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JENKINS

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JENKINS HANDS-ON

1. **Create 3 instances (Master, Slave1, Slave2) on Linux server.**
2. **Install Jenkins on Master. (Refer the above steps or the Jenkins installation documentation)**
3. **Set up a Jenkins Master-Slave Cluster**
4. **Create a CI CD pipeline triggered by Git Webhook.**

Install Jenkins

```
sudo apt update
sudo apt install openjdk-11-jdk
wget -q -O - https://pkg.jenkins.io/debian-stable/jenkins.io.key | sudo apt-key add -

sudo sh -c 'echo deb https://pkg.jenkins.io/debian-stable binary/ >
/etc/apt/sources.list.d/jenkins.list'

sudo apt update
sudo apt install jenkins
systemctl status jenkins
```

First, we have created 3 instances Master Slave1and Slave2. And then we have installed the Jenkins on Master Machine. Now Let us set up the Jenkins Master-Slave Cluster.

Step 1: Check the status of the Jenkins first.

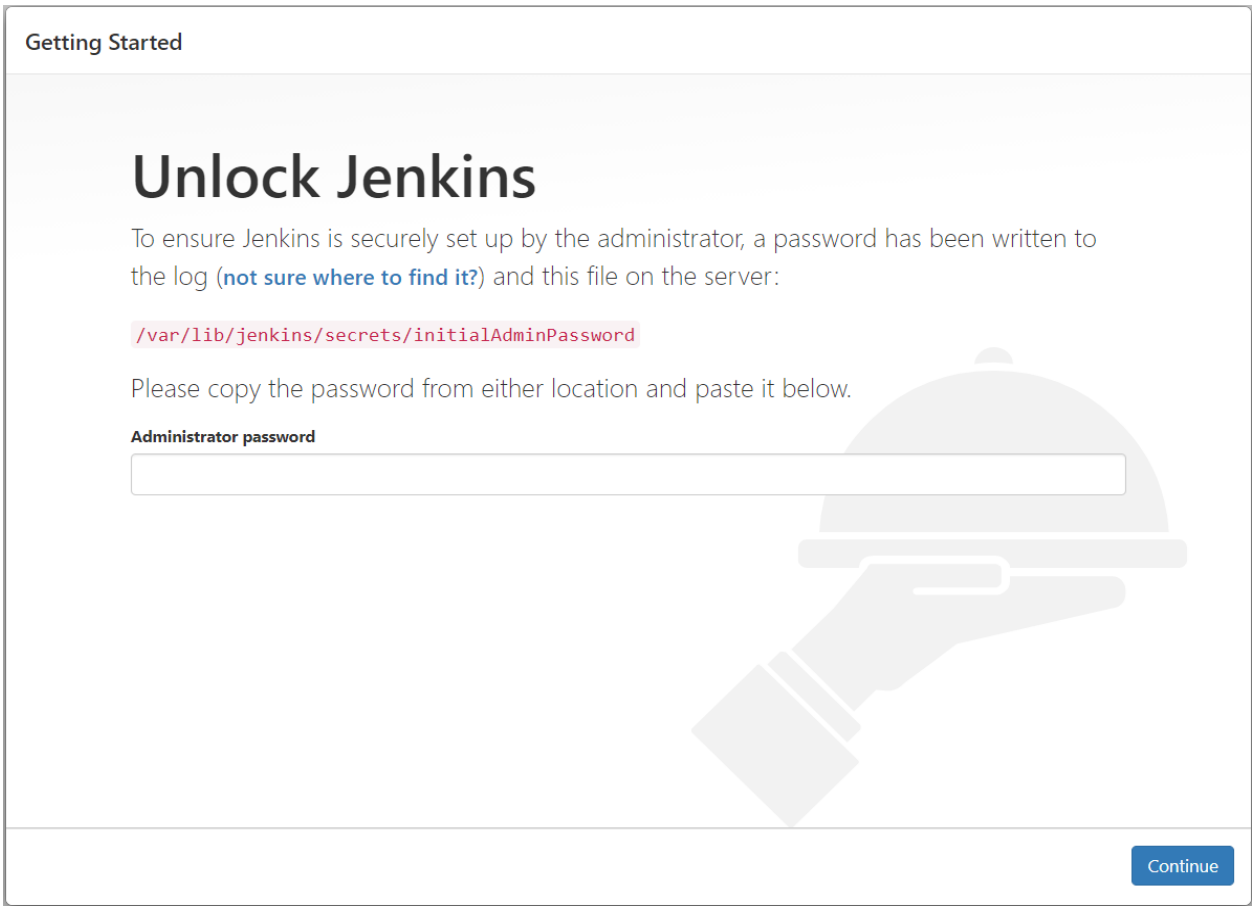
```
$ service jenkins status
```

```
ubuntu@instance-1:~$ systemctl status jenkins
● jenkins.service - LSB: Start Jenkins at boot time
   Loaded: loaded (/etc/init.d/jenkins; bad; vendor preset: enabled)
   Active: active (exited) since Fri 2021-02-12 12:28:52 UTC; 4min 59s ago
     Docs: man:systemd-sysv-generator(8)
  Process: 29631 ExecStart=/etc/init.d/jenkins start (code=exited, status=0/SUCCESS)

Feb 12 12:28:50 instance-1 systemd[1]: Starting LSB: Start Jenkins at boot time...
Feb 12 12:28:51 instance-1 jenkins[29631]: Correct java version found
Feb 12 12:28:51 instance-1 jenkins[29631]:   * Starting Jenkins Automation Server jenkins
Feb 12 12:28:51 instance-1 su[29682]: Successful su for jenkins by root
Feb 12 12:28:51 instance-1 su[29682]: + ??? root:jenkins
Feb 12 12:28:51 instance-1 su[29682]: pam_unix(su:session): session opened for user jenkins by (uid=0)
Feb 12 12:28:52 instance-1 jenkins[29631]:    ...done.
Feb 12 12:28:52 instance-1 systemd[1]: Started LSB: Start Jenkins at boot time.
```

Step 2: Now open browser and enter ***masterIP:8080***

You should land on a page like this:



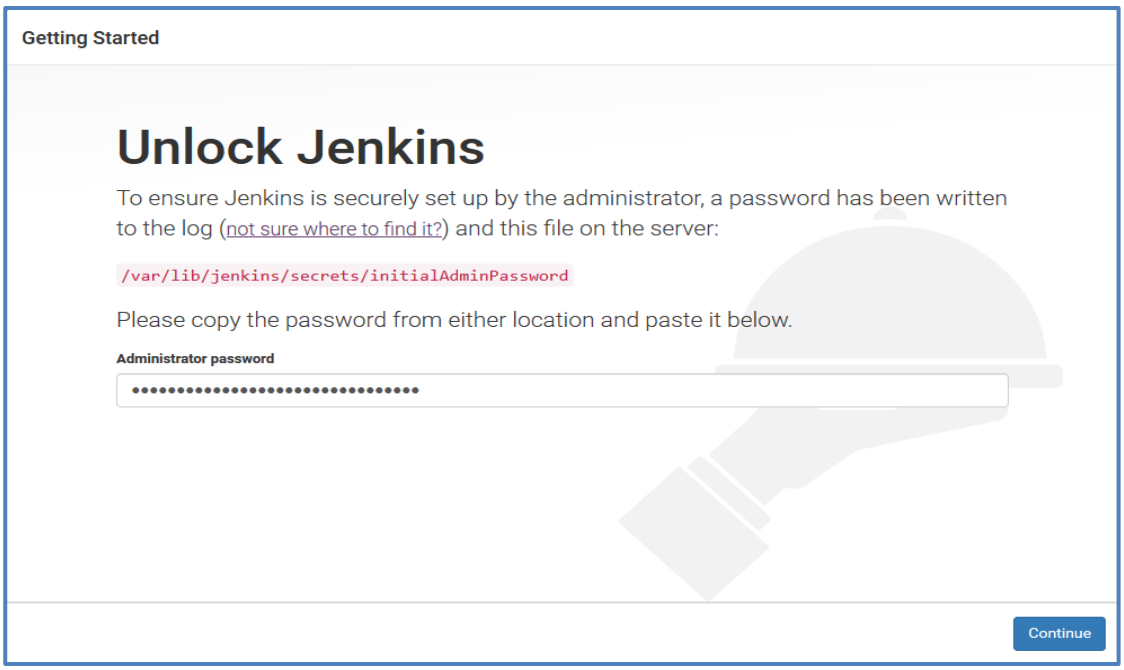
Step 3: Copy the path mentioned in the page and perform cat operation in master terminal.

```
$ sudo cat <path>
```

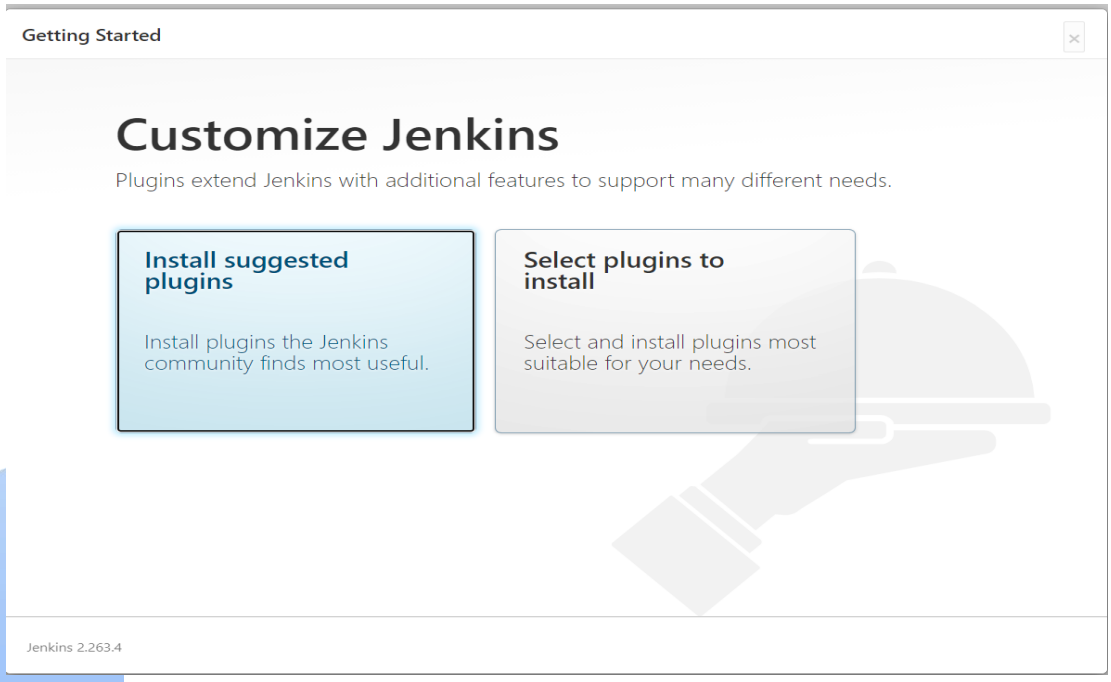
```
ubuntu@instance-1:~$ sudo cat /var/lib/jenkins/secrets/initialAdminPassword
79f304f38fb7467382b3601a58d75b54
ubuntu@instance-1:~$
```

This will give us the password which we will use to unlock our Jenkins.

Copy the password from there and paste it on the Jenkins Server page.

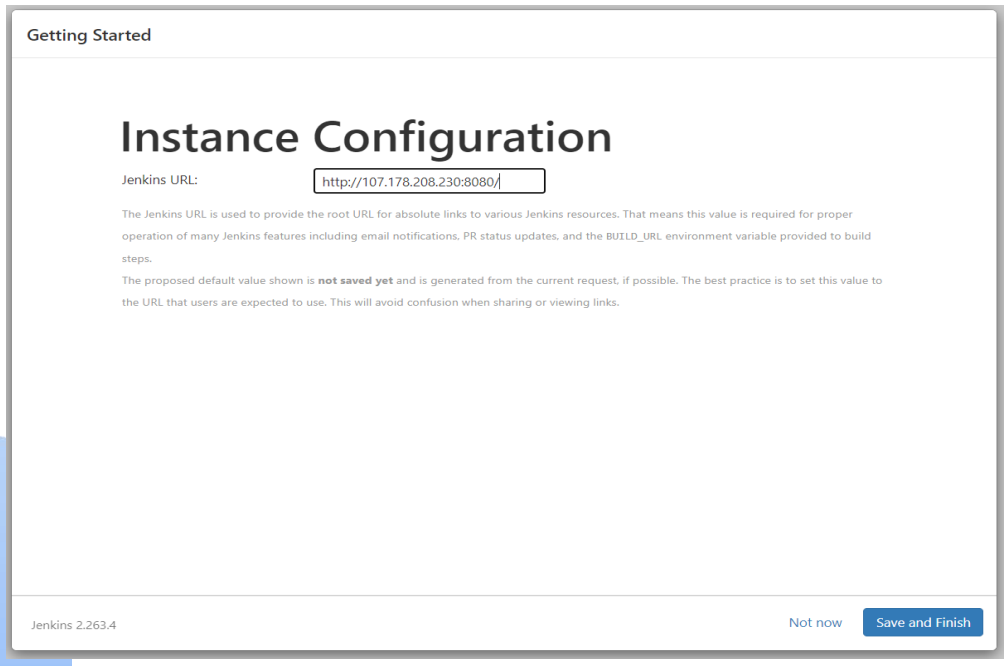


Now click on continue. Then click on Install Suggested Plugins.

