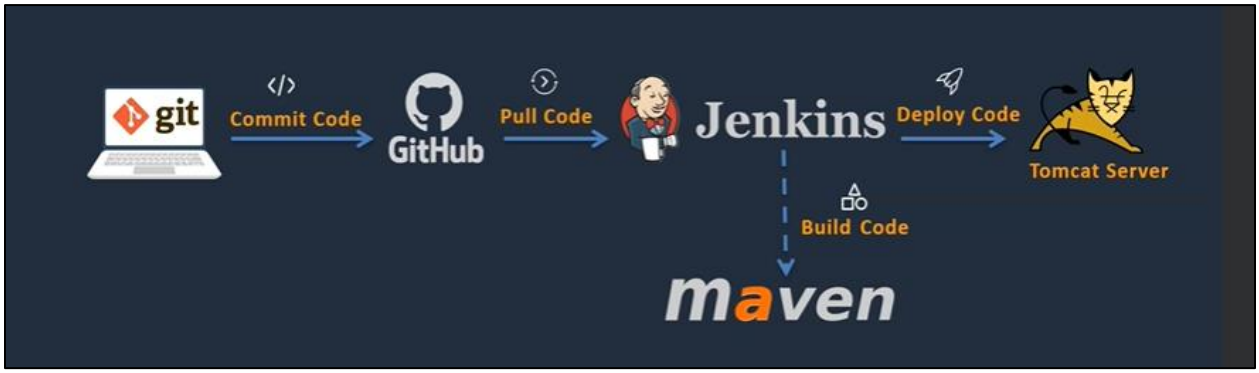
/var/lib/jenkins/workspace/FirstMavenProject/webapp/target/webapp.war

```
Console Output
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  18.038 s
[INFO] Finished at: 2024-03-08T17:38:27Z
[INFO] ------------------------------------------------------------------------
Waiting for Jenkins to finish collecting data
[JENKINS] Archiving /var/lib/jenkins/workspace/FirstMavenProject/webapp/pom.xml to com.example.maven-project/webapp/1.0-SNAPSHOT/webapp-1.0-SNAPSHOT.pom
[JENKINS] Archiving /var/lib/jenkins/workspace/FirstMavenProject/webapp/target/webapp.war to com.example.maven-project/webapp/1.0-SNAPSHOT/webapp-1.0-SNAPSHOT.war
[JENKINS] Archiving /var/lib/jenkins/workspace/FirstMavenProject/server/pom.xml to com.example.maven-project/server/1.0-SNAPSHOT/server-1.0-SNAPSHOT.pom
[JENKINS] Archiving /var/lib/jenkins/workspace/FirstMavenProject/server/target/server.jar to com.example.maven-project/server/1.0-SNAPSHOT/server-1.0-SNAPSHOT.jar
[JENKINS] Archiving /var/lib/jenkins/workspace/FirstMavenProject/pom.xml to com.example.maven-project/maven-project/1.0-SNAPSHOT/maven-project-1.0-SNAPSHOT.pom
channel stopped
Finished: SUCCESS
```



Deployment Artifacts on a Tomcat Server

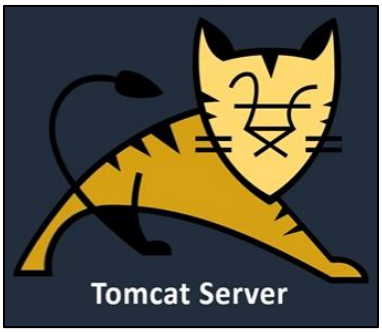
-



Till Now, we have build our code. Now how we can deploy our code on the target environment.

As a target environment we are going to use the **Tomcat Server**.

Setup Tomcat Server



- Setup a Linux EC2 Instance.
- Install Java.
- Configure Tomcat.
- Start Tomcat Server.
- Access Web UI on port 8080.

Steps to follow:

- Create an EC2 instance.

Commands:

sudo yum update -y
sudo yum upgrade -y
sudo nano /etc/hostname --- #change the hostname to Jenkins master
sudo init 6 --- #To restart the machine

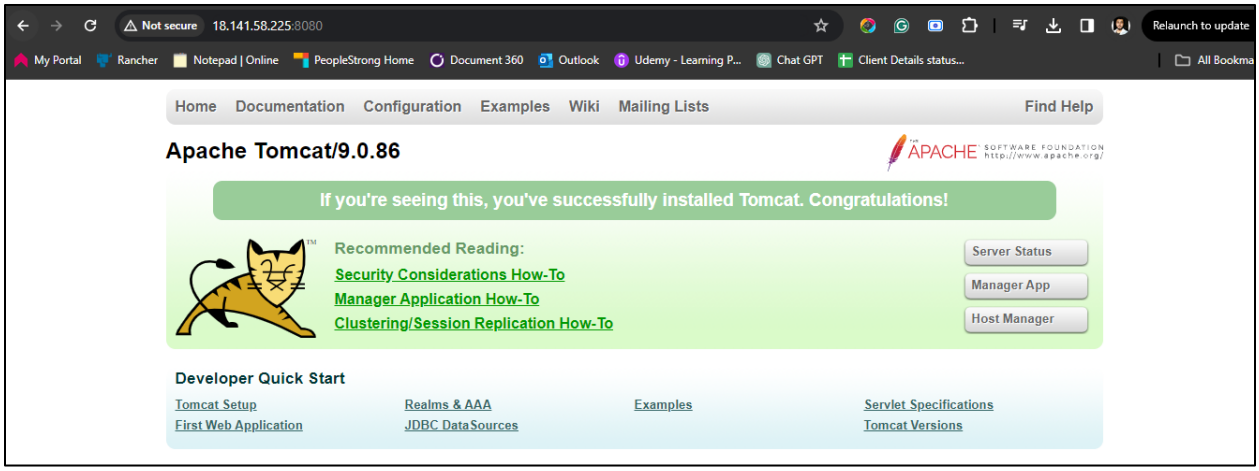
Install Java
yum install java-17 -y

Install Tomcat
wget https://downloads.apache.org/tomcat/tomcat-9/v9.0.86/bin/apache-tomcat-9.0.86.tar.gz
tar -xvzf apache-tomcat-9.0.86.tar.gz
cd /apache-tomcat-9.0.86/bin
./startup.sh --#To start the Tomcat Services

```
[root@TomcatServer bin]# ./startup.sh
Using CATALINA_BASE:   /home/ec2-user/apache-tomcat-9.0.86
Using CATALINA_HOME:   /home/ec2-user/apache-tomcat-9.0.86
Using CATALINA_TMPDIR: /home/ec2-user/apache-tomcat-9.0.86/temp
Using JRE_HOME:        /
Using CLASSPATH:       /home/ec2-user/apache-tomcat-9.0.86/bin/bootstrap.jar:/home/ec2-user/apache-tomcat-9.0.86/bin/tomcat-juli.jar
Using CATALINA_OPTS:
Tomcat started.
```

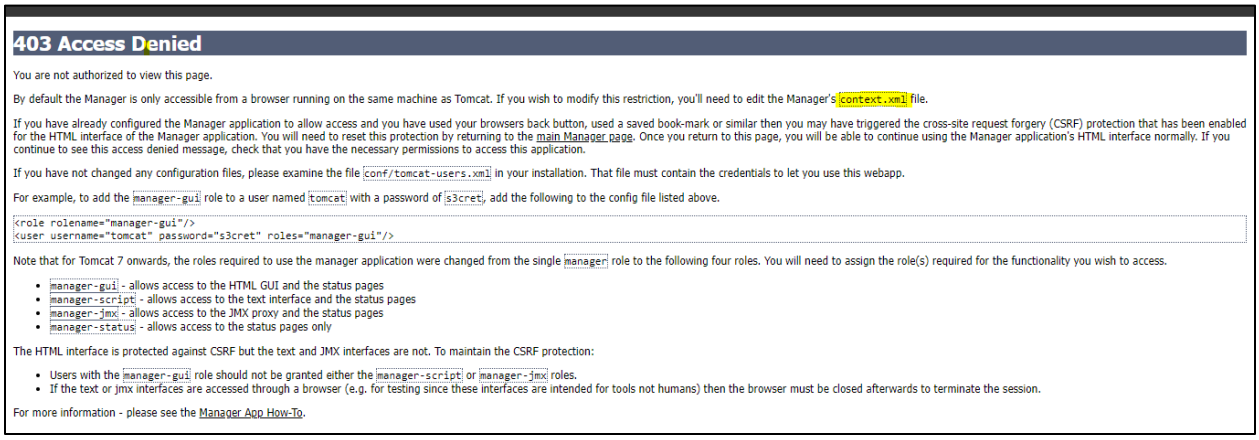
- Now go to browser > Copy the Public IP of Tomcat Server

  Example: 18.141.58.225:8080



- Click on Manager App.

You will get the 403 Forbidden. This is because by default the manager is only accessible from the browser running on the same mission as Tomcat.



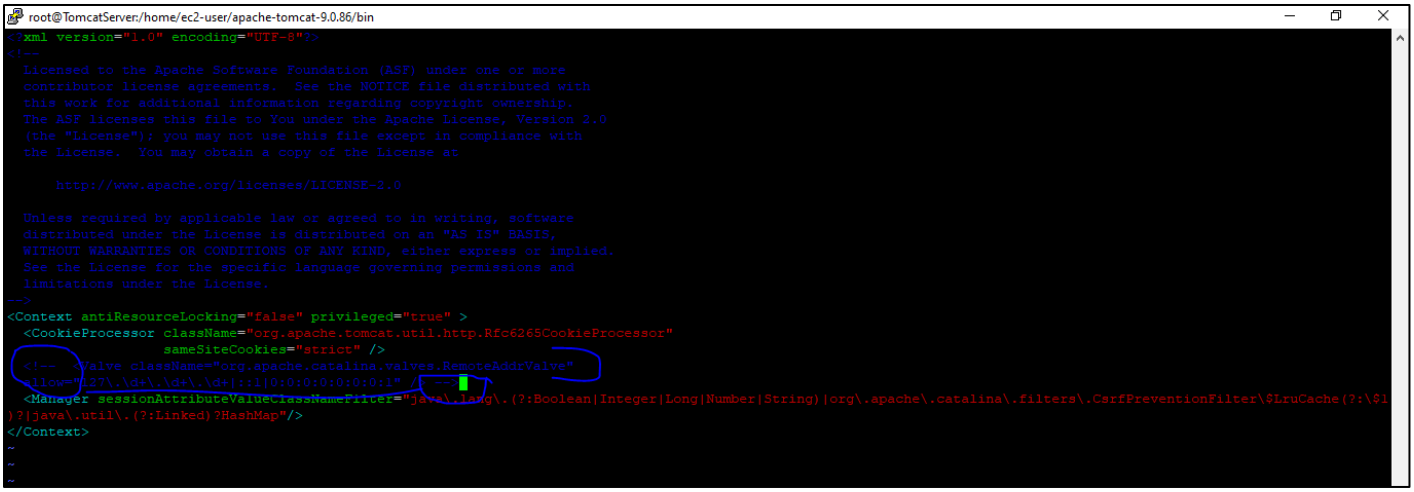
To Access tomcat outside of the tomcat server. Follow the below steps.

find / -name context.xml --# To find the location on the file.

vi /home/ec2-user/apache-tomcat-9.0.86/webapps/host-manager/META-INF/context.xml

Comment Out below line which means that the tomcat will be allowed to run from the localhost only.

<!-- <Valve className="org.apache.catalina.valves.RemoteAddrValve"
allow="127\.\d+\.\d+\.\d+|::1|0:0:0:0:0:0:0:1" /> -->



Same steps perform in another manager app.

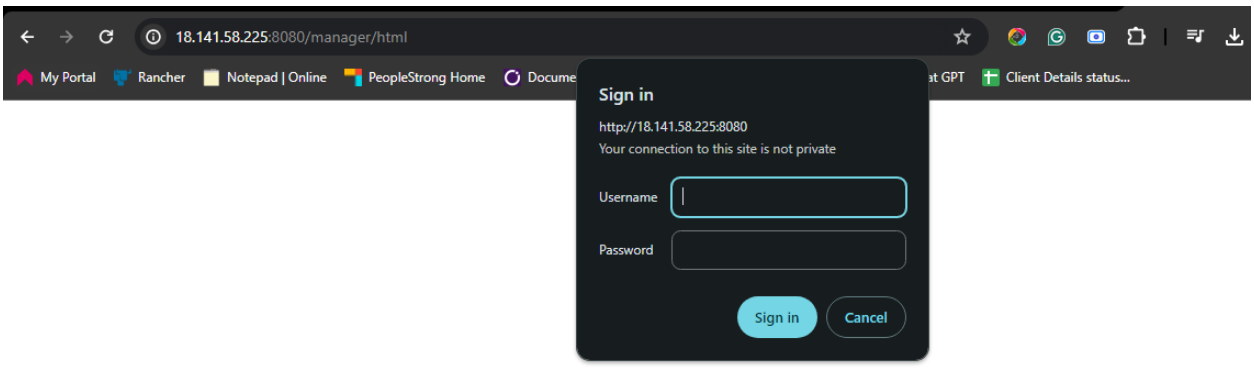
vi /home/ec2-user/apache-tomcat-9.0.86/webapps/manager/META-INF/context.xml

<!-- <Valve className="org.apache.catalina.valves.RemoteAddrValve"
allow="127\.\d+\.\d+\.\d+|::1|0:0:0:0:0:0:0:1" /> -->

Now restart the Tomcat services.

cd /apache-tomcat-9.0.86/bin
./shutdown.sh --#To Shutdown service
./startup.sh --#To Start the service

Now when you click on Manager App, it will ask you for credentials.



Update user's information in the tomcat-users.xml file. Go to tomcat home directory and add below users to conf/tomcat-users.xml file. --#Add roles and users in the user.xml file

<role rolename="manager-gui"/>
<role rolename="manager-script"/>
<role rolename="manager-jmx"/>
<role rolename="manager-status"/>
<user username="admin" password="Ammy@567" roles="manager-gui, manager-script, manager-jmx, manager-status"/>--#Enter Password.
<user username="deployer" password="Ammy@567" roles="manager-script"/> --#Enter Password.
<user username="tomcat" password="Ammy@567" roles="manager-gui"/> --#Enter Password.

```
  The sample user and role entries below are intended for use with the
  examples web application. They are wrapped in a comment and thus are ignored
  when reading this file. If you wish to configure these users for use with the
  examples web application, do not forget to remove the <!.. ..> that surrounds
  them. You will also need to set the passwords to something appropriate.
-->
<!--
  <role rolename="tomcat"/>
  <role rolename="role1"/>
  <user username="tomcat" password="<must-be-changed>" roles="tomcat"/>
  <user username="both" password="<must-be-changed>" roles="tomcat,role1"/>
  <user username="role1" password="<must-be-changed>" roles="role1"/>
-->

<role rolename="manager-gui"/>
<role rolename="manager-script"/>
<role rolename="manager-jmx"/>
<role rolename="manager-status"/>
<user username="admin" password="Ammy@567" roles="manager-gui, manager-script, manager-jmx, manager-status"/>
<user username="deployer" password="Ammy@567" roles="manager-script"/>
<user username="tomcat" password="Ammy@567" roles="manager-gui"/>

</tomcat-users>
```

cd /apache-tomcat-9.0.86/bin
./shutdown.sh --#To Shutdown service
./startup.sh --#To Start the service

Now login with:

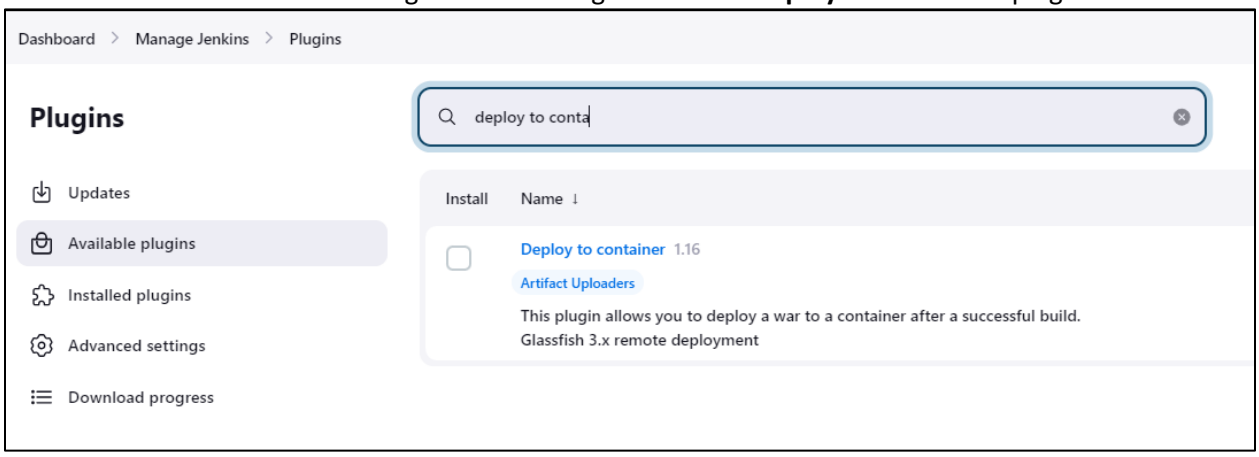
tomcat
Ammy@567

Integrate Tomcat with Jenkins

- Install **“Deploy to container”.**
- Configure Tomcat server with Credentials.

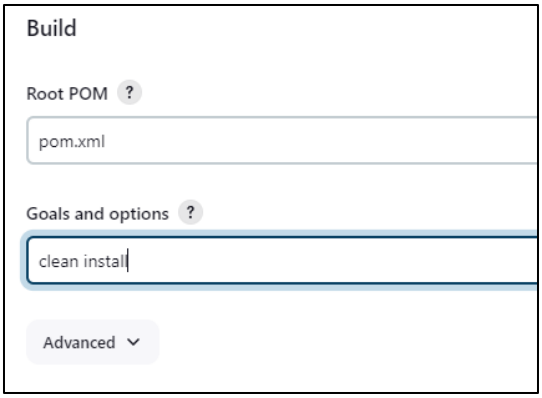
Steps to follow:

- Go to Jenkins GUI > Manage Jenkins > Plugins > Install **'Deploy To container'** plugin.

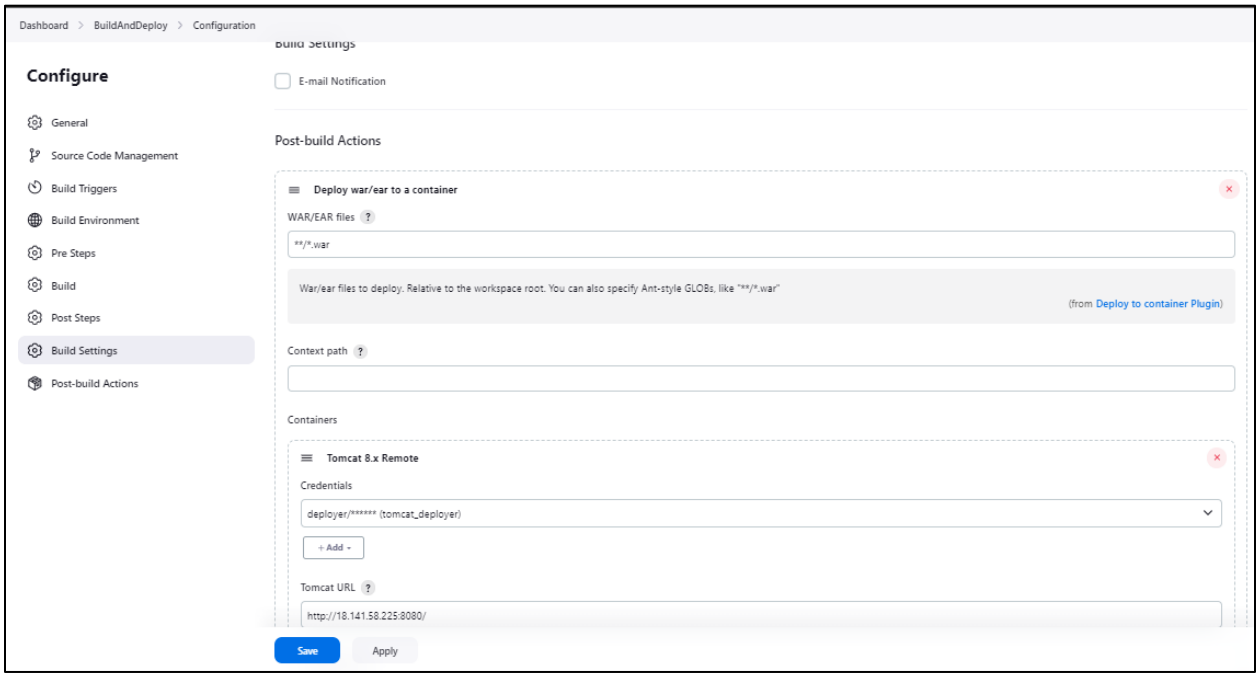


- Manage Jenkins > Credentials > System > Global credentials (unrestricted) > Add Credentials

- Now create new job **'BuildAndDeploy'** > Use Maven job.



- Select **'Deploy war/ear to a container'** in Post Build Action under Build Settings.
- Enter the path where the .war file is created.
  /var/lib/jenkins/workspace/FirstMavenProject/webapp/target/webapp.war
  Enter only --****/*.war**
- Now add **'Tomcat 8.x'** Remote in Containers.
- Select the credentials which we define for tomcat in Jenkins GUI.
- Now enter the tomcat URL.
  http://18.141.58.225:8080/
- Apply > Save.
- Build now.



In the tomcat server the .war file will be created in the below location:
/apache-tomcat-9.0.86/webapps

```
[root@TomcatServer apache-tomcat-9.0.86]# ls
bin             CONTRIBUTING.md  logs        RELEASE-NOTES  webapps
BUILDING.txt    lib              NOTICE      RUNNING.txt    work
conf            LICENSE          README.md   temp
[root@TomcatServer apache-tomcat-9.0.86]# cd webapps
[root@TomcatServer webapps]# ls
docs  examples  host-manager  manager  ROOT  webapp  webapp.war
[root@TomcatServer webapps]#
```

Now in Tomcat the webapp is visible and when you click on it you will see the outputs.

Tomcat Web Application Manager

Message:	OK

Manager			
List Applications	HTML Manager Help	Manager Help	Server Status

Applications

Path	Version	Display Name	Running	Sessions	Commands
/	*None specified*	Welcome to Tomcat	true	0	Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes
/docs	*None specified*	Tomcat Documentation	true	0	Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes
/examples	*None specified*	Servlet and JSP Examples	true	0	Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes
/host-manager	*None specified*	Tomcat Host Manager Application	true	0	Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes
/manager	*None specified*	Tomcat Manager Application	true	1	Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes
/webapp	*None specified*	Webapp	true	0	Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes

New user Register for DevOps Learning

Please fill in this form to create an account.

Enter Name Enter Full Name
Enter mobile Enter moible number
Enter Email Enter Email
Password Enter Password
Repeat Password Repeat Password

By creating an account you agree to our Terms & Privacy.

Register

Already have an account? Sign in.

Thankyou, Happy Learning

Now if you want to change the code which you are viewing in the tomcat server.

- Pull this code onto the local workstation.
- Update the code and commit it on GitHub.
- Once it is committed, we can compile and build our code with the help of maven.
- Create a folder in your local system and copy the path in the Git Bash App.

cd D:/AWS/DevOps Project --#Change \ fwd slash to / bckwd slash, because it is treated as a Linux.

```
Aman.Duggal@AmanD-OEG MINGW64 ~
$ cd D:/AWS/DevopsProject

Aman.Duggal@AmanD-OEG MINGW64 /d/AWS/DevopsProject
$
```

- git clone https://github.com/amanduggal001/hello-world.git

```
Aman.Duggal@AmanD-OEG MINGW64 /d/AWS/DevopsProject
$ git clone https://github.com/amanduggal001/hello-world.git
Cloning into 'hello-world'...
remote: Enumerating objects: 333, done.
remote: Total 333 (delta 0), reused 0 (delta 0), pack-reused 333
Receiving objects: 100% (333/333), 35.85 KiB | 2.39 MiB/s, done.
Resolving deltas: 100% (74/74), done.
```

- cd /hello-world/webapp/src/main/webapp
- vi index.jsp
- Change the code - copy code from https://www.geeksforgeeks.org/html-registration-form/

git status

```
Aman.Duggal@AmanD-OEG MINGW64 /d/AWS/DevopsProject/hello-world/webapp/src/main/webapp (master)
$ git status
On branch master
Your branch is up to date with 'origin/master'.

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        modified:   index.jsp

no changes added to commit (use "git add" and/or "git commit -a")
```

git add .
git status

```
Aman.Duggal@AmanD-OEG MINGW64 /d/AWS/DevopsProject/hello-world/webapp/src/main/webapp (master)
$ git status
On branch master
Your branch is up to date with 'origin/master'.

Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        modified:   index.jsp
```

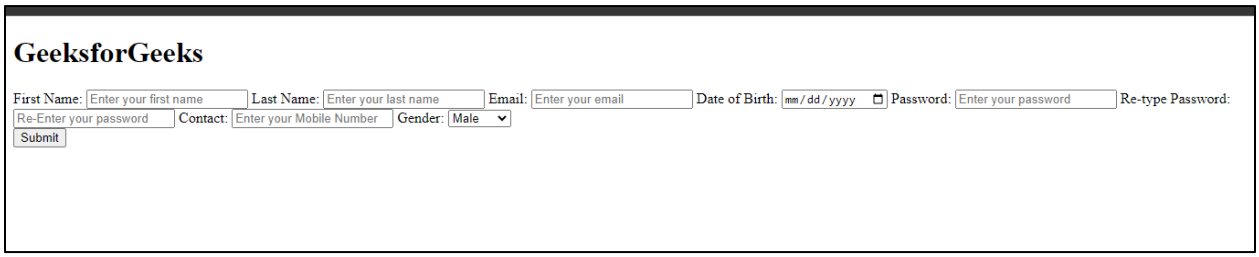
git commit -m "updated index.jsp file"

```
Aman.Duggal@AmanD-OEG MINGW64 /d/AWS/DevopsProject/hello-world/webapp/src/main/webapp (master)
$ git commit -m "updated index.jsp file"
[master 0c63047] updated index.jsp file
 Committer: Aman Duggal <Aman.Duggal@businessnext.com>
Your name and email address were configured automatically based
on your username and hostname. Please check that they are accurate.
You can suppress this message by setting them explicitly. Run the
following command and follow the instructions in your editor to edit
your configuration file:

    git config --global --edit

After doing this, you may fix the identity used for this commit with:

    git commit --amend --reset-author

 1 file changed, 74 insertions(+), 37 deletions(-)
```

git push origin master --#To push the code

Once Push the code will be updated in the github.

- Now Build the job **'BuildAndDeploy'**
- Open the Tomcat Server > Manager App > Webapp
- New Registration form will be open.



Now till here we are manually executing the job from jenkins whenever we are changing or update the code.

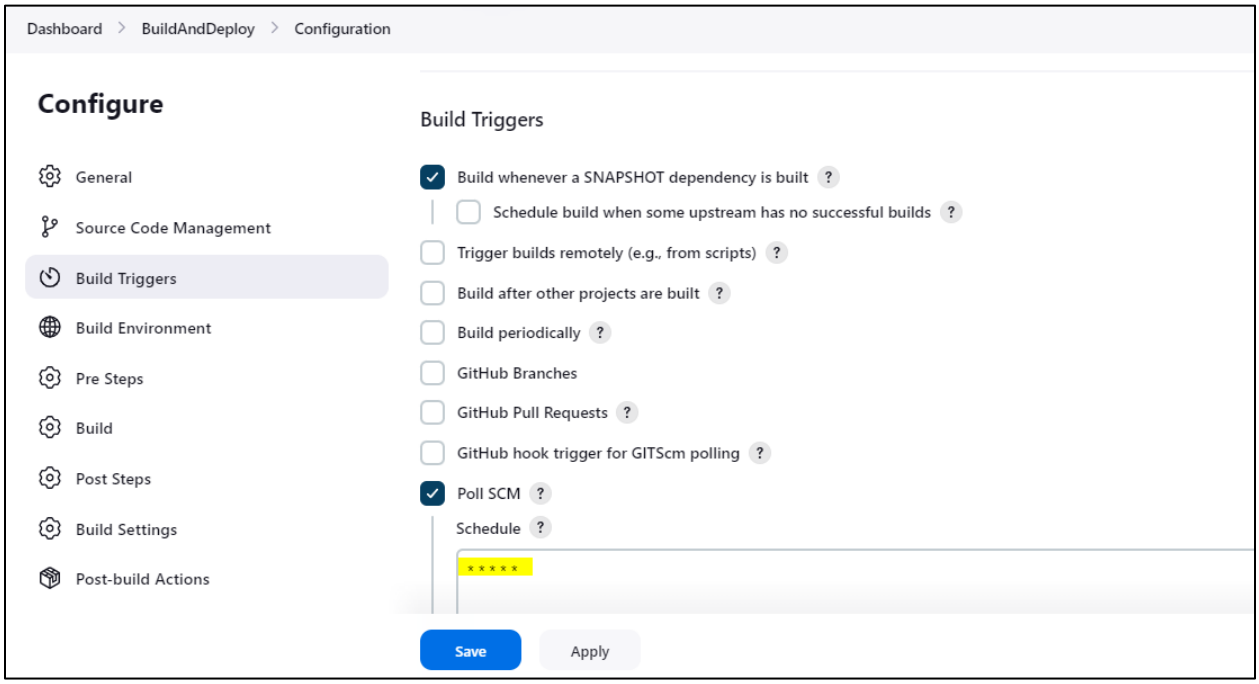
Our Purpose is whenever there is a change in GitHub it should automatically identify and execute the build job and deploy the code.

To do that Build triggers are used.

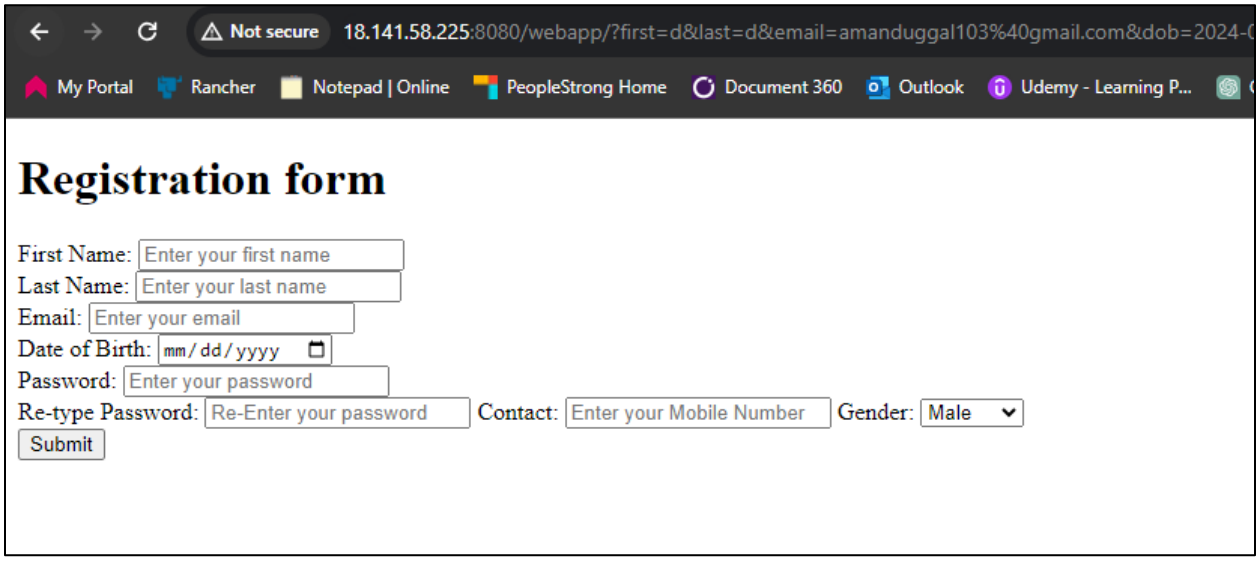
- Go to Jenkins > Configure the **'BuildAndDeploy'** job.
- In Build triggers select the **Poll SCM**.
  Poll SCM will validate whether there is any changes anywhere in repository or not in GitHub. If there are no changes, build is not going to happen.
  If there are some changes, build going to executed.

  Difference in Build periodically and Poll SCM is in Build periodically irrespective of any code change the build will be executed in the defined time period and in Poll SCM it will execute only when there is some changes.

- Select Poll SCM and enter * * * * *



Now whenever you made changes in code and push your code in GitHub the Jenkins will automatically build the job.



Setup Docker environment

Now we can deploy our code on Docker Container.

Setup Docker Host:

- Setup a Linux EC2 Instance.
- Install Docker.
- Start Docker Services.
- Basic docker commands.

Steps to follow:

- Create an EC2 instance for Docker.

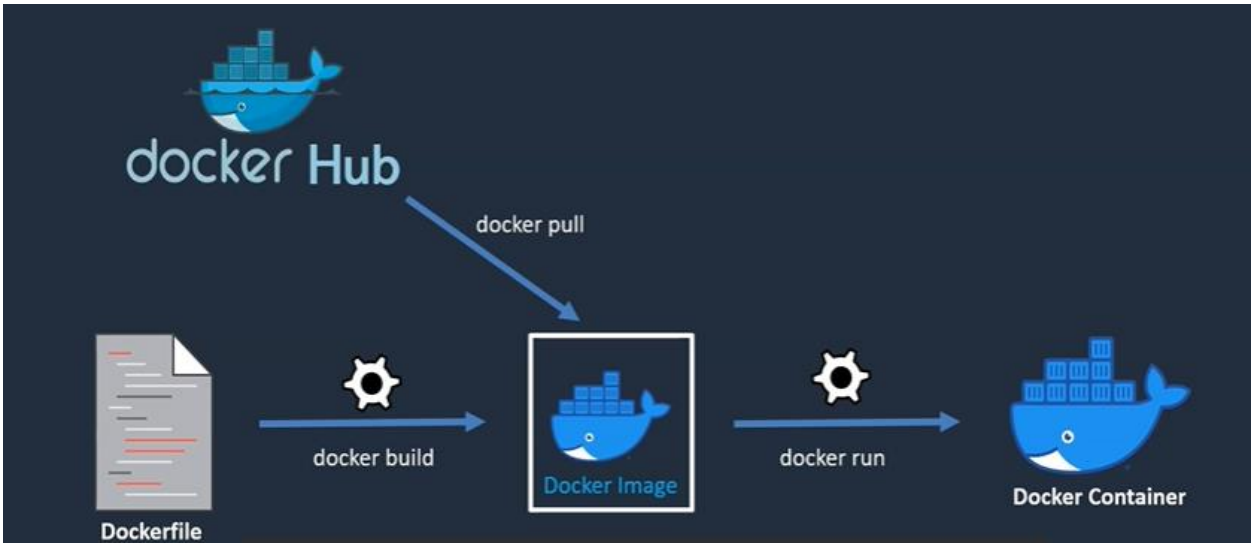
Commands:

```
sudo yum update -y
sudo yum upgrade -y
sudo nano /etc/hostname    --- #change the hostname to Jenkins master
sudo init 6  --- #To restart the machine
```

Installing Docker

```
yum install docker -y
docker --version

# start docker services
service docker start
service docker status
```

How to Create Docker Container



Docker pull tomcat
Docker images --#to view the images

```
[root@DockerServer ec2-user]# docker images
REPOSITORY   TAG       IMAGE ID       CREATED      SIZE
tomcat       latest    405afe63d576   2 days ago   455MB
```

Now convert this image to container.

docker run -d --name tomcat-container -p 8081:8080 tomcat

By default docker run on port no. 8080, similar way we need to specify on which port no. container is running.

