Creating a demo Java application and Push it to the Dockerhub using Github and Jenkins

To start, let's create a new `Maven` project with `any Java IDE`.

In `src/main/java` path, let's create a class called `Main`. It will contain the code for our simple console application.

In the `Main` class, write a small program to check if an input is even or odd

Here is the final code for the `Main` class:

```
    public class Main {
        public static void main(String[] args) {
            System.out.println(checkIfInputIsAnEvenNumber(122));
// Testing in the main method
        }

        public static boolean checkIfInputIsAnEvenNumber(int
number){
            return number % 2 == 0;
        }
    }
```

If you run the above code, the output will be `true`.

In the code snippet above, we are creating a `static` method so that we can write unit tests. We want to see how Jenkins will automate testing.

- If the input `int` is even or odd, the method will return true or false respectively.

Now, let's write a unit test to test our `checkIfInputIsAnEvenNumber` method. First, in the `src/test/java` path, let's create a test class `TestMain` to test the method.

```
    import org.junit.jupiter.api.Test;
    import static org.junit.jupiter.api.Assertions.assertTrue;

    public class TestMain {

        @Test
        public void testInputIsEven(){
            assertTrue(Main.checkIfInputIsAnEvenNumber(23)); //
Assertion
        }
    }
```

You can run the test above in your IDE.

Alternatively, we can use a `Maven` command to run all our unit tests in the command line, as shown below:

```
    $ mvn test
```

When we use `23` as our input data, the test fails:

```
-------------------------------------------------------
 T E S T S
-------------------------------------------------------
Running TestMain
Tests run: 1, Failures: 1, Errors: 0, Skipped: 0, Time elapsed: 0.008 sec <<< FAILURE!
TestMain.testInputIsEven()  Time elapsed: 0.006 sec  <<< FAILURE!
org.opentest4j.AssertionFailedError: expected: <true> but was: <false>
        at org.junit.jupiter.api.AssertionUtils.fail(AssertionUtils.java:38)
        at org.junit.jupiter.api.AssertTrue.assertTrue(AssertTrue.java:40)
        at org.junit.jupiter.api.AssertTrue.assertTrue(AssertTrue.java:35)
        at org.junit.jupiter.api.Assertions.assertTrue(Assertions.java:137)
        at TestMain.testInputIsEven(TestMain.java:10)


Results :

Failed tests:   TestMain.testInputIsEven(): expected: <true> but was: <false>

Tests run: 1, Failures: 1, Errors: 0, Skipped: 0

[INFO] ------------------------------------------------------------------------
[INFO] BUILD FAILURE
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  2.638 s
[INFO] Finished at: 2021-05-11T13:15:06+01:00
[INFO] ------------------------------------------------------------------------
[ERROR] Failed to execute goal org.apache.maven.plugins:maven-surefire-plugin:2.12.4:test (default-test) on project Java-jenkins-
in-docker: There are test failures.
[ERROR]
[ERROR] Please refer to /home/odazie/Desktop/Java-jenkins-in-docker/target/surefire-reports for the individual test results.
[ERROR] -> [Help 1]
[ERROR]
```

Let's change the test input data to `22` and run the `Maven` command:

```
    assertTrue(Main.checkIfInputIsAnEvenNumber(22)); //
Assertion
```

```
-------------------------------------------------------
 T E S T S
-------------------------------------------------------
Running TestMain
Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.003 sec

Results :

Tests run: 1, Failures: 0, Errors: 0, Skipped: 0

[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  2.852 s
[INFO] Finished at: 2021-05-11T13:24:36+01:00
[INFO] ------------------------------------------------------------------------
```

The test passes. In a few steps, we will see how Jenkins can automate this process.

Hosting the demo application on GitHub

We are going to push our `Java` application code to `GitHub`. When we make any change (commit) to our application on GitHub, `Jenkins` will trigger a `post-commit` build process remotely.

- open up the terminal.
- Navigate to the directory of our demo application and run:

```
$ git init
```

- We will add all our application files using the command below:

```
$ git add .
```

- We can now commit our files:

```
$ git commit -m "Added java demo application files"
```

- Copy the created repository clone `URL` on GitHub.
- Then add the `remote URL` where we will push the local repository:

```
$ git remote add origin  <REMOTE_URL>
```

Verify the remote URL and push the changes of our local repository to Github:

```
    $ git remote -v
    $ git push origin main
```

Setting up Jenkins in Docker

Docker-in-Docker

As we set up Jenkins in Docker, we need to remember the goal of our setup: `dockerizing of an application`. For this to happen, we need to execute `docker commands`, as well as access other containers.

To achieve this functionality, we need a `Dockerfile` that configures a `Jenkins environment`. It will be capable of running Docker commands and managing docker containers.

Copy a `Dockerfile` in any directory and go to the directory from powershell

Run below command to create `jenkins-docker image` using the above `Dockerfile` :

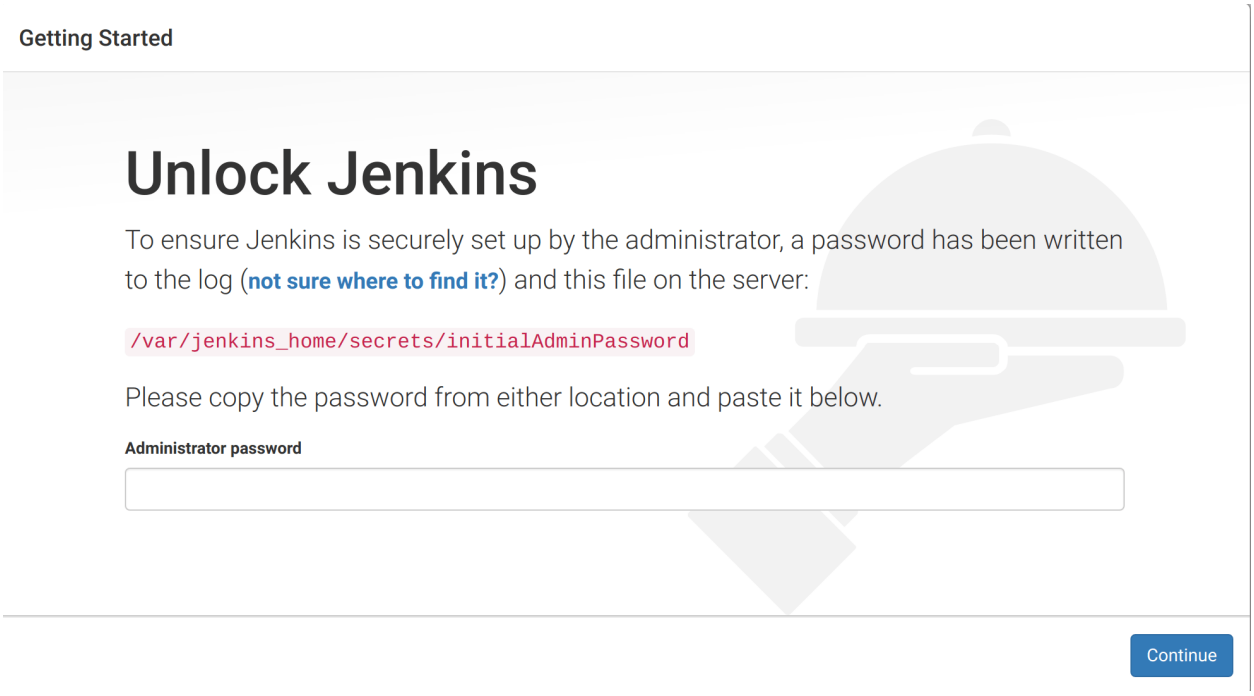
```
    $ docker image build -t jenkins-docker .
```