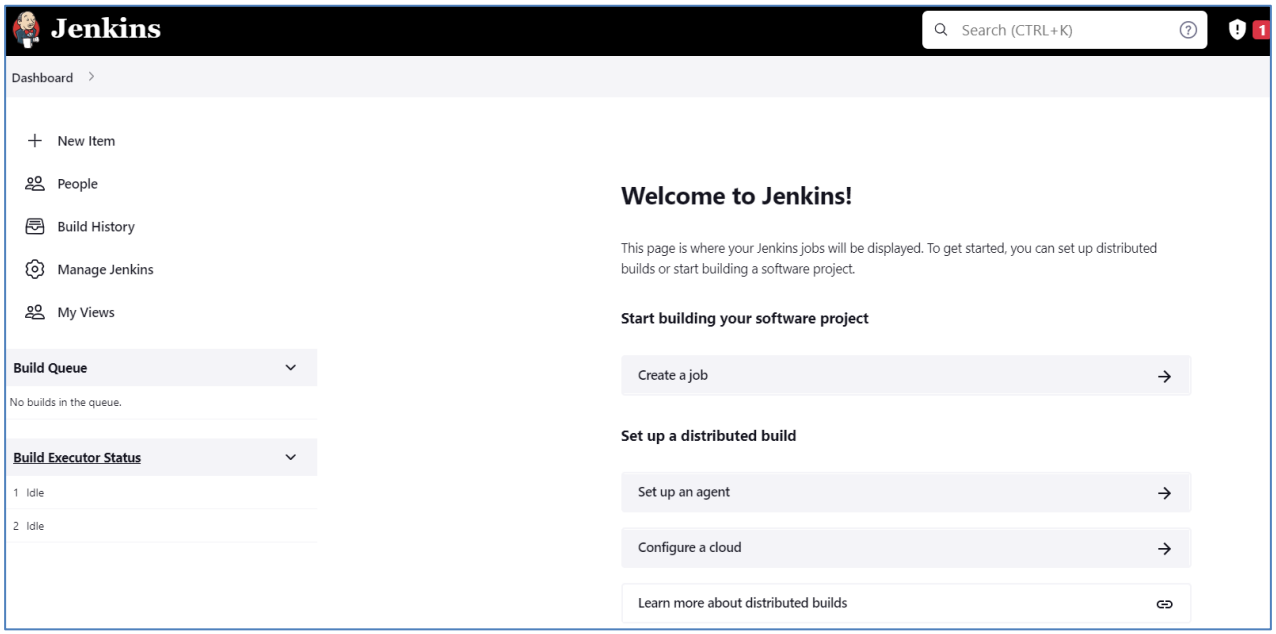


Step 4: Once done, enter the Admin User details.

Then click on **Save and Continue**.



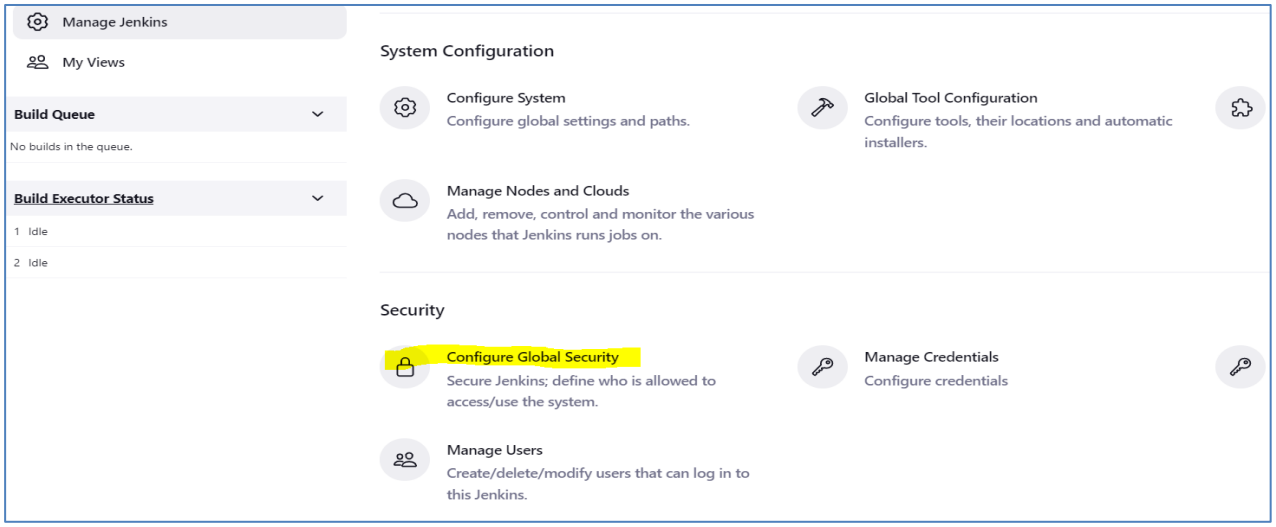
Again, click **Save and Finish**. Click on **Install Suggested Plugins.** Once it's done we will land on a page as shown below.



This is our **Jenkins Dashboard**.

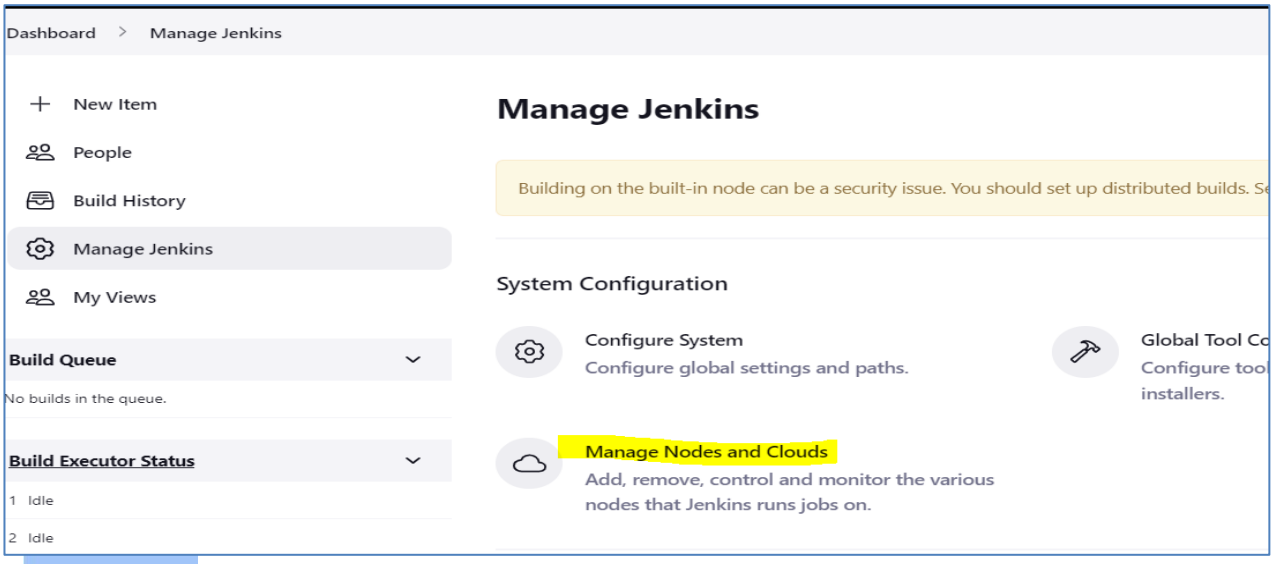
Hands-On: Configure Slave nodes

Step 5: Go to **Manage Jenkins**. Click on **Configure Global Security.**

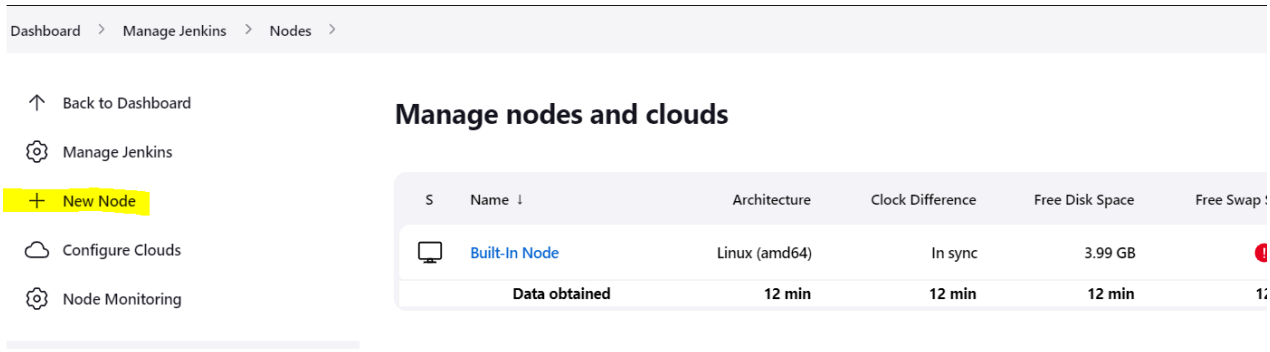


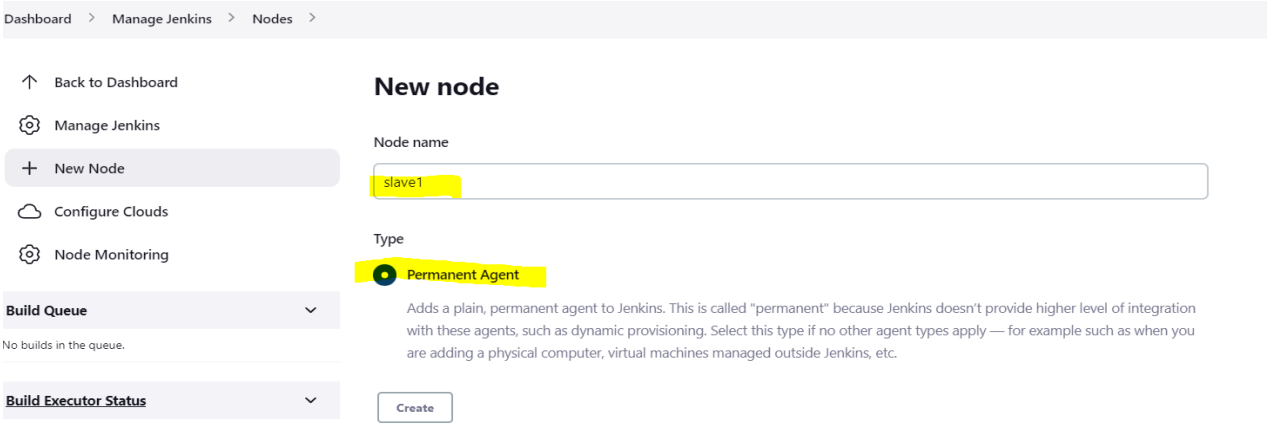
Step 6: Change the **Agents** to **Random**. Then click on **Save**.

Step 7: Now go to **Manage Nodes**.



Step 8: Click on **New Node.** Add **Slave1** as new node and make **Permanent Agent**. Click on **ok**.