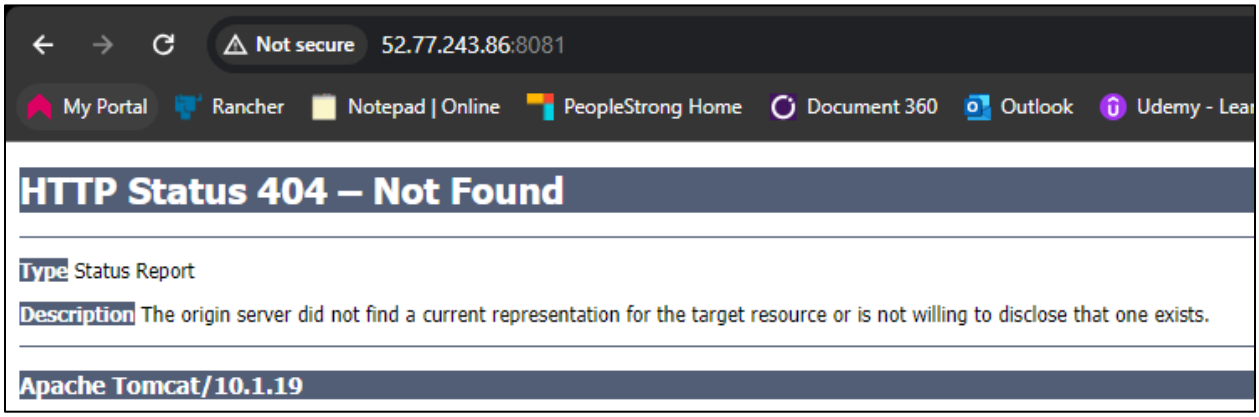
Container run inside the docker host, if you want to access it outside of the Docker host, then we need to map it to the external port, here we are using 8081.

It means that internally the tomcat is running on port number 8080, but externally we exposing it to the external network on port number 8081.

```
[root@DockerServer ec2-user]# docker run -d --name tomcat-container -p 8081:8080
 tomcat
c2f3354c16e8f94f5b5a1fe758676b05a502b8b2ab828d8970e7e01767cb2175
[root@DockerServer ec2-user]# docker ps
CONTAINER ID   IMAGE     COMMAND             CREATED         STATUS         PORT
S                                    NAMES
c2f3354c16e8   tomcat    "catalina.sh run"   6 seconds ago   Up 5 seconds   0.0.
0.0:8081->8080/tcp, :::8081->8080/tcp   tomcat-container
[root@DockerServer ec2-user]#
```

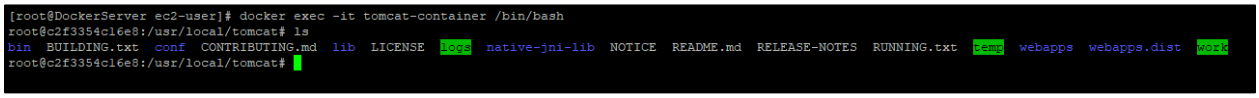
Now you can access your container outside the docker host.

On browser 52.77.243.86:8081 (Public IP:Port No.)



To Fix this issue, get into the docker container.

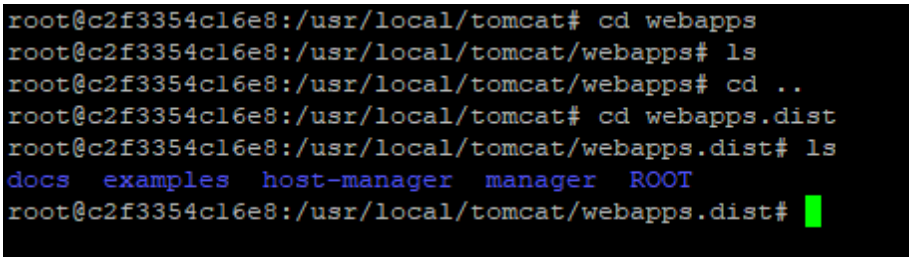
docker exec -it tomcat-container /bin/bash



We are facing this issue since, whenever we try to access Tomcat from the browser it will look into the application on webapps directory.
But if you go inside the webapps directory you don't see any contents. But they are keeping all the information under the webapps.dist directory.

Now go inside the webapps.dist directory.

cd webapps.dist

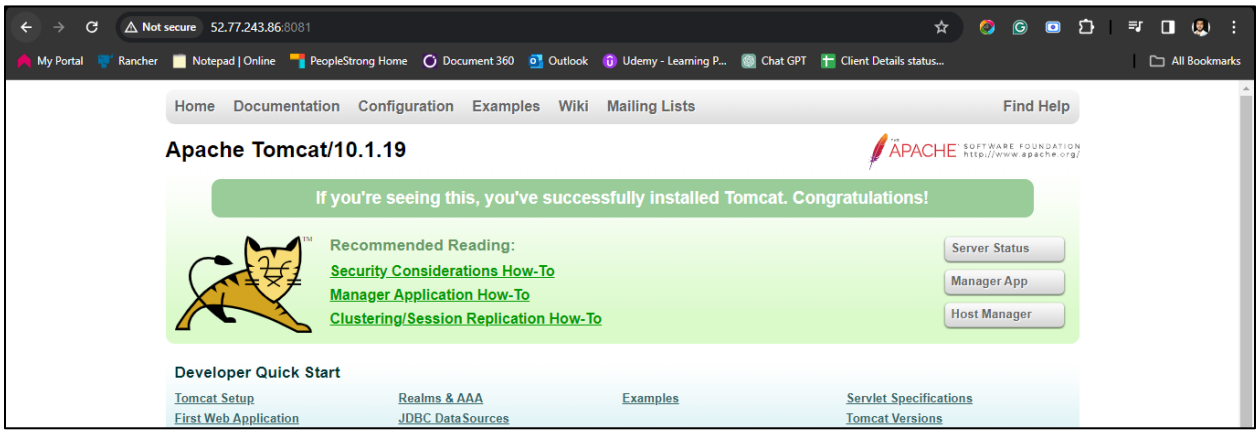


Copy the content into the webapps directory then only we can access our application.

cp -R * ../webapps/ --#copying all files and directories from the current directory to the "webapps" directory.

```
root@c2f3354c16e8:/usr/local/tomcat/webapps.dist# cp -R * ../webapps/
root@c2f3354c16e8:/usr/local/tomcat/webapps.dist# cd ..
root@c2f3354c16e8:/usr/local/tomcat# cd webapps
root@c2f3354c16e8:/usr/local/tomcat/webapps# ls
docs  examples  host-manager  manager  ROOT
root@c2f3354c16e8:/usr/local/tomcat/webapps#
```

Now you can view your application.

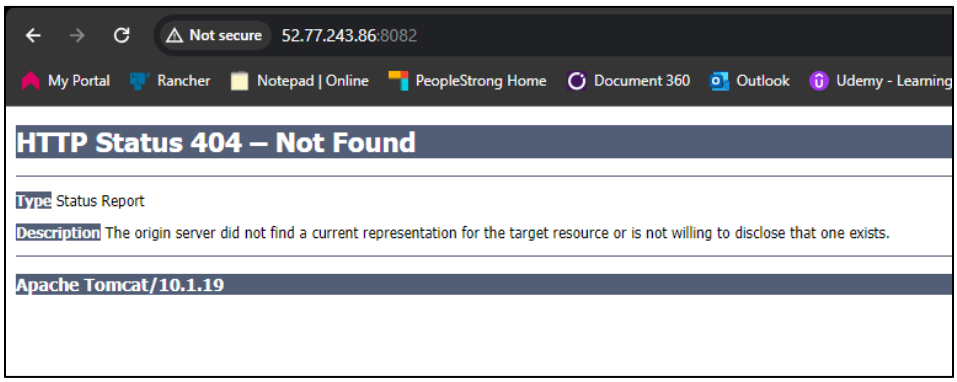


The changes we have made to the container is temporary.

Let's look.

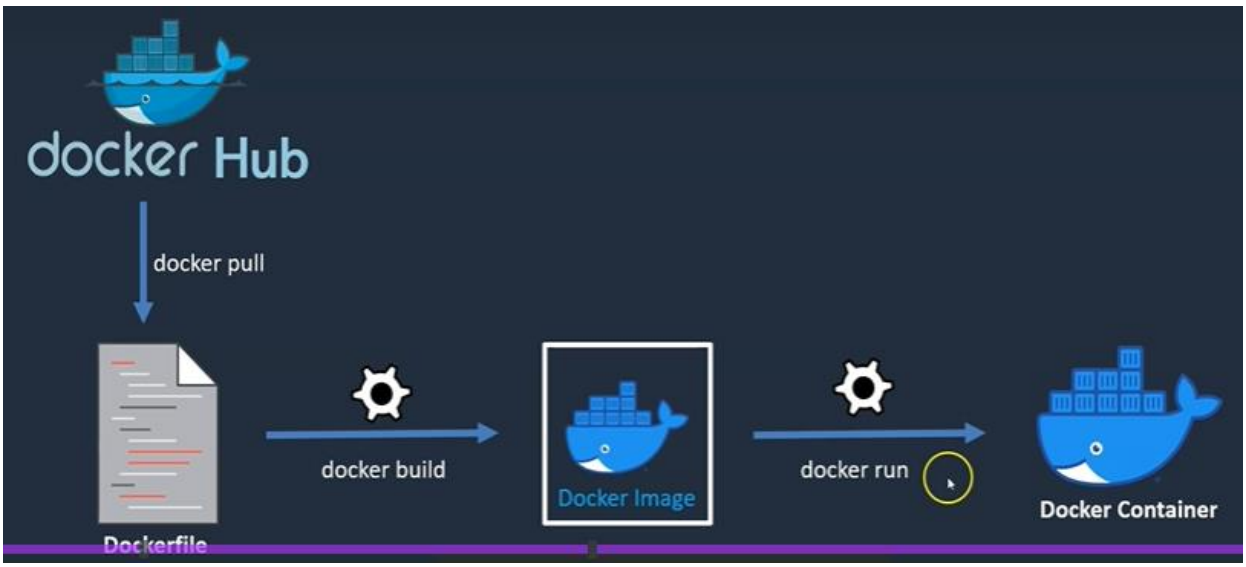
Exit --# To exit from existing container.
docker stop tomcat-container --#To stop the running container.
docker run -d --name tomcat2 -p 8082:8080 tomcat --#Create another container with the same image.

Now when you browse your container on browser you will get the same error, since we have fix the error only for the specific previous container.

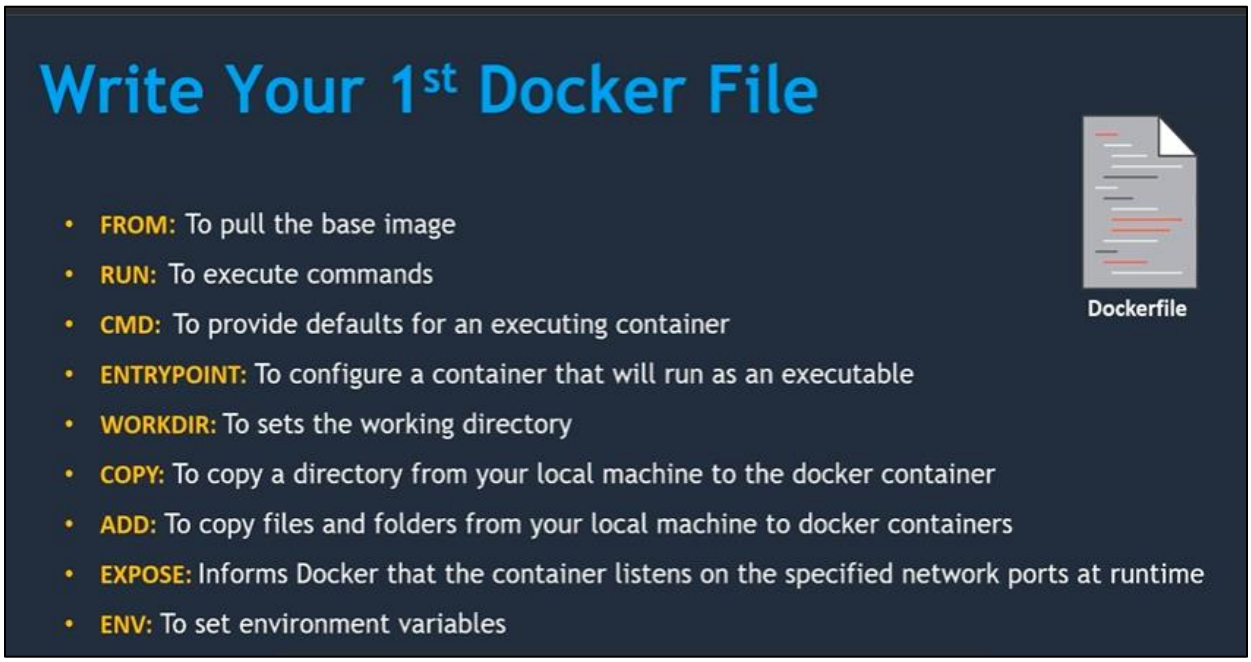


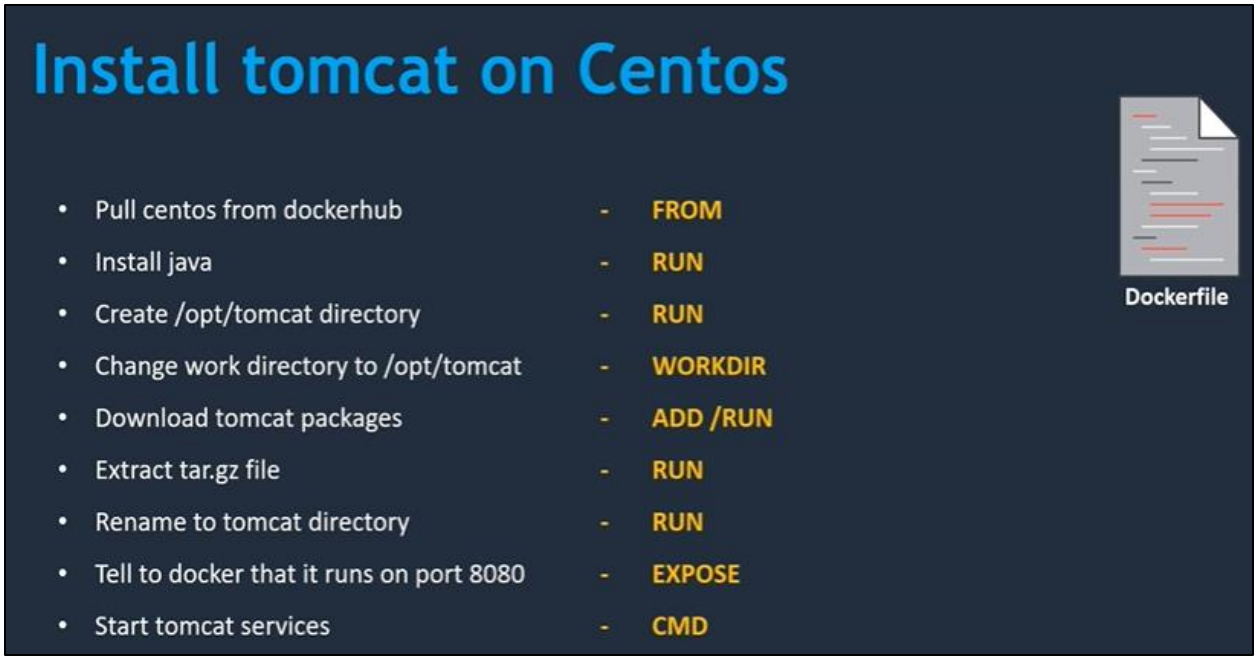
- To fix this permanently, we can create a docker file.
- Pull the tomcat image and will do the customization like copying the file from the webapp.dist to webapp so that the content will be accessible under webapps directory.
- Once, customization done we will create the docker image, so the changes will be captured.
- From the image we will launch the tomcat container.

How to create Docker Container



Create a first Docker file





--Note: This is the sample docker file for learning purpose we are using the centos instead of tomcat.
vi Dockerfile

```
FROM centos:latest

RUN cd /etc/yum.repos.d/
RUN sed -i 's/mirrorlist/#mirrorlist/g' /etc/yum.repos.d/CentOS-*
RUN sed -i 's|#baseurl=http://mirror.centos.org|baseurl=http://vault.centos.org|g'
/etc/yum.repos.d/CentOS-*

RUN yum -y install java
CMD /bin/bash
RUN mkdir /opt/tomcat
WORKDIR /opt/tomcat
ADD https://downloads.apache.org/tomcat/tomcat-9/v9.0.86/bin/apache-tomcat-9.0.86.tar.gz .
RUN tar -xvzf apache-tomcat-9.0.86.tar.gz
RUN mv apache-tomcat-9.0.86/* /opt/tomcat
EXPOSE 8080
CMD ["/opt/tomcat/bin/catalina.sh", "run"]
```

```
FROM centos:latest
RUN cd /etc/yum.repos.d/
RUN sed -i 's/mirrorlist/#mirrorlist/g' /etc/yum.repos.d/CentOS-*
RUN sed -i 's|#baseurl=http://mirror.centos.org|baseurl=http://vault.centos.org|g' /etc/yum.repos.d/CentOS-*
RUN yum -y install java
CMD /bin/bash
RUN mkdir /opt/tomcat
WORKDIR /opt/tomcat
ADD https://downloads.apache.org/tomcat/tomcat-9/v9.0.86/bin/apache-tomcat-9.0.86.tar.gz .
RUN tar -xvzf apache-tomcat-9.0.86.tar.gz
RUN mv apache-tomcat-9.0.86/* /opt/tomcat
EXPOSE 8080
CMD ["/opt/tomcat/bin/catalina.sh", "run"]
~
~
```

docker build -t mytomcat .

Open the browser and check publicip:portno, if the webpage is open or not.

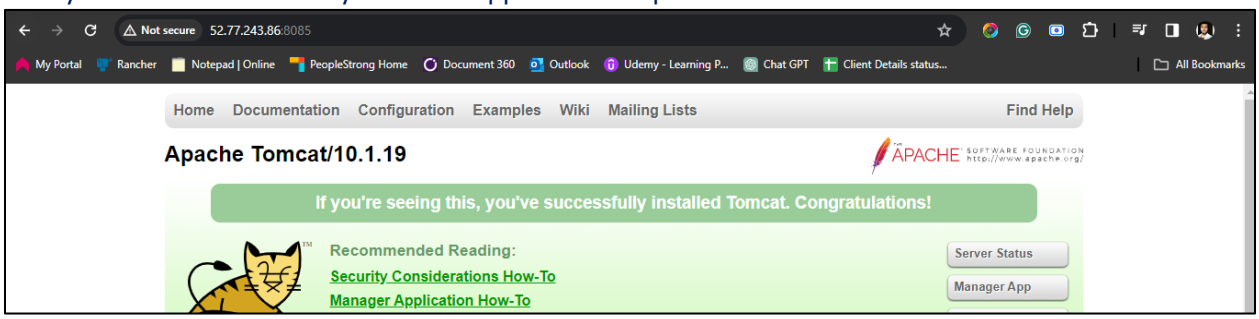
Now create Docker file

FROM tomcat:latest
RUN cp -R /usr/local/tomcat/webapps.dist/* /usr/local/tomcat/webapps

```
root@DockerServer:/home/ec2-user
FROM tomcat:latest
RUN cp -R  /usr/local/tomcat/webapps.dist/* /usr/local/tomcat/webapps
~
~
~
~
~
```

docker build -t mytomcatserver .
docker images
docker run -d --name tomcatcontainer -p 8085:8080 mytomcatserver

Now you will see without any error the application is open.



Integrate Docker with Jenkins

- Create a dockeradmin user.
- Install “Publish Over SSH” plugin.
- Add Dockerhist to Jenkins “Configure systems”.

Commands:

cat /etc/passwd --#shows list of users.
cat /etc/group --#show list of groups.

Now, we should create a user and add him to the Docker group (Docker group is by default present)

useradd dockeradmin --#To add user.
passwd dockeradmin --#To create password for the user
(Enter the password)

id dockeradmin --#it shows the users belong to which group.

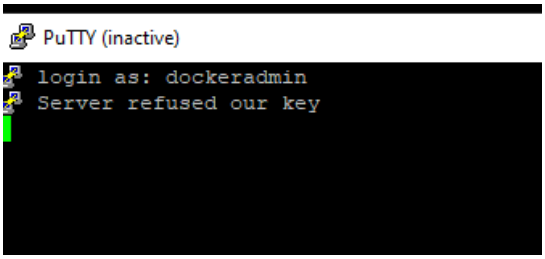
```
[root@DockerServer ec2-user]# id dockeradmin
uid=1001(dockeradmin) gid=1001(dockeradmin) groups=1001(dockeradmin)
[root@DockerServer ec2-user]#
```

By default, the dockeradmin user belongs to is default group i.e, dockeradmin. Now add the user to docker group.

usermod -aG docker dockeradmin --#This command will add the dockeradmin user to docker group.

Now, try to login with the dockeradmin user in docker server via putty.

Loginas: dockeradmin



Here, you are not allowed to login as dockeradmin user. This issue occurred, since the EC2 instances doesn't allow the password-based authentication. We should enable it.

--To enable it, Uncomment the **passwordauthentication yes** and comment the **passwordAuthentication no** in the sshd_config file.

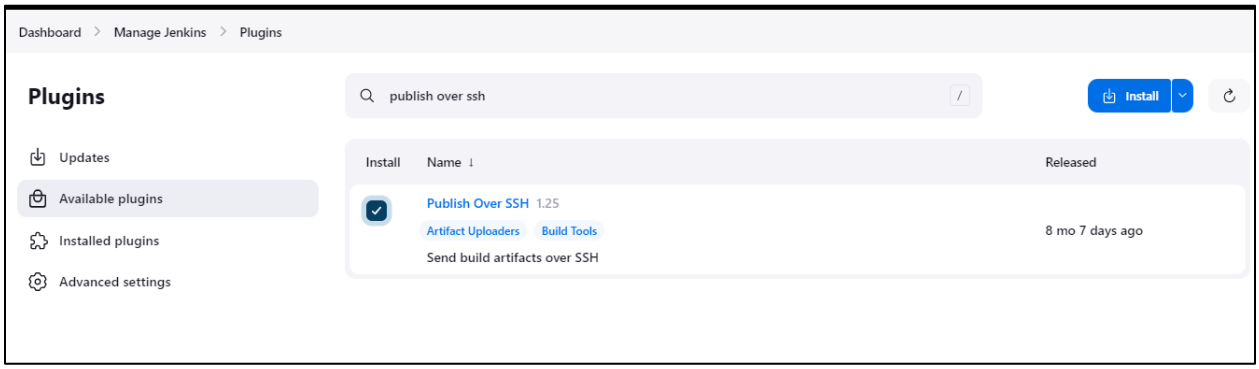
vi /etc/ssh/sshd_config

```
# HostbasedAuthentication
#IgnoreUserKnownHosts no
# Don't read the user's ~/.rhosts and ~/.shosts files
#IgnoreRhosts yes

# To disable tunneled clear text passwords, change to no here!
PasswordAuthentication yes
#PermitEmptyPasswords no
#PasswordAuthentication no

# Change to no to disable s/key passwords
#ChallengeResponseAuthentication yes
ChallengeResponseAuthentication no

# Kerberos options
#KerberosAuthentication no
#KerberosOrLocalPasswd yes
```

service sshd reload --#Reload the SSHD service.

Now login, with dockeradmin user you are able to login.

To integrate docker with the Jenkins.
Install the plugin **"Publish Over SSH"**

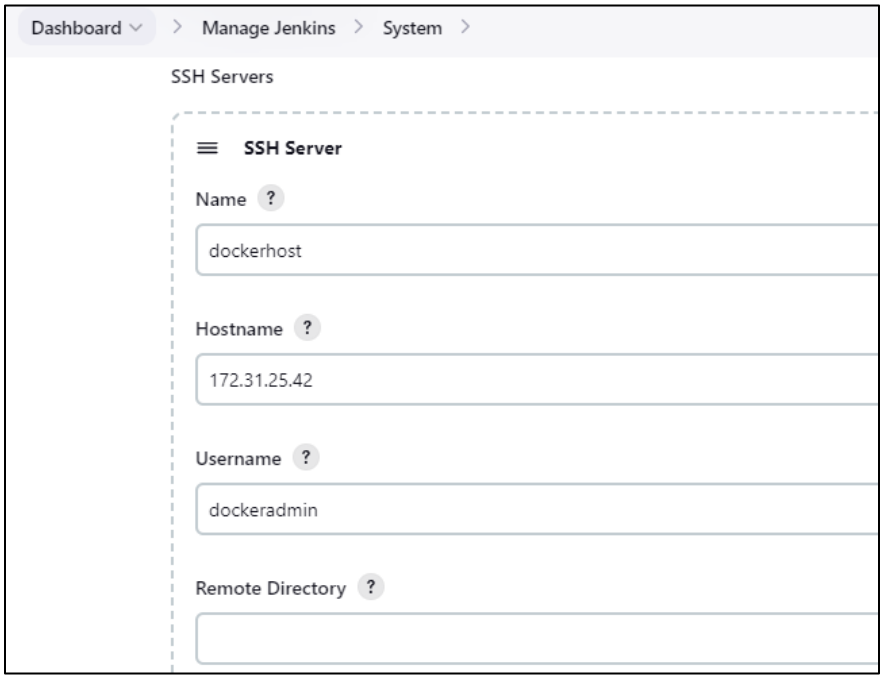


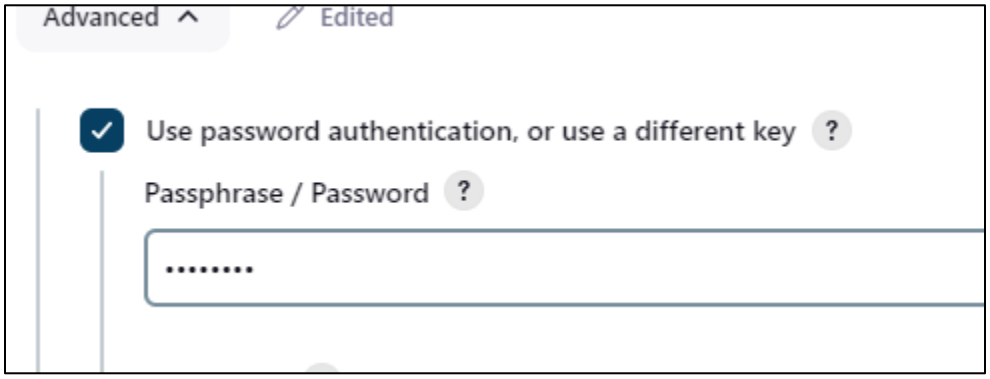
Manage Jenkins > System configuration > Publish Over SSH > SSH Server > Add

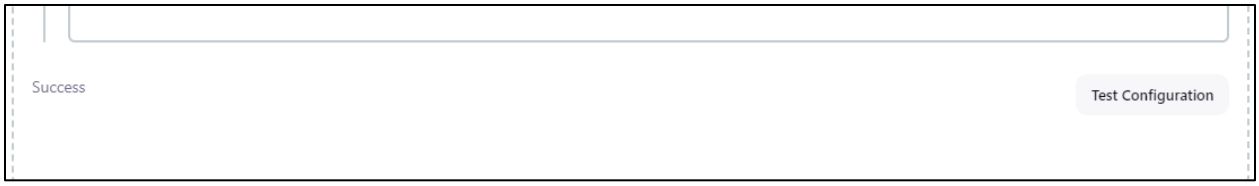
- **Name -** dockerhost
- **Hostname** - (Public Ip or private Ip docker server) (We can use both if they are in the same VPC)
- **Username -** dockeradmin --#The docker user which we have created
  --#Click on Advance
  Check mark -- Use password authentication, or use a different key
- **Passphrase / Password -** Ammy@567 --#Enter password

Click on test configuration.
SUCCESS -- Which means that I can able to authenticate from my Jenkins server to Docker host as a dockeradmin user.

- Apply > Save.







NOTE - Either you can use the password based authentication or the key based authentication. To see how we can generate the keys.

To Generate the Key -- Go to Terminal of docker

sudo su - dockeradmin --#Switch user to dockeradmin

ssh-keygen

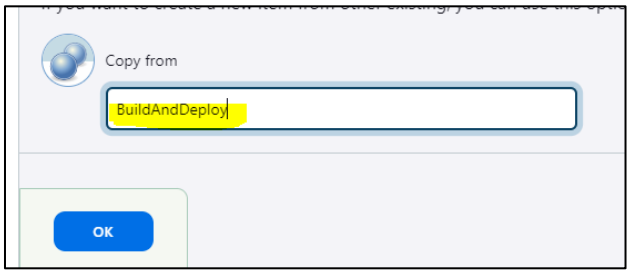
```
[dockeradmin@DockerServer ~]$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/dockeradmin/.ssh/id_rsa):
Created directory '/home/dockeradmin/.ssh'.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/dockeradmin/.ssh/id_rsa.
Your public key has been saved in /home/dockeradmin/.ssh/id_rsa.pub.
The key fingerprint is:
SHA256:AAtSarAuox0hhipjxwGr3aeaK44yjXy5Wtkl+PaGgSs dockeradmin@DockerServer
The key's randomart image is:
+---[RSA 2048]----+
|ooo .            |
|o+o. o           |
|=+... .          |
|*o.o. ..         |
|Booo..ooS        |
|=+..o+o..        |
|oo.oo..oo        |
|*.oE .....       |
|+=*oo   ..       |
+----[SHA256]-----+
[dockeradmin@DockerServer ~]$
```

The Keys gets generated in /home/dockeradmin

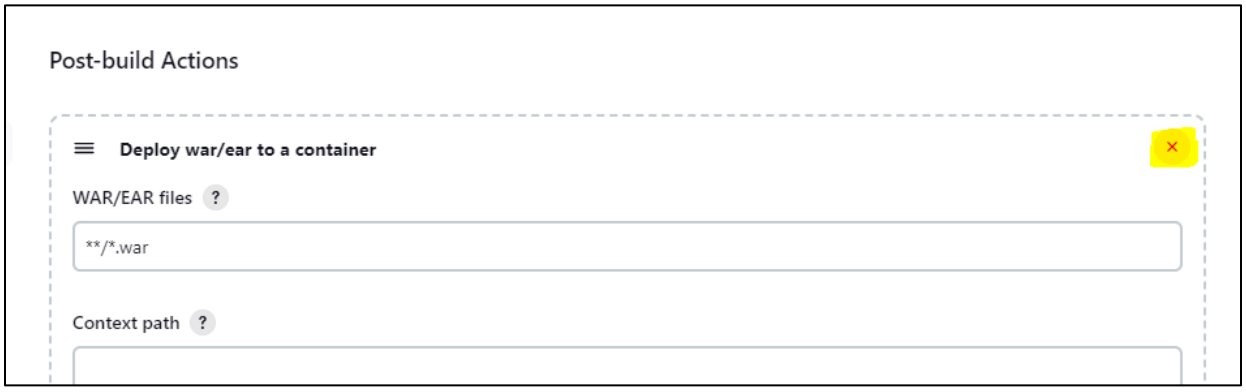
cd /home/dockeradmin

Till here the docker host is integrated with the Jenkins. Now we can create a new Jenkins job where we can build and deploy the artifacts on docker container.

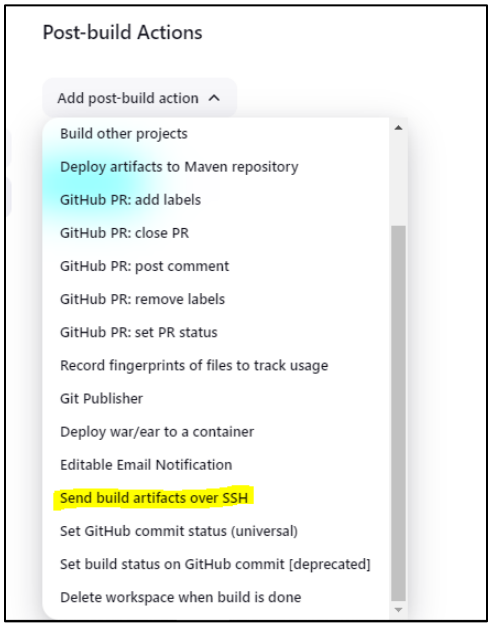
- Create a new job and copy the previous job i.e 'BuildAndDeploy' job to get all the previous job configurations.



- Delete the Existing Post-build Actions.



- Select **'Send build artifacts over SSH'** in the Post-build Actions.



- **Source file -** webapp/target/*.war --#Enter the path where the .war file has been stored. By * means it copies all the .war file present in the target folder.
- **Remove Prefix -** webapp/target

Here we are copying the .war file and while copying the war file we don't require the prefix.
We are copying the .war file to /home/dockeradmin location.

Build Now

Now check the docker terminal, and check whether the webapp.war file is copied or not.

```
[dockeradmin@DockerServer ~]$ ll
total 4
-rw-rw-r-- 1 dockeradmin dockeradmin 2582 Mar  9 18:41 webapp.war
[dockeradmin@DockerServer ~]$
```

This webapp.war file is owned by dockeradmin user and we would like to copy onto Docker Container. We can copy it manually. But what if we are copying it manually and if there are multiple builds how we make sure that your application is successfully deployed every time.

That is the reason we need to update our docker file to take this war file while creating a new container. That is how we can deploy our application along with the Tomcat.

Now create an Docker image along with the artifacts (war file) so that whenever we launch a new container it'll come up within your application.

Create a new directory to keep our Dockerfiles and artifacts, so that in future we can use that location to create our Docker images.

exit --#Exit from the dockeradmin user and come to the root user.
cd /opt
mkdir docker

```
[dockeradmin@DockerServer ~]$ exit
logout
[root@DockerServer ec2-user]# cd /opt
[root@DockerServer opt]# ls
aws  containerd  rh
[root@DockerServer opt]# mkdir docker
[root@DockerServer opt]# ls
aws  containerd  docker  rh
[root@DockerServer opt]#
```

Now give ownership of the docker directory to the dockeradmin user.

chown -R dockeradmin:dockeradmin docker

Now in the job, we will tell that instead of copying the artifacts into the dockeradmin home directory I would like to copy to the /opt/docker.

