
Jenkins From Scratch



By: Eng. Mohamed ElEmam

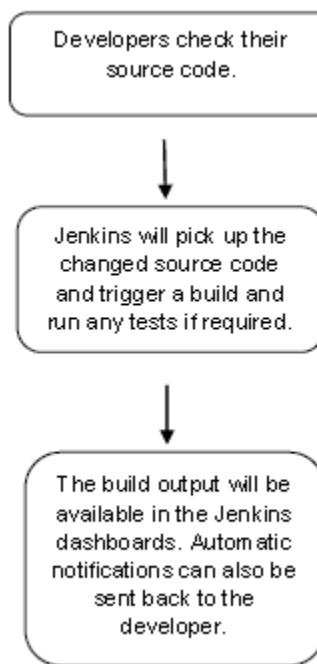
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Jenkins

Jenkins is a powerful application that allows continuous integration and continuous delivery of projects, regardless of the platform you are working on. It is a free source that can handle any kind of build or continuous integration. You can integrate Jenkins with a number of testing and deployment technologies. In this tutorial, we would explain how you can use Jenkins to build and test your software projects continuously.

Why Jenkins?

Jenkins is a software that allows **continuous integration**. Jenkins will be installed on a server where the central build will take place. The following flowchart demonstrates a very simple workflow of how Jenkins works.



Along with Jenkins, sometimes, one might also see the association of **Hudson**. Hudson is a very popular open-source Java-based continuous integration tool developed by Sun Microsystems which was later acquired by Oracle. After the acquisition of Sun by Oracle, a fork was created from the Hudson source code, which brought about the introduction of Jenkins.

What is Continuous Integration?

Continuous Integration is a development practice that requires developers to integrate code into a shared repository at regular intervals. This concept was meant to remove the problem of finding later occurrence of issues in the build lifecycle. Continuous integration requires the developers to have frequent builds. The common practice is that whenever a code commit occurs, a build should be triggered.

System Requirements

JDK	JDK 1.5 or above
Memory	2 GB RAM (recommended)
Disk Space	No minimum requirement. Note that since all builds will be stored on the Jenkins machines, it has to be ensured that sufficient disk space is available for build storage.
Operating System Version	Jenkins can be installed on Windows, Ubuntu/Debian, Red Hat/Fedora/CentOS, Mac OS X, openSUSE, FreeBSD, OpenBSD, Gentoo or Docker or AWS
Java Container	The WAR file can be run in any container that supports Servlet 2.4/JSP 2.0 or later.(An example is Tomcat 5).

Jenkins - Installation

Download Jenkins

The official website for Jenkins is [Jenkins](#). If you click the given link, you can get the home page of the Jenkins official website as shown below.



By default, the latest release and the Long-Term support release will be available for download. The past releases are also available for download. Click the Long-Term Support Release tab in the download section.



Click the link "Older but stable version" to download the Jenkins war file.

Starting Jenkins

Open the command prompt. From the command prompt, browse to the directory where the jenkins.war file is present. Run the following command

```
D:\>Java -jar Jenkins.war
```

After the command is run, various tasks will run, one of which is the extraction of the war file which is done by an embedded webserver called winstone.

```
D:\>Java -jar Jenkins.war
```

Running from: D:\jenkins.war
Webroot: \$user.home/ jenkins
Sep 29, 2015 4:10:46 PM winstone.Logger logInternal
INFO: Beginning extraction from war file