To run our `Jenkins-docker container` in the command line, we use the code below:

```
    $ docker run -it -p 8080:8080 -p 50000:50000 -v
jenkins_home:/var/jenkins_home -v
/var/run/docker.sock:/var/run/docker.sock --restart unless-
stopped jenkins-docker
```

- The above command runs our pre-built `jenkins-docker image`. The `-p` command publishes the container's ports `8080` and `50000` to the host machine.
- We should run Docker commands in our Jenkins container. However, there is only one `Docker daemon` running in our machine at a time. So what we need to do is to bind mount our `container` to our `host machine daemon` while we run the container using this argument: `-v /var/run/docker.sock:/var/run/docker.sock`
- `-v jenkins_home:/var/jenkins_home` argument creates an explicit volume on our host machine. Why? During our initial setup, we will configure Jenkins and download plugins. When we stop/restart/delete our container, we need to have our initial setup configuration intact. We wouldn't want to be doing those set ups every time we stop/restart/delete our container.
- `--restart unless-stopped` ensures that the container always restarts unless stopped using the `docker stop <container_name/container_id>` command.

After running the above command, visit localhost `localhost:8080` to set up Jenkins.



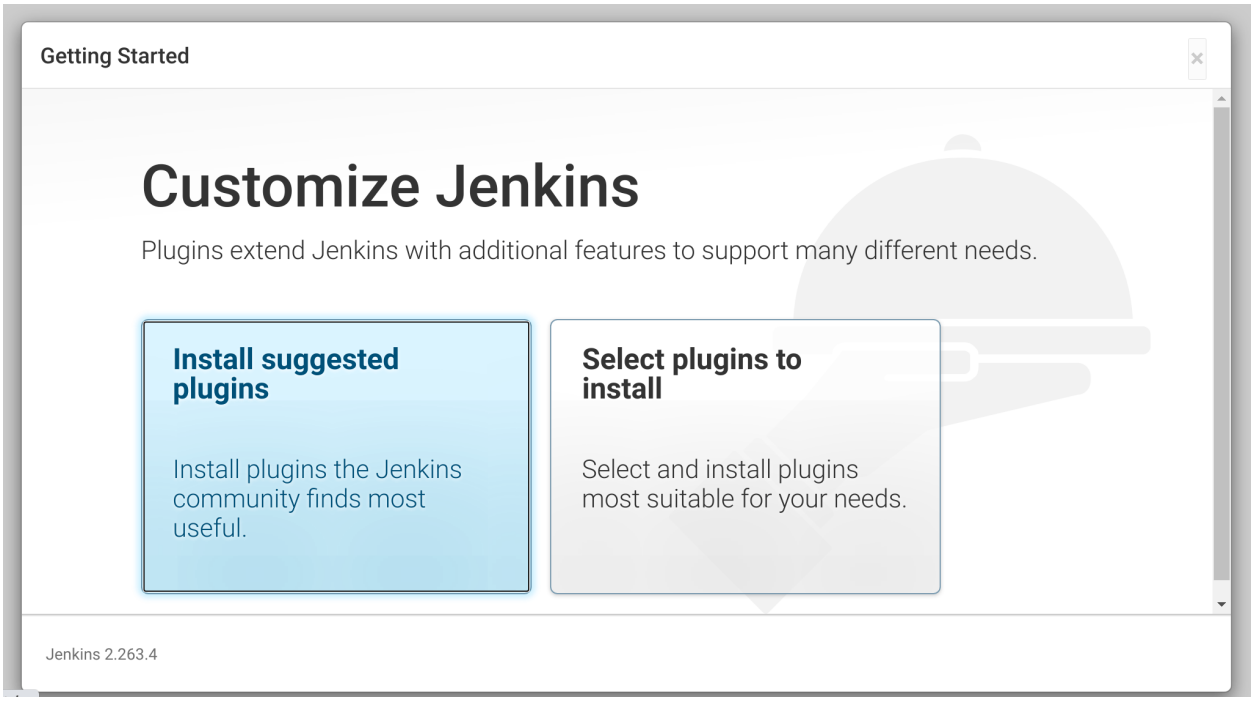
We can get the `admin` password from what command `returns`.

See what is looks like:

```
*************************************************************
*************************************************************
*************************************************************

Jenkins initial setup is required. An admin user has been created and a password generated.
Please use the following password to proceed to installation:

67cb970331e34d8eae37cd07e0a77267

This may also be found at: /var/jenkins_home/secrets/initialAdminPassword

*************************************************************
*************************************************************
*************************************************************
```

Next, we select `Install suggested plugins`.

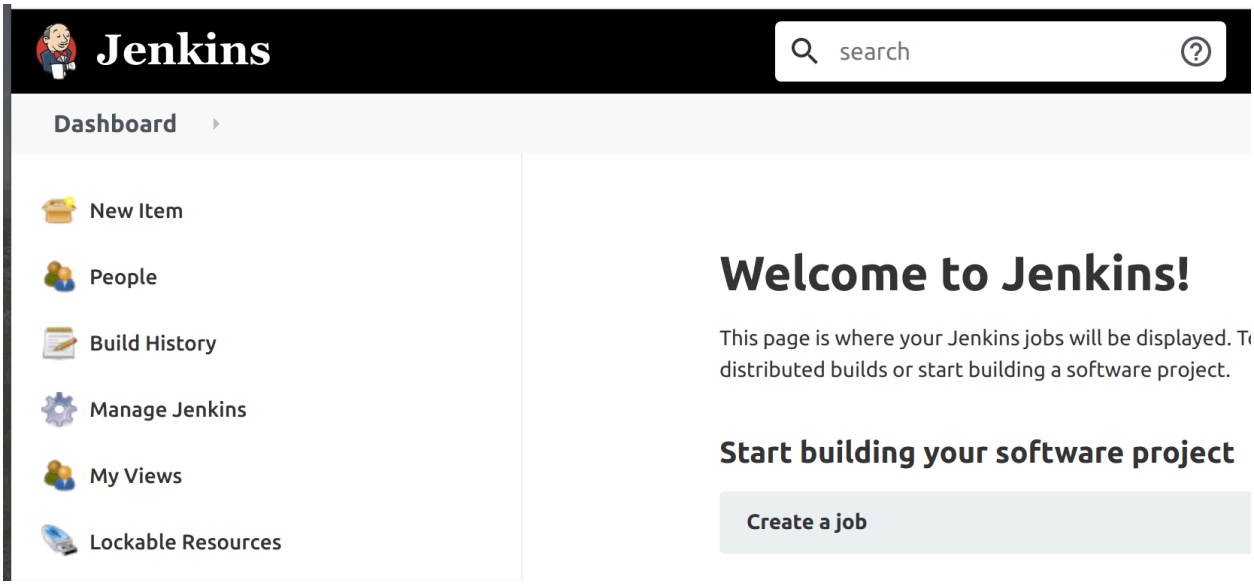
Jenkins will automatically download essential plugins:



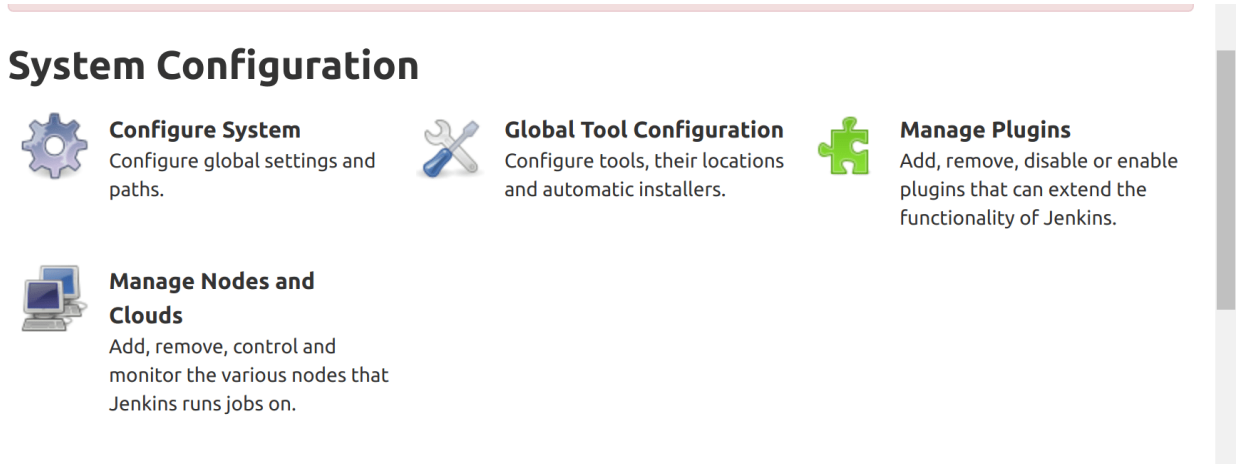
Jenkins global configurations

First, we will configure the `JDK`, `Maven`, and `Git` on our Jenkins console to enable Jenkins to clone our repository and build our application.

In our Jenkins console, go to `Manage Jenkins`.



Under `System Configurations`, click on `Global Tool Configuration`.



JDK config

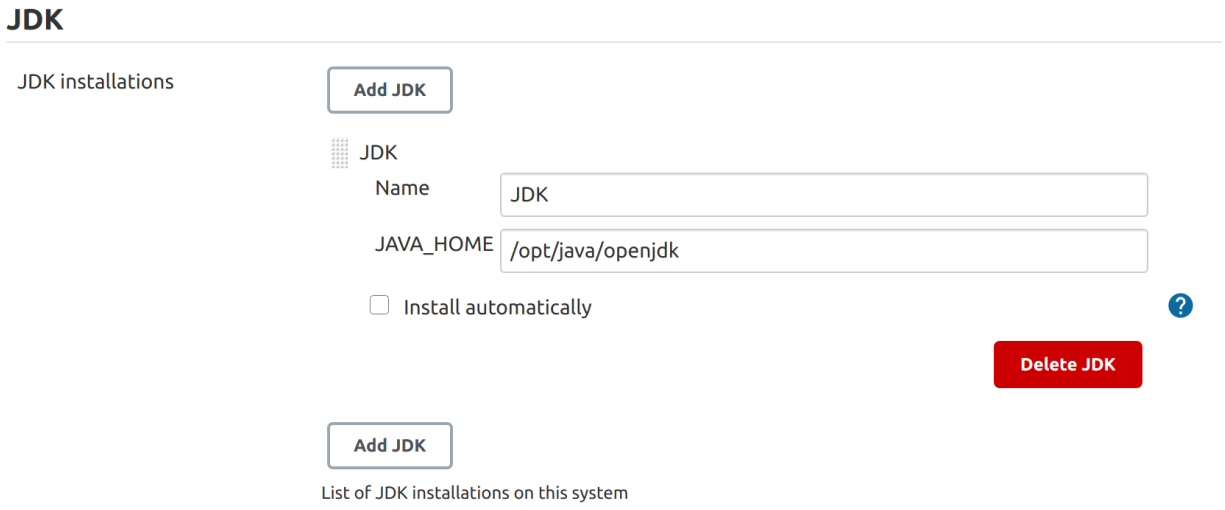
Our Jenkins container comes with an `OpenJDK`. To find it, we need to enter into the container's `bash shell` to get the `JAVA_HOME` path.

To get the `bash shell` of the container run below command in another powershell window, don't close the earlier powershell windo because Jenkins is running

```
$ docker exec -it <container_name/container_id> /bin/bash
```

Then if we're using either `macOS` or `Linux`, we run:

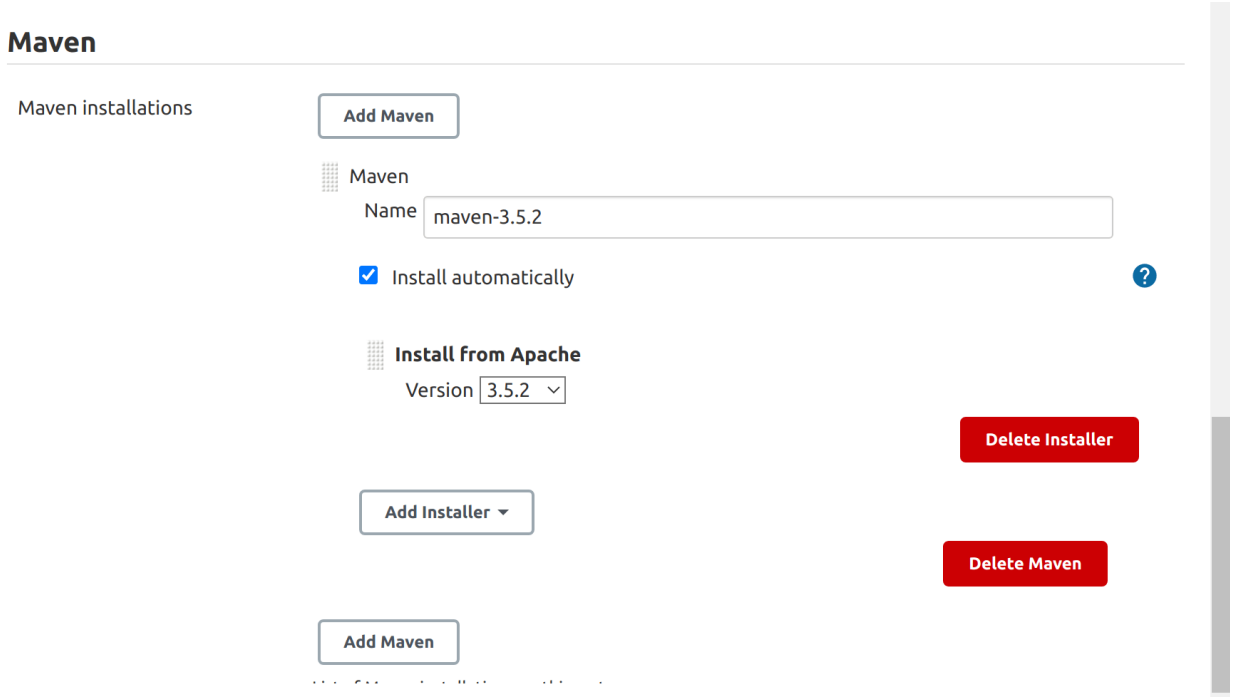
```
echo $JAVA_HOME
```



Maven config

We can direct `Jenkins` to download `Maven` from `Apache servers` instead of the `Maven directory` on our system.

Follow the guideline shown in the image below:



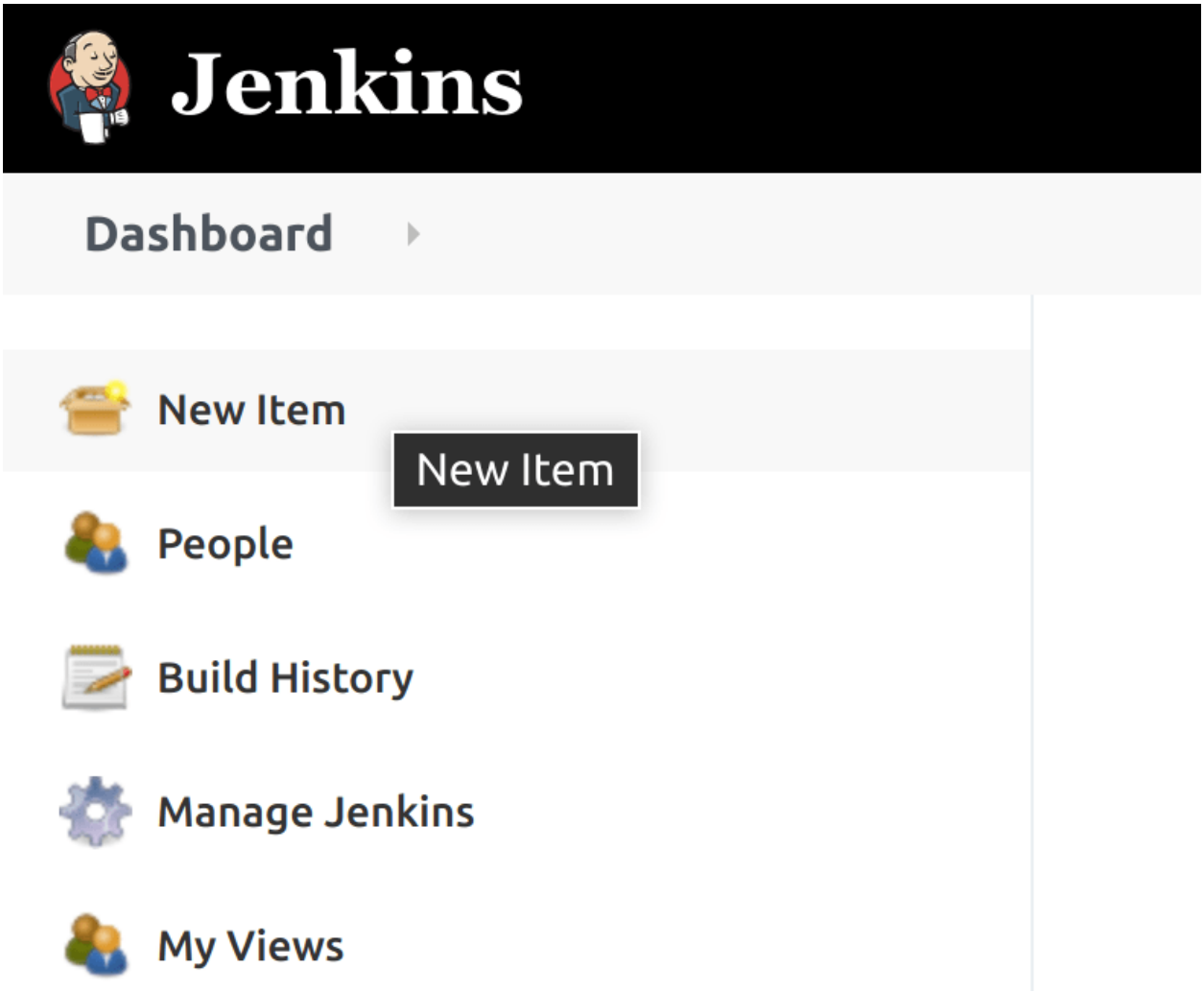
Make sure to save the configurations before exiting the page.

Putting it all together

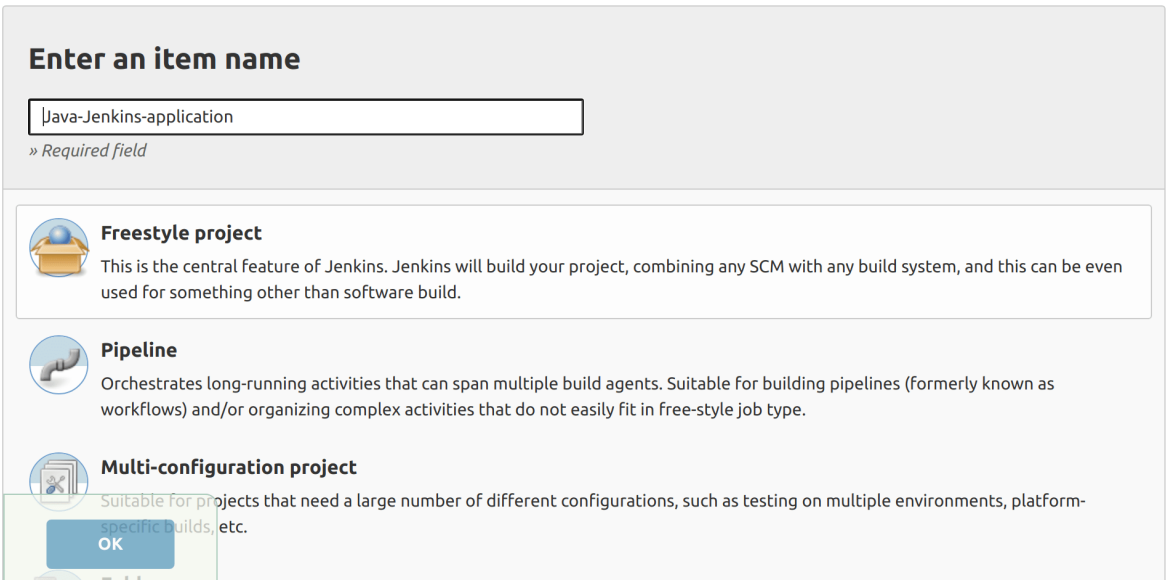
So far, we've built a simple demo Java console application, hosted our application code on Github, and set up Jenkins in Docker.