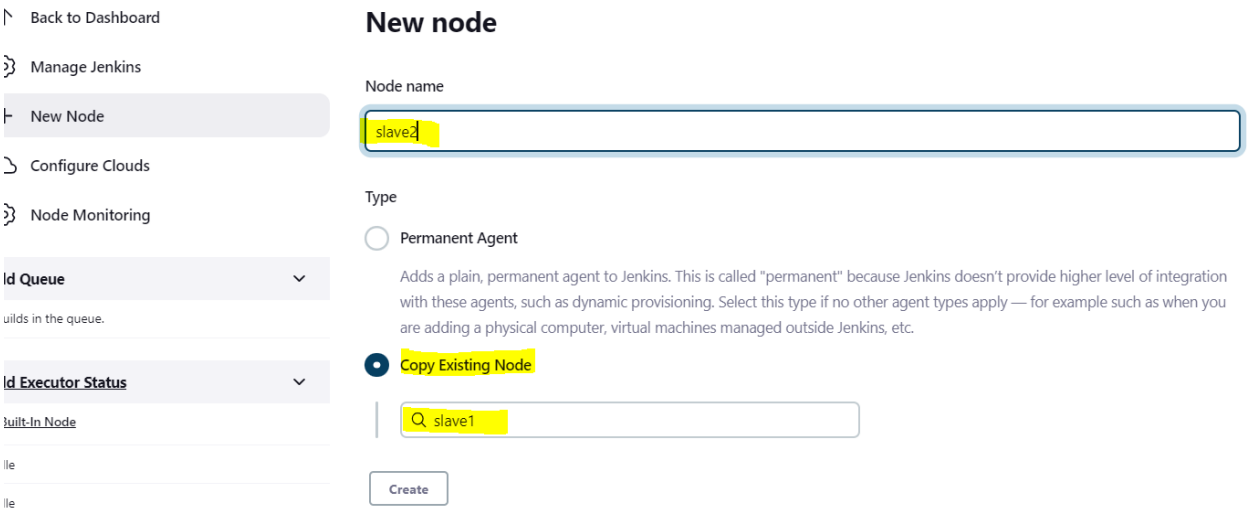




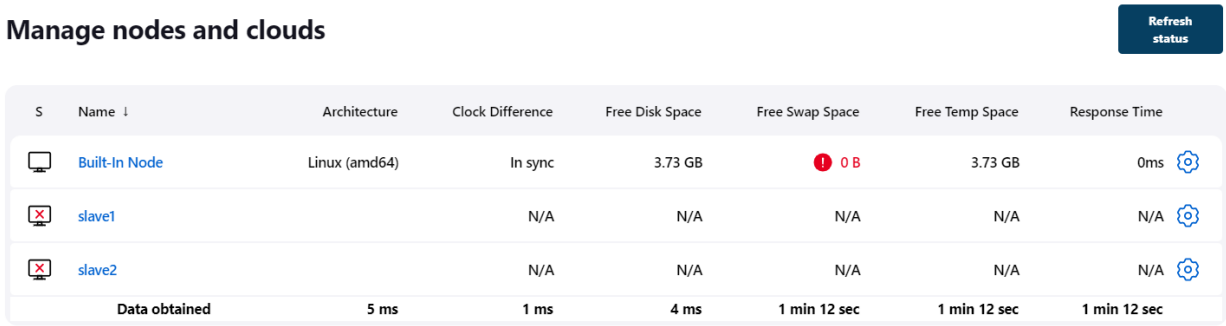
Step 9: Go to **Launch method** change it to **Launch agent by connecting it to the controller.**

Step 10: Then add the current working directory path to **/home/ubuntu/jenkins.** Then click on **Save.**

Step 11: Make another node **Slave2** and copy from **Slave1 as** shown below:



Step 12: Then click ok. You can see the list of nodes that we have on the Jenkins Dashboard.

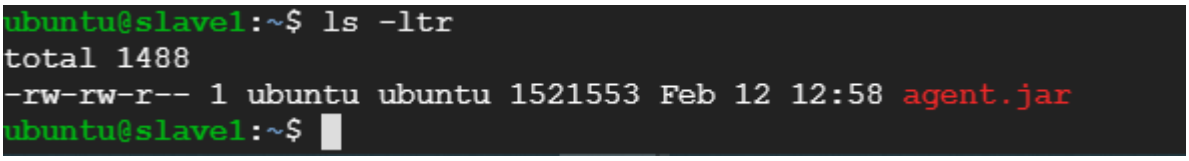


S	Name ↓	Architecture	Clock Difference	Free Disk Space	Free Swap Space	Free Temp Space	Response Time
	Built-In Node	Linux (amd64)	In sync	3.73 GB	0 B	3.73 GB	0ms
	slave1		N/A	N/A	N/A	N/A	N/A
	slave2		N/A	N/A	N/A	N/A	N/A
	Data obtained	5 ms	1 ms	4 ms	1 min 12 sec	1 min 12 sec	1 min 12 sec

Step 13: Go to the Jenkins Dashboard, Click on **Slave1**. Download the **Agent.jar** file by clicking on it.

Step 14: Now download **agent.jar** file and upload on the ubuntu server using scp, winscp or filezilla.

Step 15: Let us verify if the file has been transferred to **Slave1** or not. Open a new session on putty. Connect to slave1. Run **ls command.**



As you can see the agent.jar file appears there, which means our file has been successfully transferred to **Slave1.**

Step 16: Perform the steps for Slave2 as well. (Tip: Rename the agent.jar file of **Slave2.**

Step 17: Again, verify by opening a new putty session for Slave2.

```
ubuntu@slave1:~$ ls -ltr
total 1488
-rw-rw-r-- 1 ubuntu ubuntu 1521553 Feb 12 12:58 agent.jar
ubuntu@slave1:~$
```

Step 18: Now before moving ahead **install open jdk on both Slave1 and Slave2**.

$ sudo apt-get update

```
ubuntu@slave1:~$ sudo apt-get update
Hit:1 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic InRelease
Get:2 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
Get:3 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic-backports InRelease [74.6 kB]
Get:4 http://security.ubuntu.com/ubuntu bionic-security InRelease [88.7 kB]
Fetched 252 kB in 0s (583 kB/s)
Reading package lists... Done
```

```
ubuntu@slave2:~$ sudo apt-get update
Hit:1 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic InRelease
Get:2 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
Get:3 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic-backports InRelease [74.6 kB]
Get:4 http://security.ubuntu.com/ubuntu bionic-security InRelease [88.7 kB]
Get:5 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic/universe amd64 Packages [8570 kB]
Get:6 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic/universe Translation-en [4941 kB]
Get:7 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic/multiverse amd64 Packages [151 kB]
Get:8 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic/multiverse Translation-en [108 kB]
Get:9 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic-updates/main amd64 Packages [1884 kB]
Get:10 http://us-central1.gce.archive.ubuntu.com/ubuntu bionic-updates/main Translation-en [390 kB]
```

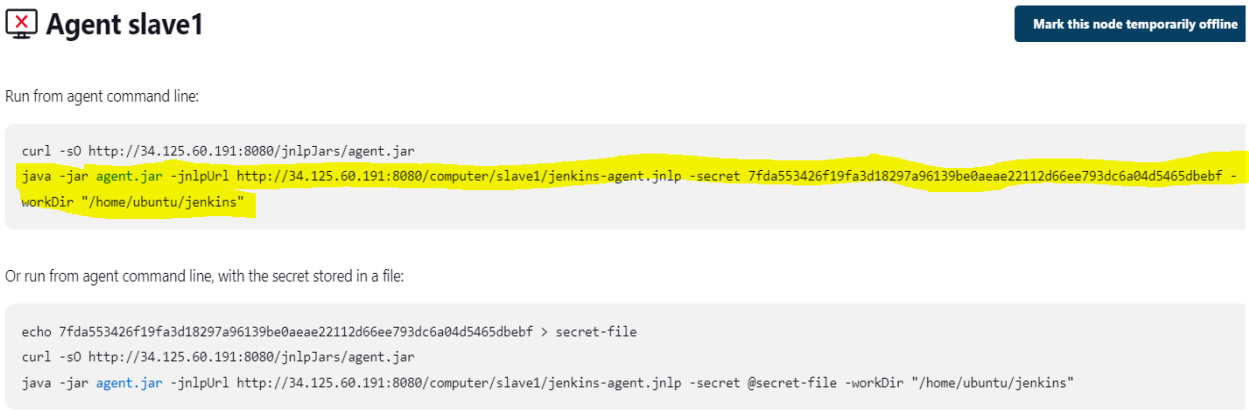
Step 19: Now install run the following installation command on both terminal.

$ sudo apt install openjdk-11-jdk

```
ubuntu@n-slave:~$ sudo apt install openjdk-11-jdk
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following package was automatically installed and is no longer required:
  libnuma1
Use 'sudo apt autoremove' to remove it.
The following additional packages will be installed:
  at-spi2-core ca-certificates-java fontconfig-config fonts-dejavu-core fonts-deja
  libasound2-data libatk-bridge2.0-0 libatk-wrapper-java libatk-wrapper-java-jni
  libdrm-amdgpu1 libdrm-intel1 libdrm-nouveau2 libdrm-radeon1 libfontconfig1 libf
  libglapi-mesa libglvnd0 libglx-mesa0 libglx0 libgraphite2-3 libharfbuzz0b libic
```

Step 20: Now we will connect Slave1 and Slave2 to the Jenkins Server. Go to the Jenkins Dashboard, Click on Slave1, **Copy the command line** as shown.

Run the command line from Slave1 as shown below.




```
ubuntu@slave1:~$ echo ba206675983f0546ee5fab69611cfdcf8bd969a85565207b0a881a0ca4f76582 > secret-file
ubuntu@slave1:~$ java -jar agent.jar -jnlpUrl http://107.178.208.230:8080/computer/slave1/slave-agent.jnlp -secret @secret-file -workDir "/home/ubuntu/jenkins"
Feb 12, 2021 1:08:26 PM org.jenkinsci.remoting.engine.WorkDirManager initializeWorkDir
INFO: Using /home/ubuntu/jenkins/remoting as a remoting work directory
Feb 12, 2021 1:08:26 PM org.jenkinsci.remoting.engine.WorkDirManager setupLogging
INFO: Both error and output logs will be printed to /home/ubuntu/jenkins/remoting
Feb 12, 2021 1:08:26 PM hudson.remoting.jnlp.Main createEngine
INFO: Setting up agent: slave1
Feb 12, 2021 1:08:26 PM hudson.remoting.jnlp.Main$CuiListener <init>
INFO: Jenkins agent is running in headless mode.
Feb 12, 2021 1:08:26 PM hudson.remoting.Engine startEngine
INFO: Using Remoting version: 4.5
Feb 12, 2021 1:08:26 PM org.jenkinsci.remoting.engine.WorkDirManager initializeWorkDir
INFO: Using /home/ubuntu/jenkins/remoting as a remoting work directory
Feb 12, 2021 1:08:26 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Locating server among [http://107.178.208.230:8080/]
Feb 12, 2021 1:08:26 PM org.jenkinsci.remoting.engine.JnlpAgentEndpointResolver resolve
INFO: Remoting server accepts the following protocols: [JNLP4-connect, Ping]
Feb 12, 2021 1:08:26 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Agent discovery successful
  Agent address: 107.178.208.230
  Agent port:    37689
  Identity:      e7:1c:03:31:93:ac:f0:16:c5:30:7d:96:34:5e:39:00
Feb 12, 2021 1:08:26 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Handshaking
Feb 12, 2021 1:08:26 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Connecting to 107.178.208.230:37689
Feb 12, 2021 1:08:26 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Trying protocol: JNLP4-connect
Feb 12, 2021 1:08:27 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Remote identity confirmed: e7:1c:03:31:93:ac:f0:16:c5:30:7d:96:34:5e:39:00
Feb 12, 2021 1:08:29 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Connected
```

It shows "**Connected**".

Step 21: Perform the **Step-20** for **Slave2** as well.

Agent slave2

Mark this node temporarily offline

Run from agent command line:

```
curl -sO http://34.125.60.191:8080/jnlpJars/agent.jar
java -jar agent.jar -jnlpUrl http://34.125.60.191:8080/computer/slave2/jenkins-agent.jnlp -secret 2b276330d0eefeb5194efd402bcf5f0acfd225f0bbd14c7e3eed06991d361f5d -
workDir "/home/ubuntu/jenkins"
```

Or run from agent command line, with the secret stored in a file:

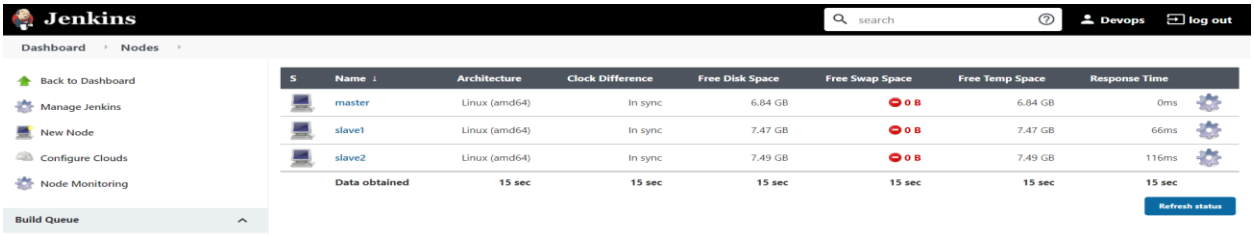
```
echo 2b276330d0eefeb5194efd402bcf5f0acfd225f0bbd14c7e3eed06991d361f5d > secret-file
curl -sO http://34.125.60.191:8080/jnlpJars/agent.jar
java -jar agent.jar -jnlpUrl http://34.125.60.191:8080/computer/slave2/jenkins-agent.jnlp -secret @secret-file -workDir "/home/ubuntu/jenkins"
```