Basically, previously the webapp.war files are copied on the dockeradmin user only now we define the all the war files should be copied n the common location for which we created a docker directory and make the owner to dockeradmin user. By this we don't have manually copy the file from dockeradmin user to the root user.

Now move the Dockerfile which we have previously created to the /opt/docker directory.

cd /home/ec2-user/
mv Dockerfile /opt/docker/

Now Dockerfile is owned by the root and give the ownership of the Dockerfile to the dockeradmin as well.

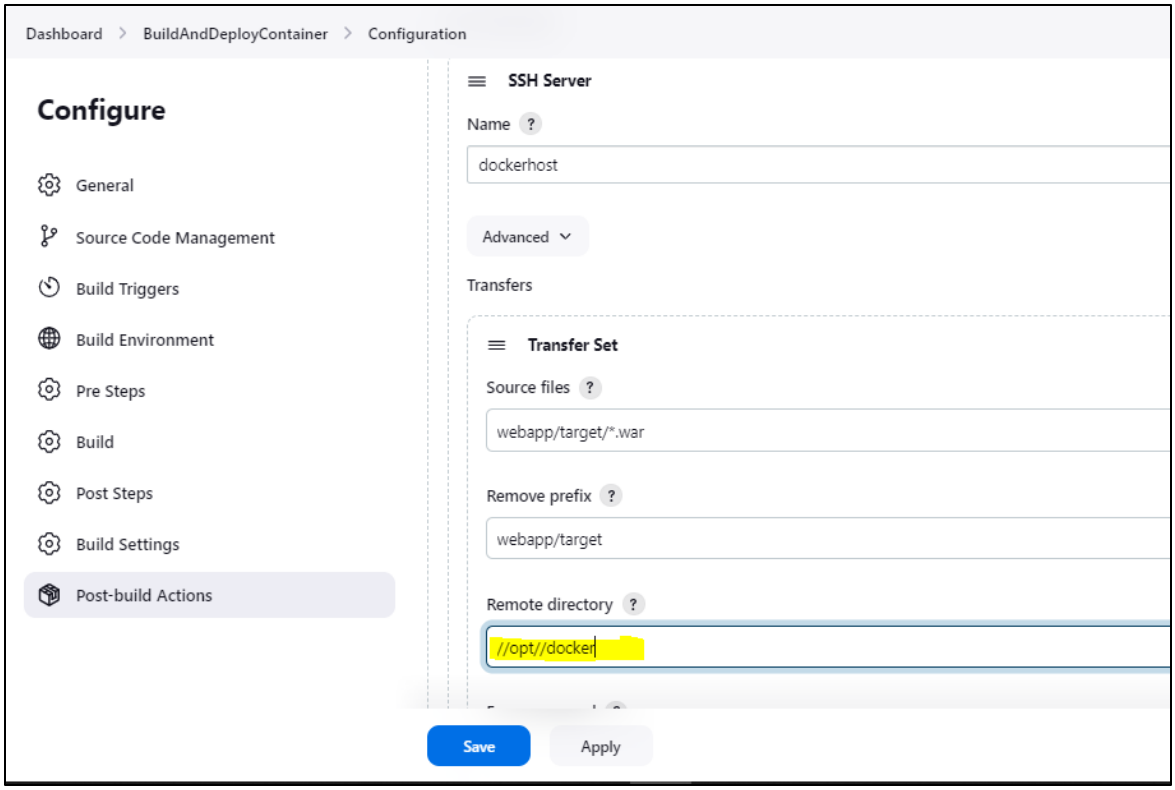
cd /opt/docker/
chown -R dockeradmin:dockeradmin /opt/docker

```
[root@DockerServer docker]# ll
total 4
-rw-r--r-- 1 root root 90 Mar  9 14:28 Dockerfile
[root@DockerServer docker]# chown -R dockeradmin:dockeradmin /opt/docker
[root@DockerServer docker]# ll
total 4
-rw-r--r-- 1 dockeradmin dockeradmin 90 Mar  9 14:28 Dockerfile
[root@DockerServer docker]#
```

Now go to the Jenkins job and tell to don't copy the artifacts into the dockeradmin user.

Open the Job >Configure

Remote Directory - //opt//docker



Build Now

Now check the webapp.war file is copied or not?

```
[root@DockerServer docker]# ll
total 8
-rw-r--r-- 1 dockeradmin dockeradmin   90 Mar  9 14:28 Dockerfile
-rw-rw-r-- 1 dockeradmin dockeradmin 2582 Mar  9 19:28 webapp.war
```

Now, we need to create an container along with .war file. Then only we can access our application from the browser.

Edit the Dockerfile and mention to copy the .war file to the webapps diectory.

COPY ./*.war /usr/local/tomcat/webapps

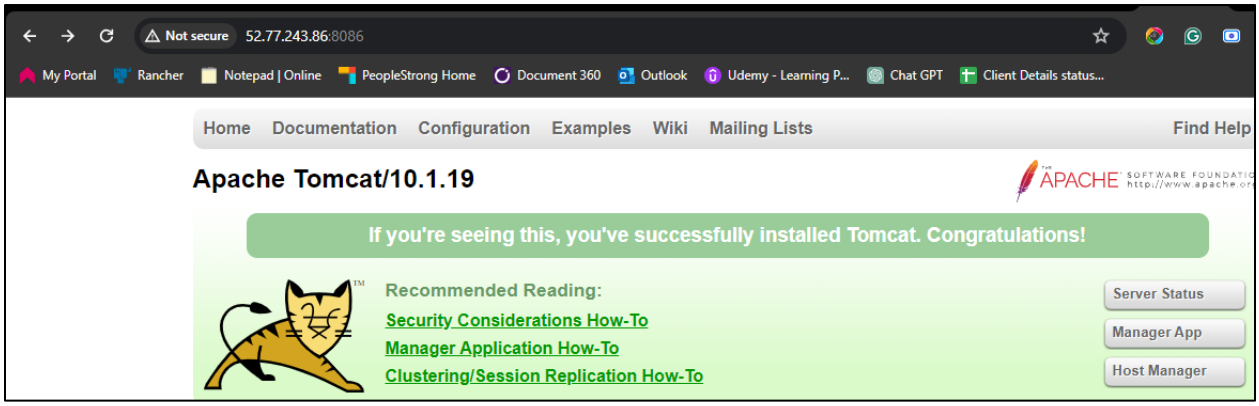
```
FROM tomcat:latest
RUN cp -R  /usr/local/tomcat/webapps.dist/* /usr/local/tomcat/webapps
COPY ./*.war /usr/local/tomcat/webapps
~
~
~
~
```

docker build -t tomcat.v1 . --#.represent to find the Dockerfile in the current directory.
docker images

```
[root@DockerServer docker]# docker images
REPOSITORY    TAG       IMAGE ID       CREATED          SIZE
tomcat        v1        072d71clef07   6 seconds ago    460MB
demotomcat    latest    0ce94428fc68   5 hours ago      460MB
test1         latest    11d956292295   5 hours ago      511MB
mytomcat      latest    36dbd0afcfa2   6 hours ago      276MB
tomcat        latest    405afe63d576   3 days ago       455MB
centos        latest    5d0da3dc9764   2 years ago      231MB
[root@DockerServer docker]# docker run -d --name tomcatv1 -p 8086:8080 tomcat:v1

5ada457974a211f0b2dd47e79a11f71b8d4137a7812d631074435599e504589
[root@DockerServer docker]#
```

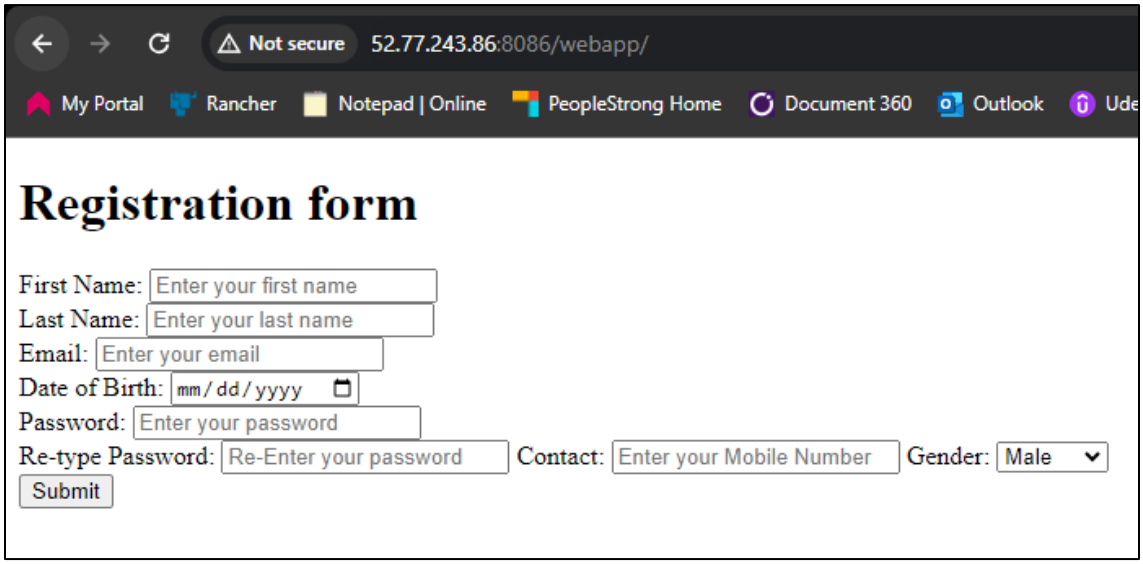
docker run -d --name tomacatv1 -p 8086:8080 tomcat:v1

Now check on browser, publicip:portno
52.77.243.86:8086



To View the application.

52.77.243.86:8086/webapp



Here we can access our application through Docker container.

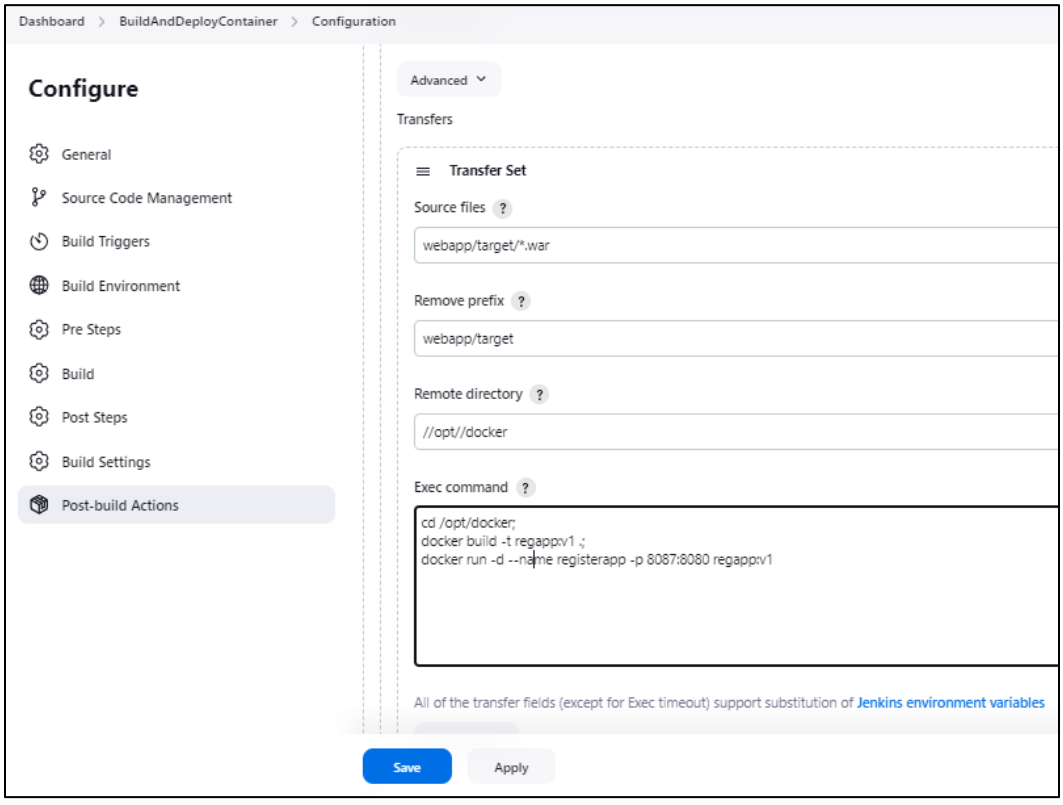
Till here, we created a job with the we could be able to build our code and copy the artifacts under the Docker host. But from there to create a container we have executed the commands like Docker build and Docker run.

This is not the right way, because we want to automate end-to-end pipeline. Means once we commit our code onto GitHub it should be able to build it and create artifact and copying the artifact onto Docker host creating a Docker image and creating a container out of it.
That is what should happen automatically.

Configure the Existing job **'BuildAndDeployContainer'**

Under Post-build Actions enter the predefined commands.

cd /opt/docker;
docker build -t regapp:v1 .;
docker run -d --name registerapp -p 8087:8080 regapp:v1



Here, once the artifact has been copied, go inside the /opt/docker and build the image.
Once Image is build, create a container out of it.

Now, before executing the job, stop and remove all the previous docker containers and images.

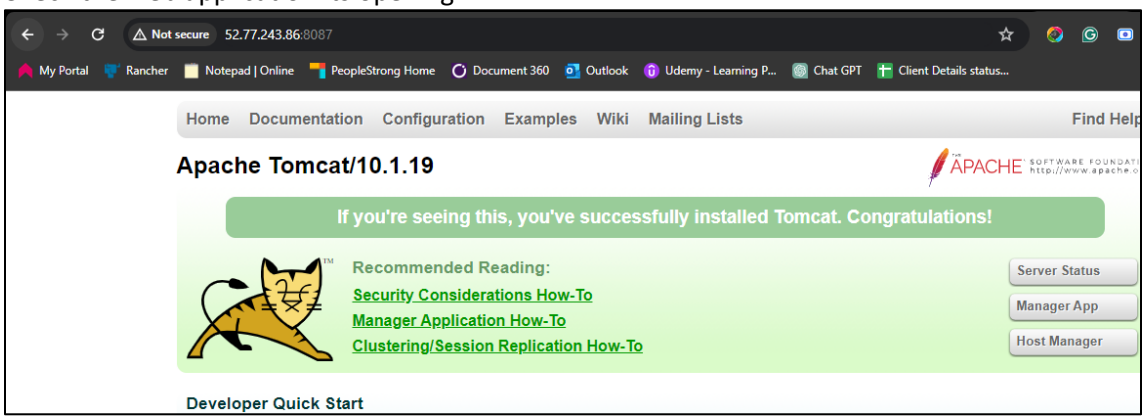
docker stop $(docker ps -q) --#To stop all the running containers at one go.
docker container prune --# To remove/ delete all the container in one go.
docker image prune -a --#To remove/delete all the images in one go.

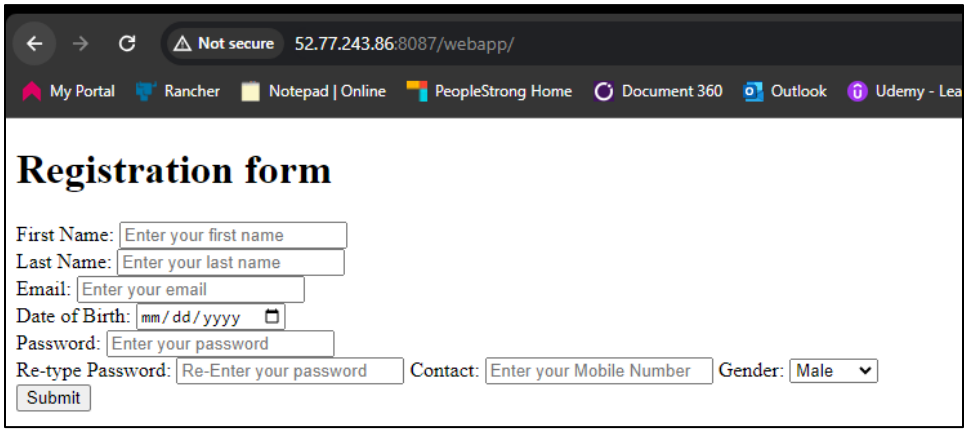
Now execute the job.

Now you see the **webapp.war** file is updated by the time and all images and containers are created automatically without giving any command.

```
[root@DockerServer docker]# ll
total 8
-rw-r--r-- 1 dockeradmin dockeradmin  129 Mar  9 19:34 Dockerfile
-rw-rw-r-- 1 dockeradmin dockeradmin 2582 Mar  9 20:17 webapp.war
[root@DockerServer docker]# docker images
REPOSITORY   TAG       IMAGE ID       CREATED              SIZE
regapp       v1        749506236639   About a minute ago   460MB
tomcat       latest    405afe63d576   3 days ago           455MB
[root@DockerServer docker]# docker ps -a
CONTAINER ID   IMAGE       COMMAND             CREATED              STATUS              PORTS                                       NAMES
a963bcc85840   regapp:v1   "catalina.sh run"   About a minute ago   Up About a minute   0.0.0.0:8087->8080/tcp, :::8087->8080/tcp   registerapp
[root@DockerServer docker]# docker ps
CONTAINER ID   IMAGE       COMMAND             CREATED              STATUS              PORTS                                       NAMES
a963bcc85840   regapp:v1   "catalina.sh run"   About a minute ago   Up About a minute   0.0.0.0:8087->8080/tcp, :::8087->8080/tcp   registerapp
[root@DockerServer docker]#
```

Check the web application its opening.





Now let's try to update the hello-world program (source-code) from git and let's see if our jenkins job should trigger automatically without any manual intervention.

Open the Git Bash.

cd /d/AWS/DevopsProject/hello-world/webapp/src/main/webapp
vi index.jsp
--#Edit the code or just change the Heading

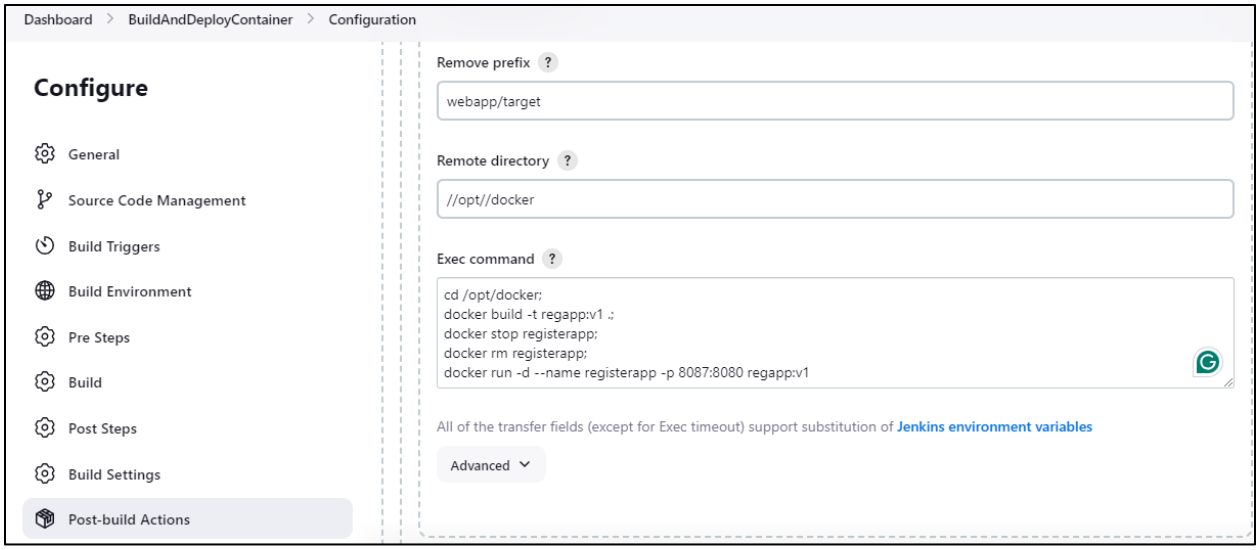
git status
git add .
git commit -m "updated index.jsp file"
git push origin master

```
Aman.Duggal@AmanD-OEG MINGW64 /d/AWS/DevopsProject/hello-world/webapp/src/main/w
ebapp (master)
$ git commit -m "Updated index.jsp file"
[master 3b6a759] Updated index.jsp file
 Committer: Aman Duggal <Aman.Duggal@businessnext.com>
Your name and email address were configured automatically based
on your username and hostname. Please check that they are accurate.
You can suppress this message by setting them explicitly. Run the
following command and follow the instructions in your editor to edit
your configuration file:

    git config --global --edit

After doing this, you may fix the identity used for this commit with:

    git commit --amend --reset-author

 1 file changed, 1 insertion(+), 1 deletion(-)

Aman.Duggal@AmanD-OEG MINGW64 /d/AWS/DevopsProject/hello-world/webapp/src/main/w
ebapp (master)
$ git push origin master
Enumerating objects: 13, done.
Counting objects: 100% (13/13), done.
Delta compression using up to 8 threads
Compressing objects: 100% (5/5), done.
Writing objects: 100% (7/7), 578 bytes | 578.00 KiB/s, done.
Total 7 (delta 2), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (2/2), completed with 2 local objects.
To https://github.com/amanduggal001/hello-world.git
   d36fe04..3b6a759  master -> master

Aman.Duggal@AmanD-OEG MINGW64 /d/AWS/DevopsProject/hello-world/webapp/src/main/w
```

The job will get failed, because in the post build action of the job we have defined the container name i.e. regapp, so whenever on the next build the job is trying to create the new container with the same name the conflict error occurred since the regapp container is already created.

To overcome this we can add the command to stop and delete the existing container before creating it.

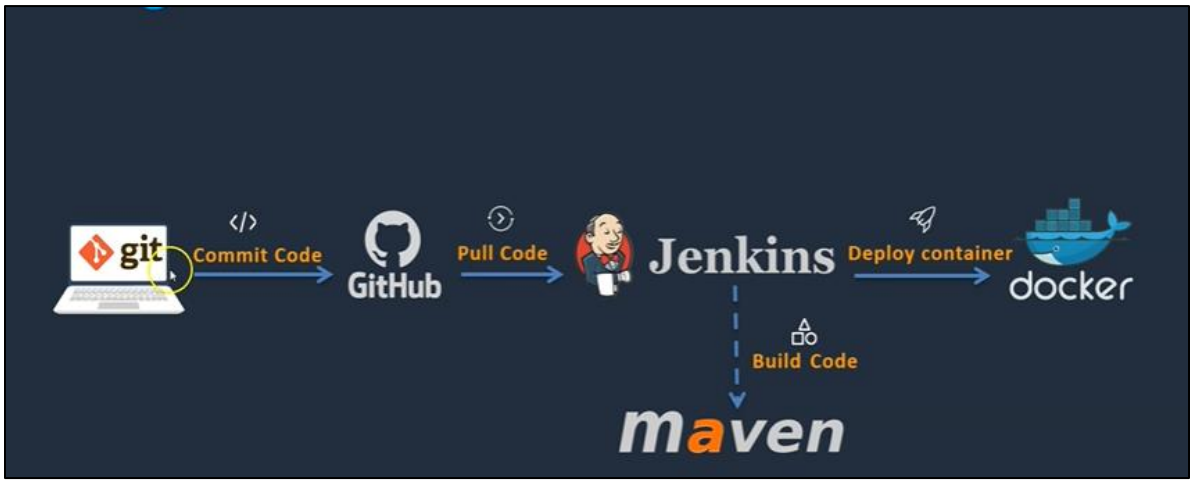
cd /opt/docker;
docker build -t regapp:v1 .;
docker stop registerapp;
docker rm registerapp;
docker run -d --name registerapp -p 8087:8080 regapp:v1



Now again make any changes in git and check if the job is automatically triggered without any error.

Till now we learn 't how to build and deploy the code by using jenkins. But if you see, this jenkins job looks ugly because we are trying to execute multiple commands. It is not right way to do this one.

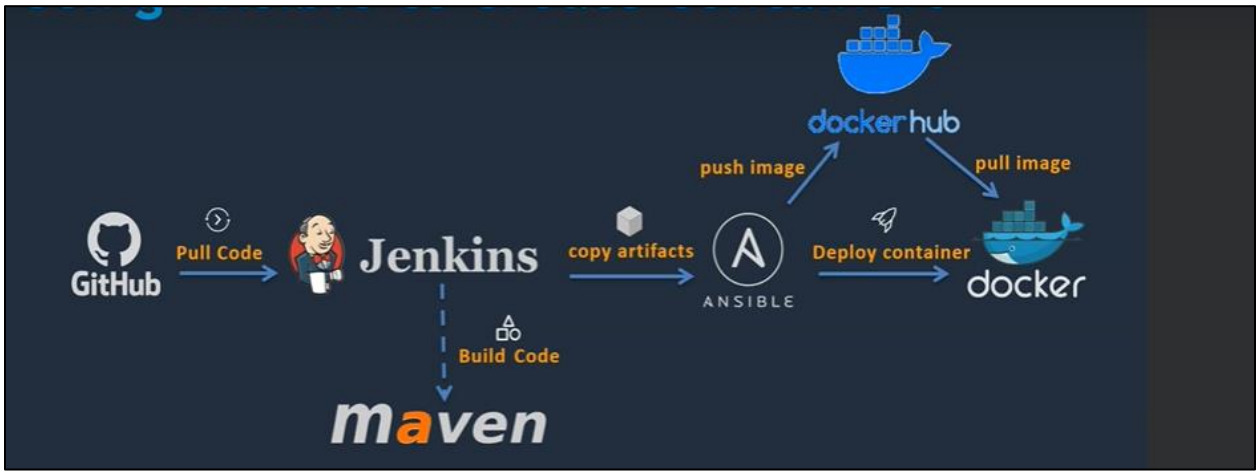
That is where we can take advantage of deployment tools.
We can use Ansible as a deployment tool in our case. By Ansible we can execute all these commands with more efficient way.



Until now, we were doing changes on our workstation, then committing those changes with help of Git onto GitHub. Once the latest code is available on Git, Jenkins could able to pull the latest code and build it with the help of Maven and it was creating Docker Images and also deploying Docker containers, and Docker host. In this case we could see Jenkins as a build and Deployment tool.

But is that any better way to handle it. Yes, that is where we can introduce deployment tool.

Setup Ansible



We can use Ansible as a deployment tool so that Jenkins need not to do the administrative kind of activities because Jenkins is more efficiently work as a build tool.

Along with Ansible we are using the docker hub. Our applications are containerized at this moment. We need a repository in case it is a non-containerized applications means the applications which we directly deploy on VM.

With the help of Ansible and Docker Hub we are going to make this CI-CD pipeline smoother.

In this case Jenkins is going to take the code from GitHub and build artifacts and copy those artifacts onto Ansible server. Now it is Ansible task to create images and deploy the containers.

Ansible is going to take the Artifacts and with the help of Docker file it creates a Docker image.

This Docker image we can commit it into the Docker Hub because Docker Hub is a repository to store the Docker images.

Now, whenever we execute any Ansible playbook to deploy a container this Docker host communicates with Docker hub that pull the image whatever we mentioned in our playbook and create a container out of it.

Setup Ansible Server:

- Setup EC2 instance.
- Setup **Hostname**.
- Create **ansibleadmin** user.
- Add user to the **sudoers** file.
- Generate **SSH keys**.
- Enable **Password based login**.
- Install Ansible.

Steps to follow:

Create an EC2 instance
useradd ansibleadmin --#To Create a new user.
passwd ansibleadmin --#To setup the password.

Now add this user in the sudoers group to provide the admin privileges.

visudo

Add the user in the visudo file.

```
# %sys ALL = NETWORKING, SOFTWARE, SERVICES, STORAGE, DELEGATING, PR
ATE, DRIVERS

## Allows people in group wheel to run all commands
%wheel  ALL=(ALL)       ALL

## Same thing without a password
# %wheel        ALL=(ALL)       NOPASSWD: ALL
ansbibleadmin   ALL=(ALL)       NOPASSWD: ALL
## Allows members of the users group to mount and unmount the
## cdrom as root
# %users  ALL=/sbin/mount /mnt/cdrom, /sbin/umount /mnt/cdrom
```

Now enable the password based authentication.

vi /etc/ssh/sshd_config

--#Uncomment the PasswordAuthentication yes

```
# To disable tunneled clear text passwords, change to no here!
PasswordAuthentication yes
#PermitEmptyPasswords no
#PasswordAuthentication no

# Change to no to disable s/key passwords
#ChallengeResponseAuthentication yes
```

service sshd reload --# To reload the SSHD service.
sudo su - ansibleadmin --#Switch user to ansibleadmin.

Now generate ssh keys.
ssh-keygen
exit --#Come back to the root user.

amazon-linux-extras install ansible2 - -#Install ansible packages.
python --version --#Check if the python is installed or not as ansible required the python.
ansible --version --# Check the ansible version.

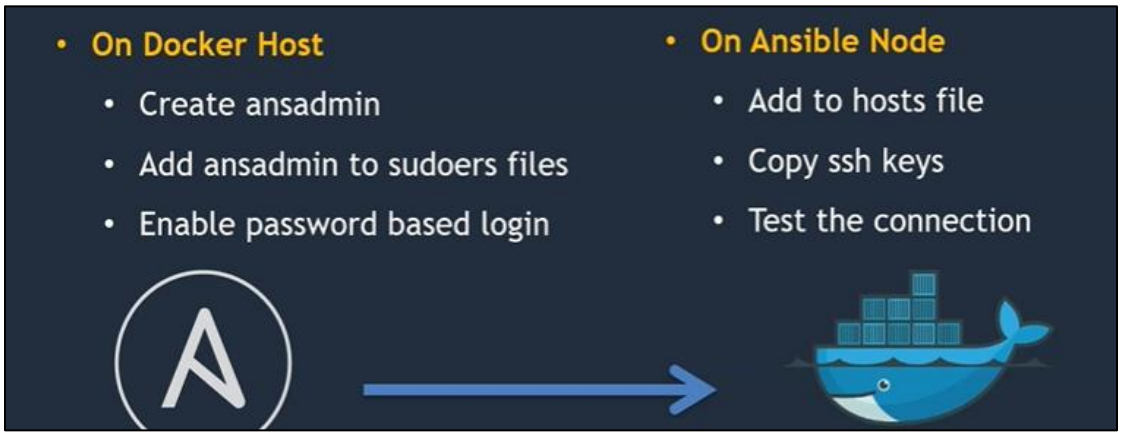
```
[root@AnsibleServer ec2-user]# python --version
Python 2.7.18
[root@AnsibleServer ec2-user]# ansible --version
ansible 2.9.23
  config file = /etc/ansible/ansible.cfg
  configured module search path = [u'/root/.ansible/plugins/modules', u'/usr/sha
re/ansible/plugins/modules']
  ansible python module location = /usr/lib/python2.7/site-packages/ansible
  executable location = /bin/ansible
  python version = 2.7.18 (default, Dec 18 2023, 22:08:43) [GCC 7.3.1 20180712 (
Red Hat 7.3.1-17)]
[root@AnsibleServer ec2-user]#
```

Till now, we have successfully installed the ansible, now the next thing is we need to prepare our Ansible system to create docker images.

Integrate Docker with Ansible

We are going to write a playbook, that playbook is going to tell our DockerHost how to create a container.

Manage Docker Host with Ansible



For this we need to add our DockerHost as a client in Ansible system.

On Docker Host -

We need to perform some steps in docker host, first we create a user in docker host **'ansibleadmin'** same as we created in the ansible host.
Add the user to the sudoers group and enable the password-based authentication.

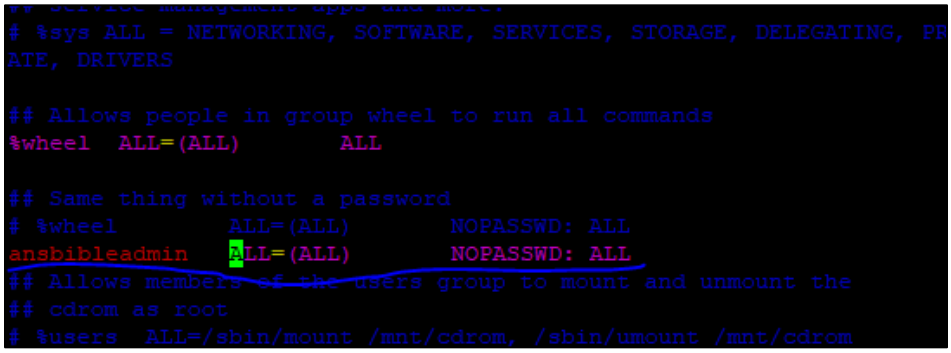
Same steps that we have done on the ansible server, because with the ansibleadmin user itself Anisble is going to manage our DockerHost.

useradd ansibleadmin --#To Create a new user.
passwd ansibleadmin --#To setup the password.

Now add this user in the sudoers group to provide the admin privileges.

visudo

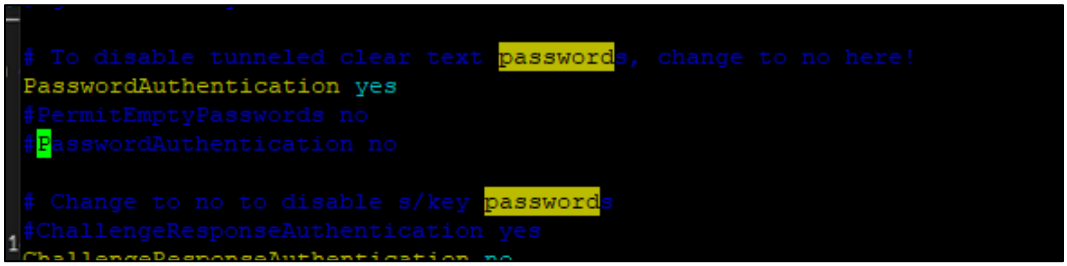
Add the user in the visudo file.



Now enable the password based authentication.

vi /etc/ssh/sshd_config

--#Uncomment the PasswordAuthentication yes



service sshd reload --# To reload the SSHD service.

On Ansible node-

- We need to add the **DockerHost IP** address in the inventory file (host file).
- We need to copy the SSH Keys, we will be copying the Ansible server public key onto Dockerhost **ansibleadmin** user so that the passwordless authentication get enabled.
- At last we can test the connection by executing some ping commands.

vi /etc/ansible/hosts
--#Add the private ip of the Docker host in the host file of the ansible.

```
# leading 0s:

## db-[99:101]-node.exa
#
#


172.31.25.42
```

Now we need to copy our **ansibleadmin** user keys onto the target ansibleadmin user account (docker host).