Now let's put it all together by using Jenkins to automate the building, testing, dockerizing, and deploying our application Docker image to Docker Hub after every commit made to our application repository hosted on GitHub.

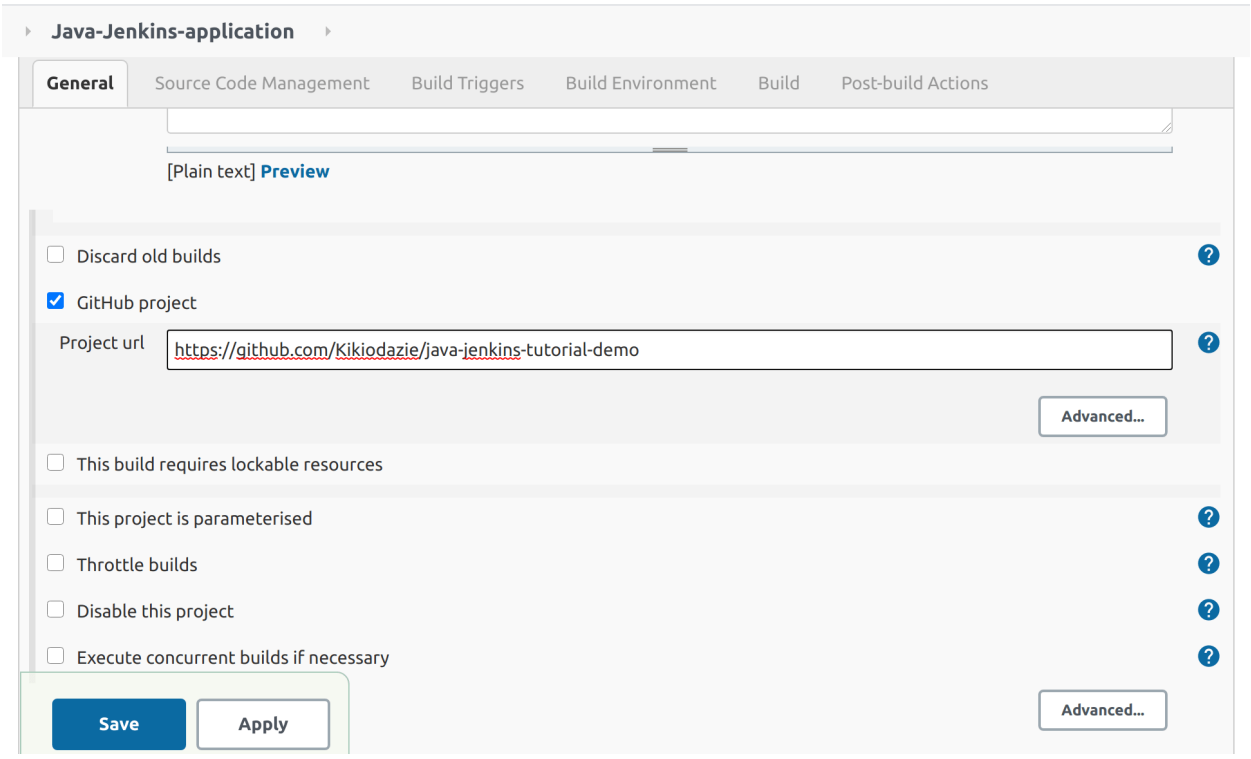
To start, let's create a new Jenkins item:



Then select `Freestyle project`:

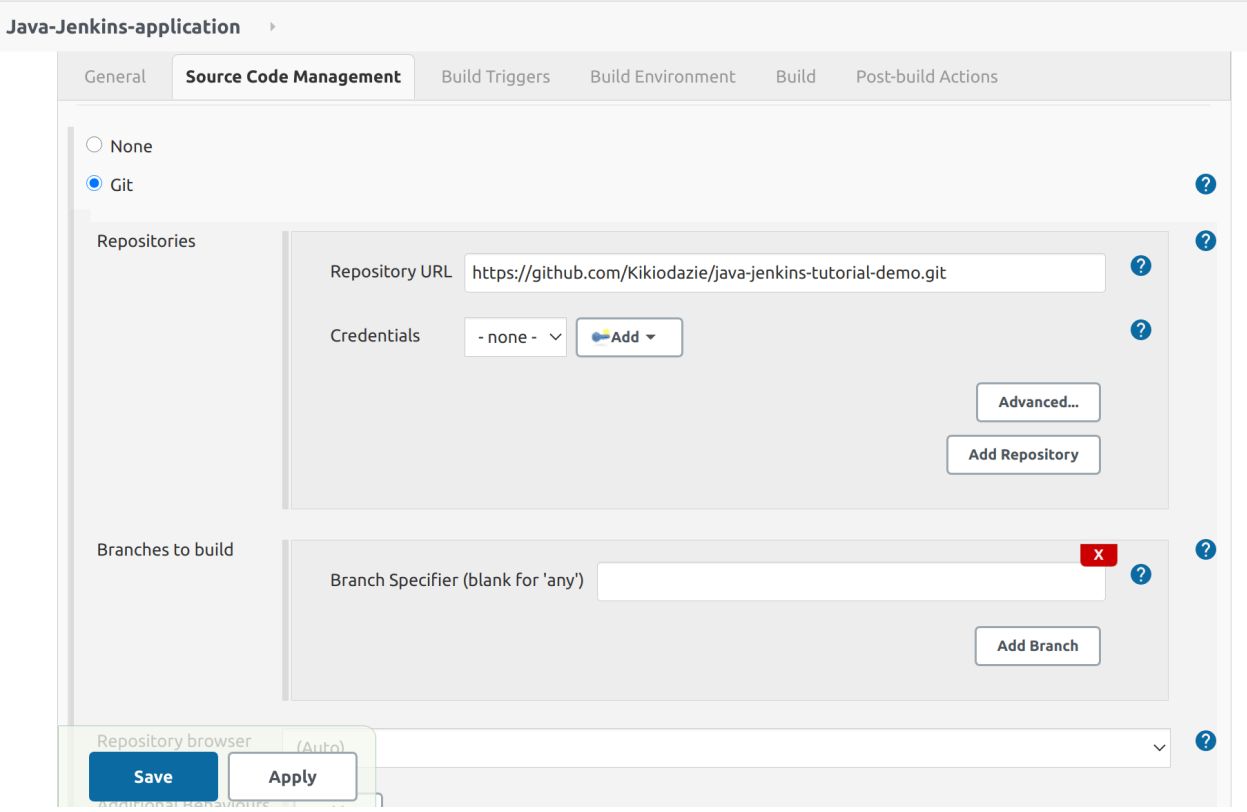


To configure our `Freestyle project`, select GitHub project and add the project URL:



For our `Source Code Management` (or **SCM** for short), select `Git`, add the `remote Git repository URL` of the project and leave the `branch`

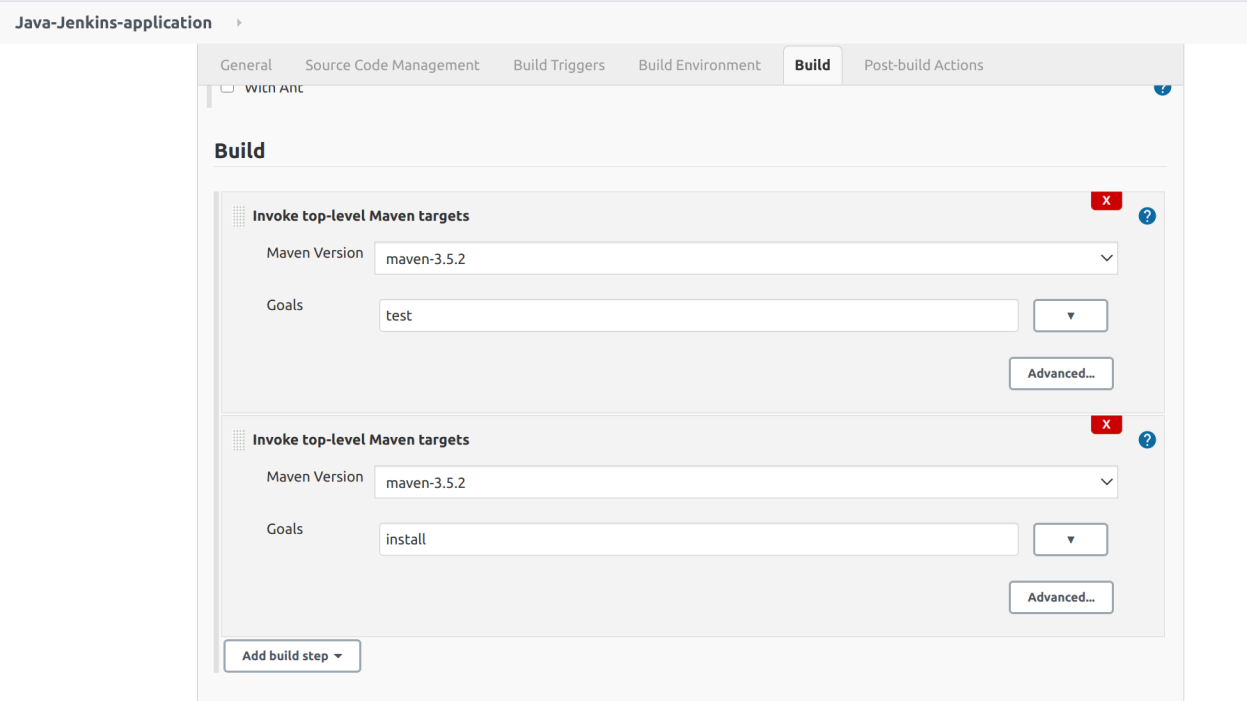
`field` empty so any commit made to any branch triggers our entire `Jenkins` process:



For `Build Triggers`, select `Poll SCM`, which checks whether we made changes (i.e. new commits) and then rebuilds our project. `Poll SCM` periodically checks the `SCM` even if nothing has changed in the repository.

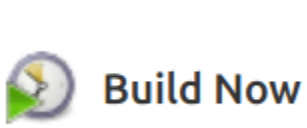
Next, we skip the `Build Environment` tab. In the `Build` window, we will add two `Invoke top-level Maven targets` steps.

Finally, we click on `apply` and save our `Freestyle project` configuration.

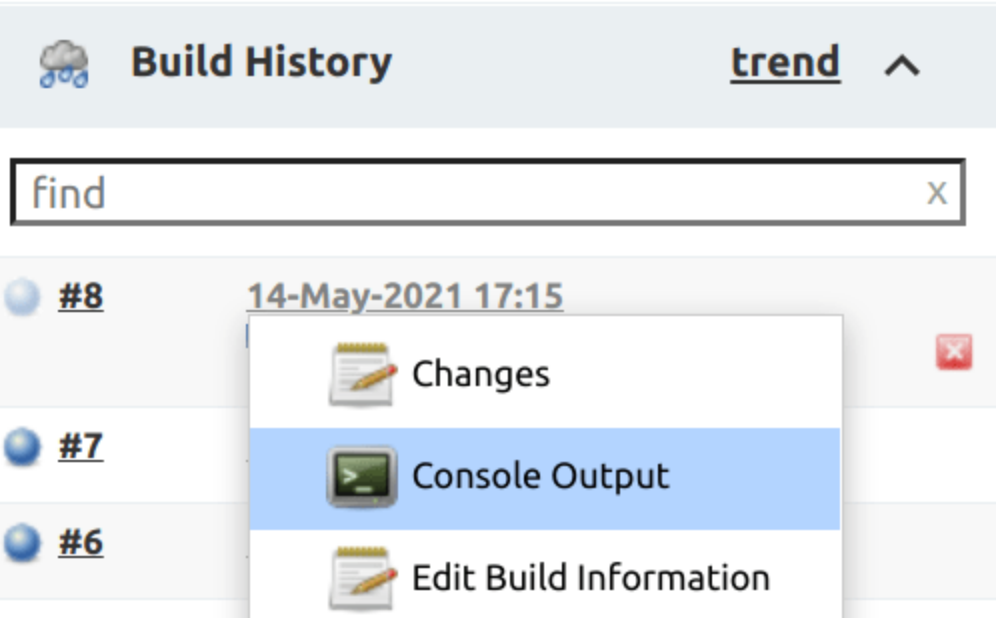


The above build steps run `$ mvn test` and `$ mvn install` commands automatically. If you recall our previous steps, we manually ran the test command for our unit test.

For testing purposes, let's build our project to see if the current configuration works. Click on `Build Now`.