Paste the command line in the Slave2 Terminal.

```
ubuntu@slave2:~$ echo 1e7ccf69323b5a4e50e390b5577ca559cea8175f3e1b91cf3307fa639511058d > secret-file
ubuntu@slave2:~$ java -jar agent.jar -jnlpUrl http://107.178.208.230:8080/computer/slave2/slave-agent.jnlp -secret @secret-file -workDir "/home/ubuntu/jenkins"
Feb 12, 2021 1:09:33 PM org.jenkinsci.remoting.engine.WorkDirManager initializeWorkDir
INFO: Using /home/ubuntu/jenkins/remoting as a remoting work directory
Feb 12, 2021 1:09:33 PM org.jenkinsci.remoting.engine.WorkDirManager setupLogging
INFO: Both error and output logs will be printed to /home/ubuntu/jenkins/remoting
Feb 12, 2021 1:09:34 PM hudson.remoting.jnlp.Main createEngine
INFO: Setting up agent: slave2
Feb 12, 2021 1:09:34 PM hudson.remoting.jnlp.Main$CuiListener <init>
INFO: Jenkins agent is running in headless mode.
Feb 12, 2021 1:09:34 PM hudson.remoting.Engine startEngine
INFO: Using Remoting version: 4.5
Feb 12, 2021 1:09:34 PM org.jenkinsci.remoting.engine.WorkDirManager initializeWorkDir
INFO: Using /home/ubuntu/jenkins/remoting as a remoting work directory
Feb 12, 2021 1:09:34 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Locating server among [http://107.178.208.230:8080/]
Feb 12, 2021 1:09:34 PM org.jenkinsci.remoting.engine.JnlpAgentEndpointResolver resolve
INFO: Remoting server accepts the following protocols: [JNLP4-connect, Ping]
Feb 12, 2021 1:09:34 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Agent discovery successful
  Agent address: 107.178.208.230
  Agent port:    37689
  Identity:      e7:1c:03:31:93:ac:f0:16:c5:30:7d:96:34:5e:39:00
Feb 12, 2021 1:09:34 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Handshaking
Feb 12, 2021 1:09:34 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Connecting to 107.178.208.230:37689
Feb 12, 2021 1:09:34 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Trying protocol: JNLP4-connect
Feb 12, 2021 1:09:34 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Remote identity confirmed: e7:1c:03:31:93:ac:f0:16:c5:30:7d:96:34:5e:39:00
Feb 12, 2021 1:09:35 PM hudson.remoting.jnlp.Main$CuiListener status
INFO: Connected
```

Important Note: *Don't end the Sessions that we just Connected. To perform further operations on Slave1 and Slave2 duplicate the sessions.*

So now that our Slave1 and Slave2 has been connected to Jenkins Server, it looks like this.



After we have successfully created the Master Slave Cluster on AWS Jenkins. We will now create a CI CD pipeline triggered by Git Webhook.

Hands-on: Create and Run Jenkins Jobs.

Step 1: Before that open your GitHub account and import the below given repository.

https://github.com/vistasunil/devopsIQ.git

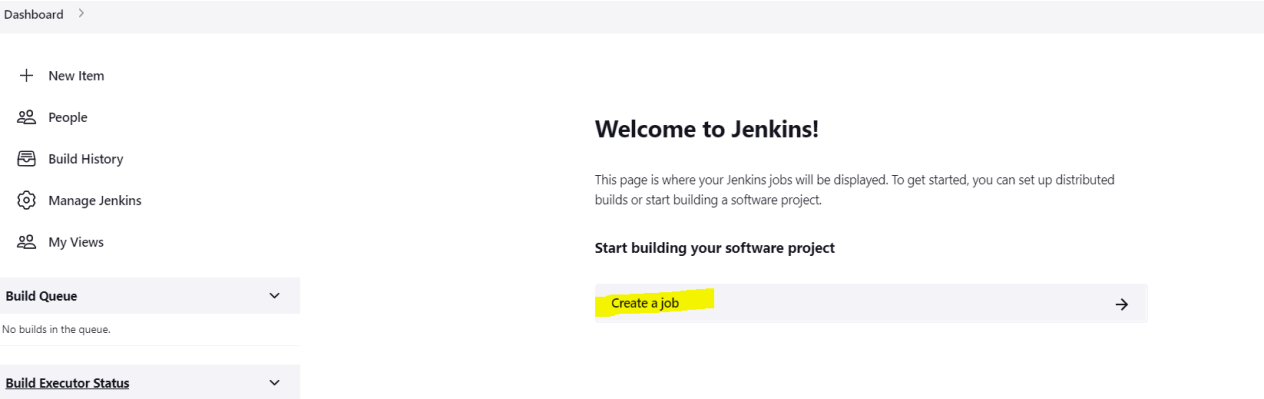
Step 2: Install docker on both **Slave1** and **Slave2**.

sudo apt install docker.io

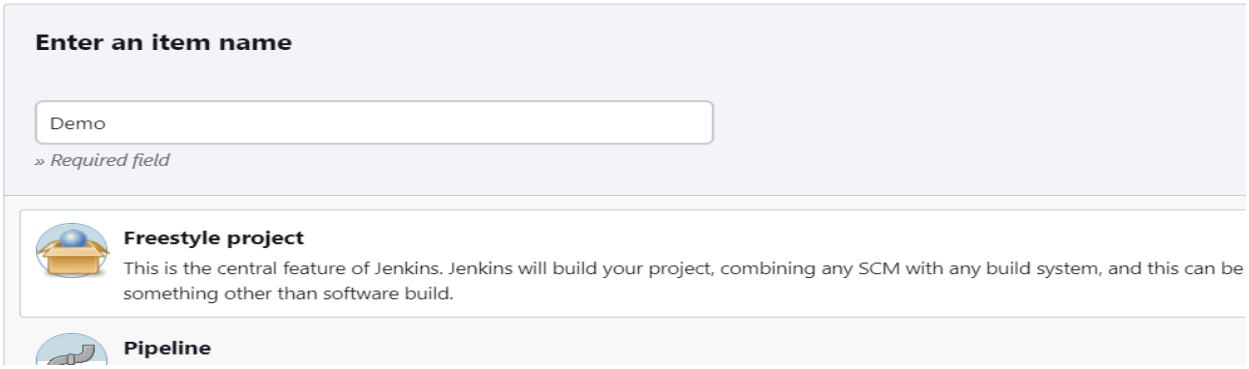
```
ubuntu@ip-172-31-34-189:~$ sudo apt install docker.io
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  bridge-utils cgroupfs-mount libltdl7 pigz ubuntu-fan
Suggested packages:
  ifupdown aufs-tools debootstrap docker-doc rinse zfs-fuse | zfsutils
The following NEW packages will be installed:
  bridge-utils cgroupfs-mount docker.io libltdl7 pigz ubuntu-fan
0 upgraded, 6 newly installed, 0 to remove and 121 not upgraded.
Need to get 40.3 MB of archives.
After this operation, 198 MB of additional disk space will be used.
```

```
ubuntu@ip-172-31-34-132:~$ sudo apt install docker.io
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  bridge-utils cgroupfs-mount libltdl7 pigz ubuntu-fan
Suggested packages:
  ifupdown aufs-tools debootstrap docker-doc rinse zfs-fuse | zfsutils
The following NEW packages will be installed:
  bridge-utils cgroupfs-mount docker.io libltdl7 pigz ubuntu-fan
0 upgraded, 6 newly installed, 0 to remove and 121 not upgraded.
Need to get 40.3 MB of archives.
After this operation, 198 MB of additional disk space will be used.
```

Step 3: Open **Jenkins Dashboard**. **Create a new job** (Freestyle Project) for Slave1.

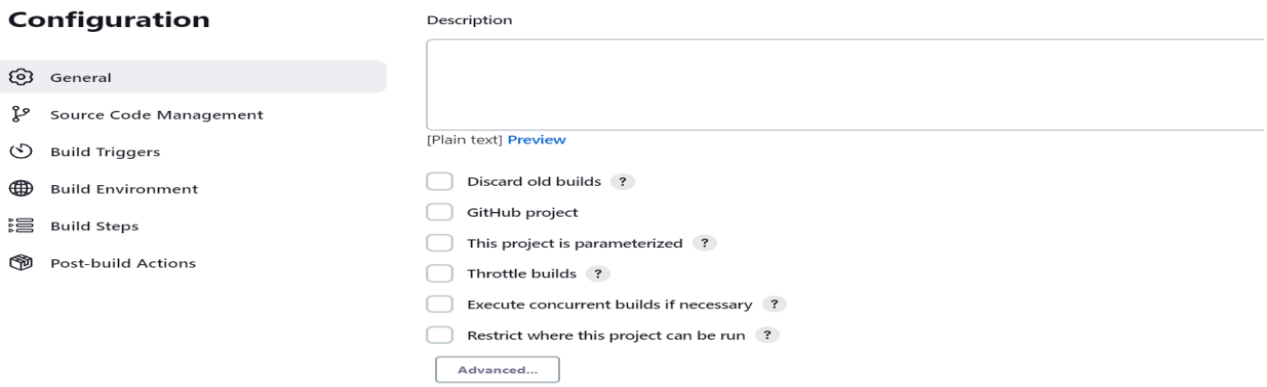


Name the Project as **Demo**, Select **Freestyle Project** option.

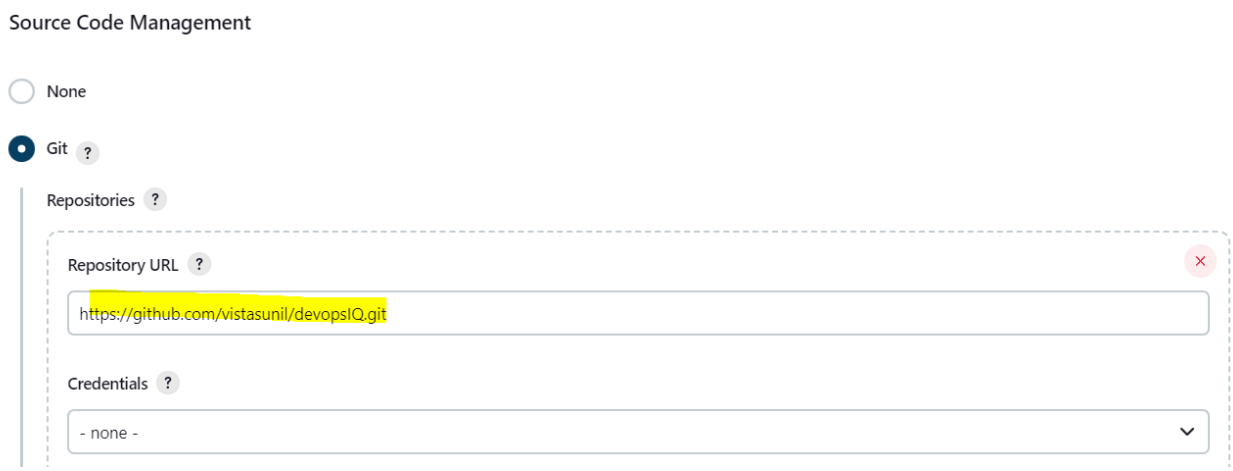


Then click on **Ok**.

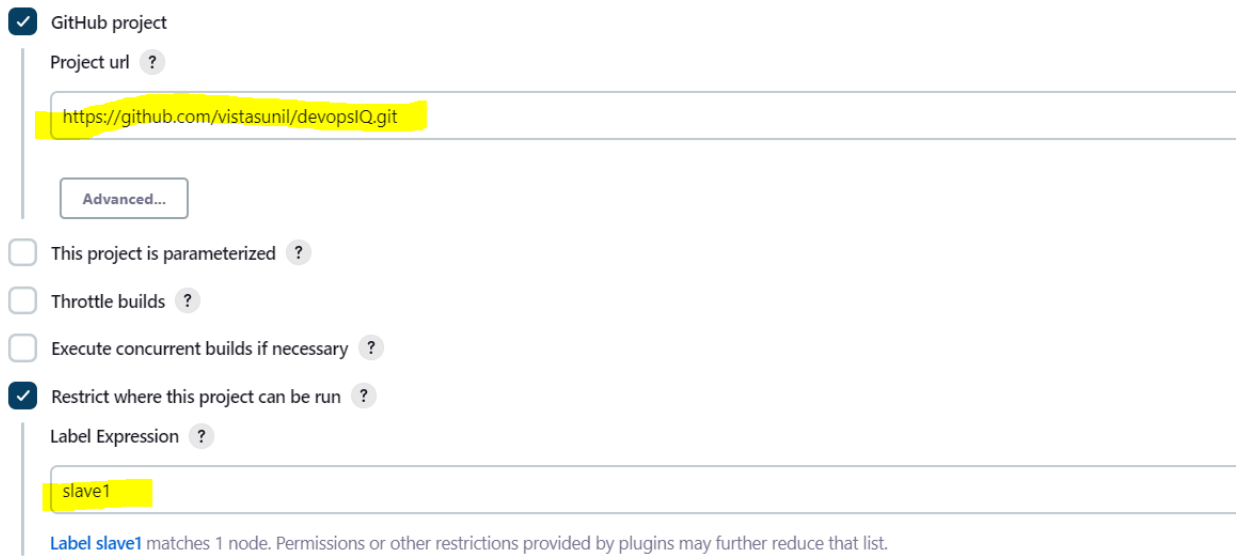
You should land on a page like this.