On ansible node -

sudo su - ansibleadmin
cd .ssh
ls
You will see the public and private keys.

```
[ansibleadmin@AnsibleServer ~]$ cd .ssh
[ansibleadmin@AnsibleServer .ssh]$ ls
id_rsa  id_rsa.pub
[ansibleadmin@AnsibleServer .ssh]$
```

Now copy this public key on the target system (docker host).

ssh-copy-id 172.31.25.42 --#Enter the private IP of the docker host.

```
[ansibleadmin@AnsibleServer .ssh]$ ssh-copy-id 172.31.25.42
/usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "/home/ansibleadmin/.ssh/id_rsa.pub"
The authenticity of host '172.31.25.42 (172.31.25.42)' can't be established.
ECDSA key fingerprint is SHA256:08LTcU01TbsUg6ftOvlnVeouP0pvqt/sQQQsF9Q5PDw.
ECDSA key fingerprint is MD5:74:35:bb:d8:32:50:14:16:fe:54:ae:32:78:71:1d:10.
Are you sure you want to continue connecting (yes/no)? yes
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is to install the new keys
ansibleadmin@172.31.25.42's password:

Number of key(s) added: 1

Now try logging into the machine, with:   "ssh '172.31.25.42'"
and check to make sure that only the key(s) you wanted were added.
```

Now, check on the docker host the authorized_keys should be added. The authorized_keys file carries the public key of the ansible host.

```
[ansibleadmin@DockerServer .ssh]$ ls
id_rsa  id_rsa.pub
[ansibleadmin@DockerServer .ssh]$ ls
authorized_keys  id_rsa  id_rsa.pub
[ansibleadmin@DockerServer .ssh]$
```

Now, test the connection between the ansible and the docker host.

ansible all -m ping --#This means, whatever hosts are there in the inventory file, try to connect to all those systems.

```
[ansibleadmin@AnsibleServer .ssh]$ ansible all -m ping
[WARNING]: Platform linux on host 172.31.25.42 is using the
could change this. See https://docs.ansible.com/ansible/2.9,
172.31.25.42 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python"
    },
    "changed": false,
    "ping": "pong"
}
[ansibleadmin@AnsibleServer .ssh]$
```

Now ansible could be able to communicate with our DockerHost, without any credentials nothing but with the Passwordless Authentication.

Integrate Ansible with Jenkins

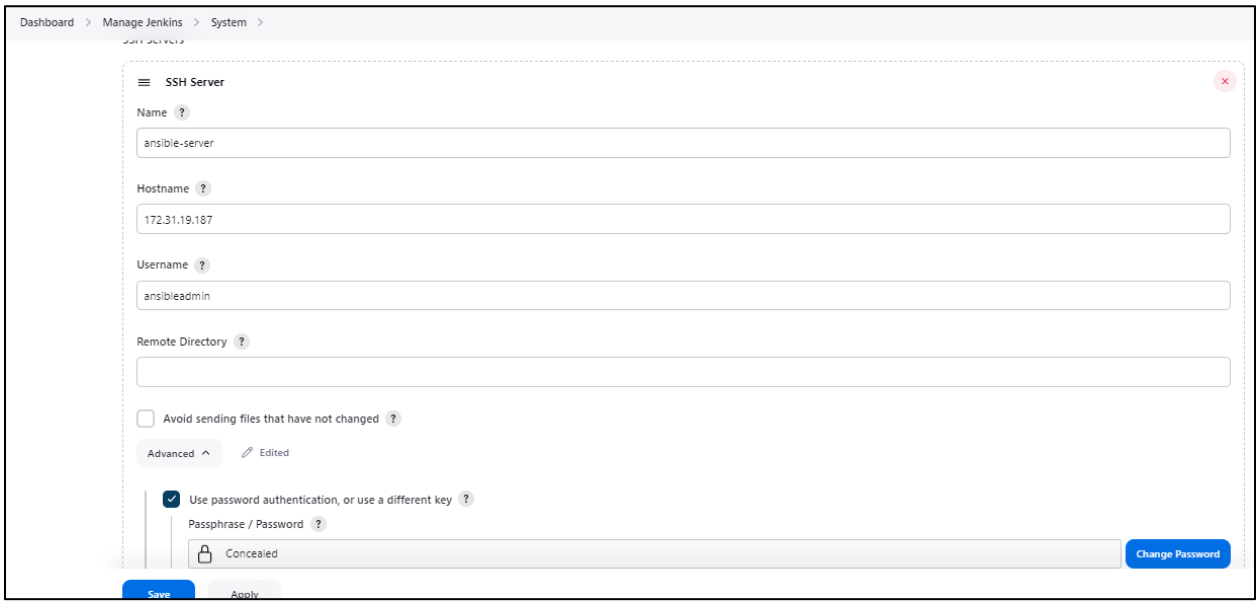
Now integrate Ansible with Jenkins, so that Jenkins can able to copy artifacts onto Ansible systems, Ansible can able to create image or it can deploy the containers on the Docker host.

By doing this, we can delegate the activities, like Jenkins can able to do only build activities, Ansible can take care of deployment activities.

Login to Jenkins server > Manage Jenkins > System configuration > Publish over SSH > Add.

Name - ansible-server
Hostname - Private Ip of the ansible server --#To check the private ip on the terminal use **ifconfig** command.
Username - ansibleadmin

Click on advance > Select **'Use password authentication, or use a different key'**
Password - Ammy@567 --#Password of ansibleadmin user.

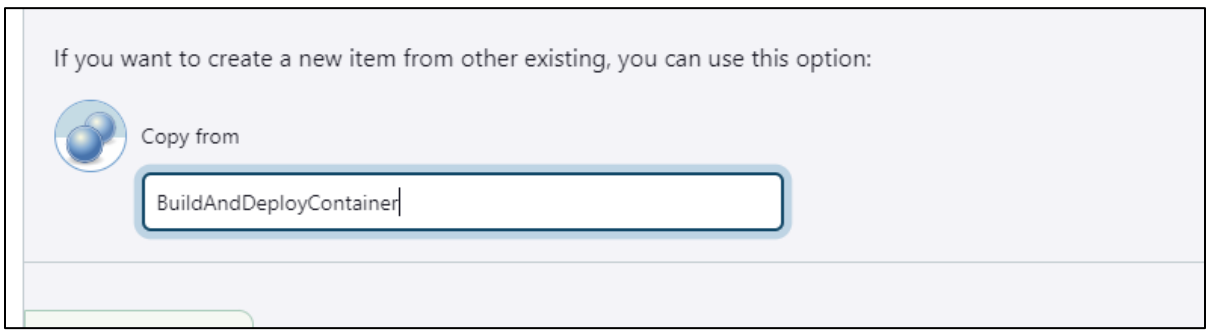


Till here, the integration of Ansible with Jenkins is successful.

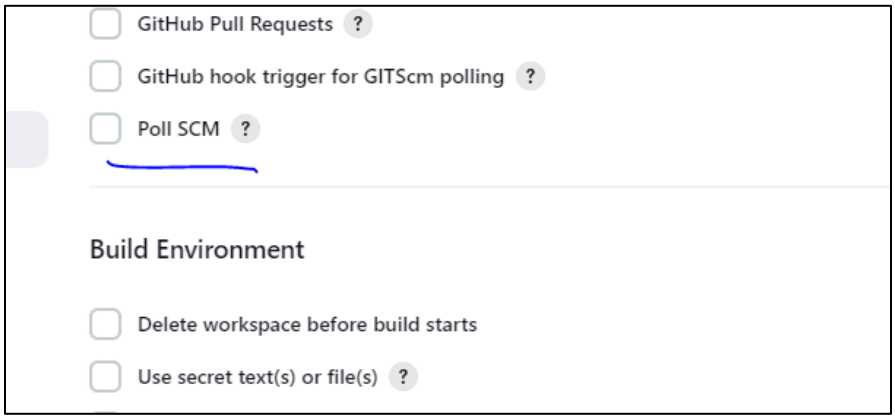
Now we are going to create a new Jenkins job where we can build and copy the artifacts onto ansible system.

Create new item in Jenkins GUI.

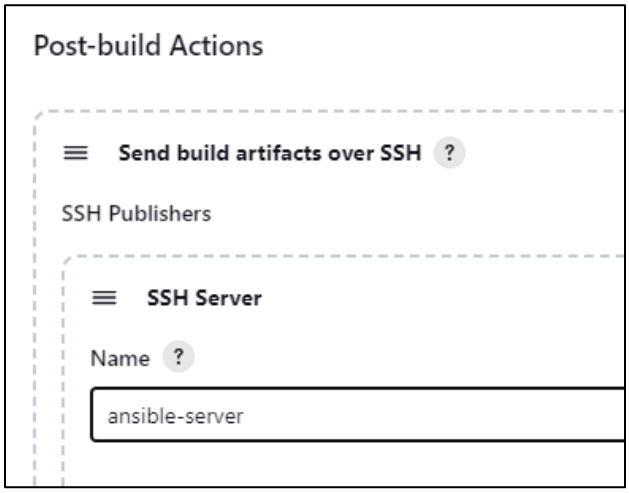
Job Name - Copy_Artifacts_Onto_Ansible
Copy the configurations from the previous job.



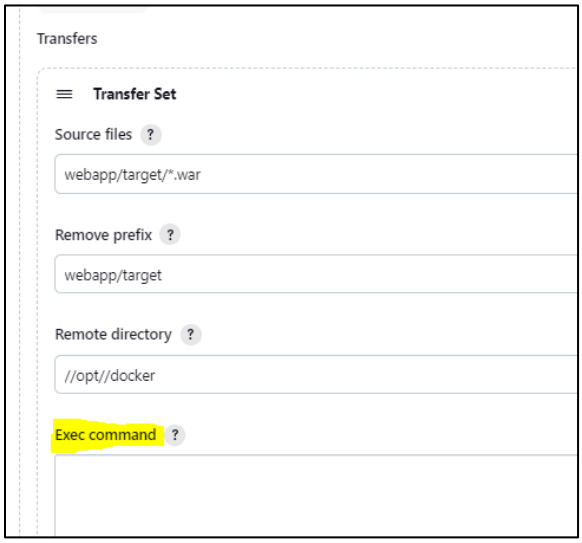
Disable the Poll SCM for now, we can enable it later whenever we need.



Select ansible-server under the SSH Server.



Remove the existing commands in the Exec command field. We can write the playbook for those commands in the ansible server.



Apply > Save.

NOTE: Since the Remote directory i.e**. //opt//docker** mentioned in the job doesn't exists in the ansible server. Let's create this directory on ansible server.

On Ansible node -

sudo su - ansibleadmin
cd /opt
mkdir docker
ll

```
[ansibleadmin@AnsibleServer opt]$ ll
total 0
drwxr-xr-x 4 root root 33 Feb 23 05:26 aws
drwxr-xr-x 2 root root  6 Mar 10 11:23 docker
drwxr-xr-x 2 root root  6 Aug 16  2018 rh
[ansibleadmin@AnsibleServer opt]$
```

Now the docker directory is created but it is owned by the root user. The problem here is if it is owned by the root user while copying artifacts from Jenkins server it uses ansibleadmin user, so you will get the permission issue.

To overcome the problem, we must grant access to this directory to ansibleadmin user.

For that we need to change ownership.

sudo chown ansibleadmin:ansibleadmin docker

```
[ansibleadmin@AnsibleServer ~]$ cd /opt
[ansibleadmin@AnsibleServer opt]$ ll
total 0
drwxr-xr-x 4 root root 33 Feb 23 05:26 aws
drwxr-xr-x 2 root root  6 Mar 10 11:23 docker
drwxr-xr-x 2 root root  6 Aug 16  2018 rh
[ansibleadmin@AnsibleServer opt]$ sudo chown ansibleadmin:ansibleadmin docker
[ansibleadmin@AnsibleServer opt]$ ll
total 0
drwxr-xr-x 4 root          root          33 Feb 23 05:26 aws
drwxr-xr-x 2 ansibleadmin ansibleadmin  6 Mar 10 11:23 docker
drwxr-xr-x 2 root          root           6 Aug 16  2018 rh
[ansibleadmin@AnsibleServer opt]$
```

Now Build the job.

Once the job is successfully completed you can see the war file under the docker folder.

```
[ansibleadmin@AnsibleServer opt]$ cd docker
[ansibleadmin@AnsibleServer docker]$ ls
webapp.war
[ansibleadmin@AnsibleServer docker]$
```

It means, we successfully copy the artifacts onto Ansible system. Now our Ansible job is creating an image by using this war file and push it into the Docker hub.

Build an image and create container on Ansible

Install docker into the ansible node.

sudo su -ansibleadmin
sudo yum install docker -y

Now add ansibleadmin to the docker group, then only we can execute docker commands as ansibleadmin.

sudo usermod -aG docker ansibleadmin
id ansibleadmin --#To check the group.

```
[ansibleadmin@AnsibleServer docker]$ sudo usermod -aG docker ansibleadmin
[ansibleadmin@AnsibleServer docker]$ ll
total 4
-rw-rw-r-- 1 ansibleadmin ansibleadmin 2606 Mar 10 11:35 webapp.war
[ansibleadmin@AnsibleServer docker]$ id ansibleadmin
uid=1001(ansibleadmin) gid=1001(ansibleadmin) groups=1001(ansibleadmin),992(dock
er)
[ansibleadmin@AnsibleServer docker]$
```

Now build the docker image, for docker image we need the docker file.

We have already created a Docker file on our docker host. So we can get it from there, instead of creating new docker file.(We are just copying the content of the docker file from the docker host and creating new docker file in the ansible host)

On Docker Node-

cd /opt/docker
cat Dockerfile
--# Copy the content.

On Ansible Node (under ansibleadmin user) -

sudo vi Dockerfile

FROM tomcat:latest
RUN cp -R /usr/local/tomcat/webapps.dist/* /usr/local/tomcat/webapps

COPY ./*.war /usr/local/tomcat/webapps

```
ansibleadmin@AnsibleServer:/opt/docker
FROM tomcat:latest
RUN cp -R  /usr/local/tomcat/webapps.dist/* /usr/local/tomcat/webapps
COPY ./*.war /usr/local/tomcat/webapps
~
```

Now we need to create an image of the Docker file.

sudo docker build -t regapp:v1 .

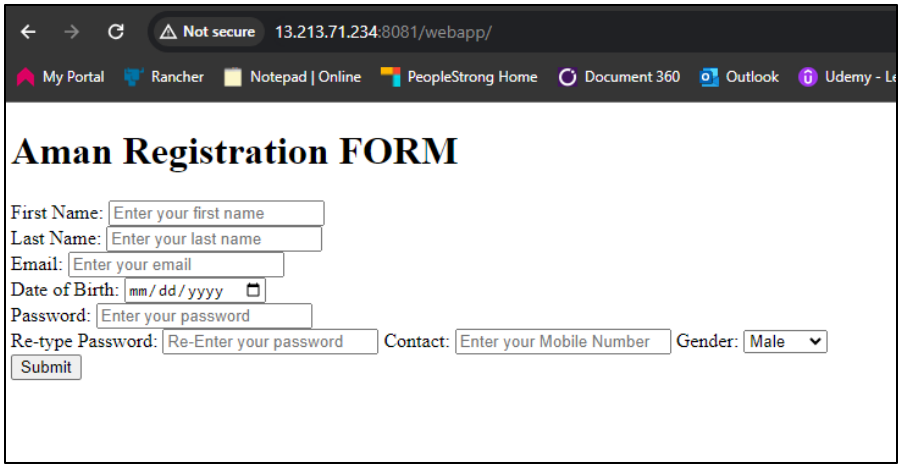
```
[ansibleadmin@AnsibleServer docker]$ sudo docker build -t regapp:v1 .
Sending build context to Docker daemon  5.632kB
Step 1/3 : FROM tomcat:latest
latest: Pulling from library/tomcat
23828d760c7b: Pull complete
e2670537dceb: Pull complete
c44aaba36909: Pull complete
c3b64924ef70: Pull complete
737fef02af8d: Pull complete
5d177a8f8e88: Pull complete
018443d5073c: Pull complete
3694d382f9eb: Pull complete
Digest: sha256:c83cd6449a4d34d6c5a9fe11934c15a09c4762a2b0db46c916a4fba032e6b117
Status: Downloaded newer image for tomcat:latest
 ---> 405afe63d576
Step 2/3 : RUN cp -R  /usr/local/tomcat/webapps.dist/* /usr/local/tomcat/webapps
 ---> Running in a14c897c1609
Removing intermediate container a14c897c1609
 ---> 07f0ccle60d8
Step 3/3 : COPY ./*.war /usr/local/tomcat/webapps
 ---> b8a783ale25a
Successfully built b8a783ale25a
Successfully tagged regapp:v1
```

NOTE - If permission denied message come while build the docker image provide the privilege using the below command
sudo chmod 777 /var/run/docker.sock

docker images
docker run -it --name amancontainer -p 8081:8080 regapp:v1 --#This will create the container.

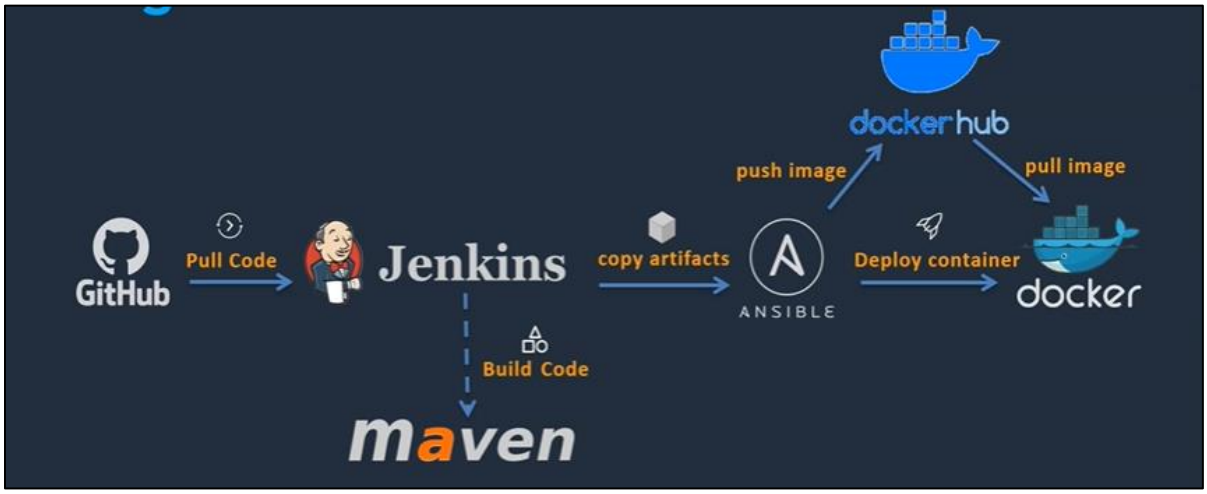
Now validate on browser if the application is opening.

Publicip of ansible:portno/webapp



The application is opening successfully. But here we are providing the manual commands on our Ansible.
Now next, we can create the Ansible Playbook which can do all these activities.

Ansible playbook to create image and container



So far, we have created an Ansible server, and we have integrated it with Jenkins so Jenkins could able to copy artifacts. With those artifacts we have created a Docker image by using manual commands.

Now this image is available on Ansible system, now how can we make available to our target environment, which means the Docker host, that is what the Docker Hub comes to our picture.

If we use Docker Hub, we can push our image onto Docker Hub.

This Docker Hub can be accessible by any Docker system.

Now, from Ansible we can instruct to this Docker host to go and pull the image from the Docker Hub and create a container.
This is how, Docker host can pull the image and create a container out of it.

Now this image is customized by Ansible which means that the artifacts which we have created, so we can see our application is running on Docker host and our end user can access this docker host.

Before creating an Ansible Playbook, let quickly see how Ansible Playbook does work.

To run the ansible playbook, we need to use the command,
ansible-playbook

We need to define where we need to run this ansible playbook for that we can provide with the -Iioption, that is inventory.
Now where does the inventory exist?
If we didn't give the -i option, it will take the default inventory which is in
/etc/ansible/hosts

So, whatever servers are present in the hosts file it will execute by default.

In our case, we need to execute ansible playbook on Ansible server.

But in the hosts file we mentioned only the docker host IP address.

So, we can add our Ansible server IP address to the host file and we can tell to the Ansible server that they should execute only on Ansible Server.

Take the private IP of the Ansible Server.

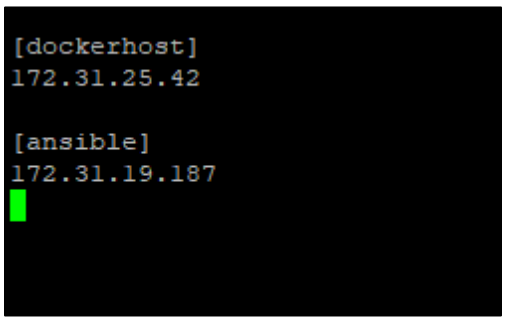
ifconfig --#To check the IP address.

Add the private IP of the Ansible server and define the group on host's file.

By keeping the IP under group, so whenever I give ansible (group name), while executing command, it will take the IP under the group.

vi /etc/ansible/hosts

[dockerhost]
172.31.25.42
[ansible]
172.31.19.187



Now to make work with Ansible, you should copy your SSH keys onto Ansible server itself. Otherwise, you cannot be able to communicate with this system.

To Test the connection.

ansible all -a uptime

```
[ansibleadmin@AnsibleServer docker]$ ansible all -a uptime
The authenticity of host '172.31.19.187 (172.31.19.187)' can't be established.
ECDSA key fingerprint is SHA256:35MQToDDAOaVJxIqxvjxn6l6ynPw7mxjWyqfoxe8Bzg.
ECDSA key fingerprint is MD5:e5:1c:c5:58:d3:60:9f:b8:a0:09:42:44:b3:35:7c:ed.
Are you sure you want to continue connecting (yes/no)? [WARNING]: Platform linux on host 172.31.25.42 is using the discovered
 future installation of another Python interpreter
could change this. See https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more informat
172.31.25.42 | CHANGED | rc=0 >>
 14:07:35 up 1 day,  1:38,  1 user,  load average: 0.00, 0.00, 0.00

172.31.19.187 | UNREACHABLE! => {
    "changed": false,
    "msg": "Failed to connect to the host via ssh: Host key verification failed.",
    "unreachable": true
}
[ansibleadmin@AnsibleServer docker]$
```

The connection failed with ansible but connection successful with the dockerhost.

To resolve this, we should copy the ssh keys (authorized keys) to the ansible system.

ssh-copy-id 172.31.19.187

Now, check the connection.
ansible all -a uptime

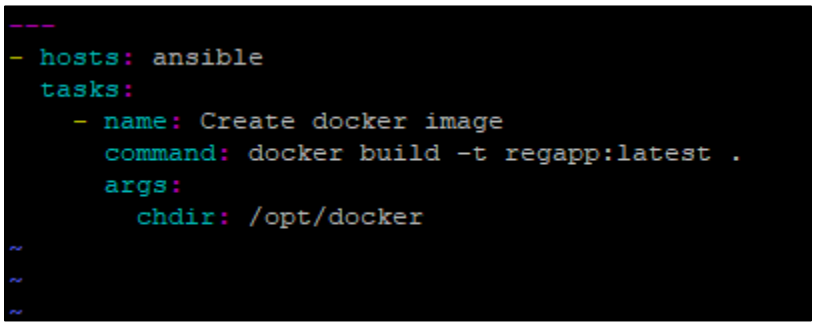
```
[ansibleadmin@AnsibleServer docker]$ ansible all -a uptime
[WARNING]: Platform linux on host 172.31.25.42 is using the discovered Python
interpreter at /usr/bin/python, but future installation of another Python
interpreter could change this. See https://docs.ansible.com/ansible/2.9/referen
ce_appendices/interpreter_discovery.html for more information.
172.31.25.42 | CHANGED | rc=0 >>
 17:02:10 up 1 day,  4:33,  1 user,  load average: 0.00, 0.00, 0.00
[WARNING]: Platform linux on host 172.31.19.187 is using the discovered Python
interpreter at /usr/bin/python, but future installation of another Python
interpreter could change this. See https://docs.ansible.com/ansible/2.9/referen
ce_appendices/interpreter_discovery.html for more information.
172.31.19.187 | CHANGED | rc=0 >>
 17:02:10 up  7:54,  3 users,  load average: 0.08, 0.02, 0.01
[ansibleadmin@AnsibleServer docker]$
```

ssh-copy-id localhost --#For local host

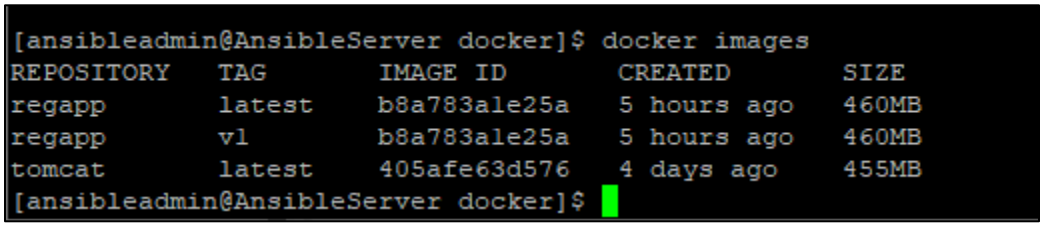
Now write ansible playbook.

vi regapp.yml

```
---
- hosts: ansible
  tasks:
    - name: Create docker image
      command: docker build -t regapp:latest .
      args:
        chdir: /opt/docker
```



ansible-playbook regapp.yml --check --#To dry run the command to check if the file is executing properly.
ansible-playbook regapp.yml
docker images



This is how we can create Docker image by using ansible playbook.

Now let's see how we can commit or push this Docker image onto Docker Hub. So that our Docker host can be able to pull the image and create a container out of it.

To commit the image on the docker hub use the below steps:

docker login
Username: amanduggal001
Password: Ammy@56789

Now we cannot directly push the image to the docker hub account like,

docker push regapp:latest

```
[ansibleadmin@AnsibleServer docker]$ docker push regapp:latest
The push refers to repository [docker.io/library/regapp]
8c2cf7ee328b: Preparing
762d4b745489: Preparing
f57cd456a2a2: Preparing
88ca17fbd2cd: Preparing
6f37c5d016c8: Preparing
c1793f638462: Waiting
4df676480fd4: Waiting
d9d7e0852802: Waiting
cbb50874016a: Waiting
5498e8c22f69: Waiting
denied: requested access to the resource is denied
[ansibleadmin@AnsibleServer docker]$
```

Whenever we try to push directly it doesn't recognize that onto which account we can be able to push. That is the reason we should provide our username prefix to our image.

docker tag b8a783a1e25a amanduggal001/regapp:latest --# Added the tag of username to identify the dockerhub account.

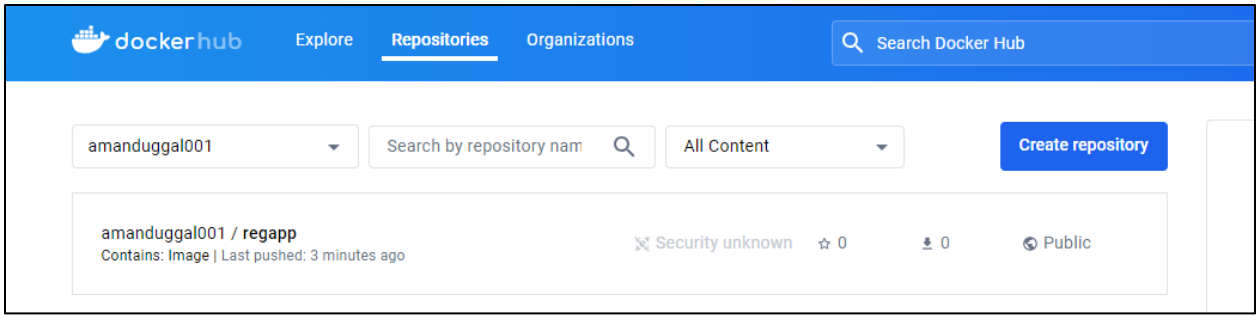
docker images

```
[ansibleadmin@AnsibleServer docker]$ docker tag b8a783a1e25a amanduggal001/regapp:latest
[ansibleadmin@AnsibleServer docker]$ docker images
REPOSITORY              TAG       IMAGE ID       CREATED       SIZE
amanduggal001/regapp    latest    b8a783a1e25a   5 hours ago   460MB
regapp                  latest    b8a783a1e25a   5 hours ago   460MB
regapp                  v1        b8a783a1e25a   5 hours ago   460MB
tomcat                  latest    405afe63d576   4 days ago    455MB
[ansibleadmin@AnsibleServer docker]$
```

docker push amanduggal001/regapp:latest --#Push the image

```
[ansibleadmin@AnsibleServer docker]$ docker push amanduggal001/regapp:latest
The push refers to repository [docker.io/amanduggal001/regapp]
8c2cf7ee328b: Pushed
762d4b745489: Pushed
f57cd456a2a2: Pushed
88ca17fbd2cd: Pushed
6f37c5d016c8: Pushed
c1793f638462: Pushed
4df676480fd4: Pushed
d9d7e0852802: Pushed
cbb50874016a: Pushed
5498e8c22f69: Pushed

latest: digest: sha256:bcff598dfa9beef73e2e2417bb5d267d72496af9759544aeda51e5bff63365ad size:
2414
[ansibleadmin@AnsibleServer docker]$
```

You can validate the image in the docker hub.

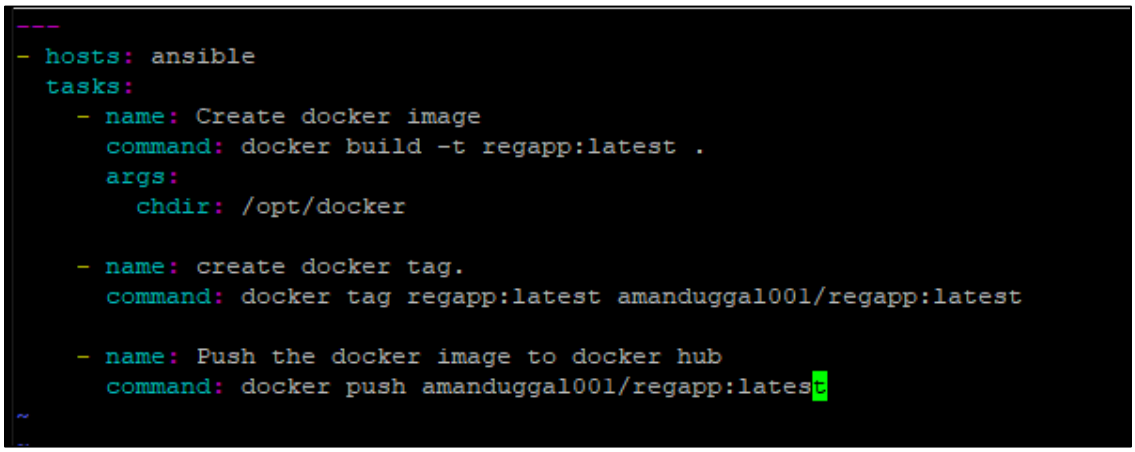


Now, next we see how we can incorporate these manual steps with our Ansible playbook, so that in Ansible we can build tag and commit image onto the Docker hub and the docker host will pull this image and create a container out of it.

Edit the ansible playbook.

vi regapp.yml

```
---
- hosts: ansible
  tasks:
    - name: Create docker image
      command: docker build -t regapp:latest .
      args:
        chdir: /opt/docker

    - name: create docker tag.
      command: docker tag regapp:latest amanduggal001/regapp:latest

    - name: Push the docker image to docker hub
      command: docker push amanduggal001/regapp:latest
```



ansible-playbook regapp.yml

```
PLAY [ansible] *****************************************************************************

TASK [Gathering Facts] *********************************************************************
[WARNING]: Platform linux on host 172.31.19.187 is using the discovered Python interpreter at
/usr/bin/python, but future installation of another Python interpreter could change this. See
https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more
information.
ok: [172.31.19.187]

TASK [Create docker image] *****************************************************************
changed: [172.31.19.187]

TASK [create docker tag.] ******************************************************************
changed: [172.31.19.187]

TASK [Push the docker image to docker hub] *************************************************
changed: [172.31.19.187]

PLAY RECAP *********************************************************************************
172.31.19.187              : ok=4    changed=3    unreachable=0    failed=0    skipped=0    re
scued=0    ignored=0
```

Till now, ansible playbook will build, commit and push the image to the docker hub. But we have to execute the ansible playbook manually to run those tasks.

Now we will automate the execution of ansible playbook via Jenkins.

Jenkins server will initial this Ansible Playbook whenever there is new code come in. That is where we need to create a new image.

Go to Jenkins > configure the job **'Copy_Artifact_Onto_Ansible'**

Add the below command under the Exec command field.
ansible-playbook /opt/docker/regapp.yml

Enable the Poll SCM which ensures to execute the job in every minute and build if any new commit found.

Now, whenever any commit or any change is done the job gets executed. Once this job is executed our Ansible playbook should get executed.
Once that is done, we could be able to see the Docker images with the latest time stamps.

Go to Git Bash
cd D:/AWS/DevopsProject/hello-world/webapp/src/main/webapp

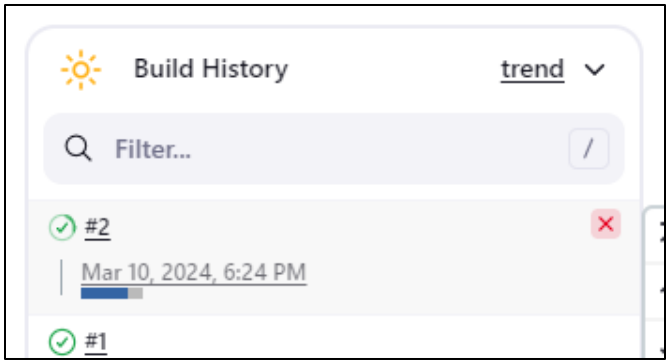
vi index.jsp

Change the source code.

git add .
git commit -m "bugfix"
git push origin master

```
Aman.Duggal@AmanD-OEG MINGW64 /d/AWS/DevopsProject/hello-world/webapp/src/mai
ebapp (master)
$ git push origin master
Enumerating objects: 13, done.
Counting objects: 100% (13/13), done.
Delta compression using up to 8 threads
Compressing objects: 100% (5/5), done.
Writing objects: 100% (7/7), 546 bytes | 273.00 KiB/s, done.
Total 7 (delta 2), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (2/2), completed with 2 local objects.
To https://github.com/amanduggal001/hello-world.git
   07955e1..3f9724e  master -> master
```

Build automatically starts once we push the code.



This means that once code change happens, Jenkins trigger job, copy artifacts onto Ansible, Ansible creates image.

Now we left out only with one step that is creating a container out of this image.

For that in Ansible Playbook we tell our docker host to go and connect to the Docker hub, pull this image, and create a container out of it.