We can view the console output in the `Build History`:



Our console output should look a lot like the image below:

```
-------------------------------------------------------
 T E S T S
-------------------------------------------------------
Running TestMain
Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.005 sec

Results :

Tests run: 1, Failures: 0, Errors: 0, Skipped: 0

[INFO]
[INFO] --- maven-jar-plugin:2.4:jar (default-jar) @ Java-jenkins-in-docker ---
[INFO] Building jar: /var/jenkins_home/workspace/Java-Jenkins-application/target/Java-jenkins-in-docker-1.0-SNAPSHOT.jar
[INFO]
[INFO] --- maven-install-plugin:2.4:install (default-install) @ Java-jenkins-in-docker ---
[INFO] Installing /var/jenkins_home/workspace/Java-Jenkins-application/target/Java-jenkins-in-docker-1.0-SNAPSHOT.jar to
/root/.m2/repository/org/example/Java-jenkins-in-docker/1.0-SNAPSHOT/Java-jenkins-in-docker-1.0-SNAPSHOT.jar
[INFO] Installing /var/jenkins_home/workspace/Java-Jenkins-application/pom.xml to /root/.m2/repository/org/example/Java-jenkins-in-docker/1.0-
SNAPSHOT/Java-jenkins-in-docker-1.0-SNAPSHOT.pom
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time: 2.481 s
[INFO] Finished at: 2021-05-14T17:15:22Z
[INFO] Final Memory: 12M/216M
[INFO] ------------------------------------------------------------------------
Finished: SUCCESS
```

If we commit changes, we don't need to manually click `Build Now`. Jenkins will automatically build our Freestyle project.

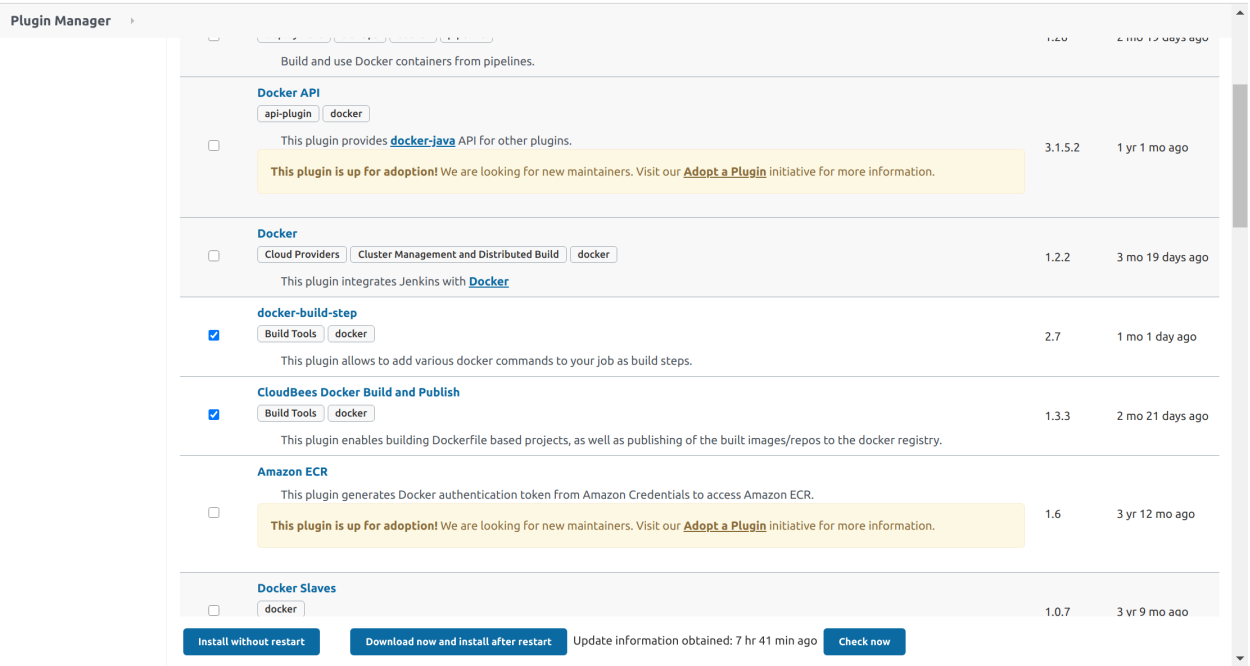
Building and deploying our Docker image to Docker Hub

We are almost there. What's left is for us to configure Jenkins to build the Docker image of our Java application and deploy that image to Docker Hub.

To achieve this, we need a few Jenkins plugins installed.

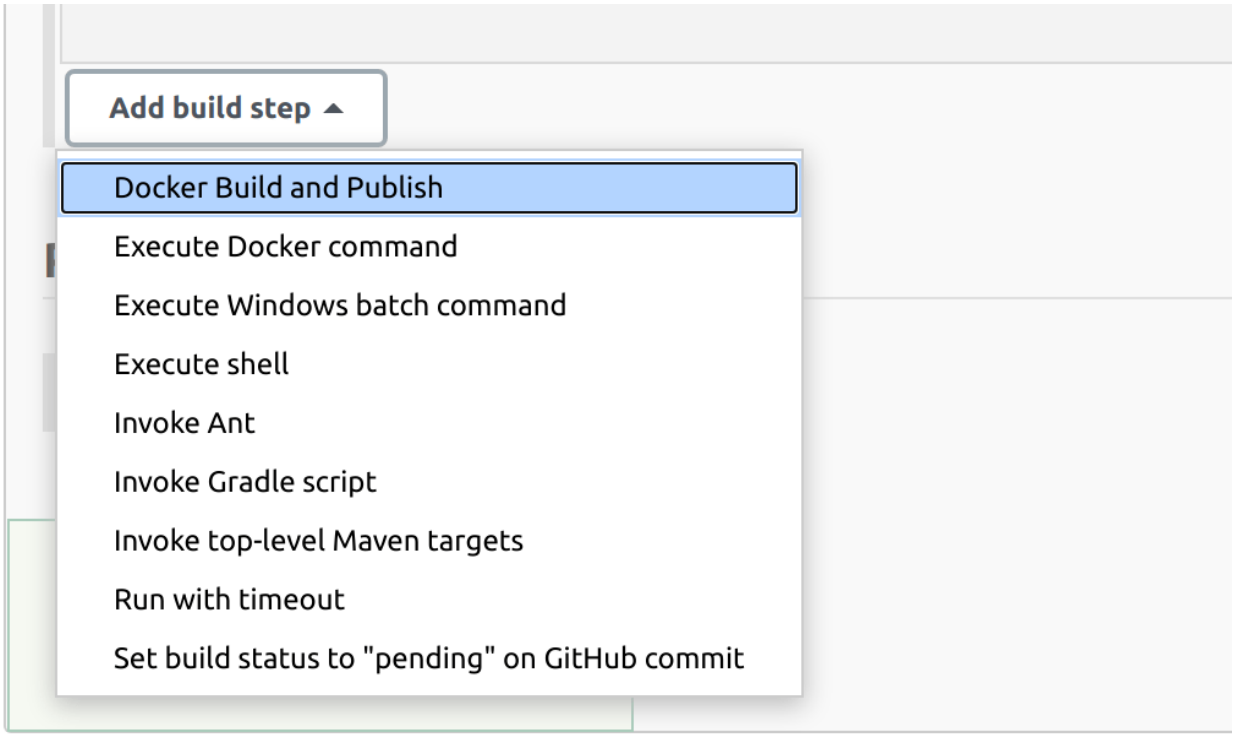
In `Manage Jenkins`, select `Manage Plugins` under `System Configurations`, `search` and `install` the following plugins:

- docker-build-step
- CloudBees Docker Build and Publish



To check if the plugins have been installed, let's go back to our Freestyle project configuration and in the `Build` tab, click on `Add build step`.