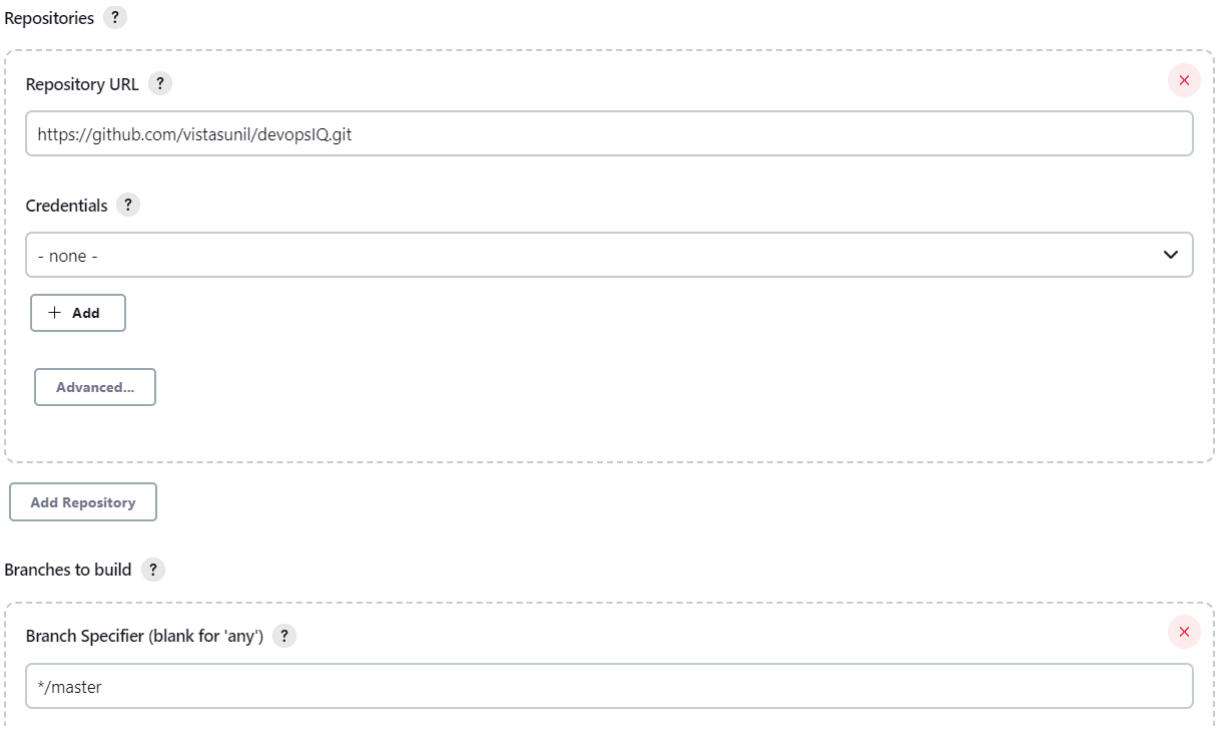
Step 4: Place your git repository link https://github.com/vistasunil/devopsIQ.git as shown below.



Click on **Restrict where this project can be run**. Add **Slave1** there.

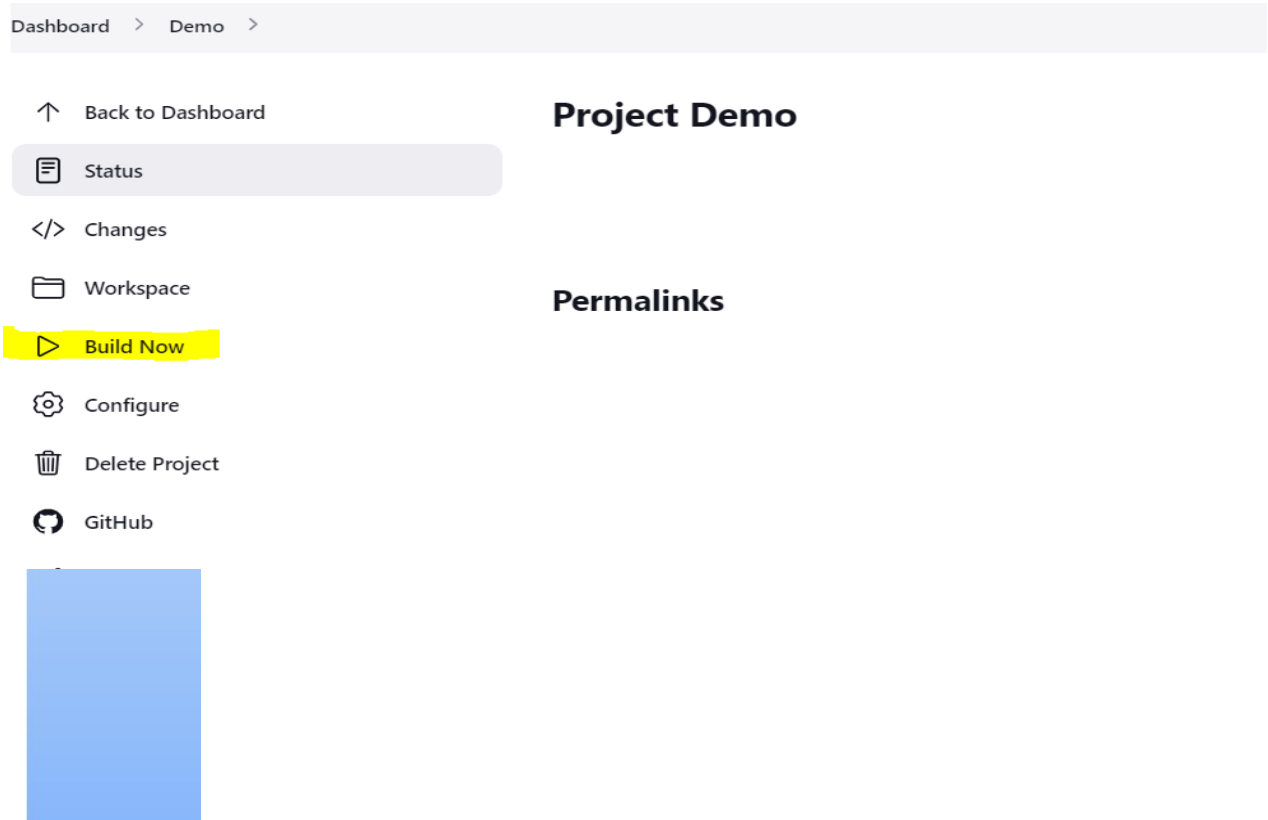


Go to **Source Code Management**, click on **git**, add the **git repository link** there as well.

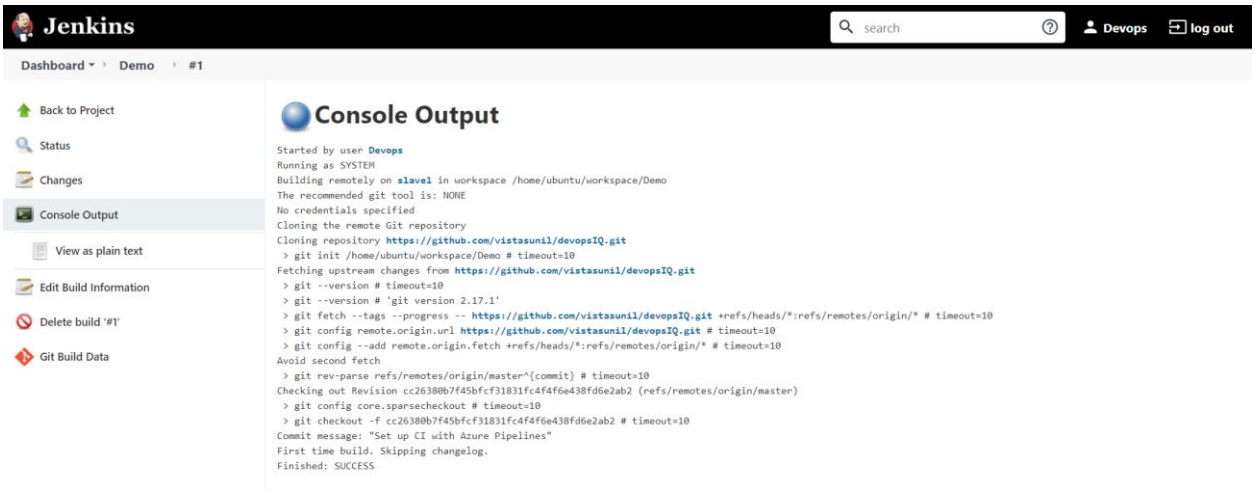


Click on **Save.**

Step 5: Click on **Build Now,** if the building is done without any error there will be **blue circle** in the building history.



Click on the blue circle of build #1.



You can see it has been built successfully. Let us verify that.

Step 6: Go to slave1.

```
$ ls

$ cd workspace

$ ls

$ cd Demo

$ ls
```

```
ubuntu@slave1:~$ ls -ltr
total 1500
-rw-rw-r-- 1 ubuntu ubuntu 1521553 Feb 12 12:58 agent.jar
-rw-rw-r-- 1 ubuntu ubuntu      65 Feb 12 13:08 secret-file
drwxrwxr-x 3 ubuntu ubuntu    4096 Feb 12 13:08 jenkins
drwxrwxr-x 3 ubuntu ubuntu    4096 Feb 12 13:20 workspace
ubuntu@slave1:~$ cd workspace/
ubuntu@slave1:~/workspace$ ls -ltr
total 4
drwxrwxr-x 4 ubuntu ubuntu 4096 Feb 12 13:20 Demo
ubuntu@slave1:~/workspace$ cd Demo/
ubuntu@slave1:~/workspace/Demo$ ls -ltr
total 11488
-rw-rw-r-- 1 ubuntu ubuntu      462 Feb 12 13:20 azure-pipelines.yml
-rw-rw-r-- 1 ubuntu ubuntu       56 Feb 12 13:20 Dockerfile
drwxrwxr-x 3 ubuntu ubuntu     4096 Feb 12 13:20 devopsIQ
-rwxrwxr-x 1 ubuntu ubuntu 11748168 Feb 12 13:20 docker-compose
ubuntu@slave1:~/workspace/Demo$
```

You can see the repository files there. This means the git repository has been successfully cloned into the Demo job.

Now we will deploy the website that we have stored in our repository.

Step 7: To run the **Dockerfile** we have to check the copy the present working directory.

```
ubuntu@slave1:~/workspace/Demo$ pwd
/home/ubuntu/workspace/Demo
```

Now go back to configuring the job.

Step 8: Click on **Build**, then go to **Execute shell**

```
sudo docker rm -f $(sudo docker ps -a -q)

sudo docker build /home/ubuntu/Jenkins/workspace/Demo -t
devopsdemo

sudo docker run -it -p 82:80 -d devopsdemo
```

Click on save.

Before building our job again we must add one arbitrary container in slave1.

Step 9: Add container by performing the following command.

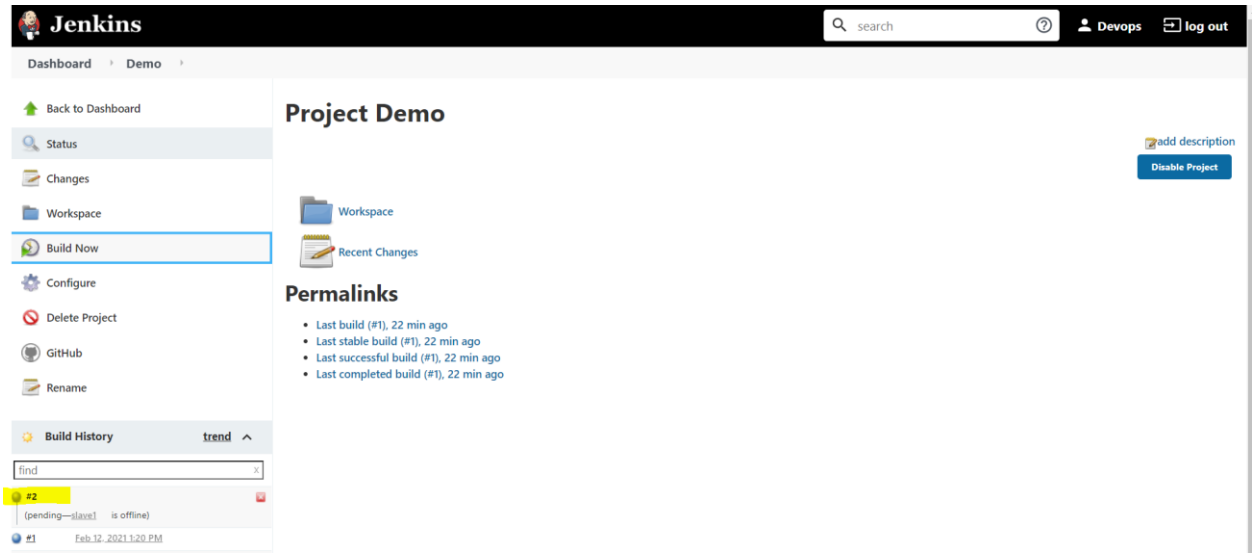
$ sudo docker run -it -d ubuntu

```
ubuntu@slave1:~/workspace/Demo$ sudo docker run -it -d ubuntu
Unable to find image 'ubuntu:latest' locally
latest: Pulling from library/ubuntu
83ee3a23efb7: Pull complete
db98fc6f11f0: Pull complete
f611acd52c6c: Pull complete
Digest: sha256:703218c0465075f4425e58fac086e09e1de5c340b12976ab9eb8ad26615c3715
Status: Downloaded newer image for ubuntu:latest
472b62d1a51c241cfaa273b34f7abb922436bcb35b2c8c78f75853eaa42dd89c
```

Now we have added in a container.