Write one more Ansible playbook and mention to create a new container on the Docker host. Then the Docker host can understand the instructions and it goes and pull the image from the docker hub and create a container out of it.

vi deploy_regapp.yml

```
---
- hosts: dockerhost
  tasks:
    - name: create container
      command: docker run -d --name regapp-server -p 8082:8080 amanduggal001/regapp:latest
```

Test the playbook.

ansible-playbook deploy_regapp.yml --check

```
[ansibleadmin@AnsibleServer docker]$ ansible-playbook deploy_repapp.yml --check

PLAY [dockerhost] ***************************************************************************

TASK [Gathering Facts] **********************************************************************
[WARNING]: Platform linux on host 172.31.25.42 is using the discovered Python interpreter at
/usr/bin/python, but future installation of another Python interpreter could change this. See
https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more
information.
ok: [172.31.25.42]

TASK [create container] *********************************************************************
skipping: [172.31.25.42]

PLAY RECAP **********************************************************************************
172.31.25.42               : ok=1    changed=0    unreachable=0    failed=0    skipped=1    re
scued=0    ignored=0
```

Now, login to the docker host system, we'll delete all our containers. Then we will execute this job manually so that we can see a new container is getting created.

On docker host node -

docker rm -f $(docker ps -q) --#To remove all the docker containers
docker rmi -f $(docker images -q) --#To remove all the docker images

```
[dockeradmin@DockerServer /]$ docker images
REPOSITORY   TAG       IMAGE ID   CREATED   SIZE
[dockeradmin@DockerServer /]$ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
[dockeradmin@DockerServer /]$ docker ps -a
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
```

On ansible host node –

ansible-playbook deploy_repapp.yml --# It will pull the image from the docker hub and create a container out of it.

```
[ansibleadmin@AnsibleServer docker]$ ansible-playbook deploy_repapp.yml

PLAY [dockerhost] ***************************************************************************

TASK [Gathering Facts] **********************************************************************
[WARNING]: Platform linux on host 172.31.25.42 is using the discovered Python interpreter at
/usr/bin/python, but future installation of another Python interpreter could change this. See
https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more
information.
ok: [172.31.25.42]

TASK [create container] *********************************************************************
fatal: [172.31.25.42]: FAILED! => {"changed": true, "cmd": ["docker", "run", "-d", "--name", "
regapp-server", "-p", "8082:8080", "amandugga1001/regapp:latest"], "delta": "0:00:00.063761",
"end": "2024-03-10 19:22:30.319490", "msg": "non-zero return code", "rc": 126, "start": "2024-
03-10 19:22:30.255729", "stderr": "docker: Got permission denied while trying to connect to th
e Docker daemon socket at unix:///var/run/docker.sock: Post \"http://%2Fvar%2Frun%2Fdocker.soc
k/v1.24/containers/create?name=regapp-server\": dial unix /var/run/docker.sock: connect: permi
ssion denied.\nSee 'docker run --help'.", "stderr_lines": ["docker: Got permission denied whil
e trying to connect to the Docker daemon socket at unix:///var/run/docker.sock: Post \"http://
%2Fvar%2Frun%2Fdocker.sock/v1.24/containers/create?name=regapp-server\": dial unix /var/run/do
cker.sock: connect: permission denied.", "See 'docker run --help'."], "stdout": "", "stdout_li
nes": []}

PLAY RECAP **********************************************************************************
172.31.25.42               : ok=1    changed=0    unreachable=0    failed=1    skipped=0    re
scued=0    ignored=0
```

You will get the exception due to permission issue on /var/run/docker.sock. The issue occurred because we are working as ansibleadmin user.

To grant permission go to **docker host node**.

chmod 777 /var/run/docker.sock

chmod: This is a command in Unix-like operating systems used to change the permissions of a file or directory.

777: This is a permission setting in octal notation. In the context of file permissions:

The first digit (7) corresponds to the owner's permissions.
The second digit (7) corresponds to the group's permissions.
The third digit (7) corresponds to others' (everyone else's) permissions.
In octal notation, each digit represents a combination of read (4), write (2), and execute (1) permissions.
The digits are added to represent the cumulative permissions.

So, 7 means read (4) + write (2) + execute (1), which is the highest level of permission.

ansible-playbook deploy_repapp.yml

```
[ansibleadmin@AnsibleServer docker]$ ansible-playbook deploy_repapp.yml

PLAY [dockerhost] ***************************************************************************************************

TASK [Gathering Facts] **********************************************************************************************
[WARNING]: Platform linux on host 172.31.25.42 is using the discovered Python interpreter at /usr/bin/python, but fu
could change this. See https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more
ok: [172.31.25.42]

TASK [create container] *********************************************************************************************
changed: [172.31.25.42]

PLAY RECAP **********************************************************************************************************
172.31.25.42               : ok=2    changed=1    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0

[ansibleadmin@AnsibleServer docker]$
```

Once the playbook is executed check on **Docker Host**, image is pull from the docker hub and created a container out of it.

NOTE- We run ansible playbook on ansible server, and the images and containers are created on the docker server.

docker images
docker ps

```
[dockeradmin@DockerServer /]$ docker images
REPOSITORY                  TAG       IMAGE ID       CREATED          SIZE
amanduggal001/regapp        latest    5398975c833f   16 minutes ago   460MB
[dockeradmin@DockerServer /]$ docker ps
CONTAINER ID   IMAGE                           COMMAND             CREATED          STATUS          PORTS                                       NAMES
762d10e6898a   amanduggal001/regapp:latest   "catalina.sh run"   17 seconds ago   Up 16 seconds   0.0.0.0:8082->8080/tcp, :::8082->8080/tcp   amancontainer
[dockeradmin@DockerServer /]$
```

Now check the application on browser,

Docker Host public ip: port no/webapp
52.77.243.86:8082/webapp/

Now, the problem arises whenever you execute the same playbook (deploy_repapp.yml) the conflict occurs. Since the container name is already used by another container and the port no is already in use.

```
[ansibleadmin@AnsibleServer docker]$ ansible-playbook deploy_repapp.yml

PLAY [dockerhost] ***************************************************************

TASK [Gathering Facts] **********************************************************
[WARNING]: Platform linux on host 172.31.25.42 is using the discovered Python
interpreter at /usr/bin/python, but future installation of another Python
interpreter could change this. See https://docs.ansible.com/ansible/2.9/referen
ce_appendices/interpreter_discovery.html for more information.
ok: [172.31.25.42]

TASK [create container] *********************************************************
fatal: [172.31.25.42]: FAILED! => {"changed": true, "cmd": ["docker", "run", "-d
", "--name", "amancontainer", "-p", "8082:8080", "amanduggal001/regapp:latest"],
 "delta": "0:00:00.064055", "end": "2024-03-11 16:56:36.596890", "msg": "non-zer
o return code", "rc": 125, "start": "2024-03-11 16:56:36.532835", "stderr": "doc
ker: Error response from daemon: Conflict. The container name \"/amancontainer\"
 is already in use by container \"762d10e6898abcec0e21073fa9fe3cdd53f80fe9f60a38
442c55c194e05dfc9c\". You have to remove (or rename) that container to be able t
o reuse that name.\nSee 'docker run --help'.", "stderr_lines": ["docker: Error r
esponse from daemon: Conflict. The container name \"/amancontainer\" is already
in use by container \"762d10e6898abcec0e21073fa9fe3cdd53f80fe9f60a38442c55c194e0
5dfc9c\". You have to remove (or rename) that container to be able to reuse that
 name.", "See 'docker run --help'."], "stdout": "", "stdout_lines": []}

PLAY RECAP **********************************************************************
172.31.25.42               : ok=1    changed=0    unreachable=0    failed=1    s
kipped=0    rescued=0    ignored=0
```

To overcome this problem, we need to execute the same steps that we have taken on our Jenkins sometime back.
That is first remove the existing container then remove the existing image. The question comes as to why we need to remove the image because if there is an existing image present it won't go to the Docker Hub to pull the latest image.

At last, create a new container.

Deploy Ansible Playbook

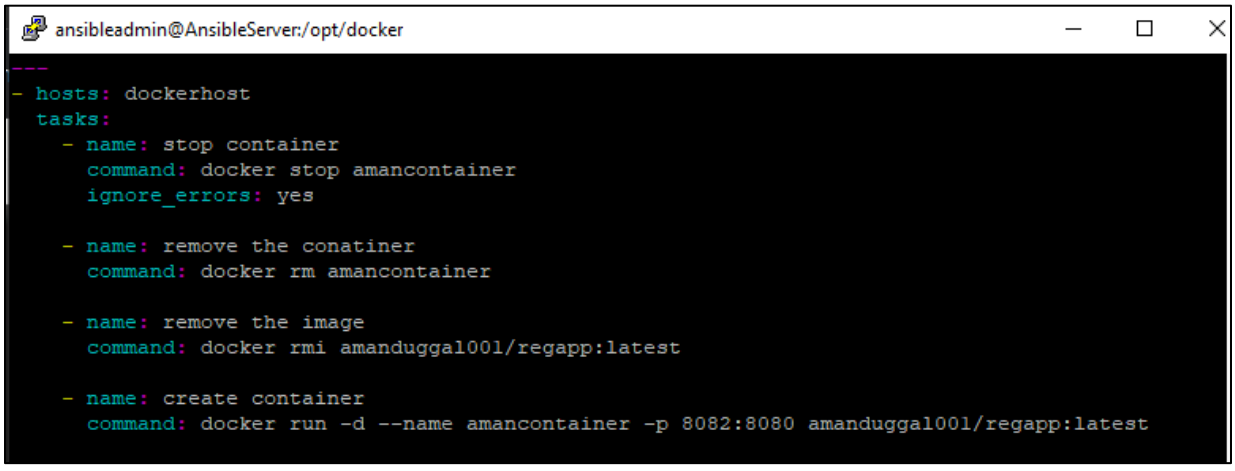
- Remove existing container.
- Remove existing image.
- Create a new container.

Once this is done, we can add our deployment process to our Jenkins so that Jenkins can take care of the entire Continuous Integration and Continuous deployment of our containers.

Edit the existing ansible playbook.

vi deploy_repapp.yml

```
---
- hosts: dockerhost
  tasks:
    - name: stop container
      command: docker stop amancontainer
      ignore_errors: yes          --#Incase if we have these containers stop it and in case these containers doesn't exists don't fail the playbook.

    - name: remove the conatiner
      command: docker rm amancontainer

    - name: remove the image
      command: docker rmi amanduggal001/regapp:latest

    - name: create container
      command: docker run -d --name amancontainer -p 8082:8080 amanduggal001/regapp:latest
```



ansible-playbook deploy_repapp.yml

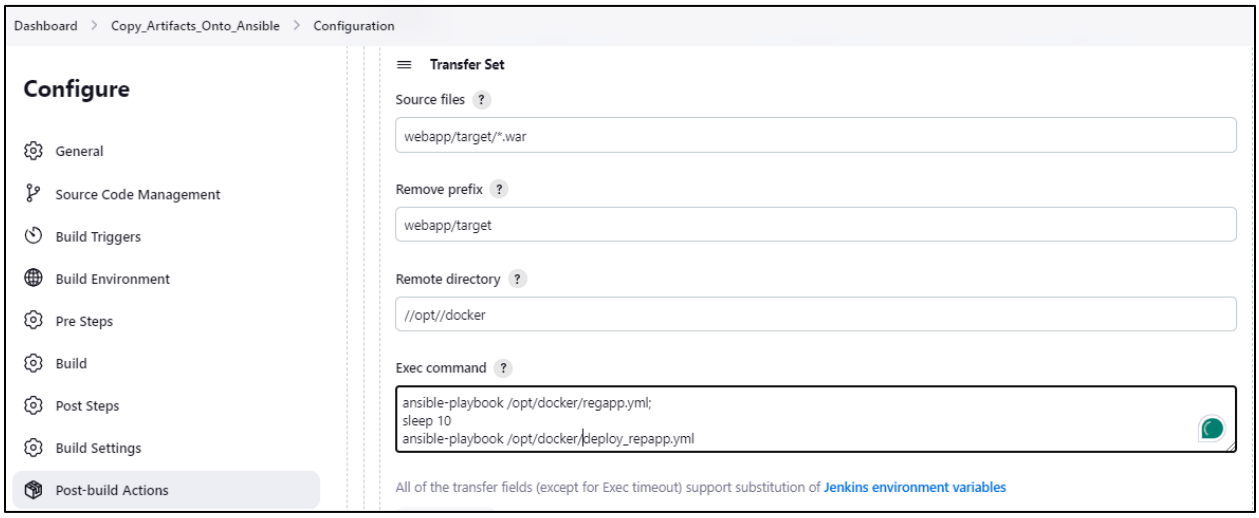
Check on docker server the container will be created.

Now, it's time to automate the process.

Go to Jenkins> Configure the job **'Copy_Artifacts_Onto_Ansible'**

Under Post-build Actions, enter the ansible command to execute the ansible playbook.

```
ansible-playbook /opt/docker/regapp.yml;
sleep 10  --#To wait for 10 sec then the next command will execute.
ansible-playbook /opt/docker/deploy_repapp.yml
```



Apply > Save.

Now make some changes in the source code, so that it's going to trigger the Jenkins job.

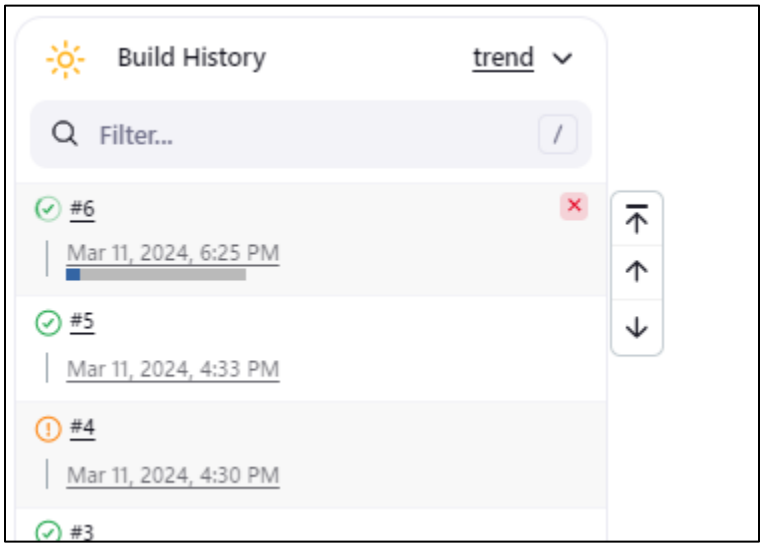
Go to Git Bash
cd D:/AWS/DevopsProject/hello-world/webapp/src/main/webapp

vi index.jsp

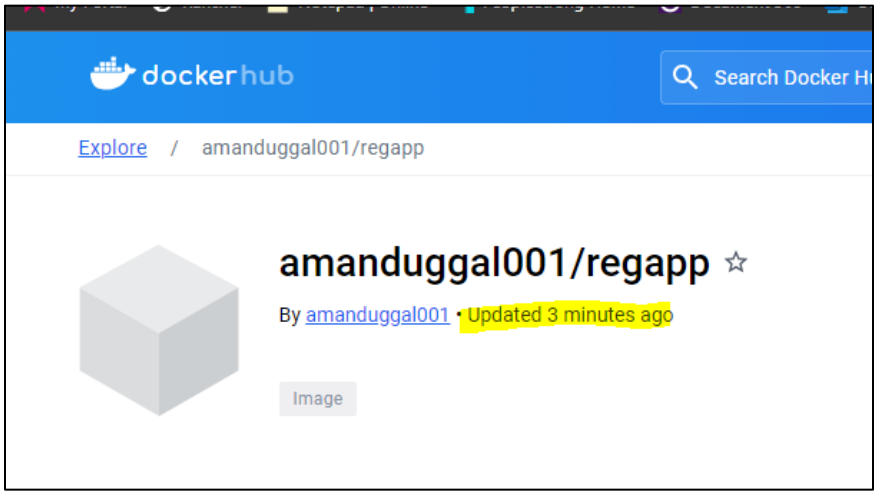
Change the source code.

```
git add .
git commit -m "bugfix"
git push origin master
```

Once pushed the image, the job gets initializing.



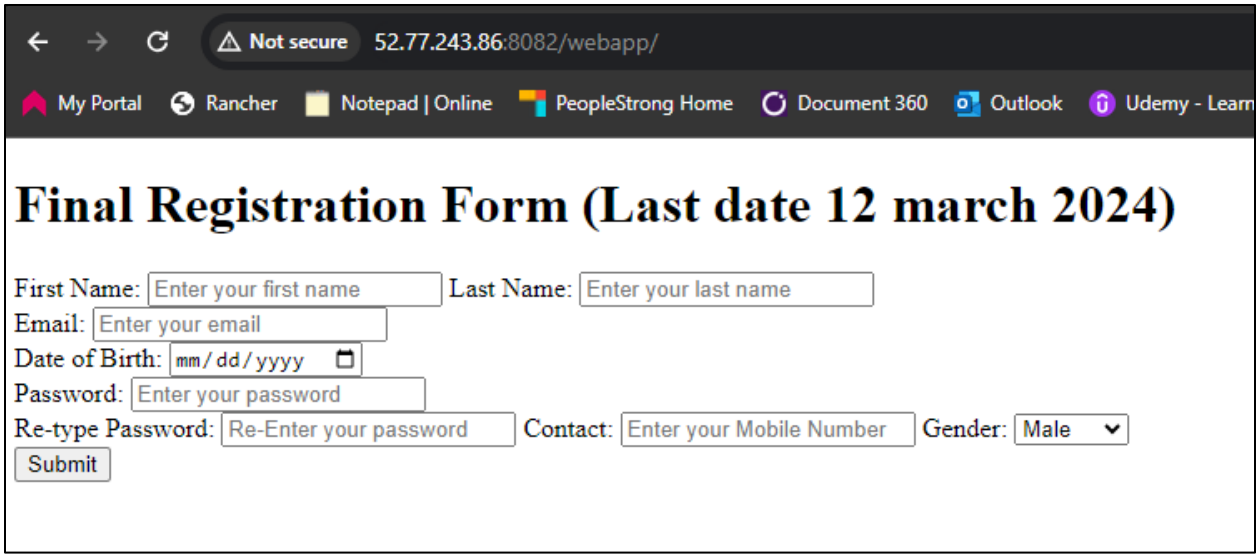
So, first thing what is going to happen is, it is going to update the image in our Ansible server and same thing updated over docker hub.
After that it should be able to delete the existing container on docker host and create a new container.



New images and containers are created.

```
[root@DockerServer docker]# docker images
REPOSITORY              TAG       IMAGE ID       CREATED              SIZE
amanduggal001/regapp    latest    726b3ead2dc6   About a minute ago   460MB
[root@DockerServer docker]# docker ps
CONTAINER ID   IMAGE                          COMMAND             CREATED         STATUS         PORTS                                       NAMES
19d482b2f077   amanduggal001/regapp:latest    "catalina.sh run"   52 seconds ago  Up 51 seconds  0.0.0.0:8082->8080/tcp, :::8082->8080/tcp   amancontainer
[root@DockerServer docker]#
```

Updated source code reflected on application.



Till now we have modify our Jenkins job in such a way if someone changes the source code it should automatically build the code, create an image, create a container and we could able to access those changes from the browser.

Deploying on as a Container

But if you see the problem whenever there are some changes, we are terminating the existing container and creating a new container, during this time end user cannot be able to access the application.

Another thing is if our container is terminated, how we can come to know that it is not working? or how we can create a new container automatically?

Till now, we don't have such kind of mechanisms to handle these, that is where container management system comes.

We are using the container management service i.e. Kubernetes. Due to its multiple advantages, we are not going to deploy our application as the docker container, but we are deploy it as a part on Kubernetes environment.

Deploying on as a POD

Kubernetes Installation

We are using the AWS EKSCTL (command line utility) for managing the containers.

Pre- Requisites:

- Create an EC2 Instance.
- Install AWS CLI latest version.

This EC2 instance we are using it as a bootstrap image. We are going to setup Kubernetes with the help of this bootstrap image and this Ec2 instance is going to communicate with the EKS service through the AWS CLI.

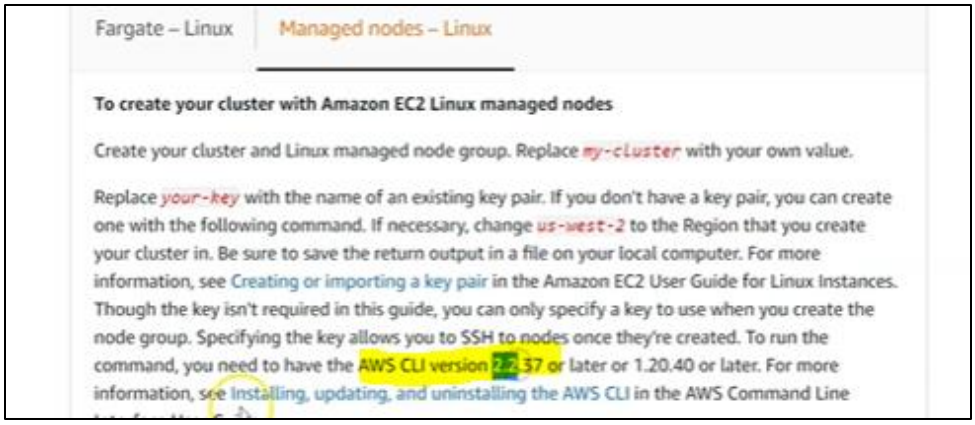
Check the AWS Version

On Kubernetes Terminal

aws --version

```
ec2-user@KubernetesServer:~
[ec2-user@KubernetesServer ~]$ aws --version
aws-cli/1.18.147 Python/2.7.18 Linux/5.10.210-201.852.amzn2.x86_64 botocore/1.18.6
```

As a prerequisite, it is required to install the AWS CLI version 2.2.



- **Download the AWS CLI Version 2** --https://docs.aws.amazon.com/cli/latest/userguide/getting-started-install.html

curl "https://awscli.amazonaws.com/awscli-exe-linux-x86_64.zip" -o "awscliv2.zip"
unzip awscliv2.zip
sudo ./aws/install

sudo su - --#This command is used to switch to the root user in a Linux system. The - option ensures that the environment variables are set as if the root user had logged in directly.

aws --version

```
[root@KubernetesServer ec2-user]# sudo su -
Last login: Mon Mar 11 20:33:58 UTC 2024 on pts/0
[root@KubernetesServer ~]# aws --version
aws-cli/2.15.27 Python/3.11.8 Linux/5.10.210-201.852.amzn2.x86_64 exe/x86_64.amz
n.2 prompt/off
[root@KubernetesServer ~]#
```

- **Now setup kubectl, check the AWS documentation for the latest versions and install it.**

https://docs.aws.amazon.com/eks/latest/userguide/install-kubectl.html

curl -O https://s3.us-west-2.amazonaws.com/amazon-eks/1.29.0/2024-01-04/bin/linux/amd64/kubectl

ls

```
[root@KubernetesServer ~]# ls
kubectl
```

Now, we are downloading the kubctl packages. Once it is downloaded, we need to add execution permissions.

chmod +x kubectl

Move the kubectl file to /usr/local/bin.

mv kubectl /usr/local/bin --#This is the default path of Linux OS and by default whenever we execute kubectl command it will go and pick up from this location.

echo $PATH --#We could see usr/local/bin in our path. So whenever we execute any command it is going to validate in this location.

```
[root@KubernetesServer ~]# echo $PATH
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/root/bin
```

kubectl version --# To check if the kubectl is successfully installed or not.

```
[root@KubernetesServer ~]# kubectl version
Client Version: v1.29.0-eks-5e0fdde
Kustomize Version: v5.0.4-0.20230601165947-6ce0bf390ce3
The connection to the server localhost:8080 was refused - did you specify the ri
ght host or port?
[root@KubernetesServer ~]#
```

Similarly, install EKSCTL. --https://docs.aws.amazon.com/emr/latest/EMR-on-EKS-DevelopmentGuide/setting-up-eksctl.html

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

cd /tmp

```
[root@KubernetesServer ~]# cd /tmp
[root@KubernetesServer tmp]# ls
eksctl  systemd-private-41456dd44cb4465c96cac7e383ef003f-chronyd.service-cNVlJ3
[root@KubernetesServer tmp]#
```

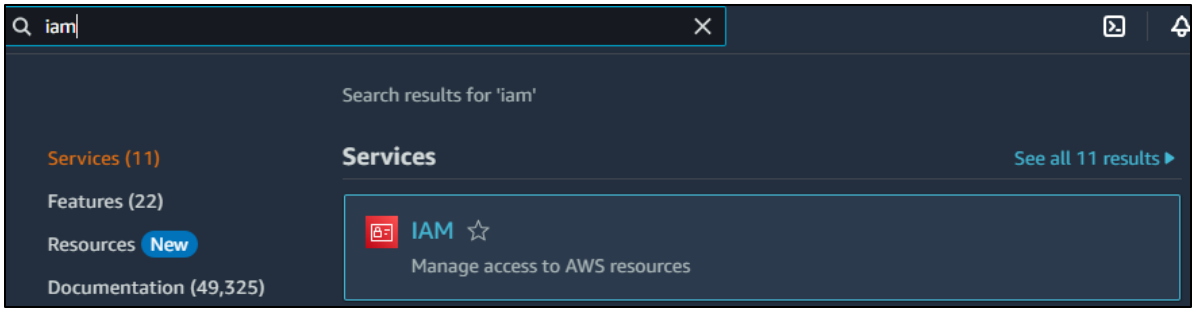
mv eksctl /usr/local/bin --#Move to default path.

eksctl version

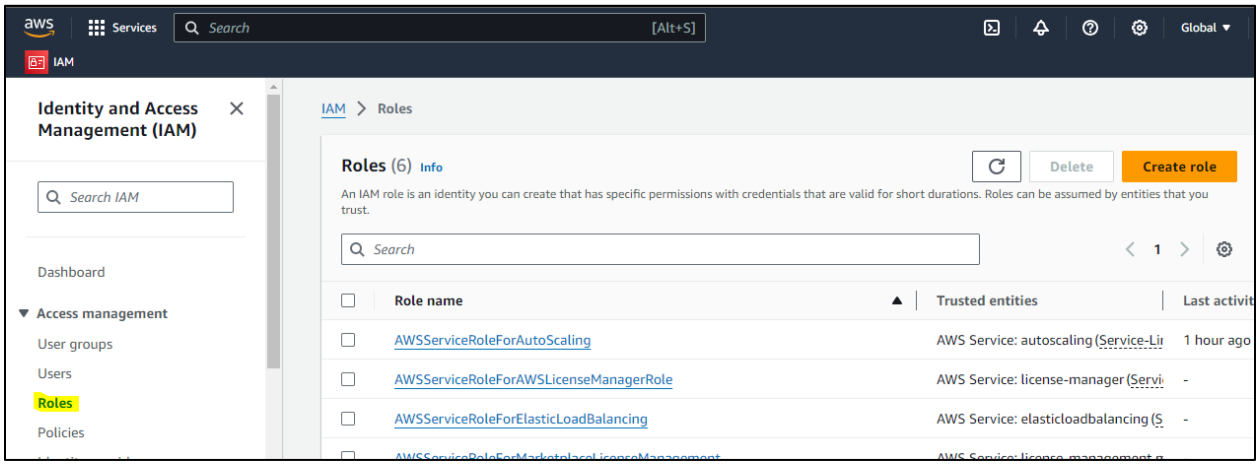
```
[root@KubernetesServer tmp]# eksctl version
0.173.0
[root@KubernetesServer tmp]#
```

Now create an IAM role.

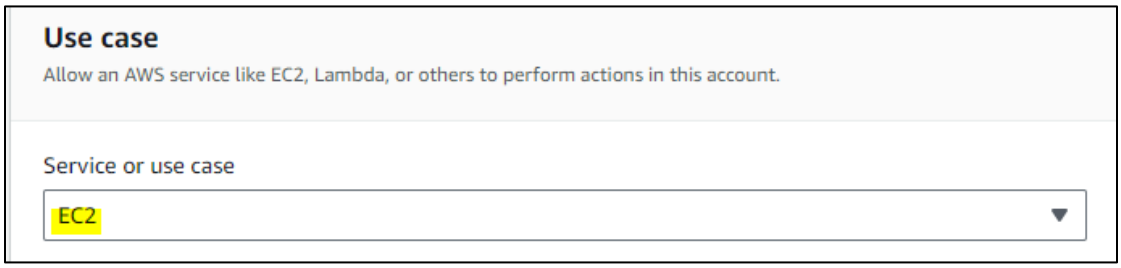
Go to AWS console and search for IAM service.



Select Roles> Create role.

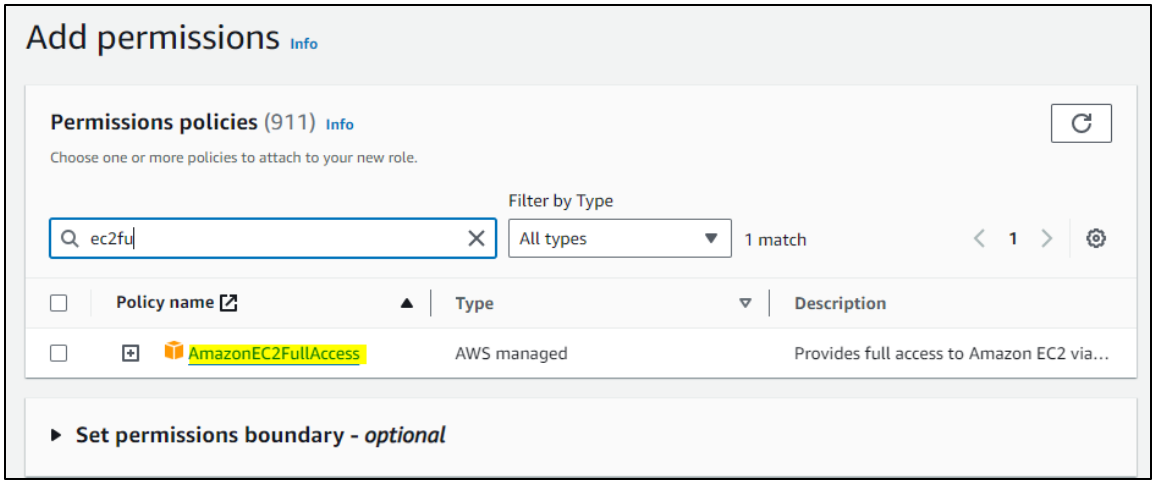


Select EC2 under Service or use case > Next.

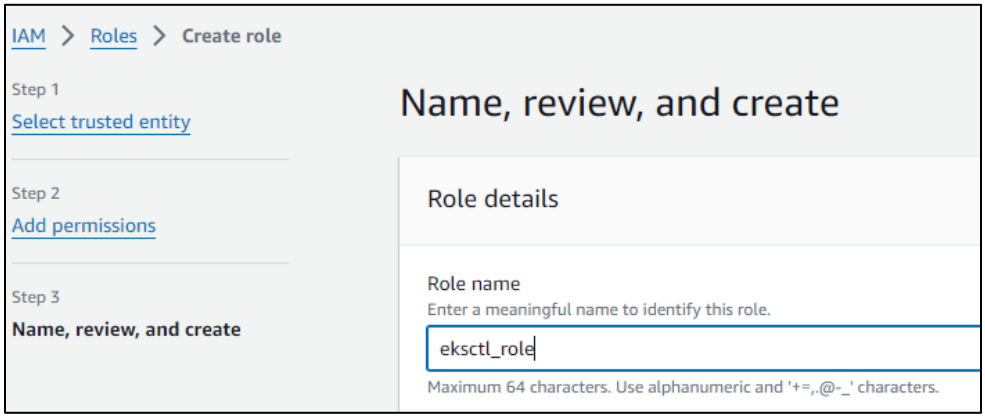


Add below Permission > Next.

- AmazonEC2FullAccess
- AWSCloudFormationFullAccess
- IAMFullAccess

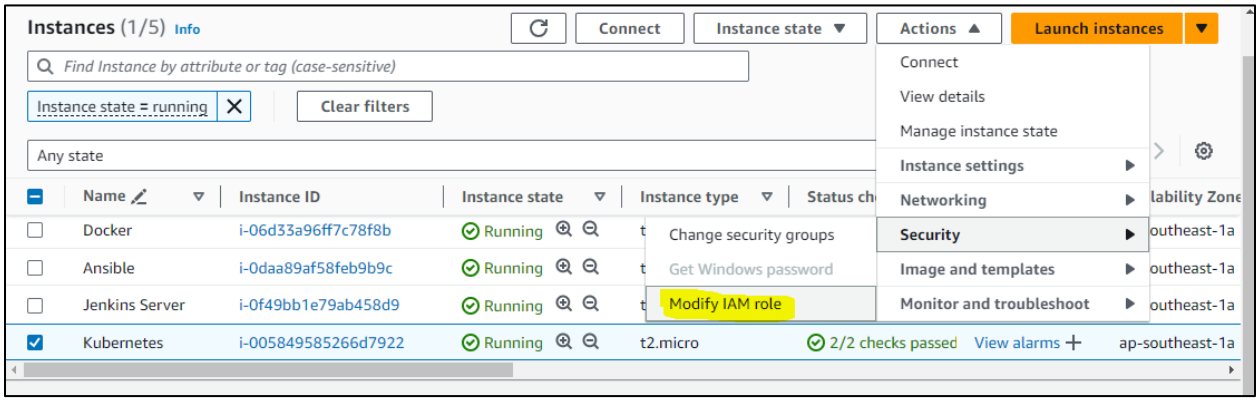


Enter role name > Click on 'Create a role'.

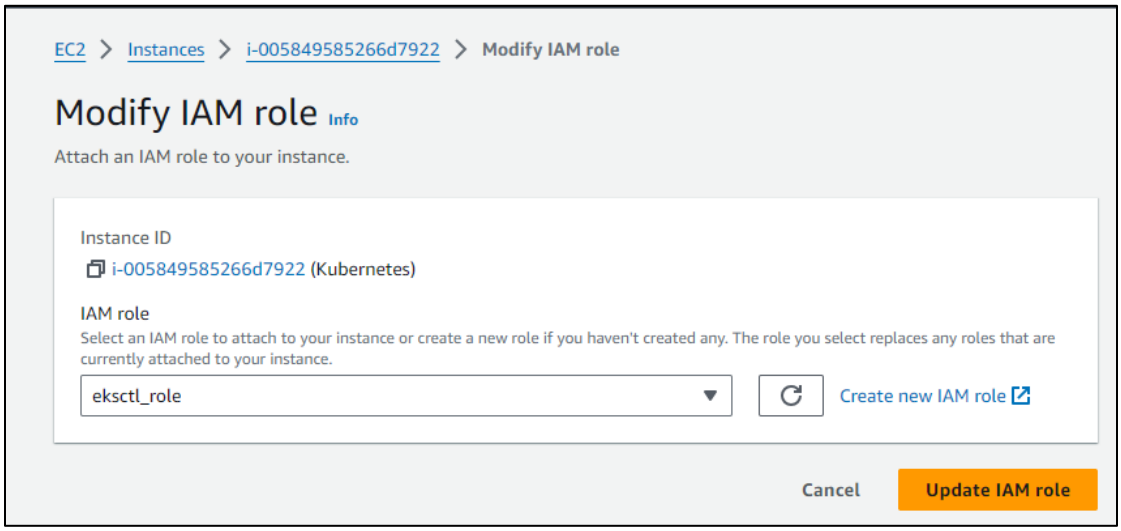


Add this role to our Kubernetes EC2 instance.