We will see the `Docker Build and Publish` option:



To build a Docker image, we need a Dockerfile to notify docker which base image to build our image from and other Java-related configurations. We also need to generate a JAR (Java ARchive) file.

In the `build profile`, navigate to the `pom.xml` file and add a finalName.

This `finalname` will be our `JAR name`:

```
<build>
  <finalName>java-jenkins-docker</finalName>
</build>
```

Now let's create our `Dockerfile` into the docker container running in another powershell window

Go to the Jenkins directory path

Open the `terminal` and navigate to our Java application directory:

```
$ touch Dockerfile
```

And in our `Dockerfile`:

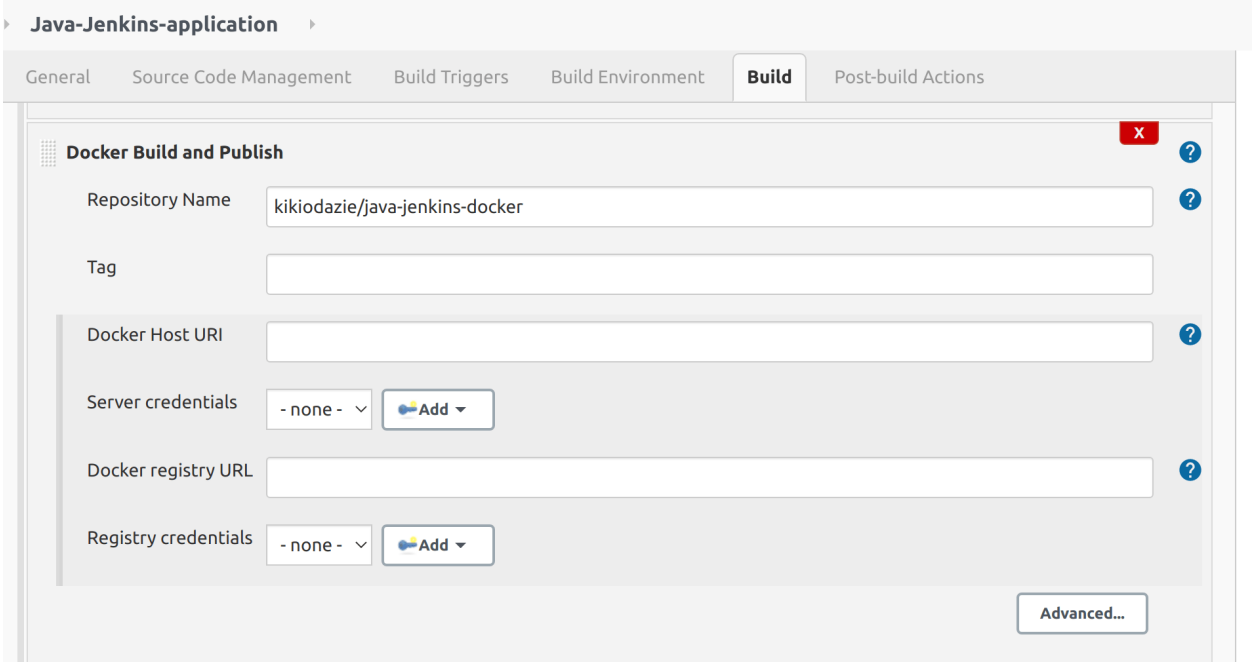
```
FROM openjdk:8
ADD target/java-jenkins-docker.jar java-jenkins-docker.jar
ENTRYPOINT ["java", "-jar","java-jenkins-docker.jar"]
EXPOSE 8080
```

Add the new files and then commit the changes to the GitHub repository. This will trigger a Jenkins post-commit build process as we configured.

Now we can add our `build steps` to build and deploy our Java application's Docker image. For this, we will need a `Docker Hub account`. You can create one here.

Then, in the `build step` set:

- Repository name: `Docker_id/jar_name` example `kikiodazie/java-jenkins-docker`
- For this demo, we will leave the rest of the fields empty then `Apply` and `save`.



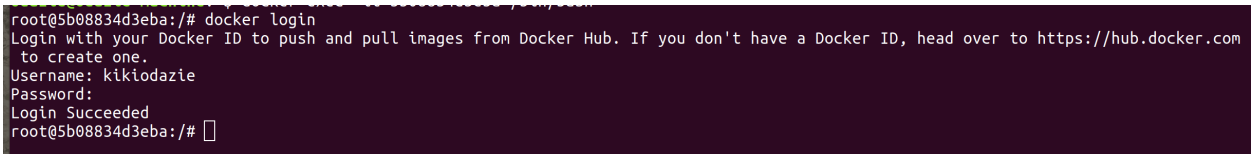
To give Jenkins access, we need to login to our `Docker Hub account` inside our `Jenkins container` through the command line, as shown below:

```
$ docker exec -it <container_name/container_id> /bin/bash
```

Then inside the container, run the `Docker login` command:

```
$ docker login
```

To complete this process, input your login credentials:



Go back to your project and click `Build Now`, then navigate to the console output. The output should look, as shown in the image below.

This means that our image has been successfully built and pushed to Docker Hub:

Java-Jenkins-application ▸ **#11 kikiodazie/java-jenkins-docker**

```
Step 2/4 : ADD target/java-jenkins-docker.jar java-jenkins-docker.jar
 ---> d523f79b3209
Step 3/4 : ENTRYPOINT ["java", "-jar","java-jenkins-docker.jar"]
 ---> Running in 1fbfcc038069
Removing intermediate container 1fbfcc038069
 ---> 34b71e8f60ba
Step 4/4 : EXPOSE 8080
 ---> Running in 21d1fdd9c67d
Removing intermediate container 21d1fdd9c67d
 ---> 2c5e739a89f8
Successfully built 2c5e739a89f8
Successfully tagged kikiodazie/java-jenkins-docker:latest
[Java-Jenkins-application] $ docker inspect 2c5e739a89f8
[Java-Jenkins-application] $ docker push kikiodazie/java-jenkins-docker
The push refers to repository [docker.io/kikiodazie/java-jenkins-docker]
5f62f322bdd4: Preparing
ceaf9e1ebef5: Preparing
9b9b7f3d56a0: Preparing
f1b5933fe4b5: Preparing
f1b5933fe4b5: Layer already exists
9b9b7f3d56a0: Layer already exists
ceaf9e1ebef5: Layer already exists
5f62f322bdd4: Pushed
latest: digest: sha256:9acac06d0134daecc9f35afe1530a0554d7b5bd7eaf609ff96681fe0d94ca922 size: 1155
Finished: SUCCESS
```