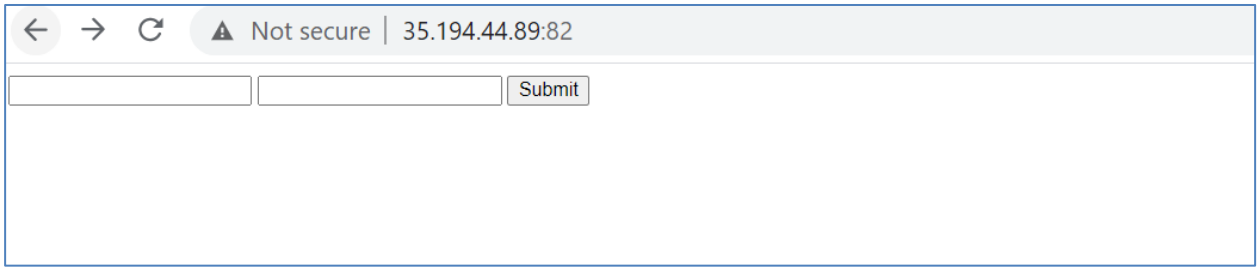
```
ubuntu@slave1:~/workspace/Demo$ sudo docker ps
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS               NAMES
472b62d1a51c        ubuntu              "/bin/bash"         24 seconds ago      Up 22 seconds                           cranky_hofstadter
ubuntu@slave1:~/workspace/Demo$
```

Step 10: Now open Jenkins Dashboard and **build the project**.



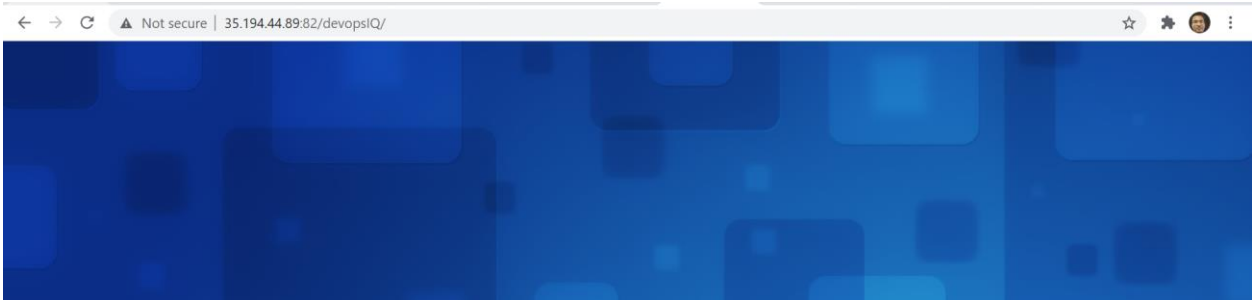
Building was successful.

Step 11: Now open browser and enter **Slave1 IP:82**



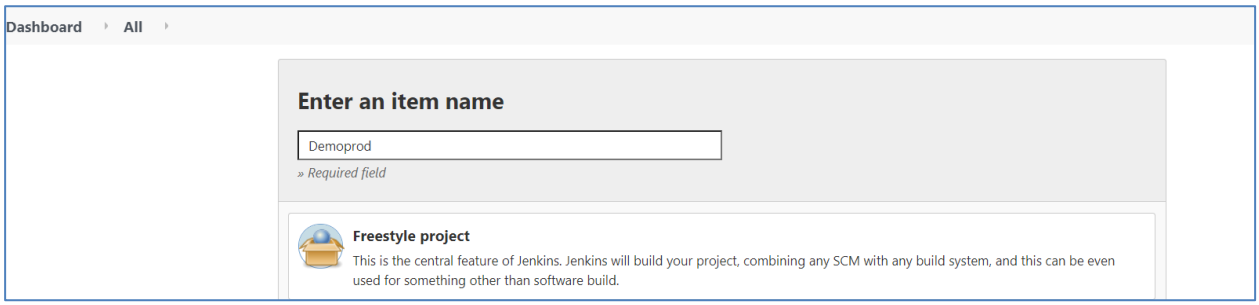
This is the apache page that means our container is working perfectly.

Step 12: Now enter **slave1 IP:82/devopsIQ/** in the browser.

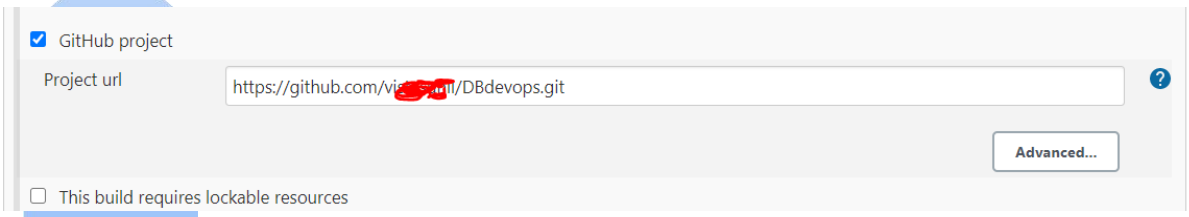


Now, we will create a new project.

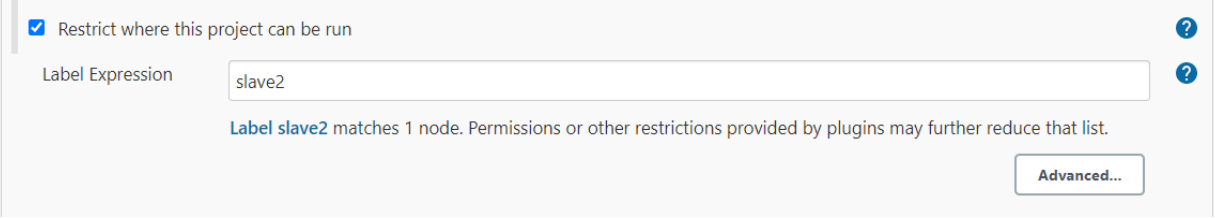
Step 13: Create a new project.



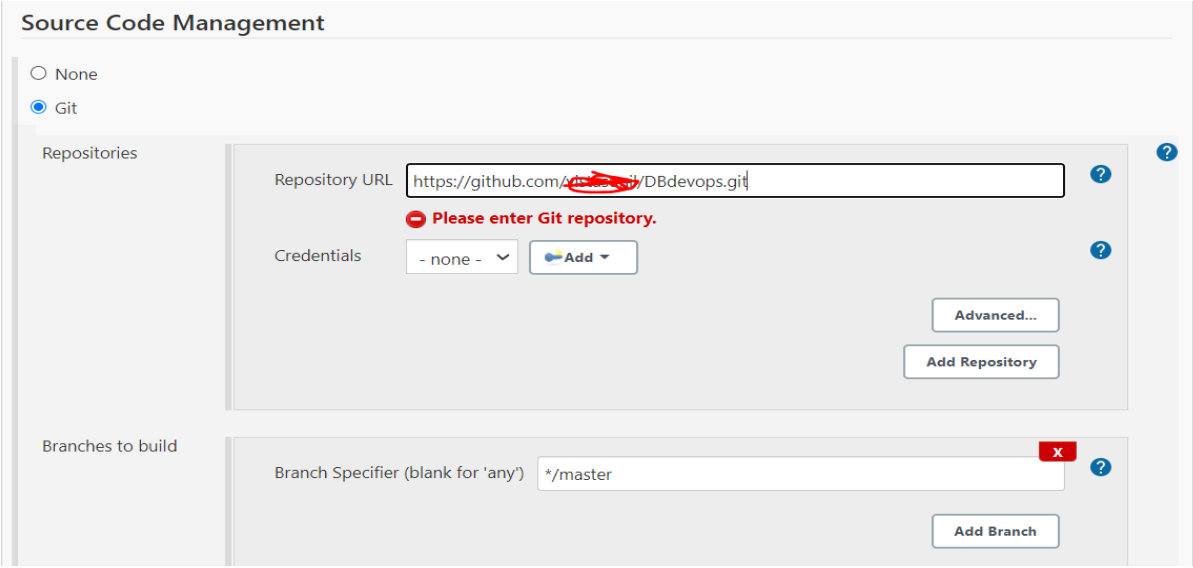
Step 14: Click on git project. Enter the git hub repository URL.



Step 15: Click on **Restrict where this project can be run** enter **Slave2.**



Step 16: Go to Source code management enter the git repository URL there as well.

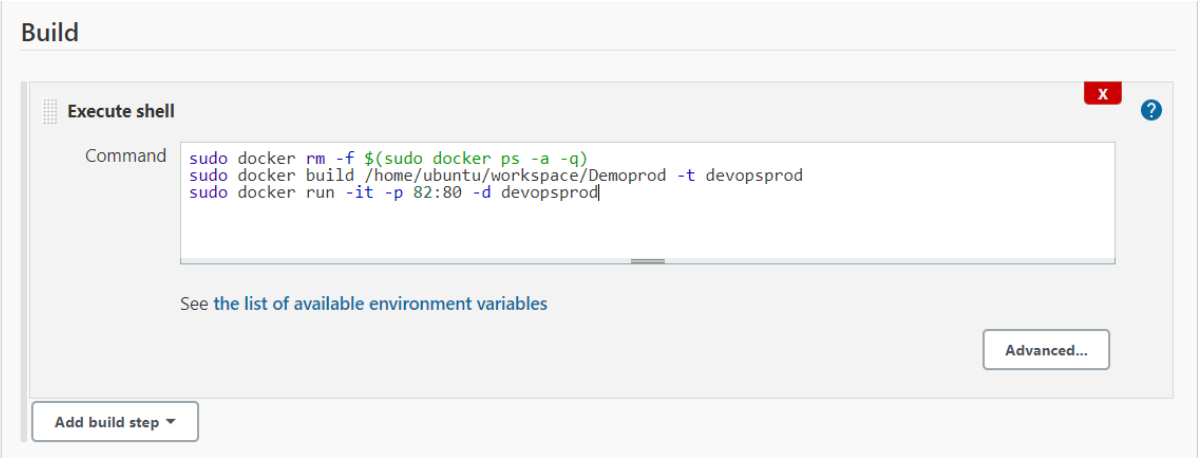


Step 17: Now enter the following command in the **Execution shell**

```
sudo docker rm -f $(sudo docker ps -a -q)

sudo docker build /home/ubuntu/workspace/Demoprod -t
devopsprod

sudo docker run -it -p 82:80 -d devopsprod
```