Select EC2 instance > Actions > Security > Modify IAM.



Select your IAM role.



Now this Kubernetes server (Bootstrap server have access to almost all the AWS services because we have given administrative privileges.

- **Now create a cluster.**

Format:
eksctl create cluster --name cluster-name \ --#Your name of the cluster.
--region region-name \ --#On which region we wish to create the cluster.
--node-type instance-type \ --#What type on instance we want to create.
--nodes-min 2 \ --#Minimum nodes.
--nodes-max 2 \--#Maximum nodes. If we don't specify by default it will create 2 instances.
--zones <AZ-1>,<AZ-2> --#On which zones it can spread in this region.

Now update this command according to your requirement.

On Terminal (K8s)

eksctl create cluster --name amancluster --region ap-southeast-1 --node-type t2.small

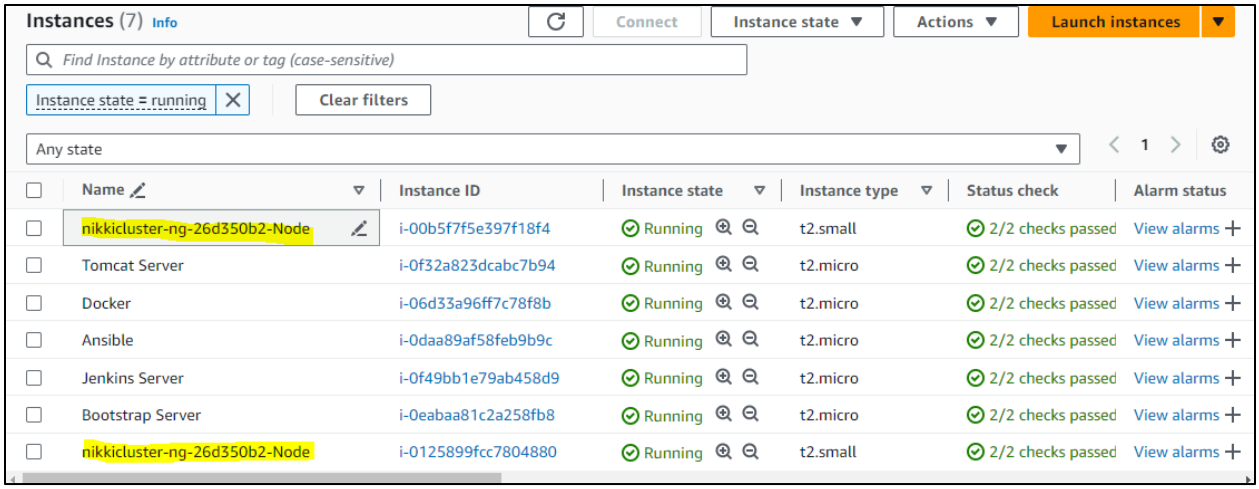
--#NOTE: This command will take 20-25 min.

eksctl delete cluster --region=ap-southeast-1 --name=amancluster --#To delete the existing cluster. Not to run every time.

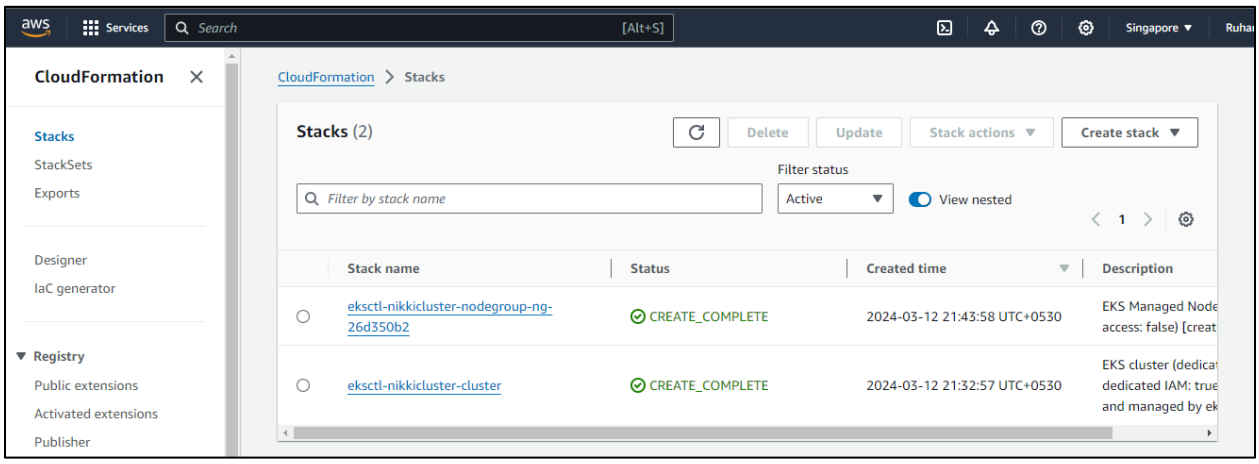
NOTE: DELETE THE CLUSTER ONCE THE PROJECT IS COMPLETED, OTHERWISE UNNECCESSARY BILL IS GENEREATED.

eksctl is going to create our environment with help of cloud formation. Once you execute the command you will see the cloud formation template which created and executing to set up our EC2 instances.

Once the command is executed properly, 2 new instances are created.



Also check the cloud formation.



cat /root/.kube/config --#This config file is created, so whoever this file they can communicate with our clusters and do the activities.

```
[root@KubernetesServer ~]# cat /root/.kube/config
apiVersion: v1
clusters:
- cluster:
    certificate-authority-data: LS0tLS1CRUdJTiBDRVJUSUZJQ0FURS0tLS0tCk1JSURCVEND
QWUyZ0F3SUJBZ01JZUtyZlNCY3V1QTR3RFZSktvWklodmNOQVFFTEJRQXdGVEVUTUJFR0ExVUUKQXhN
S2EzVmlaWEp1WlhSbGN6QWVGdzB5TkRBek1URXlNVE00TXpsYUZ3MHpOREF6TURreU1UUXpNemxhTUJV
eApFekFSQmdOVkJBTVRDbXQxWW1WeWJtVjBaWE13Z2dFaU1BMEdDU3FHU01iM0RRRUJBUVVBQTRJQkR3
QXdnZ0VLCkFvSUJBUURxT2hPTTBzODcyYkJPMFdlVjMvdStjT3VKTjNvREFuK1UvQXZJRHNKODR6eGE0
M1g5ci9iMklYN1YKRlNFMHVUSTdEUW1MSnFkZWZEaEtrU0pLSmNWVHRaUnpndDdBdm5xcGJPYlBhQkll
OVFibmh0dFhvK2tmNGRKYQovckpFeDNRNHBYcHRlYU5sNUZEMEZpS2pmbWh5QnViZ09RRytyaUpKVFpl
TnRPaUwxZU5XOSsremtsS2pIdlJxCmpQbTFGSDB0UzJwRm9GOTl0UWZpZGtqWTRJT3EzQXBIY0drSE9U
eXFpQlMzdlVkUUd4TTV6VFhSbTQ5VGN6ZHoKT0EzOEsydFRXTkFSW1lqRUM0TXFWWjd4NkloR0pHSXJS
MXRncTYzUFkzY3RBSHIwcU9JaG9Nd1AwSSsrc0xhUgpuR3NhTThRWFZnRjcyelFvTjZEbnBFSGJHWWF0
QWdNQkFBR2pXVEJYTUE0R0ExVWREd0VCL3dRRUF3SUNwREFQCkJnT1ZIUklCQWY4RUJUQURBUUgvTUIw
R0ExVWREZlFXQkJSUGt6a2ZyTzJDNE9zYmFKYUhqME9SVzllQlV6QVYKQmdOVkhSRUVEakFNZ2dwcmRX
SmxjbTVsZEdWeklBMEdDU3FHU01iM0RRRUJDdlVBQTRJQkFRRFRSa0tWND10OAolYW1vV3lpNGZTdzVz
Z3hKdEVGWVBPaGYrMm0zM1Z0aFg1ZktmZUUzRWNJcnUrNVJnTGJFUVJZS3pzZk9BbWFFCnNIOHY3RmpW
eU1FQnNYaEtLK2FLSUxkdm45NUNkVTZvQUMrbmNzcGIreGtYVm51S0ZyeWhqbTdMeGxPeDdFUUYKQU1V
MU95eXVkTlErclBQRFF2Ry9FUlhYdjhzZmFyclNVMmpwUTd0VGl5V1JtWUxiNllmWHZteElIMlNQZitx
eApHZUVQYVNiRGhYMitoWDZTaVlEczlRYjBhNE0rSFhoNVltTS0l6aWtpSi9FWDFTU3clWGdYMW5LUkc3
WVg1Q3JnCktSMFRlbk9CM0NHNFNKZU14Z3JINkRPSXh4a0kzNy9WRWklUlRVN3k2U3dTb0VJYjNQUHMx
cXdkTFJIZms4VFoKakZrdGIlbml2WEpLCi0tLS0tRU5EIENFUlRJRklDQVRFLS0tLS0K
    server: https://404CECFC1851612850C2E309382B3164.gr7.ap-southeast-1.eks.amaz
onaws.com
  name: newcluster.ap-southeast-1.eksctl.io
contexts:
- context:
    cluster: newcluster.ap-southeast-1.eksctl.io
    user: i-005849585266d7922@newcluster.ap-southeast-1.eksctl.io
  name: i-005849585266d7922@newcluster.ap-southeast-1.eksctl.io
current-context: i-005849585266d7922@newcluster.ap-southeast-1.eksctl.io
```

```
2024-03-12 16:17:04 [ℹ]  nodegroup "ng-26d350b2" has 2 node(s)
2024-03-12 16:17:04 [ℹ]  node "ip-192-168-16-10.ap-southeast-1.compute.internal" is ready
2024-03-12 16:17:04 [ℹ]  node "ip-192-168-58-155.ap-southeast-1.compute.internal" is ready
2024-03-12 16:17:05 [ℹ]  kubectl command should work with "/root/.kube/config", try 'kubectl get nodes'
2024-03-12 16:17:05 [✔]  EKS cluster "nikkicluster" in "ap-southeast-1" region is ready
[root@ip-172-31-27-151 tmp]# kubectl version
Client Version: v1.29.0-eks-5e0fdde
Kustomize Version: v5.0.4-0.20230601165947-6ce0bf390ce3
Server Version: v1.29.1-eks-508b6b3
[root@ip-172-31-27-151 tmp]# kubectl get nodes
NAME                                           STATUS   ROLES    AGE     VERSION
ip-192-168-16-10.ap-southeast-1.compute.internal   Ready    <none>   2m57s   v1.29.0-eks-5e0fdde
ip-192-168-58-155.ap-southeast-1.compute.internal   Ready    <none>   2m50s   v1.29.0-eks-5e0fdde
[root@ip-172-31-27-151 tmp]#
```

Commands:

kubectl get nodes --#To see the pods.

kubectl get all --#To see what all services are running.

kubectl run webapp --image=httpd --#To create the pod.

kubectl delete pod webapp --#To delete pod.

```
[root@ip-172-31-27-151 tmp]# kubectl get all
NAME                 TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
service/kubernetes   ClusterIP   10.100.0.1   <none>        443/TCP   52m
[root@ip-172-31-27-151 tmp]# kubectl run webapp --image=httpd
pod/webapp created
[root@ip-172-31-27-151 tmp]# kubectl get all
NAME         READY   STATUS    RESTARTS   AGE
pod/webapp   1/1     Running   0          87s

NAME                 TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
service/kubernetes   ClusterIP   10.100.0.1   <none>        443/TCP   83m
[root@ip-172-31-27-151 tmp]#
```

Now, to understand how Kubernetes is going to help our applications and workloads more efficiently we are going to deploy the Nginx application.

Our intention is to run our register application on the k8s cluster so that in case if something happens to our pod or container it should be able to reprovision (recreated).

That is how we make sure that our application is highly available for the end user.

kubectl create deployment demo-nginx --image=nginx --port=80 --replicas=2

By using this command, we are going to pull the nginx image from the docker hub and create a deployment called demo-nginx. And, in the backend it is going to create a replica set of 2 pods. It exposes the nginx to port number 80.

kubectl get deployment

kubectl get replicaset

kubectl get pod

kubectl get all

```
[root@ip-172-31-27-151 tmp]# kubectl get deployment
NAME         READY   UP-TO-DATE   AVAILABLE   AGE
demo-nginx   2/2     2            2           22s
[root@ip-172-31-27-151 tmp]# kubectl get replicaset
NAME                    DESIRED   CURRENT   READY   AGE
demo-nginx-5c97459668   2         2         2       40s
[root@ip-172-31-27-151 tmp]# kubectl get pod
NAME                          READY   STATUS    RESTARTS   AGE
demo-nginx-5c97459668-lnbcq   1/1     Running   0          54s
demo-nginx-5c97459668-xtg7s   1/1     Running   0          54s
[root@ip-172-31-27-151 tmp]# kubectl get all
NAME                              READY   STATUS    RESTARTS   AGE
pod/demo-nginx-5c97459668-lnbcq   1/1     Running   0          68s
pod/demo-nginx-5c97459668-xtg7s   1/1     Running   0          68s

NAME                 TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
service/kubernetes   ClusterIP   10.100.0.1   <none>        443/TCP   98m

NAME                         READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/demo-nginx   2/2     2            2           68s

NAME                                    DESIRED   CURRENT   READY   AGE
replicaset.apps/demo-nginx-5c97459668   2         2         2       68s
[root@ip-172-31-27-151 tmp]#
```

Expose the deployment as service. This will create an ELB in front of those 2 containers and allow us to publicly access them.

Now, we are going to expose this application to the external network for that we are going to use -

kubectl expose deployment demo-nginx --port=80 --type=LoadBalancer

The kubectl expose command is used in Kubernetes to create a new service and expose it to the external world or other parts of the cluster.

- **kubectl expose:** This is the main command to expose a resource in Kubernetes.
- **deployment demo-nginx:** Specifies the resource type (deployment) and the name of the deployment you want to expose (demo-nginx in this case).
- **--port=80:** Specifies the port on which the service will be exposed. In this case, the service will be exposed on port 80.
- **--type=**LoadBalancer: Specifies the type of service to create. In this example, it's set to LoadBalancer. This type is typically used in cloud environments where a cloud provider's load balancer will be provisioned to distribute external traffic among the pods in the service. The external IP address assigned to the load balancer will be used to access the service.

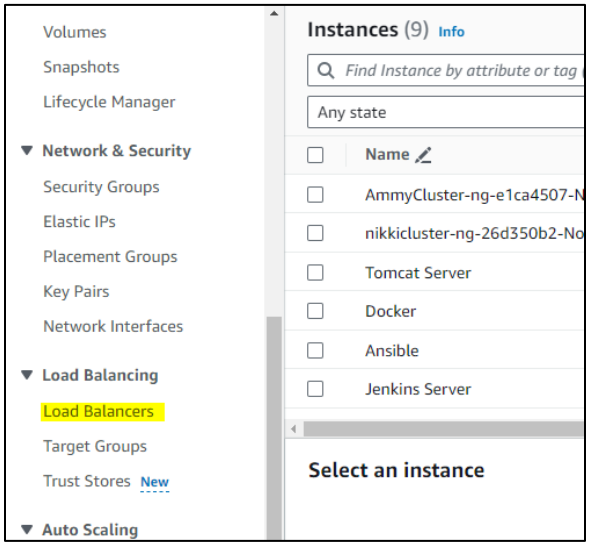
After running this command, Kubernetes will create a new service that forwards traffic to the pods managed by the demo-nginx deployment on port 80. If you are using a cloud provider that supports LoadBalancer services, Kubernetes will automatically provision a load balancer for you.

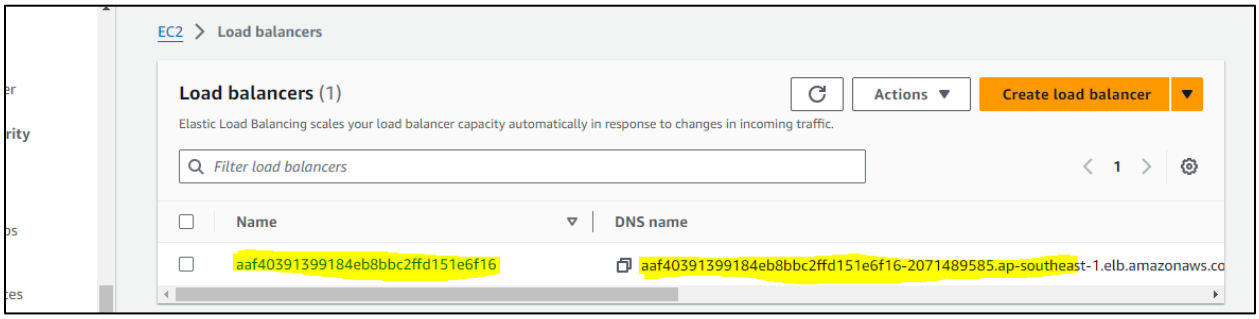
kubectl get services --#To check the service.

```
[root@ip-172-31-27-151 tmp]# kubectl expose deployment demo-nginx --port=80 --type=LoadBalancer
service/demo-nginx exposed
[root@ip-172-31-27-151 tmp]# kubectl get services
NAME         TYPE           CLUSTER-IP      EXTERNAL-IP                                                                PORT(S)        AGE
demo-nginx   LoadBalancer   10.100.235.39   aaf40391399184eb8bbc2ffd151e6f16-2071489585.ap-southeast-1.elb.amazonaws.com   80:32038/TCP   8s
kubernetes   ClusterIP      10.100.0.1      <none>                                                                     443/TCP        106m
[root@ip-172-31-27-151 tmp]#
```

Once, we have created, we can access our application with the External IP (See the SS). But this will take a while to open, because we have used the Load Balancer. So it is going to create an actual Load Balancer in the AWS Cloud.

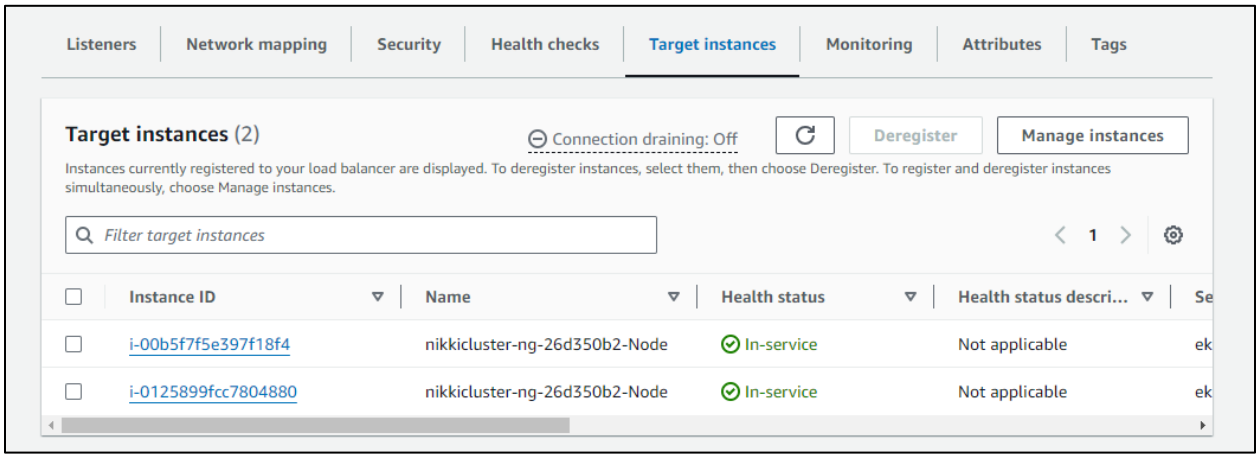
To check, Go to the AWS console > Load Balancers



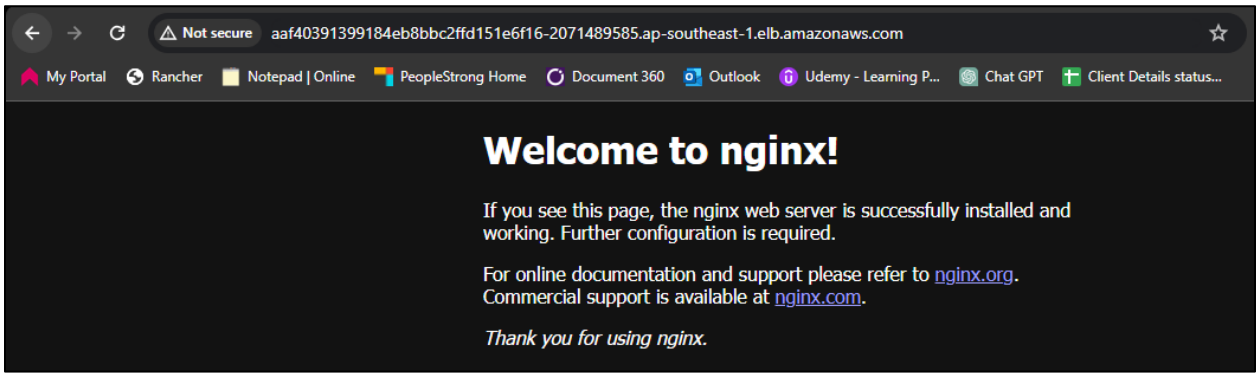


You will see the load balancer is created. (Compare the name with the LB external ip from the terminal).

Also, the 2 instances are tagged with the load balancers.



Now, check if our application is opening from browser. Copy the DNS address and paste it on the browser and you will see the nginx application page.



Create 1st manifest file

Till now, we are manually giving single commands to create the deployments, services. But this is not the correct way.

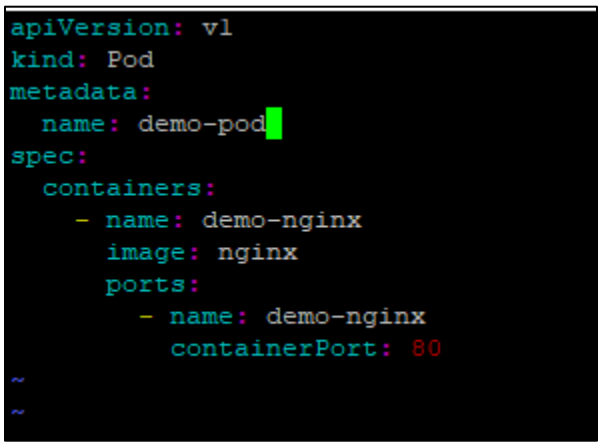
Now we can see how we can create a Pod and service by using the manifest files. For that delete the existing configurations.

kubectl delete deployment demo-nginx -- #To delete the deployment.

kubectl delete service/demo-nginx --#To delete the services like load balancer.

vi pod.yml --#To create a manifest file.

```
apiVersion: v1
kind: Pod
metadata:
  name: demo-pod
spec:
  containers:
    - name: demo-nginx
      image: nginx
      ports:
        - name: demo-nginx
          containerPort: 80
```



Now, to expose our pod we need to create a service.

vi service.yml

```
apiVersion: v1
kind: Service
metadata:
  name:  demo-service
spec:
  ports:
    - name: nginx-port
      port: 80
      targetPort: 80

  type: LoadBalancer
```

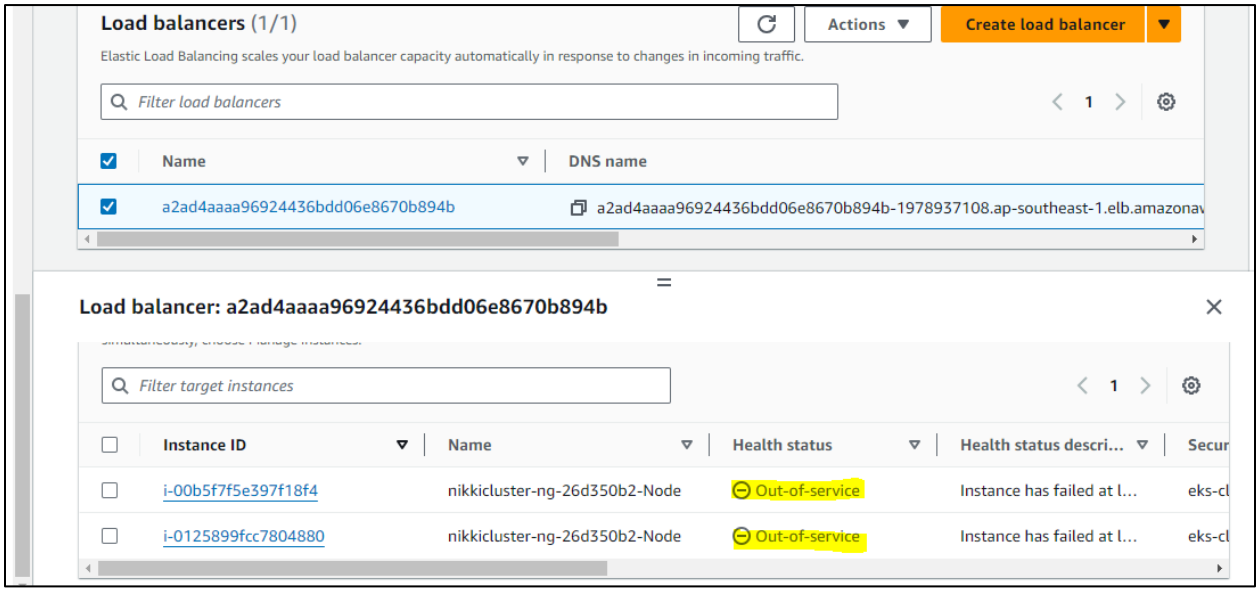
```
apiVersion: v1
kind: Service
metadata:
  name:  demo-service
spec:
  ports:
    - name: nginx-port
      port: 80
      targetPort: 80

  type: LoadBalancer
~
```

kubectl apply -f pod.yml --#To execute the manifest file.
kubeclt apply -f service.yml
kubectl get pods
kubectl get services

```
[root@ip-172-31-27-151 tmp]# kubectl get pods
NAME       READY   STATUS    RESTARTS   AGE
demo-pod   1/1     Running   0          69s
```

```
[root@ip-172-31-27-151 tmp]# kubectl get services
NAME           TYPE           CLUSTER-IP     EXTERNAL-IP                                                                PORT(S)        AGE
demo-service   LoadBalancer   10.100.34.35   a2ad4aaaa96924436bdd06e8670b894b-1978937108.ap-southeast-1.elb.amazonaws.com   80:30699/TCP   20s
kubernetes     ClusterIP      10.100.0.1     <none>                                                                     443/TCP        140m
```

Now, you will see the LB is created but the instances are out of service.



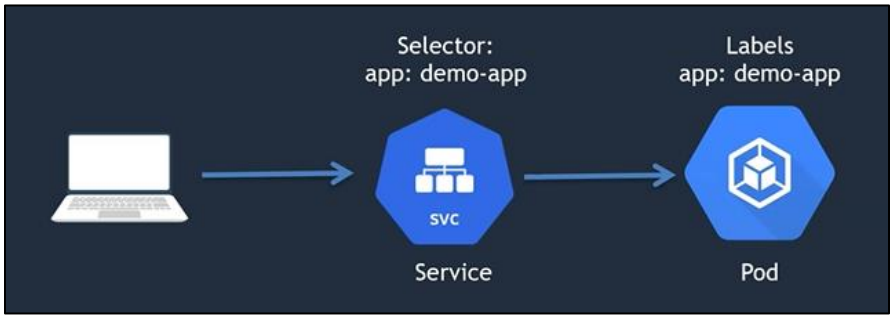
This is because we have created a pod and service and while creating a service, we got a Load Balancer and that LB we are accessing from the external network.

So, whenever we send the request from the external network to the service, how does it know that it has to send it to pod only. Because in the cluster there could be hundreds of pods. That is why we are using the labels in our manifest file.

In the service level, if we use the same label as of pods, then it means that any request comes to this service it looks for the Selector and this Selector have the label and whatever pods are having this label, it is going to forward req to that specific pod.

This is how it's work.

Setup Pod and Service



Now, add the label in pod.yml and service.yml.

vi pod.yml

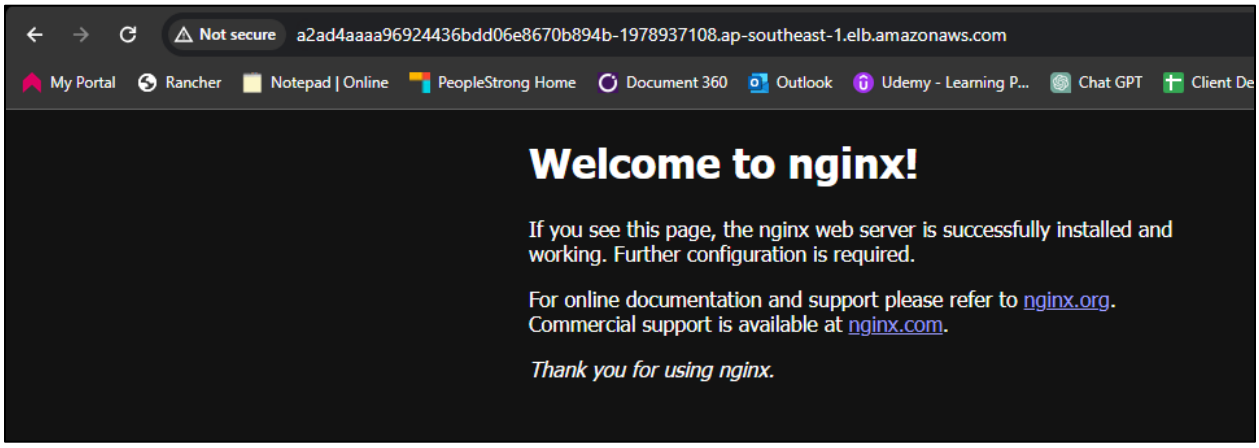
```
apiVersion: v1
kind: Pod
metadata:
  name: demo-pod
  labels:
    app: demo-app
spec:
  containers:
    - name: demo-nginx
      image: nginx
      ports:
        - name: demo-nginx
          containerPort: 80
~
~
```

vi service.yml

```
apiVersion: v1
kind: Service
metadata:
  name:  demo-service
spec:
  ports:
    - name: nginx-port
      port: 80
      targetPort: 80
  selector:
    app: demo-app

  type: LoadBalancer
~
```

kubectl apply -f pod.yml --#It will update the existing pod configuration. no need to delete the pod before apply.
kubectl apply -f service.yml
kubectl describe service/demo-service --# It will shows the details and tell where it has to forward the request.

Now, check if our application is opening from browser. Copy the DNS address and paste it on the browser and you will see the nginx application page.



Till now, we have learnt how to create pods and services by using the manifest files. But when we delete pod it will not create the another pod after deletion. To overcome this we can use the deployment object in the manifest file.

First, delete the previous pods and services.

kubectl get all
kubectl delete service/demo-service
kubectl delete pod/demo-pod

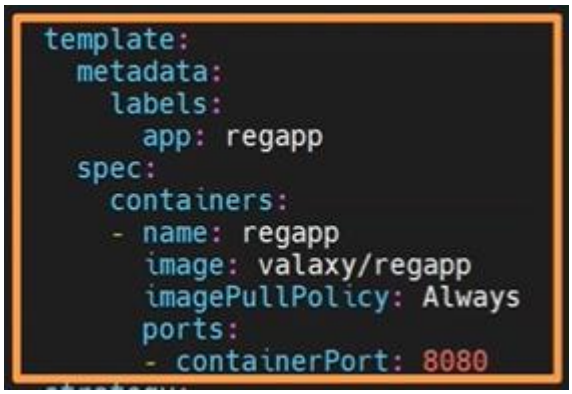
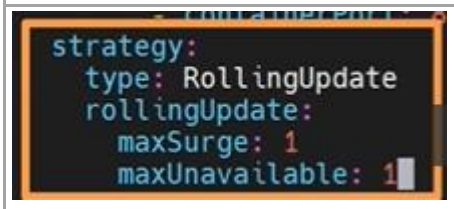
```
[root@ip-172-31-27-151 ~]# kubectl get all
NAME          READY   STATUS    RESTARTS   AGE
pod/demo-pod   1/1     Running   0          2d18h

NAME                   TYPE           CLUSTER-IP     EXTERNAL-IP                                                               PORT(S)        AGE
service/demo-service   LoadBalancer   10.100.34.35   a2ad4aaaa96924436bdd06e8670b894b-1978937108.ap-southeast-1.elb.amazonaws.com   80:30699/TCP   2d18h
service/kubernetes     ClusterIP      10.100.0.1     <none>                                                                    443/TCP        2d20h
[root@ip-172-31-27-151 ~]# kubectl delete service/demo-service
service "demo-service" deleted
[root@ip-172-31-27-151 ~]# kubectl delete pod/demo-pod
pod "demo-pod" deleted
[root@ip-172-31-27-151 ~]# kubectl get all
NAME                 TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
service/kubernetes   ClusterIP   10.100.0.1   <none>        443/TCP   2d20h
[root@ip-172-31-27-151 ~]#
```

Now, rewrite the manifest file, which pull the register app from the docker hub and create a pod out of it.

But while creating a pod we will make sure that in case something goes wrong with the pod it is going to recreate again and again. Also, incase wwe commit the latest image over dockerhub our kubernetes is going to terminate the existing pods and create the new pods with the latest image.