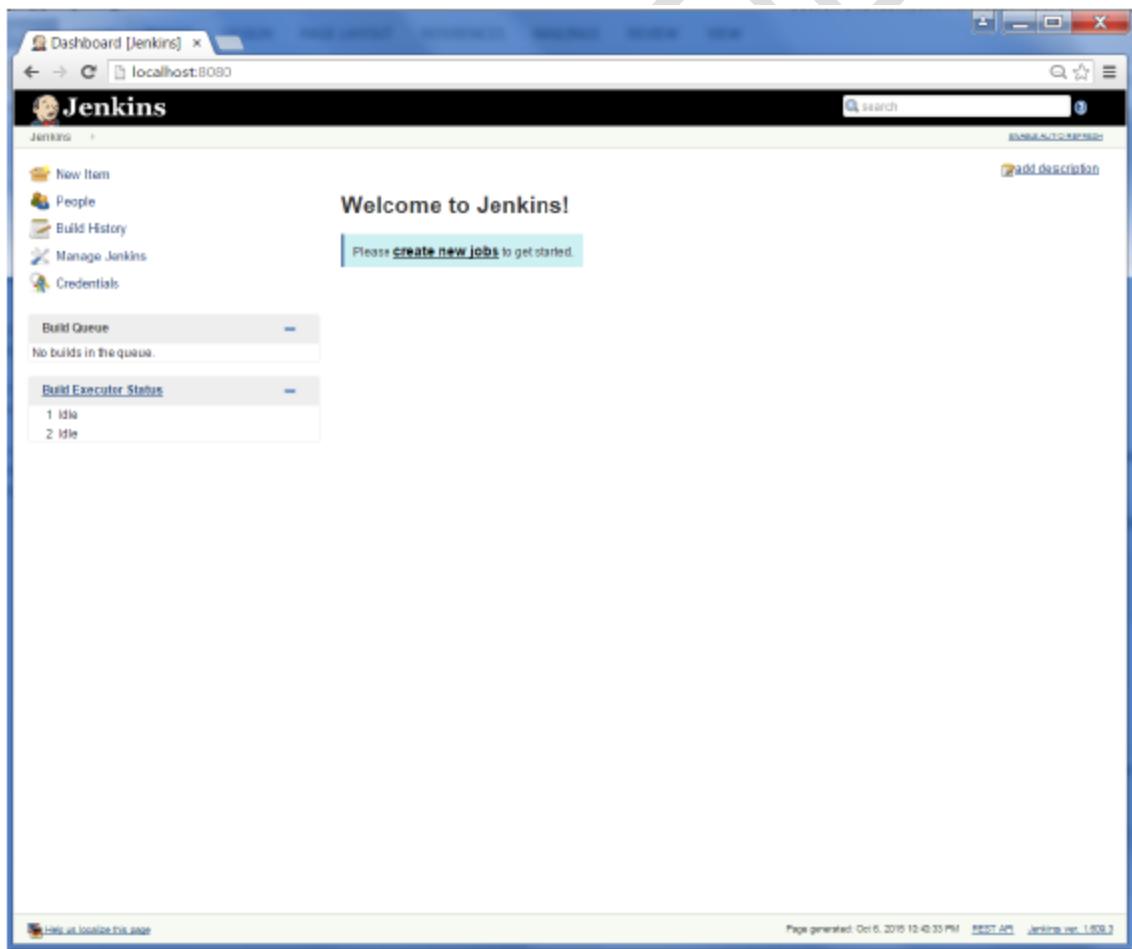
Once the processing is complete without major errors, the following line will come in the output of the command prompt.

INFO: Jenkins is fully up and running

Accessing Jenkins

Once Jenkins is up and running, one can access Jenkins from the link –
http://localhost:8080

This link will bring up the Jenkins dashboard.



Jenkins – Tomcat Setup

The following prerequisites must be met for Jenkins Tomcat setup.

Step 1: Verifying Java Installation

To verify Java installation, open the console and execute the following java command.

OS	Task	Command
Windows	Open command console	\>java -version
Linux	Open command terminal	\$java -version

If Java has been installed properly on your system, then you should get one of the following outputs, depending on the platform you are working on.

OS	Output
Windows	Java version "1.7.0_60" Java (TM) SE Run Time Environment (build 1.7.0_60-b19) Java Hotspot (TM) 64-bit Server VM (build 24.60-b09, mixed mode)
Linux	java version "1.7.0_25" Open JDK Runtime Environment (rhel-2.3.10.4.el6_4-x86_64) Open JDK 64-Bit Server VM (build 23.7-b01, mixed mode)

We assume the readers of this tutorial have Java 1.7.0_60 installed on their system before proceeding for this tutorial.

In case you do not have Java JDK, you can download it from the link [Oracle](#)

Step 2: Verifying Java Installation

Set the JAVA_HOME environment variable to point to the base directory location where Java is installed on your machine. For example,

OS	Output
Windows	Set Environmental variable JAVA_HOME to C:\ProgramFiles\java\jdk1.7.0_60
Linux	export JAVA_HOME=/usr/local/java-current