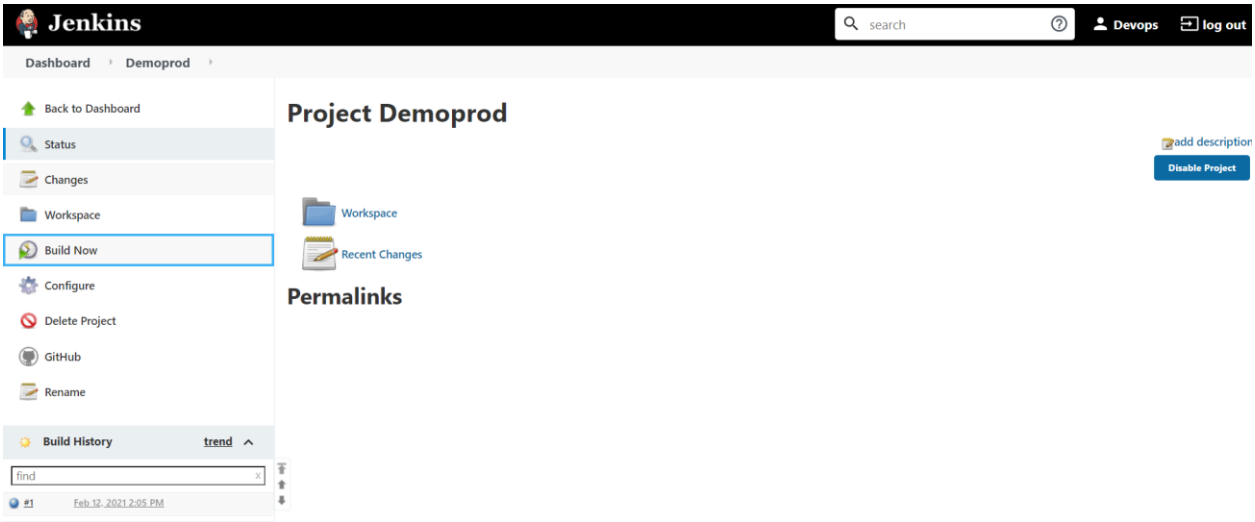
Step 18: Again, add one container to the Slave2 as shown below.

```
$ sudo docker run -it -d ubuntu
```

```
ubuntu@slave2:~$  sudo docker run -it -d ubuntu
Unable to find image 'ubuntu:latest' locally
latest: Pulling from library/ubuntu
83ee3a23efb7: Pull complete
db98fc6f11f0: Pull complete
f611acd52c6c: Pull complete
Digest: sha256:703218c0465075f4425e58fac086e09e1de5c340b12976ab9eb8ad26615c3715
Status: Downloaded newer image for ubuntu:latest
db33239c567a04c84a938c4d5c41c025b31cd75bea857a08e45af19553d7468c
```

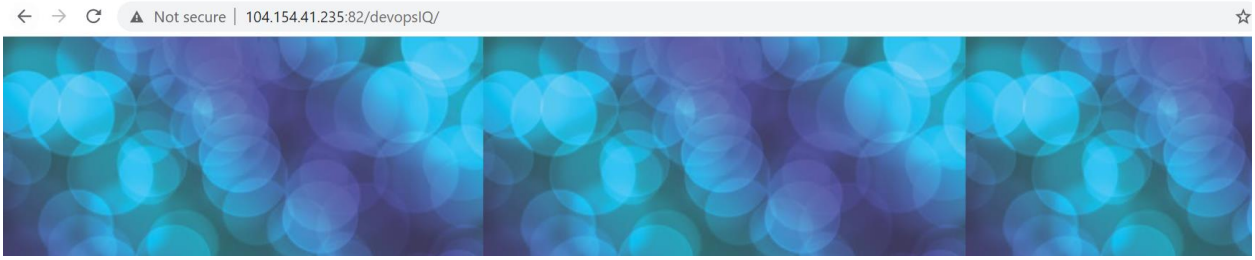
Now that we have added an arbitrary container, go to Jenkins Dashboard and build the project.

Step 19: Build the project **Demoprod**.



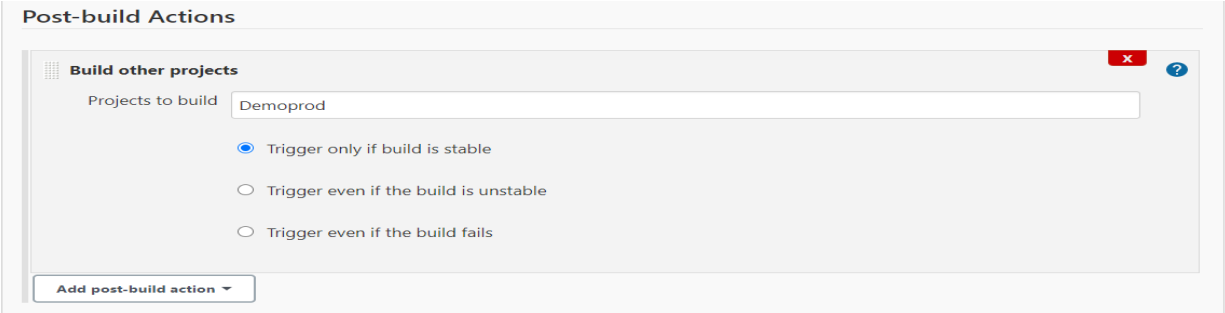
Our Project building was successful.

Step 20: Now go to the browser and enter **Slave2 IP:82/devopsIQ/**



Now trigger **Demoprod** job only when **Demo** job will be completed.

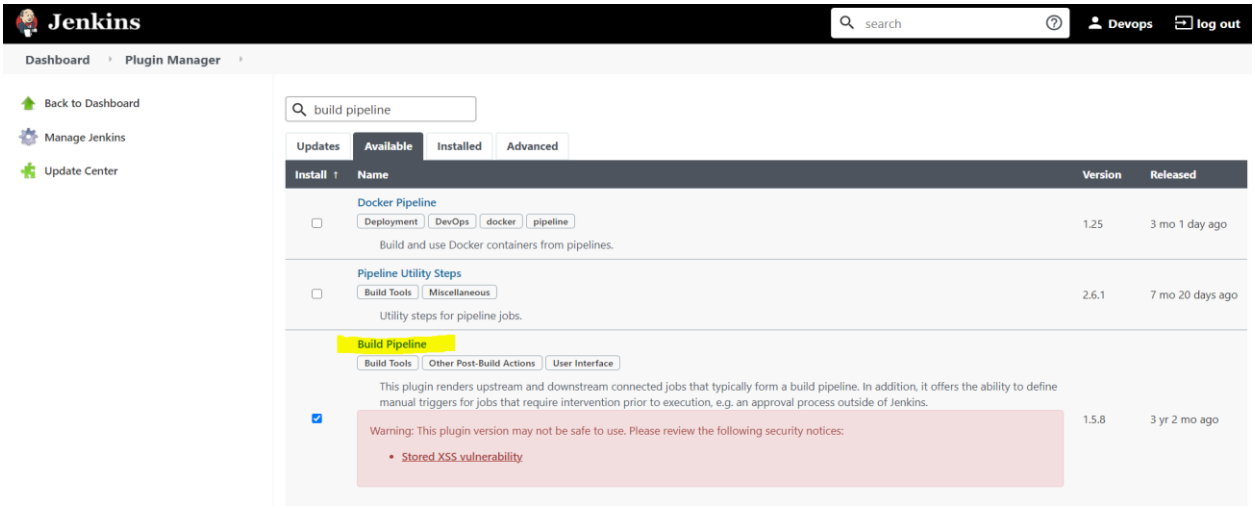
Step 21: Go to the **Demo** job, click on **Configure**. Add **Post-Build Actions**. Then go to **Build Other Projects.**



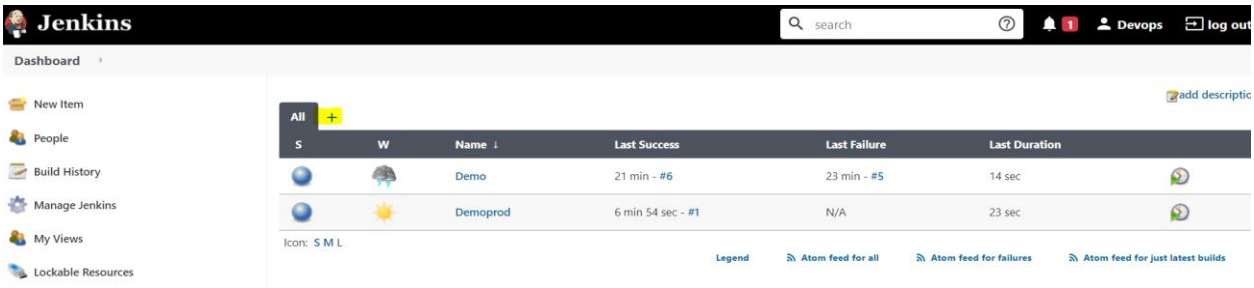
Click on Save.

Hands-on: Create a CI CD pipeline triggered by Git Webhook.

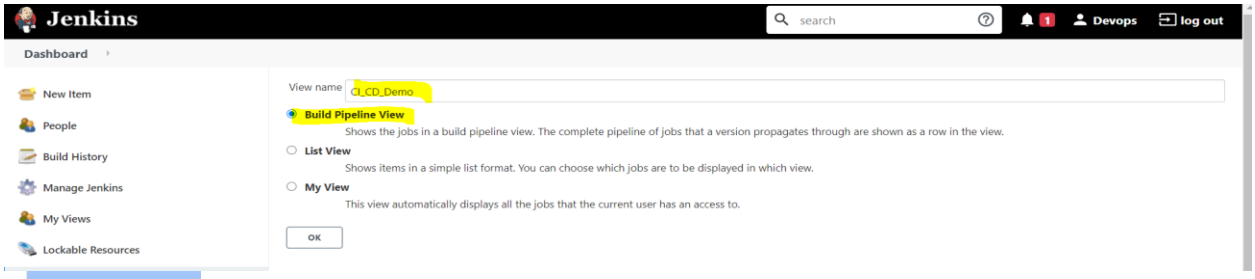
Step 22: Go to the manage Jenkins and then Manage Plugins, click on available, search for Build Pipeline. Click on install without restart.



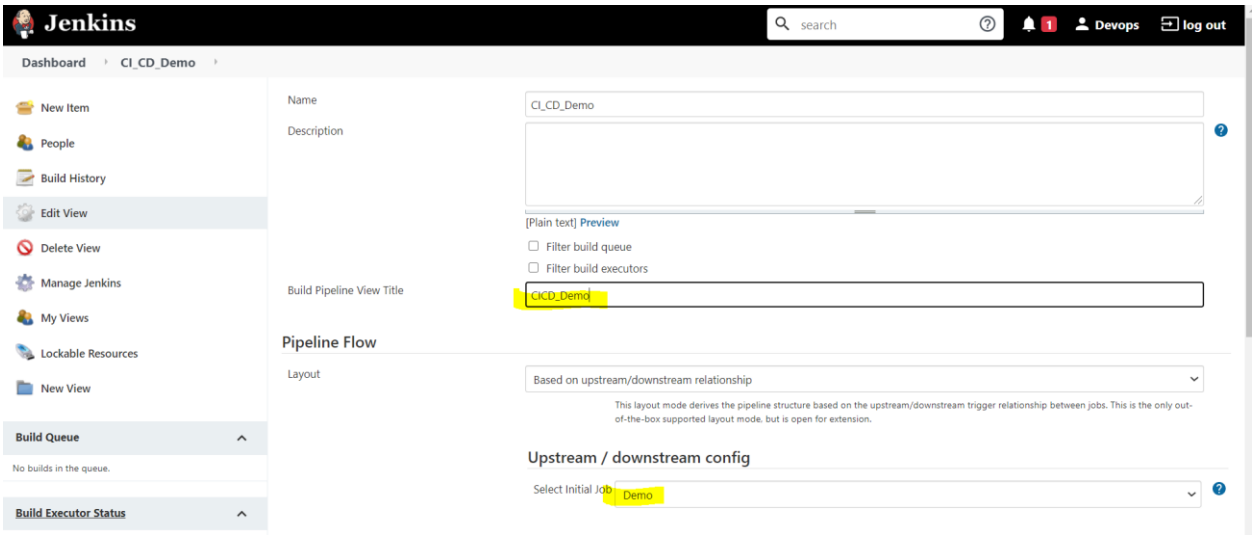
Step 23: Go to the jenkins dashboard. Click on the +.



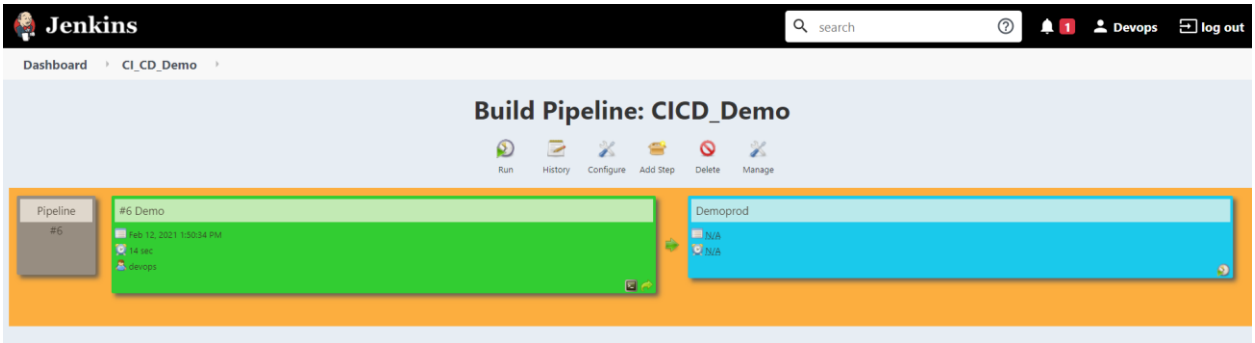
Step 24: Enter view name and click ok.