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: valaxy-regapp
  labels:
     app: regapp

spec:
  replicas: 2
  selector:
    matchLabels:
      app: regapp

  template:
    metadata:
      labels:
        app: regapp
    spec:
      containers:
      - name: regapp
        image: valaxy/regapp
        imagePullPolicy: Always
        ports:
        - containerPort: 8080
  strategy:
    type: RollingUpdate
    rollingUpdate:
      maxSurge: 1
      maxUnavailable: 1
```

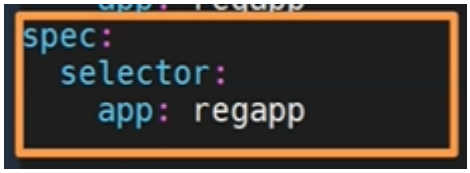
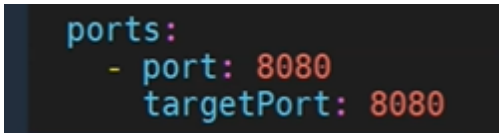
Explanation:

	This is going to tell what is Deployment name and the Deployment Label. **Deployment Name -** Valaxy Registry App **Label -** Regapp Now, this deployment need a pod, because whenever we execute a Deployment, it is going to create pods in the backend.
	This template tells, how to create a pod and what pod it has to launch. In this we have a pod definition. Then, this pod internally requires a container. Spec, is going to tell the container Definition. Container definition nothing but the details from where it can pull the image and what is the image pulling policy. Whenever we execute this deployment file it always pull the latest image from the GitHub repository. Next, on which port we can expose this container application.
	By using this information, it is going to create a replica set by matching the labels in the template.
	It represents, in case there is a new image in our GitHub, how it is going to create a pod with the new image. Let's take an example that her we have two replicas, it won't delete both. At a time, it is going to delete one container, and create a new container with new image. It will make sure that the new container is serving the application properly. Then it is going terminate the 2nd pod and create a new container with the latest image.

	That is how we will make sure that our application is not going down.

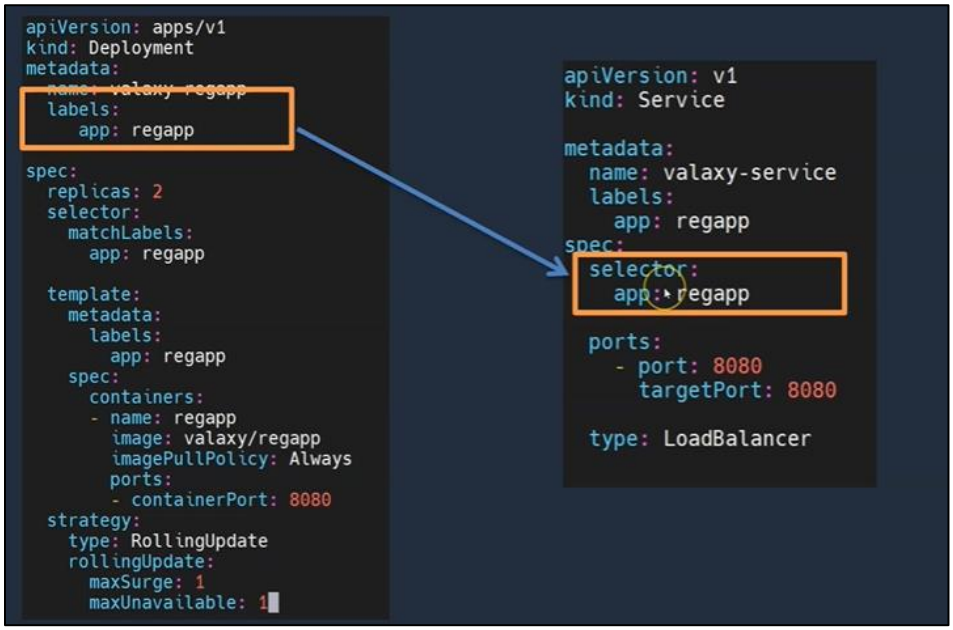
This is how, we write the deployment file. To run the deployment file we need the service also. Let's take how we write the service file.

```yaml
apiVersion: v1
kind: Service

metadata:
  name: valaxy-service
  labels:
    app: regapp
spec:
  selector:
    app: regapp

  ports:
    - port: 8080
      targetPort: 8080

  type: LoadBalancer
```

	This tells, what kind of resource we are creating.
	In this, we define the metadata. The name and what is the label.
	In specification, here we are using the 'Selector'. It confirms which Deployment it should select. This selector information and Deployment label, should match.
	We are using service type as a load balancer.
	It tells, on which port no we are exposing our service at cluster level. Next, Target Port, whenever a new request comes to our

	load balancer, on which port no. it is going to talk with the container.

This is how we need to write the service manifest file. Make sure the labels whatever we have given in the deployment file should match with the label of the service file. Similarly, the port number we mention in the Deployment file should match with the Service file.



Now create a deployment file.

vi regapp-deployment.yml

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: aman-regapp
  labels:
    app: regapp
spec:
  replicas: 2
  selector:
    matchLabels:
      app: regapp
  template:
    metadata:
      labels:
        app: regapp
```

```
  spec:
    containers:
      - name: aman-regapp
        image: amanduggal001/regapp
        imagePullPolicy: Always
        ports:
          - containerPort: 8080
 strategy:
   type: RollingUpdate
   rollingUpdate:
    maxSurge: 1
    maxUnavailable: 1
```

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: aman-regapp
  labels:
    app: regapp
spec:
  replicas: 2
  selector:
    matchLabels:
      app: regapp
  template:
    metadata:
      labels:
        app: regapp
    spec:
      containers:
        - name: aman-regapp
          image: amanduggal001/regapp
          imagePullPolicy: Always
          ports:
            - containerPort: 8080
  strategy:
    type: RollingUpdate
    rollingUpdate:
     maxSurge: 1
     maxUnavailable: 1
~
~
~
~
```

kubectl apply -f regapp-deployment.yml
kubectl get pods

```
[root@ip-172-31-27-151 tmp]# kubectl get pods
NAME                            READY   STATUS    RESTARTS   AGE
aman-regapp-7dfd865c78-wj9rs   1/1     Running   0          2m23s
aman-regapp-7dfd865c78-wlfqf   1/1     Running   0          2m23s
```

kubectl get all

```
[root@ip-172-31-27-151 tmp]# kubectl get all
NAME                                 READY   STATUS    RESTARTS   AGE
pod/aman-regapp-7dfd865c78-wj9rs     1/1     Running   0          3m54s
pod/aman-regapp-7dfd865c78-wlfqf     1/1     Running   0          3m54s

NAME                 TYPE        CLUSTER-IP    EXTERNAL-IP   PORT(S)   AGE
service/kubernetes   ClusterIP   10.100.0.1    <none>        443/TCP   2d23h

NAME                            READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/aman-regapp     2/2     2            2           3m54s

NAME                                       DESIRED   CURRENT   READY   AGE
replicaset.apps/aman-regapp-7dfd865c78     2         2         2       3m54s
```

kubectl get pod -o wide --#It tells each pod in which workload it is running.

```
[root@ip-172-31-27-151 tmp]# kubectl get pod -o wide
NAME                          READY   STATUS    RESTARTS   AGE   IP              NODE                                                NOMINATED NODE   READINESS GATES
aman-regapp-7dfd865c78-wj9rs  1/1     Running   0          5m4s  192.168.49.200  ip-192-168-58-155.ap-southeast-1.compute.internal   <none>           <none>
aman-regapp-7dfd865c78-wlfqf  1/1     Running   0          5m4s  192.168.22.150  ip-192-168-16-10.ap-southeast-1.compute.internal    <none>           <none>
```

Now, let's create a service in such a way that the traffic should flow through any of these 2 containers.

For that write the service manifest file.

vi regapp-service.yml

```
apiVersion: v1
kind: Service
metadata:
  name: app-service
  labels:
    app: regapp
spec:
  selector:
    app: regapp
  ports:
    - port: 8080
      targetPort: 8080
  type: LoadBalancer
```

```
apiVersion: v1
kind: Service
metadata:
  name: app-service
  labels:
    app: regapp
spec:
   selector:
     app: regapp
   ports:
     - port: 8080
       targetPort: 8080
   type: LoadBalancer
~
```

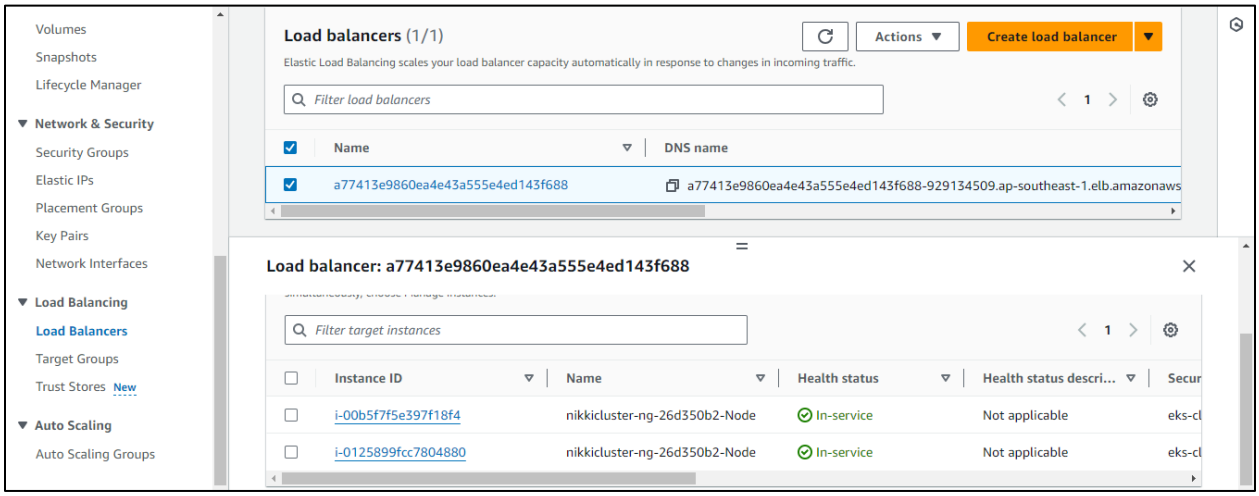
kubectl get all

```
[root@ip-172-31-27-151 tmp]# kubectl get all
NAME                                READY   STATUS    RESTARTS   AGE
pod/aman-regapp-7dfd865c78-wj9rs    1/1     Running   0          14m
pod/aman-regapp-7dfd865c78-wlfqf    1/1     Running   0          14m

NAME                  TYPE           CLUSTER-IP       EXTERNAL-IP                                                                PORT(S)          AGE
service/app-service   LoadBalancer   10.100.182.238   a77413e9860ea4e43a555e4ed143f688-929134509.ap-southeast-1.elb.amazonaws.com   8080:30508/TCP   29s
service/kubernetes    ClusterIP      10.100.0.1       <none>                                                                     443/TCP          3d

NAME                           READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/aman-regapp    2/2     2            2           14m

NAME                                      DESIRED   CURRENT   READY   AGE
replicaset.apps/aman-regapp-7dfd865c78    2         2         2       14m
[root@ip-172-31-27-151 tmp]#
```

kubectl describe service/app-service --#This will tell about service where it is mapped and what are the backend parts it is going to send.

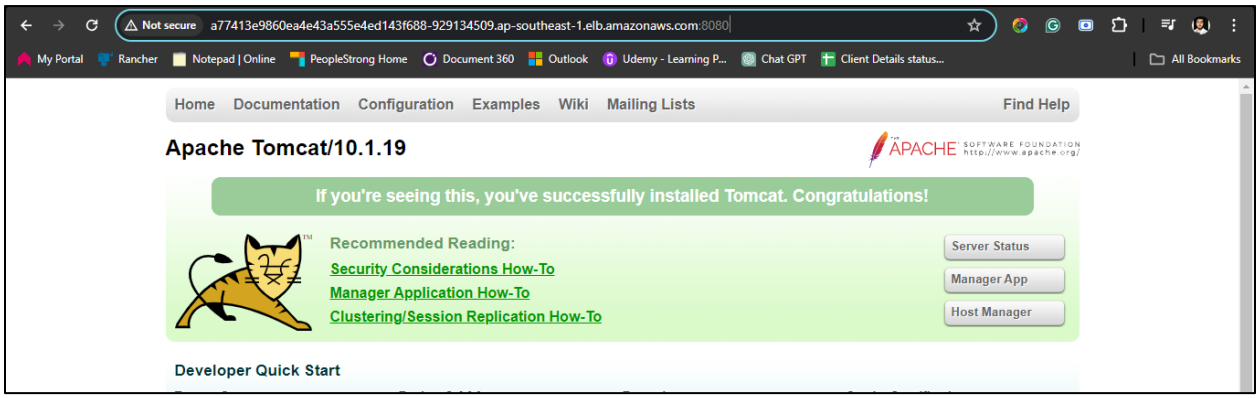
```
[root@ip-172-31-27-151 tmp]# kubectl describe service/app-service
Name:                     app-service
Namespace:                default
Labels:                   app=regapp
Annotations:              <none>
Selector:                 app=regapp
Type:                     LoadBalancer
IP Family Policy:         SingleStack
IP Families:              IPv4
IP:                       10.100.182.238
IPs:                      10.100.182.238
LoadBalancer Ingress:     a77413e9860ea4e43a555e4ed143f688-929134509.ap-southeast-1.elb.amazonaws.com
Port:                     <unset>  8080/TCP
TargetPort:               8080/TCP
NodePort:                 <unset>  30508/TCP
Endpoints:                192.168.22.150:8080,192.168.49.200:8080
Session Affinity:         None
External Traffic Policy:  Cluster
Events:
  Type    Reason                Age   From                Message
  ----    ------                ----  ----                -------
  Normal  EnsuringLoadBalancer  2m3s  service-controller  Ensuring load balancer
  Normal  EnsuredLoadBalancer   2m    service-controller  Ensured load balancer
```

Validate the Load Balancer in the AWS Instance.

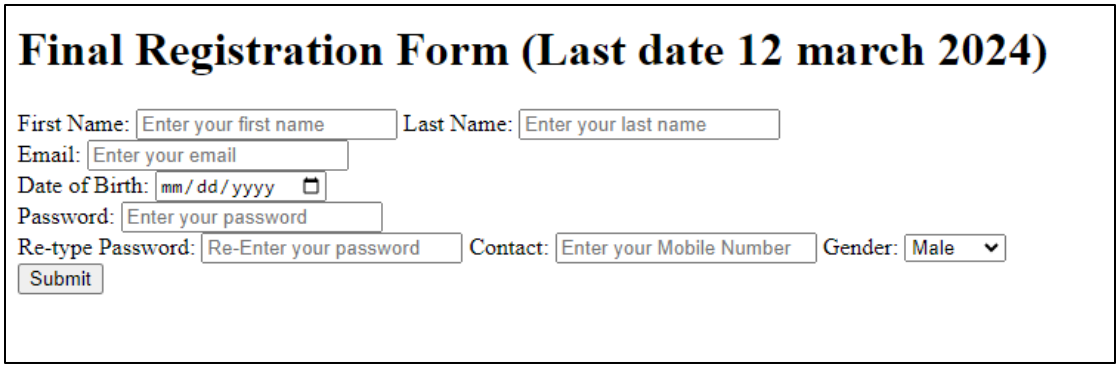


Now, validate if your application is opening on browser or not.
Use DNSname:portnumber --#Since we have define the port number 8080 so we need to mention the port number to access the application.

Example: a77413e9860ea4e43a555e4ed143f688-929134509.ap-southeast-1.elb.amazonaws.com:8080



Use DNSname:portnumber/webapp --#To access the application.

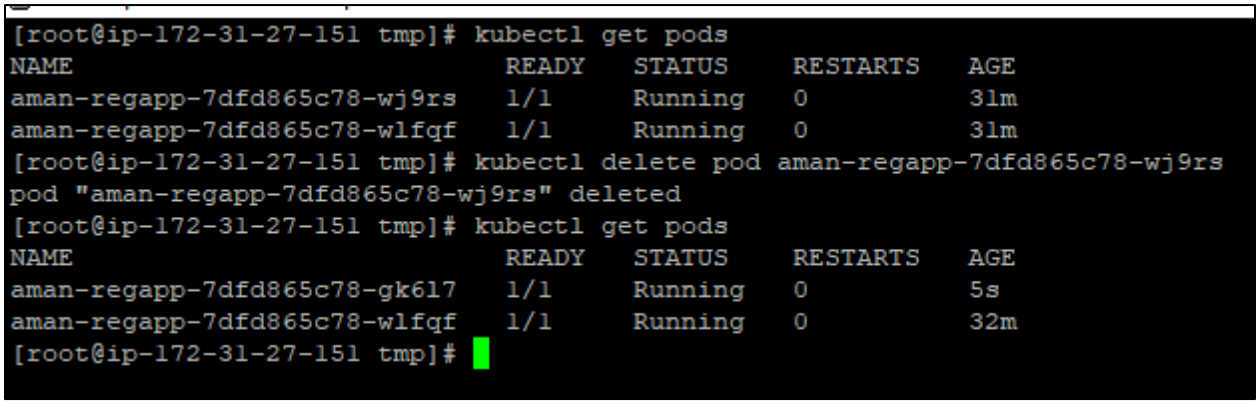


It is opening, which means we are successfully able to deploy our application on pod.

Now to validate, incase if any pod is deleted it should be reprovisioned and our application not get affected.

To Test, delete one pod.

kubectl delete pod aman-regapp-7dfd865c78-wj9rs

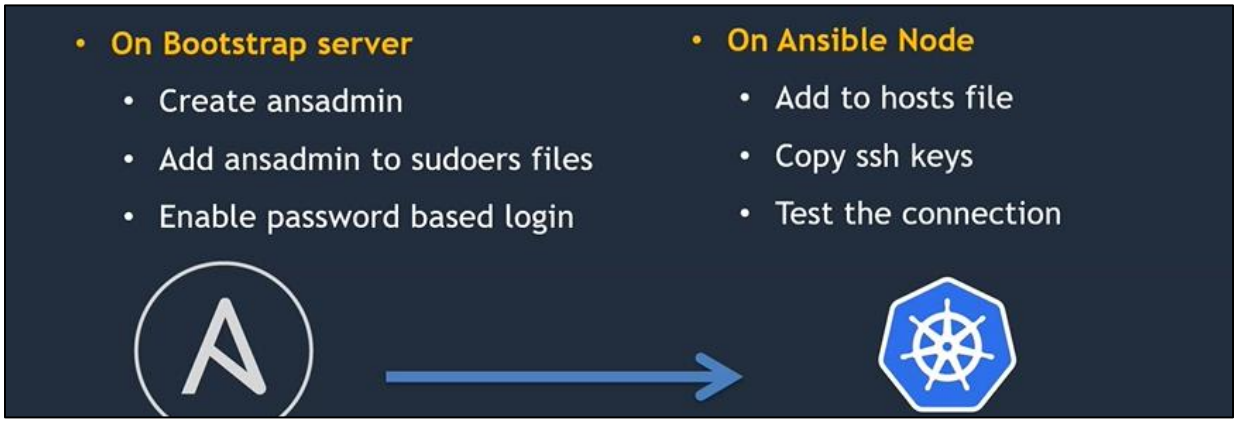


So, when we delete our pod, another pod is created immediately. That is because our replica set makes sure that we have 2 pods at any point of time.

Now, it's time to integrate our Kubernetes with our CI/CD pipeline. For that, first we need to integrate Kubernetes with the Ansible because we cannot run these kubectl commands manually.

We will tell Ansible to run the kubectl commands whenever we want to do the new deployment. That is how we use ansible to deploy the latest application on Kubernetes cluster.

Integrate Kubernetes bootstrap server with Ansible



On bootstrap image server (Kubernetes server), create a user '**ansibleadmin**' and add that user to the Sudoers file.

useradd ansibleadmin
passwd ansibleadmin

visudo --#Add the below user in the file.

ansibleadmin ALL=(ALL) NOPASSWD: ALL

```
##
## The COMMANDS section may have other options added to it.
##
## Allow root to run any commands anywhere
root    ALL=(ALL)       ALL
ansibleadmin ALL=(ALL) NOPASSWD: ALL
## Allows members of the 'sys' group to run networking, software
## service management apps and more.
# %sys ALL = NETWORKING, SOFTWARE, SERVICES, STORAGE, DELEGATING
```

Now, enable the password based authentication.

vi /etc/ssh/sshd_config --#Enable the password authentication.

```
#IgnoreRhosts yes

# To disable tunneled clear text passwords, change to no here!
PasswordAuthentication yes
#PermitEmptyPasswords no
#PasswordAuthentication no

# Change to no to disable s/key passwords
#ChallengeResponseAuthentication yes
ChallengeResponseAuthentication no

# Kerberos options
#KerberosAuthentication no
#KerberosOrLocalPasswd yes
#KerberosTicketCleanup yes
#KerberosGetAFSToken no
```

service sshd reload

Now login to ansible server.

cd /opt/docker

rewrite the deploy_repapp.yml file. Because till now we are deploying image on a Docker Container. Now we need to deploy it on the Kubernetes as a pod.

Rename the existing .yml files for the meaningful name -

mv deploy_repapp.yml docker_deployment_repapp.yml
mv regapp.yml create_image_regapp.yml

```
[root@AnsibleServer docker]# ll
total 16
-rw-rw-r-- 1 ansibleadmin ansibleadmin  352 Mar 10 17:35 create_image_regapp.yml
-rw-rw-r-- 1 ansibleadmin ansibleadmin  388 Mar 11 17:08 docker_deployment_repapp.yml
-rw-r--r-- 1 root         root          129 Mar 10 11:53 Dockerfile
-rw-rw-r-- 1 ansibleadmin ansibleadmin 2628 Mar 11 18:31 webapp.war
[root@AnsibleServer docker]#
```

Now, we need to add Bootstrap image to the hosts file. In this case are creating the inventory file here itself.

vi hosts

localhost --#Incase if required

[kubernetes]
172.31.27.151 --#Kubernetes private Ip

[ansible]
172.31.19.187 --#Ansible private Ip

```
localhost

[kubernetes]
172.31.27.151

[ansible]
172.31.19.187
~
~
```

Now we have added the server and now we need to copy the keys on kubernetes server.

On ansible server
sudo su ansibleadmin

ssh-copy-id 172.31.27.151 --#Private Ip of Kubernetes server.
Are you sure you want to continue connecting (yes/no)? yes --#Put this line to yes.

```
[ansibleadmin@AnsibleServer docker]$ ssh-copy-id 172.31.27.151
/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "/home/ansibleadmin/.ssh/id_rsa.pub"
The authenticity of host '172.31.27.151 (172.31.27.151)' can't be established.
ECDSA key fingerprint is SHA256:FopPQlUSwVFIyl0y50+8nU/nVz/eUQ24o8bX/7loy2Q.
ECDSA key fingerprint is MD5:fb:a5:8c:6c:b6:64:93:69:3b:8e:be:fb:72:03:e6:22.
Are you sure you want to continue connecting (yes/no)? yes
/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that are already installed
/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is to install the new keys
ansibleadmin@172.31.27.151's password:

Number of key(s) added: 1

Now try logging into the machine, with:   "ssh '172.31.27.151'"
and check to make sure that only the key(s) you wanted were added.

[ansibleadmin@AnsibleServer docker]$
```

anisble -i hosts all -a uptime --# -i hosts means in the current location we have hosts file and in this host file whatever server mentioned, ping to that servers.

```
[ansibleadmin@AnsibleServer docker]$ ansible -i hosts all -a uptime
[WARNING]: Platform linux on host 172.31.27.151 is using the discovered Python interpreter at /usr/bin/python, but future installation of another Python interpreter
could change this. See https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more information.
172.31.27.151 | CHANGED | rc=0 >>
 18:38:00 up 3 days,  2:54,  2 users,  load average: 0.00, 0.00, 0.00
[WARNING]: Platform linux on host localhost is using the discovered Python interpreter at /usr/bin/python, but future installation of another Python interpreter could
change this. See https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more information.
localhost | CHANGED | rc=0 >>
 18:38:01 up 5 days,  9:30,  3 users,  load average: 0.08, 0.02, 0.01
[WARNING]: Platform linux on host 172.31.19.187 is using the discovered Python interpreter at /usr/bin/python, but future installation of another Python interpreter
could change this. See https://docs.ansible.com/ansible/2.9/reference_appendices/interpreter_discovery.html for more information.
172.31.19.187 | CHANGED | rc=0 >>
 18:38:01 up 5 days,  9:30,  2 users,  load average: 0.08, 0.02, 0.01
[ansibleadmin@AnsibleServer docker]$
```

It means, it can able to communicate with our Kubernetes server.

On Ansible server, we need to copy the ansibleadmin keys to the root user, otherwise it cannot able to login as a root user.

ssh-copy-id root@172.31.27.151 --#IP of Kubernetes server.

Enter the password for the Kubernetes root user.

Setup the password of the root user in the Kubernetes server.
(On Kubernetes server)
passwd root --#Enter the password.

```
[ansibleadmin@AnsibleServer docker]$ ssh-copy-id root@172.31.27.151
/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "/home/ansibleadmin/.ssh/id_rsa.pub"
/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that are already installed
/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is to install the new keys
root@172.31.27.151's password:
Permission denied, please try again.
root@172.31.27.151's password:
Permission denied, please try again.
root@172.31.27.151's password:

Number of key(s) added: 1

Now try logging into the machine, with:   "ssh 'root@172.31.27.151'"
and check to make sure that only the key(s) you wanted were added.

[ansibleadmin@AnsibleServer docker]$
```

Create ansible playbooks for deploy and service files

Till now we see how to integrate our bootstrap server with Ansible. Now let's execute our deployment and service files using Ansible. For that we have to create Ansible Playbooks for deployment and service files.

On Ansible Server, create a playbook.

vi kube_deploy.yml

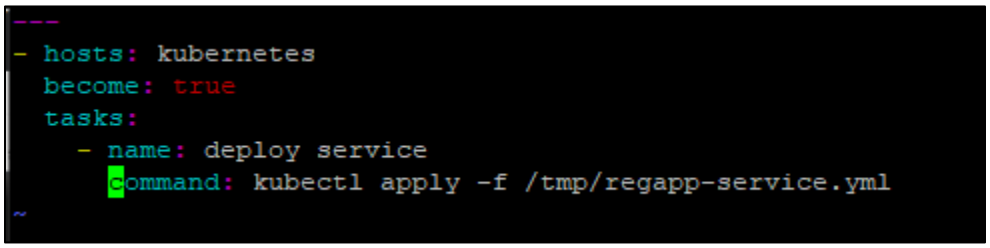
```
---
- hosts: kubernetes
  become: true
  tasks:
    - name: deploy regapp on kubernetes
      command: kubectl apply -f /tmp/regapp-deployment.yml
```

```
---
- hosts: kubernetes
  become: true
  tasks:
    - name: deploy regapp on kubernetes
      command: kubectl apply -f /tmp/regapp-deployment.yml
~
~
```

Now, similarly create an playbook for service file.

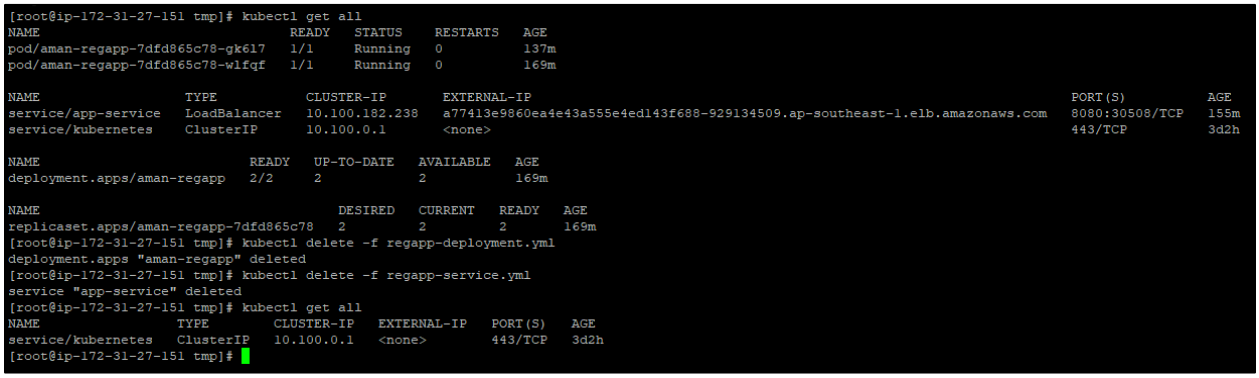
vi kube_service.yml

```
---
- hosts: kubernetes
  become: true
  tasks:
    - name: deploy service
      command: kubectl apply -f /tmp/regapp-service.yml
```



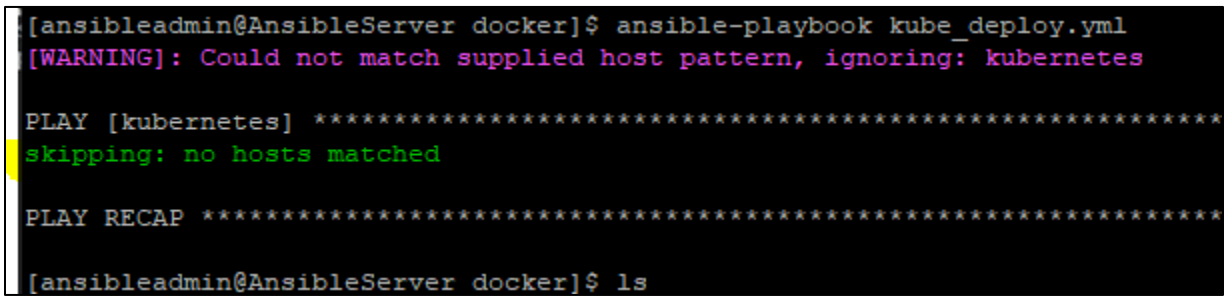
Before executing the Ansible playbook, delete the exiting pods, deployments and services on Kubernetes server.

kubectl delete -f regapp-deployment.yml\
kubectl delete -f regapp-service.yml
kubectl get all



Now, execute the playbook on the Ansible server.

ansible-playbook kube_deploy.yml



If we directly try to execute the Ansible playbook, it will skip and not execute the file properly. Since we have mentioned the hosts: kubernetes, so we need to provide the path of the hosts file where we have mentioned the Kubernetes group.

ansible-playbook -i /opt/docker/hosts kube_deploy.yml

```
[ansibleadmin@AnsibleServer docker]$ ansible-playbook -i /opt/docker/hosts kube_
deploy.yml

PLAY [kubernetes] ***************************************************************

TASK [Gathering Facts] **********************************************************
[WARNING]: Platform linux on host 172.31.27.151 is using the discovered Python
interpreter at /usr/bin/python, but future installation of another Python
interpreter could change this. See https://docs.ansible.com/ansible/2.9/referen
ce_appendices/interpreter_discovery.html for more information.
ok: [172.31.27.151]

TASK [deploy regapp on kubernetes] **********************************************
fatal: [172.31.27.151]: FAILED! => {"changed": false, "cmd": "kubectl apply -f /
root/regapp-deployment.yml", "msg": "[Errno 2] No such file or directory", "rc":
 2}

PLAY RECAP **********************************************************************
172.31.27.151              : ok=1    changed=0    unreachable=0    failed=1    s
kipped=0    rescued=0    ignored=0
```

I am getting this error. We should run this playbook as a root user. For that we need to mention in playbook the user is root, by this we didn't need to define the path also because by default it will check under the root directory.

vi kube_deploy.yml

```
---
- hosts: kubernetes
  user: root
  tasks:
    - name: deploy regapp on kubernetes
      command: kubectl apply -f regapp-deployment.yml
```

vi kube_service.yml

```
---
- hosts: kubernetes
  user: root
  tasks:
    - name: deploy service
      command: kubectl apply -f regapp-service.yml
```

Note: Make sure the files are present in the root location. If not copy the file and paste it in the root location.

```
[root@ip-172-31-27-151 tmp]# cp regapp-deployment.yml /root
[root@ip-172-31-27-151 tmp]# cp regapp-service.yml /root
[root@ip-172-31-27-151 tmp]# cd /root
[root@ip-172-31-27-151 ~]# ls
regapp-deployment.yml  regapp-service.yml
[root@ip-172-31-27-151 ~]#
```

Now, execute the playbooks.

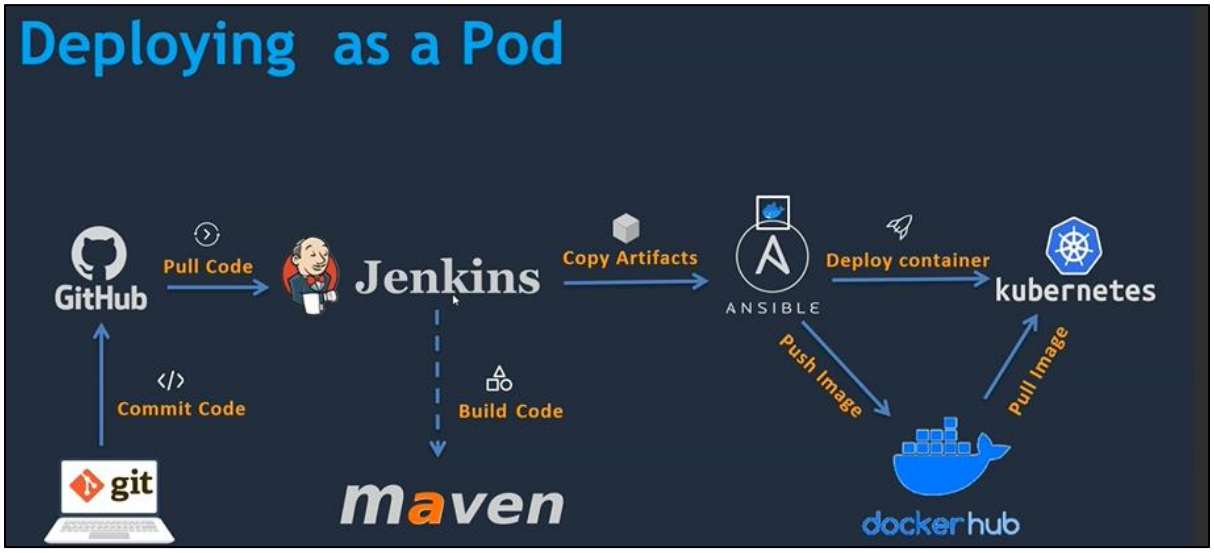
ansible-playbook -i /opt/docker/hosts kube_deploy.yml
ansible-playbook -i /opt/docker/hosts kube_service.yml

Once executed, check on the Kubernetes server if the pods and services are created there after executing the playbooks in the ansible server.

kubectl get all

```
[root@ip-172-31-27-151 ~]# kubectl get all
NAME                                READY   STATUS    RESTARTS   AGE
pod/aman-regapp-7dfd865c78-654c6    1/1     Running   0          3m7s
pod/aman-regapp-7dfd865c78-xgmnb    1/1     Running   0          3m7s

NAME                  TYPE           CLUSTER-IP       EXTERNAL-IP                                                              PORT(S)          AGE
service/app-service   LoadBalancer   10.100.180.125   a33cc63c9115b4e9aacfcce3c2405dc3-620627145.ap-southeast-1.elb.amazonaws.com   8080:30940/TCP   89s
service/kubernetes    ClusterIP      10.100.0.1       <none>                                                                   443/TCP          3d4h

NAME                           READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/aman-regapp    2/2     2            2           3m7s

NAME                                      DESIRED   CURRENT   READY   AGE
replicaset.apps/aman-regapp-7dfd865c78    2         2         2       3m8s
[root@ip-172-31-27-151 ~]#
```

Create Jenkins deployment job for Kubernetes

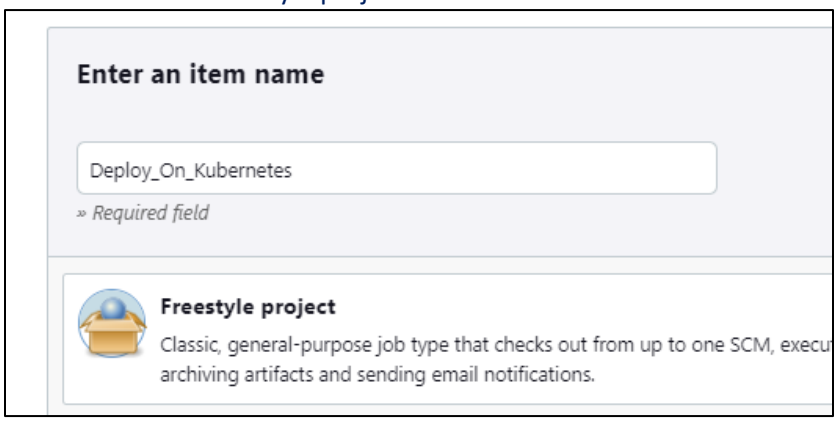


Until now, we have set up our Kubernetes environment and we created deployment and service files and we have integrated with Ansible.

Now, we could able to initialize our deployment and service files with the help of Ansible.

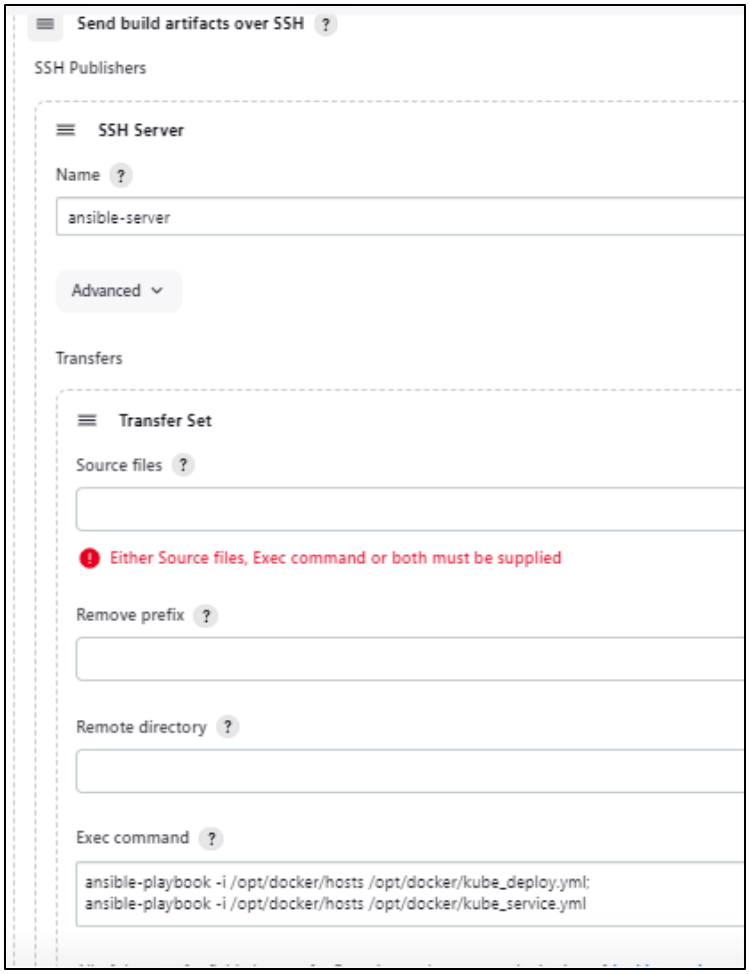
Now, we are make use of Jenkins rather than executing those playbooks manually from Ansible. For that we will create a Jenkins job that is a deployment job. It initialize the Ansible playbook to initialize deploy and service files on Kubernetes.

- Login to Jenkins GUI.
- Create a new Job **'Deploy_On_Kubernetes'**
- Create a Freestyle project.



- Add the Post build action **'Send build artifacts over SSH'**.
- Name: ansible-server

Exec Command -
ansible-playbook -i /opt/docker/hosts /opt/docker/kube_deploy.yml;
ansible-playbook -i /opt/docker/hosts /opt/docker/kube_service.yml



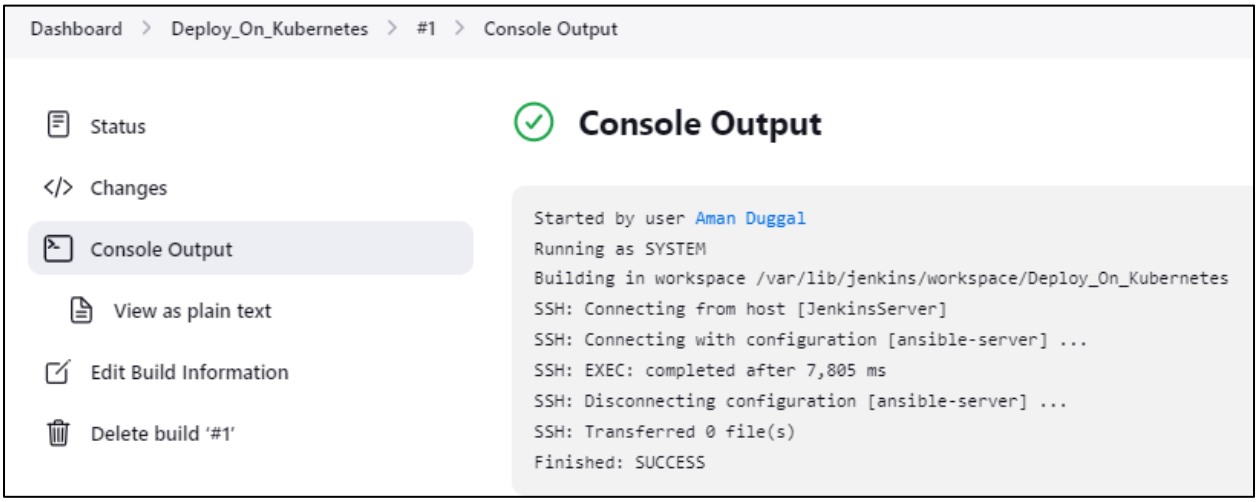
So basically, we have created the Jenkins job just to execute these two commands to execute the ansible playbooks.
This job will execute the Ansible playbooks and Ansible playbook execute the Kubernetes manifest files which will create the deployments and services.

To test the job, first delete the existing deployment and services from the Kubernetes server.

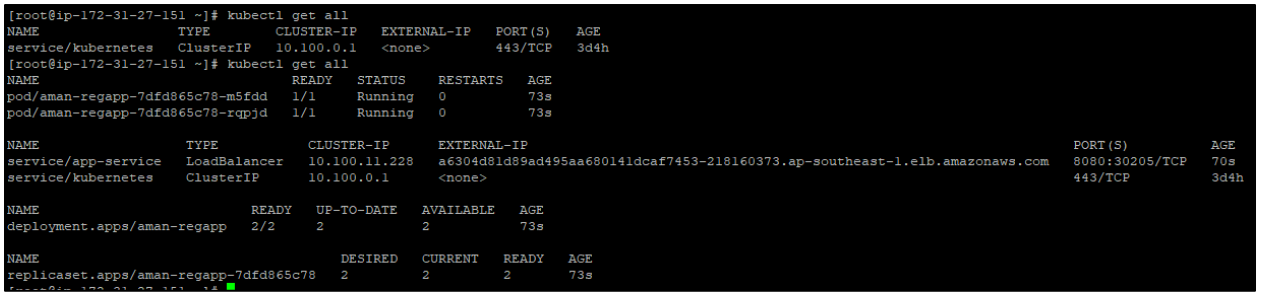
kubectl delete deployment.apps/aman-regapp
kubectl delete service/app-service
kubectl get all

```
[root@ip-172-31-27-151 ~]# kubectl get all
NAME                 TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
service/kubernetes   ClusterIP   10.100.0.1   <none>        443/TCP   3d4h
[root@ip-172-31-27-151 ~]#
```

- Now build the job **'Deploy_On_Kubernetes'**



Check the Kubernetes server, the deployments and services are created.



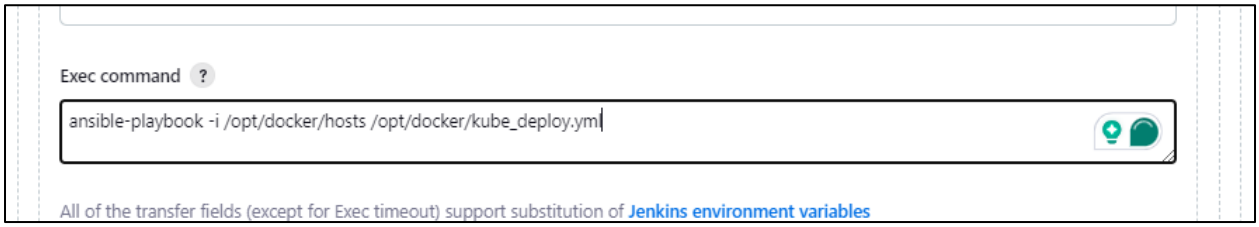
Now, instead of running two playbooks together, we can also merge the content of deployment and services just add the task of other playbook in any one of the file.

vi kube_deploy.yml

```
---
- hosts: kubernetes
  user: root
  tasks:
    - name: deploy regapp on kubernetes
      command: kubectl apply -f regapp-deployment.yml
    - name: create service on kubernetes
      command: kubectl apply -f regapp-service.yml
```

```
---
- hosts: kubernetes
  user: root
  tasks:
    - name: deploy regapp on kubernetes
      command: kubectl apply -f regapp-deployment.yml
    - name: create service on kubernetes
      command: kubectl apply -f regapp-service.yml
~
~
~
```

Go to Jenkins job and remove the other, as we don't required it more since all the content should be in kube_deploy.yml file.



Build the Job and test again.

Till now, we have created a job called **'Deploy_On_Kubernetes'** which helps us to execute the deployment and service file of Kubernetes.

But why we are executing those?

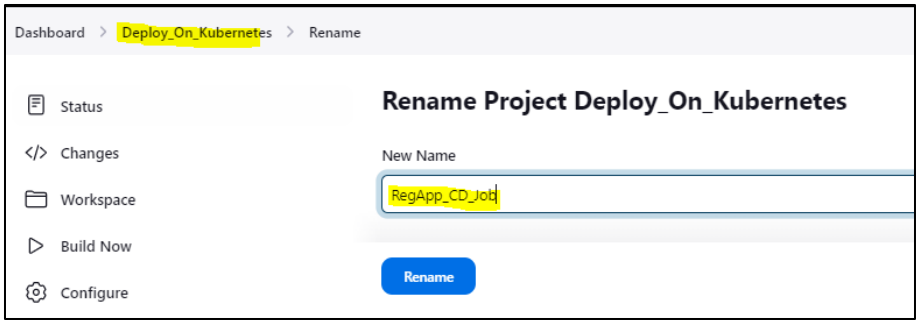
Because, if there is any changes to our source code, we need to build that job and it should create a latest image over Docker Hub. And with the latest image we need to deploy our pods.

Now, our intention is to update the image by changing the source code, so that our Kubernetes can deploy with the latest code.

That is how we can automate the entire CI/CD pipeline.

So far we have created the CD job which only creates the deployments, we need to create a CI job.

Just for better understanding, Rename the existing job i.e. **'Deploy_On_Kubernetes' to 'RegApp CD job'.**



Now, create a CI job, we just need to pull the code from the GitHub and build in the Jenkins and run the Ansible playbook in our Ansible server which we already created a .yml file previously I.e **'create_image_regapp.yml'** in which it builds the image, retag the image and push it on the Docker Hub.

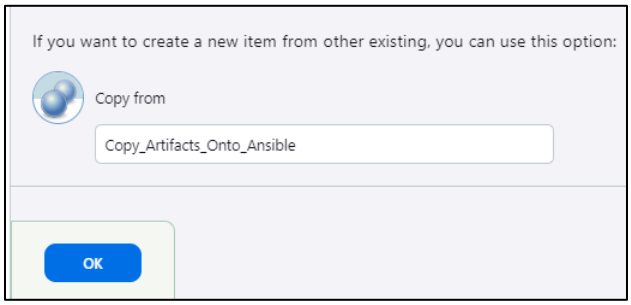
```
[ansibleadmin@AnsibleServer docker]$ cat create_image_regapp.yml
---
- hosts: ansible
  tasks:
    - name: Create docker image
      command: docker build -t regapp:latest .
      args:
        chdir: /opt/docker

    - name: create docker tag.
      command: docker tag regapp:latest amanduggal001/regapp:latest

    - name: Push the docker image to docker hub
      command: docker push amanduggal001/regapp:latest
[ansibleadmin@AnsibleServer docker]$
```

So, this file will create the latest image with the help of webapp.war file under the docker file and it commits on to the docker hub.

We previously created that Job on Jenkins i.e **'Copy_Artifacts_Onto_Ansible'**. This job will be get executed whenever there is change in source code.

Now we are creating the CI Job with the help of **'Copy_Artifacts_Onto_Ansible'** Job so that we can create an image and disable the previous job.

- Create a new Job ' RegAPP_CI_Job' and copy the configuration from the previous job i.e. **'Copy_Artifacts_Onto_Ansible'.**



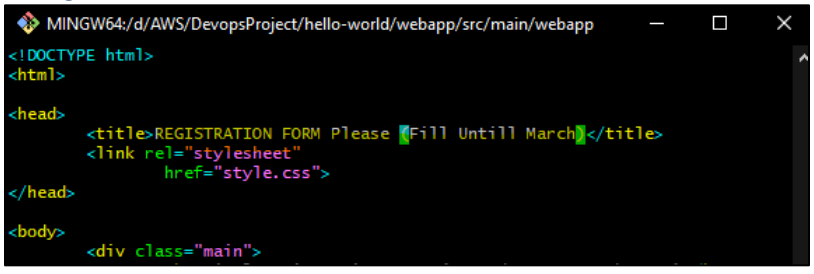
- **Description:** Build code with help of Maven and create an image on ansible and push it onto dockerhub.
- **Exec Command -** ansible-playbook /opt/docker/create_image_regapp.yml --#rename the yml file, since we renamed earlier and remove the other commands since we are deploying using the Kubernetes with other job.

First, we'll see until, if it is creating image successfully or not. For that change the source code from Git bash.

Go to Git Bash
cd D:/AWS/DevopsProject/hello-world/webapp/src/main/webapp

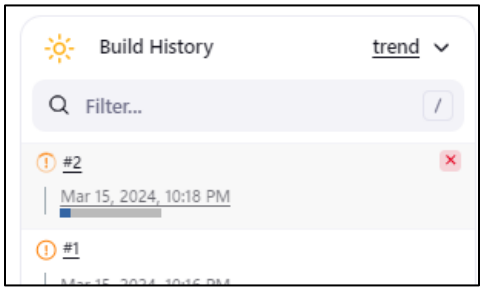
vi index.jsp

Change the source code.



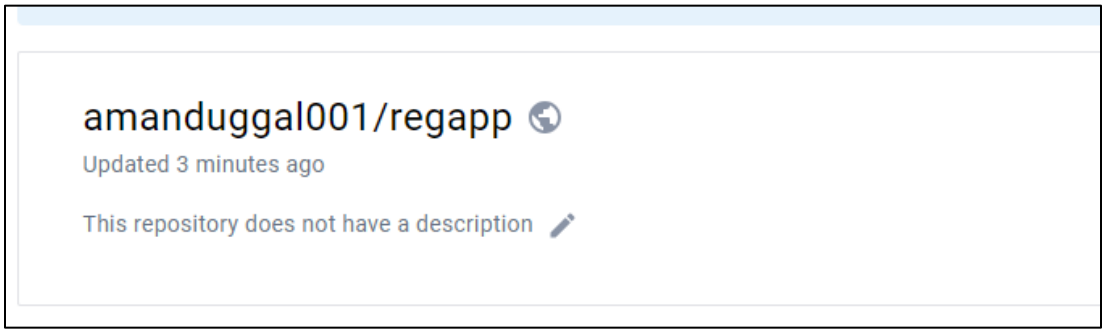
git add .
git commit -m "bugfix"
git push origin master

Once pushed the image, the job gets initializing.



Once the job is executed the images were updated.

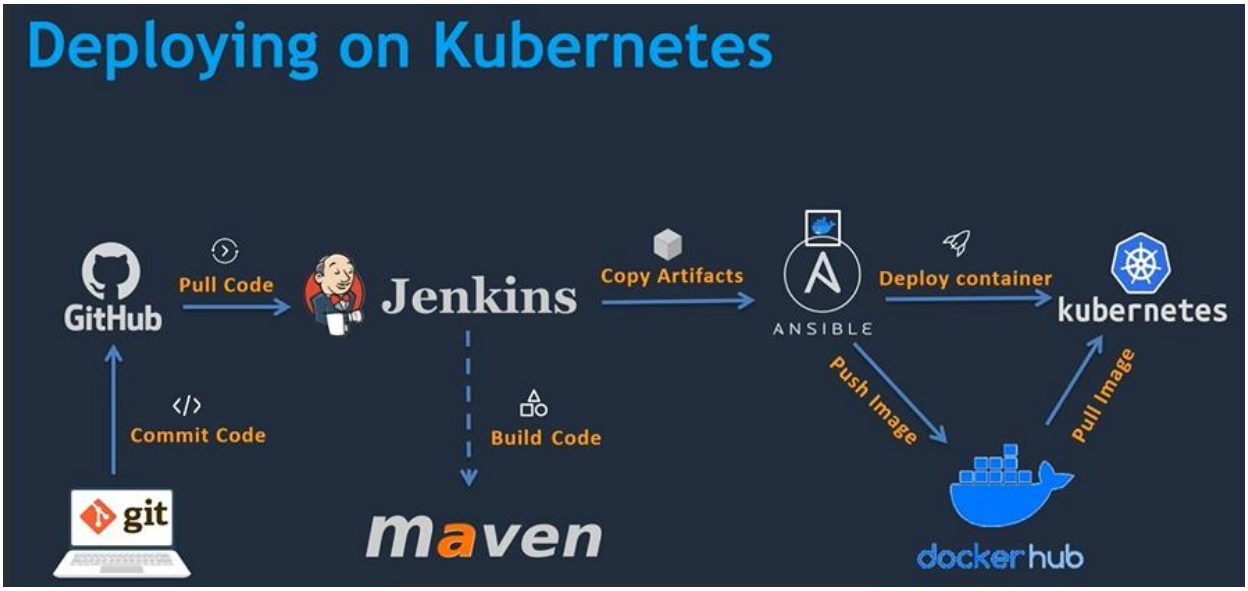
```
[ansibleadmin@AnsibleServer docker]$ docker images
REPOSITORY              TAG       IMAGE ID       CREATED          SIZE
amanduggal001/regapp    latest    5c63b010045b   56 seconds ago   460MB
regapp                  latest    5c63b010045b   56 seconds ago   460MB
amanduggal001/regapp    <none>    726b3ead2dc6   4 days ago       460MB
amanduggal001/regapp    <none>    e1dbf221af46   4 days ago       460MB
amanduggal001/regapp    <none>    5398975c833f   4 days ago       460MB
tomcat                  latest    405afe63d576   9 days ago       455MB
[ansibleadmin@AnsibleServer docker]$
```



It means that our images are successfully created without any issues and committing onto the GitHub. Now we just need to integrate our CI and CD job so that what will happen, whenever the CI is successful it should initialize the CD job. And CD job should take the latest image from docker hub and perform the latest deployment.

NOTE: Please confirm if your docker service is started or not. My Job is getting failed and after validating the issue I found that the docker service is in active.

Enable rolling update to create pod from latest docker image



So far, what we have done, we are changing the code on our workstation and these changes we are committing onto our GitHub repository.
From there, our Jenkins is pulling the code and building with the help of Maven and it is generating the .war file, we call it as a Artifacts and pushing it onto the Ansible Server.
At the same time, it is also executing Ansible playbook, which can create an image with the artifacts and commit it into the docker hub repository.
Also, we have created a job which is CD job which can be initialized with the Jenkins and it is going to initialize the Ansible Playbook. This Ansible playbook executes the deployment and service files on Kubernetes cluster.

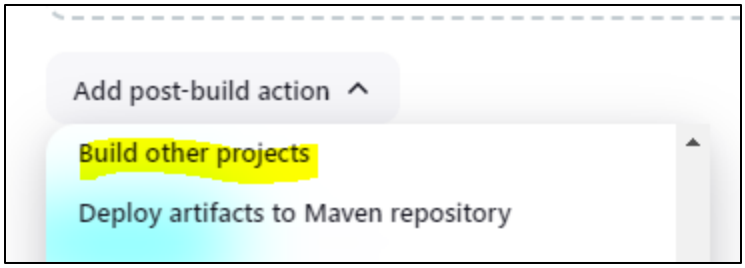
However, we are trying to integrate the CI and CD job so that whenever we do any changes over source code, it should be available under Kubernetes cluster.

Let's go and integrate the both jobs.

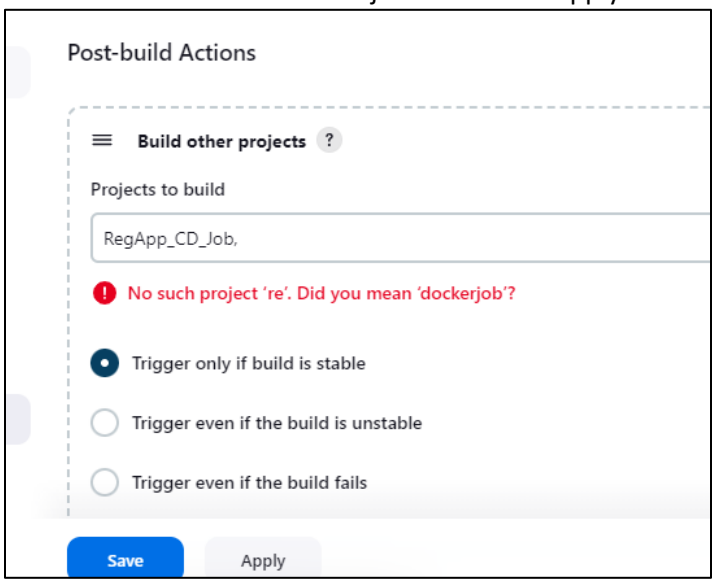
- Open the Jenkins dashboard. Here we have our CI and CD jobs.

In CI job, there is an option to initialize another Jenkins job. That is where we will tell that initialize the CD job. So that once the CI job is completed, the CD job is going take the image and do the deployments.

- Configure the CI job > Add Post Build Action > Build other projects.



- Add the CD Job under the Projects to Build > Apply > Save.



Now, do some changes on the source code and commit it inti the GitHub repository and this is going to initialize the Jenkins job and thus Jenkins job creates an Docker image and commit it over Docker Hub.

Then also, this Jenkins CI job initialize the CD job, which should be able to take the latest image from Docker Hub and do the deployment on our Kubernetes cluster.

Go to Git Bash
cd D:/AWS/DevopsProject/hello-world/webapp/src/main/webapp

vi index.jsp

Change the source code.

```
<!DOCTYPE html>
<html>

<head>
	<title>REGISTRATION FORM ---- Please (Fill Untill March)</title>
	<link rel="stylesheet"
		href="style.css">
</head>

<body>
	<div class="main">
		<h1>Final Registration Form (Last date 12 march 2024)</h1>
```

git add .
git commit -m "bugfix"
git push origin master

Once pushed the image, the job gets initializing.

```
[root@ip-172-31-27-151 ~]# kubectl get all
NAME                                READY   STATUS    RESTARTS   AGE
pod/aman-regapp-7dfd865c78-php5m    1/1     Running   0          50s
pod/aman-regapp-7dfd865c78-z5qrk    1/1     Running   0          50s

NAME                  TYPE           CLUSTER-IP      EXTERNAL-IP                                                                    PORT(S)          AGE
service/app-service   LoadBalancer   10.100.101.50   aacd4e5466809499796367b3983e452e-774048406.ap-southeast-1.elb.amazonaws.com   8080:30964/TCP   49s
service/kubernetes    ClusterIP      10.100.0.1      <none>                                                                         443/TCP          3d16h

NAME                           READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/aman-regapp    2/2     2            2           50s

NAME                                      DESIRED   CURRENT   READY   AGE
replicaset.apps/aman-regapp-7dfd865c78    2         2         2       50s
```

There is an issue, the job could not able to recognize until or unless we do changes to our deployment and service files. Add the new entry in the deployment and service file.

(On Ansible server)

vi kube_deploy.yml

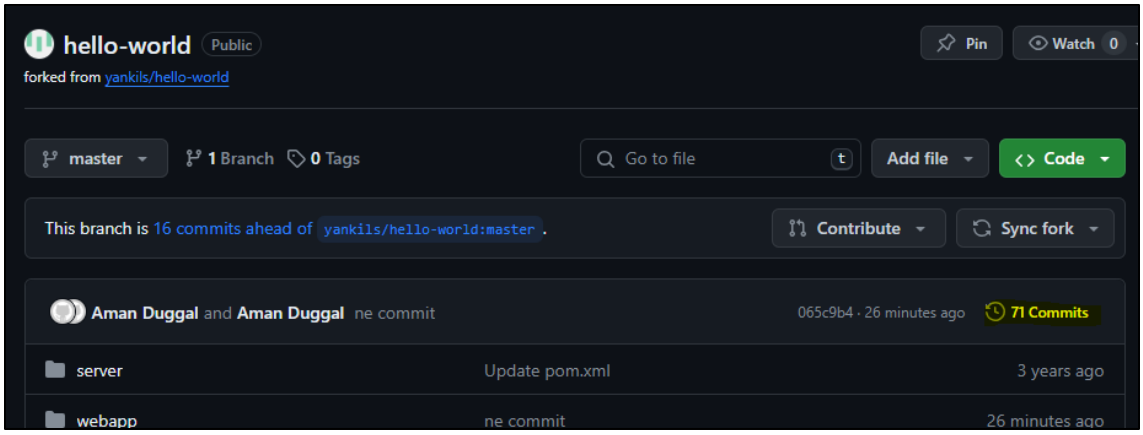
- name: update deployment with new pods if image updated in the docker hub.
  command: kubectl rollout restart deployment.apps/aman-regapp --#When you run this command, Kubernetes will restart the pods managed by the aman-regapp deployment, effectively deploying any changes made to the deployment configuration or restarting the pods for maintenance or updates.

```
---
- hosts: kubernetes
  user: root
  tasks:
    - name: deploy regapp on kubernetes
      command: kubectl apply -f regapp-deployment.yml
    - name: create service on kubernetes
      command: kubectl apply -f regapp-service.yml
    - name: update deployment with new pods if image updated in docker hub
      command: kubectl rollout restart deployment.apps/aman-regapp
~
```

So, this is going to replace our environment with the latest image.

Now, let's do a new commit, so the new commit is going to create the new image as well as new pod. So that we can see the new changes in the web browser.

Note: Whenever we commit new changes, it will be update over here.



When our CI job should initiate, whenever it is running it should replace the .war file and create the latest image on the Docker Hub repository.

```
[ansibleadmin@AnsibleServer docker]$ ll
total 28
-rw-rw-r--. 1 ansibleadmin ansibleadmin  352 Mar 16 08:34 create_image_regapp.ym
l
-rw-rw-r--. 1 ansibleadmin ansibleadmin  388 Mar 11 17:08 docker_deployment_repa
pp.yml
-rw-r--r--. 1 root         root          129 Mar 10 11:53 Dockerfile
-rw-r--r--. 1 root         root           63 Mar 15 18:20 hosts
-rw-rw-r--. 1 ansibleadmin ansibleadmin  374 Mar 16 08:37 kube_deploy.yml
-rw-rw-r--. 1 ansibleadmin ansibleadmin  125 Mar 15 20:00 kube_service.yml
-rw-rw-r--. 1 ansibleadmin ansibleadmin 2648 Mar 16 08:17 webapp.war
```

Once this is done, our CD job should get executed and this CD job should terminate these pods one by one and should be able to launch the new pods with the new application.

```
[root@ip-172-31-27-151 ~]# kubectl get pods
NAME                            READY   STATUS    RESTARTS   AGE
aman-regapp-7dfd865c78-php5m    1/1     Running   0          33m
aman-regapp-7dfd865c78-z5qrk    1/1     Running   0          33m
```

Let's go and change our source code.

Go to Git Bash
cd D:/AWS/DevopsProject/hello-world/webapp/src/main/webapp

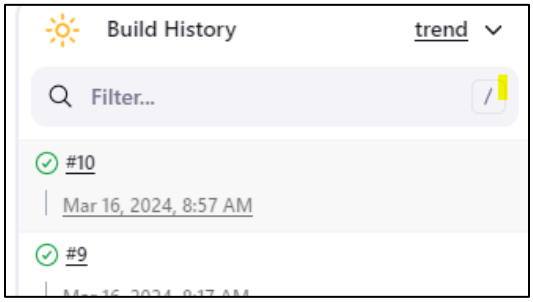
vi index.jsp

Change the source code.

```
/head>

body>
        <div class="main">
                <h1>Final Registration Form (Last date 12 march 2024)</h1>
                <form action="">
                        <label for="first">Engineer First Name:</label>
                        <input type="text" id="first"
                                name="first"
                                placeholder="Enter your first name" required>
                         <br>
                        <label for="last">Last Name:</label>
                        <input type="text" id="last"
                                name="last"
                                placeholder="Enter your last name" required>
                        <br>
```

git add .
git commit -m "new commit"
git push origin master

Once pushed the image, the job gets initializing on both CI and CD.



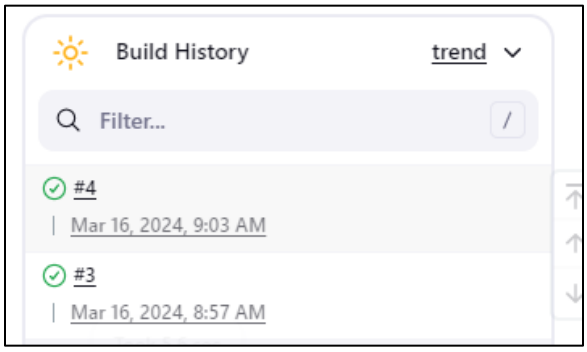
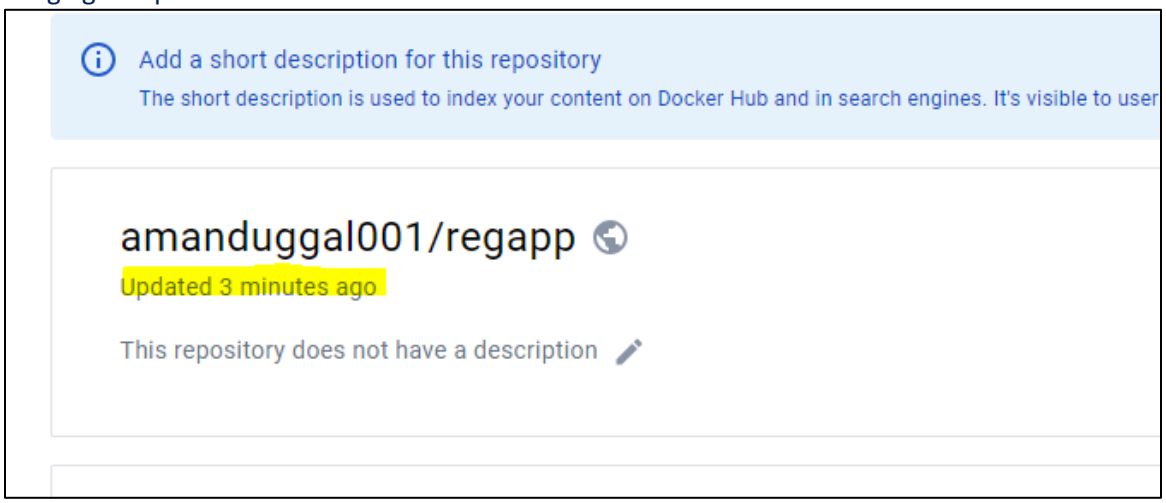
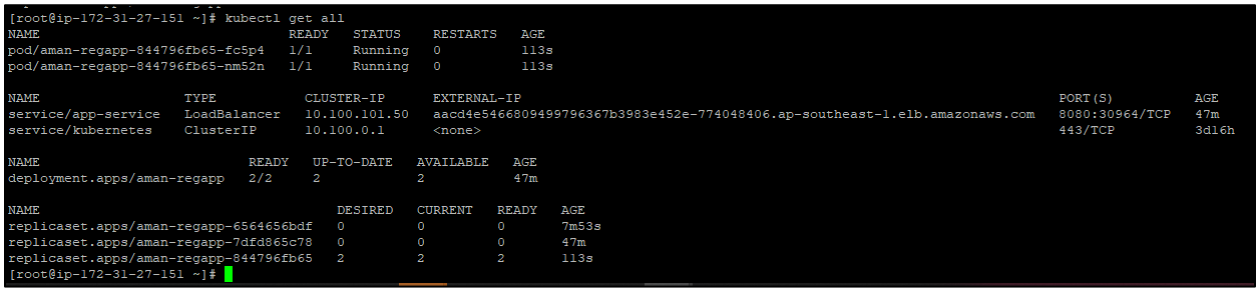


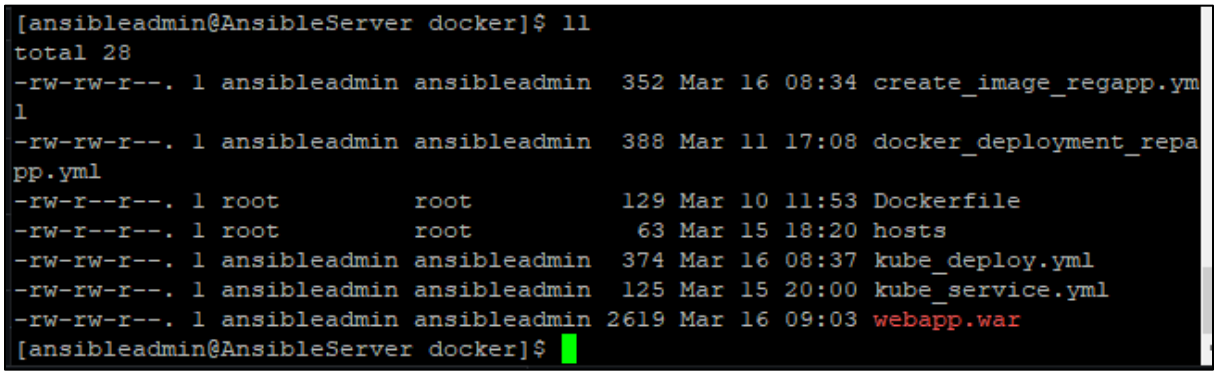
Image gets updated in the Docker Hub.



Previous Pods are terminated, and new pods are created.



webapp.war file gets updated with the latest .war file.



Application is working and opened in the web browser.