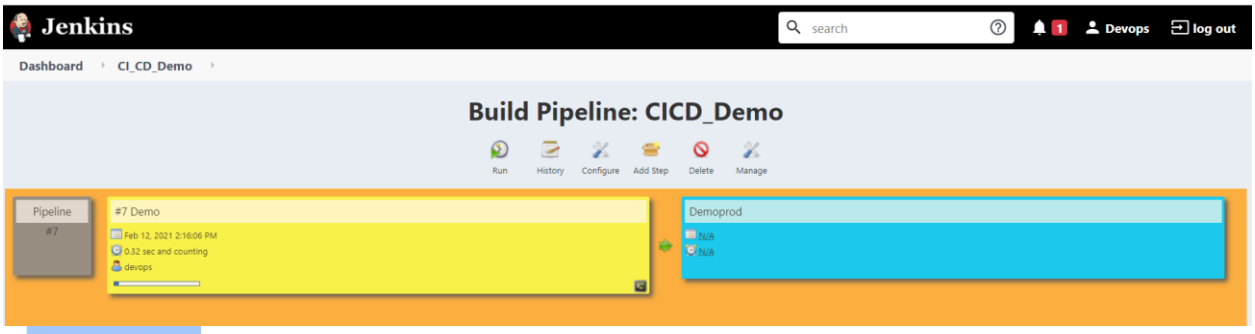
Step 25: There add the Build Pipeline View Title, then Select initial job as Demo.

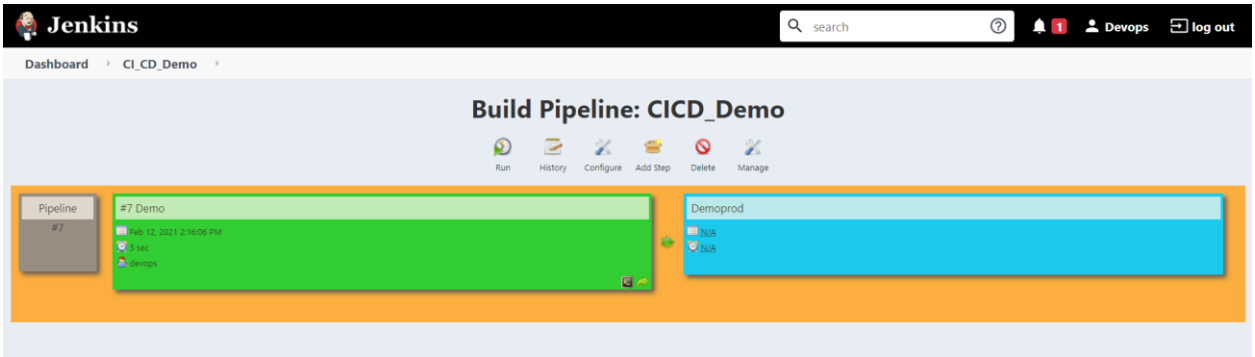


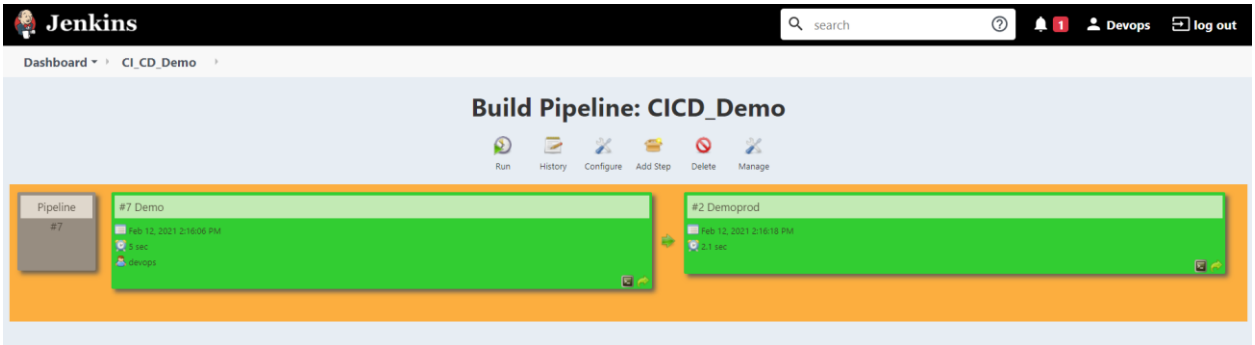
Click on ok. You should see the Pipeline Page like this.



Step 26: Click on Run. Then Refresh the Page once.

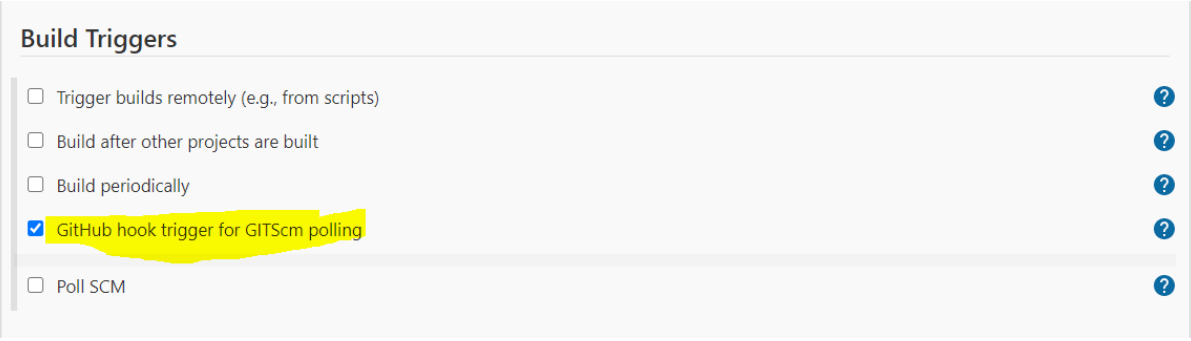






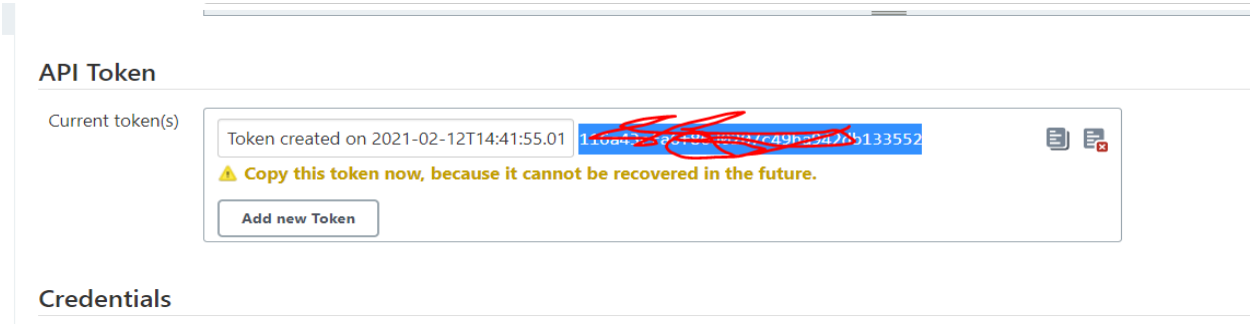
Now we will commit on GitHub, which should trigger our Jenkins Job.

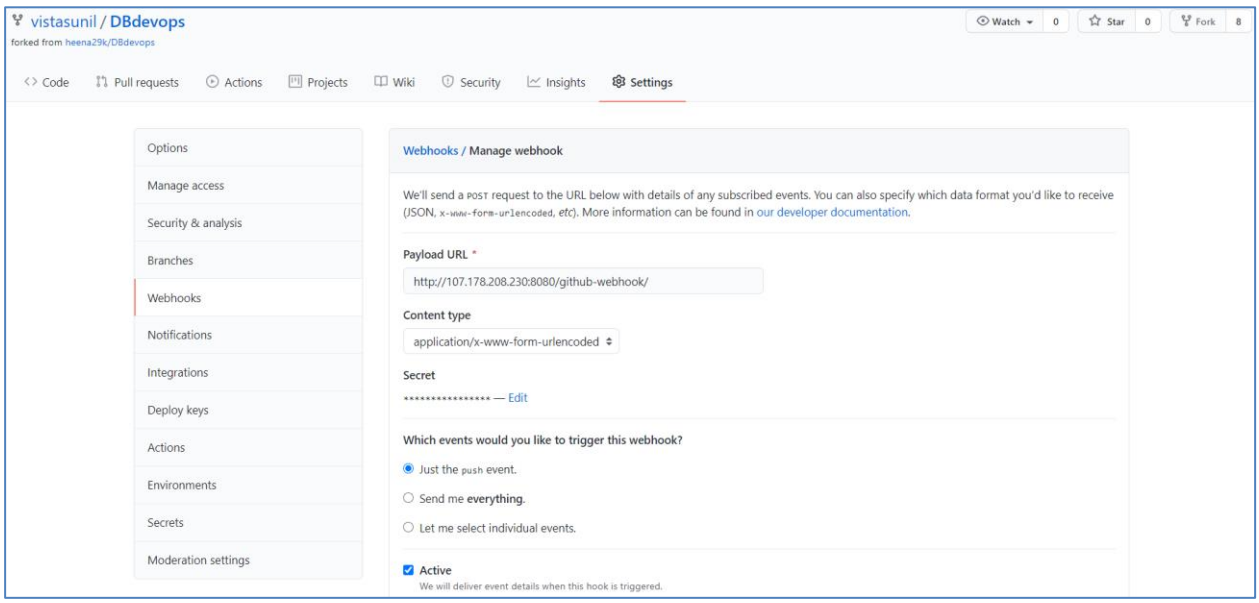
Step 27: Go to the Jenkins Dashboard. Click on Demo and then Configure. Check the ***GitHub hook trigger for GITScm polling*** option.



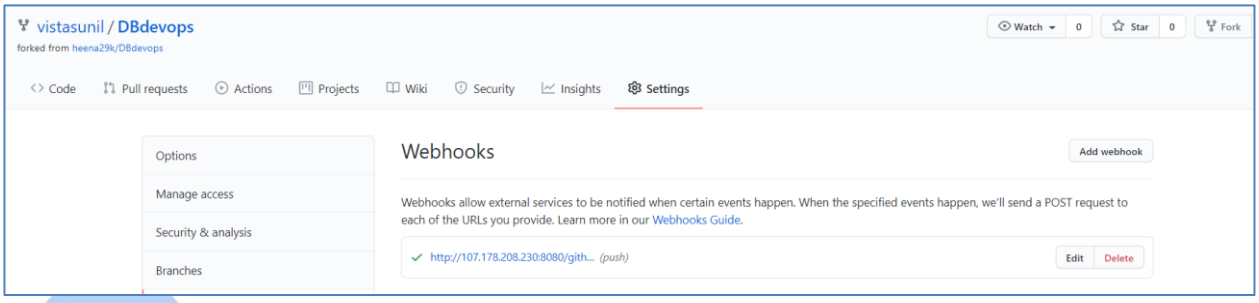
Step 28: Now configure GitHub Webhook. Go to settings, then click on Webhooks, then add webhooks. There insert the Jenkins Server Address as shown.

$ JenkinsServer Address/github-webhook/





Click on Add webhook. You should see this.



Step 29: Go to the mater terminal to trigger a built.

```
$ git clone <git repository URL>
```

```
ubuntu@instance-1:~$ git clone https://github.com/vistasunil/DBdevops.git
Cloning into 'DBdevops'...
remote: Enumerating objects: 87, done.
remote: Total 87 (delta 0), reused 0 (delta 0), pack-reused 87
Receiving objects: 100% (87/87), 11.46 MiB | 26.79 MiB/s, done.
Resolving deltas: 100% (15/15), done.
```

Step 30: Now we will try to modify the website from the master terminal. Go to the master terminal and then go to the devopsIQ directory where you can find index.html file. Open it for modification

```
$ vim index.html
```

```
ubuntu@instance-1:~$ cd DBdevops/
ubuntu@instance-1:~/DBdevops$ cd devopsIQ/
ubuntu@instance-1:~/DBdevops/devopsIQ$ vim index.html
```

Step 31: Make the modification in the **title** and **body** of that html file as shown below.

```
<html>
<title>Jenkins Updated Website</title>
<body background="images/2.jpeg">
<h1>This is webhook triggered website!!<h1>
</body>
</html>
```

Step 32: Finally, perform git add and git commit.

```
$ git add

$ git commit -m "new commit"
```

```
ubuntu@instance-1:~/DBdevops$ git add .
ubuntu@instance-1:~/DBdevops$ git commit -m "Webhook commit"
[master bc55baa] Webhook commit
 1 file changed, 2 insertions(+), 1 deletion(-)
ubuntu@instance-1:~/DBdevops$
```

Step 33: Perform git push.

```
$ git push origin master
```

```
ubuntu@instance-1:~/DBdevops$ git push origin master
```

Step 34: Go to the browser. Refresh it. And you can see the background image got changed.

Congratulations! You have successfully completed the hands on.