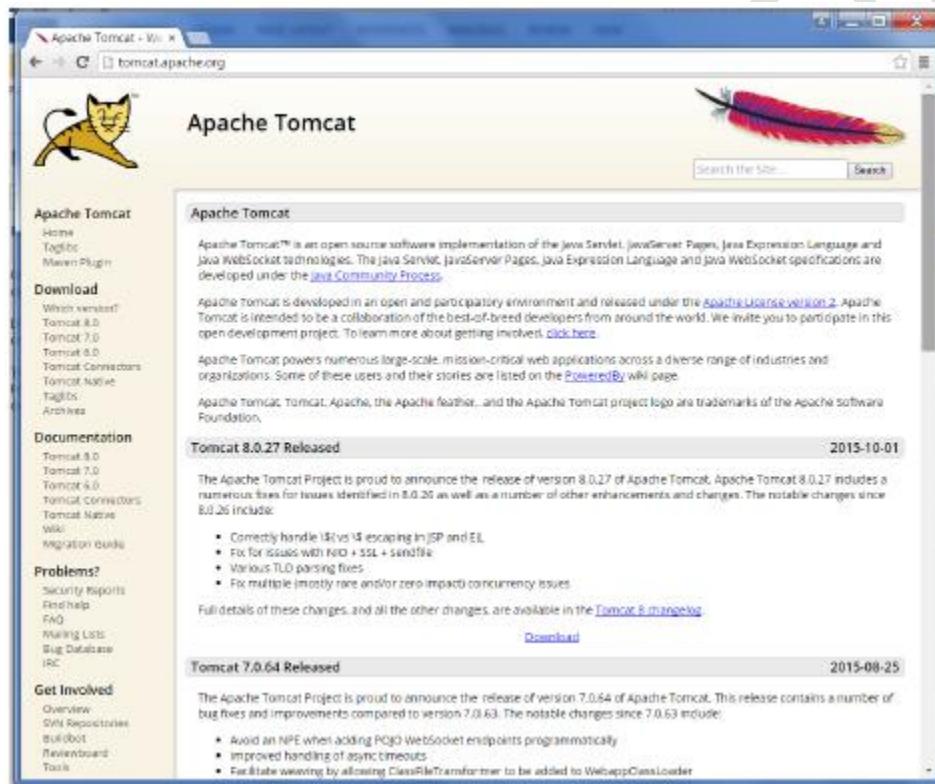
Append the full path of the Java compiler location to the System Path.

OS	Output
Windows	Append the String; C:\Program Files\Java\jdk1.7.0_60\bin to the end of the system variable PATH.
Linux	export PATH=\$PATH:\$JAVA_HOME/bin/

Verify the command java-version from command prompt as explained above.

Step 3: Download Tomcat

The official website for tomcat is [Tomcat](http://tomcat.apache.org). If you click the given link, you can get the home page of the tomcat official website as shown below.



Browse to the link <https://tomcat.apache.org/download-70.cgi> to get the download for tomcat.

Go to the 'Binary Distributions' section. Download the 32-bit Windows zip file.

Then unzip the contents of the downloaded zip file.

Step 4: Jenkins and Tomcat Setup

Copy the Jenkis.war file which was downloaded from the previous section and copy it to the webapps folder in the tomcat folder.

Now open the command prompt. From the command prompt, browse to the directory where the tomcat7 folder is location. Browse to the bin directory in this folder and run the start.bat file

```
E:\Apps\tomcat7\bin>startup.bat
```

Once the processing is complete without major errors, the following line will come in the output of the command prompt.

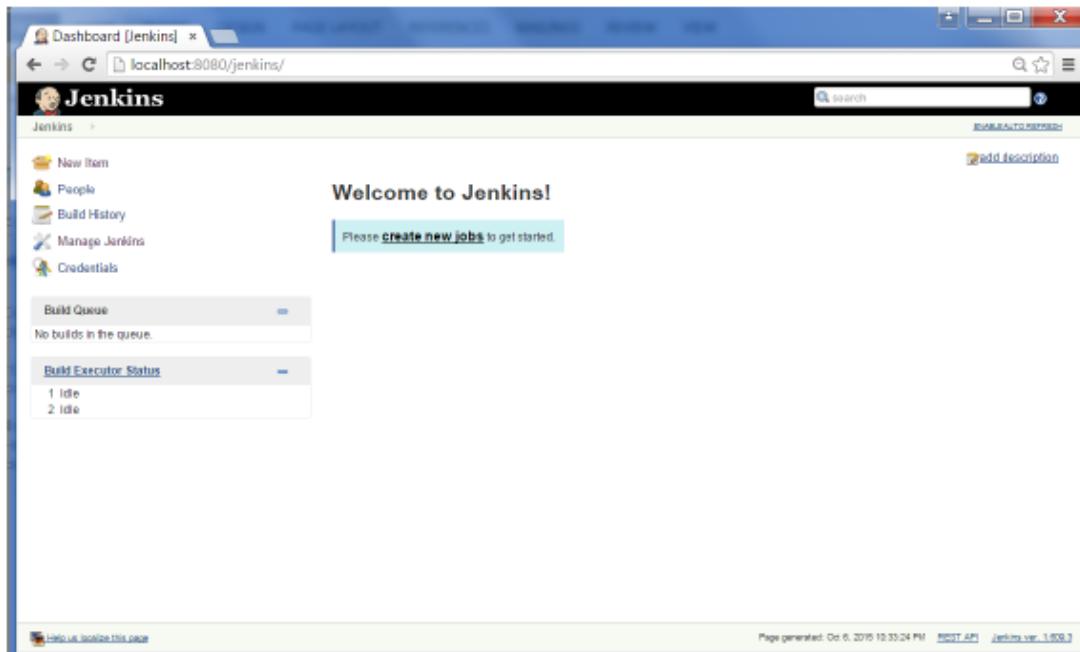
```
INFO: Server startup in 1302 ms
```

Open the browser and go to the link – <http://localhost:8080/jenkins>. Jenkins will be up and running on tomcat.

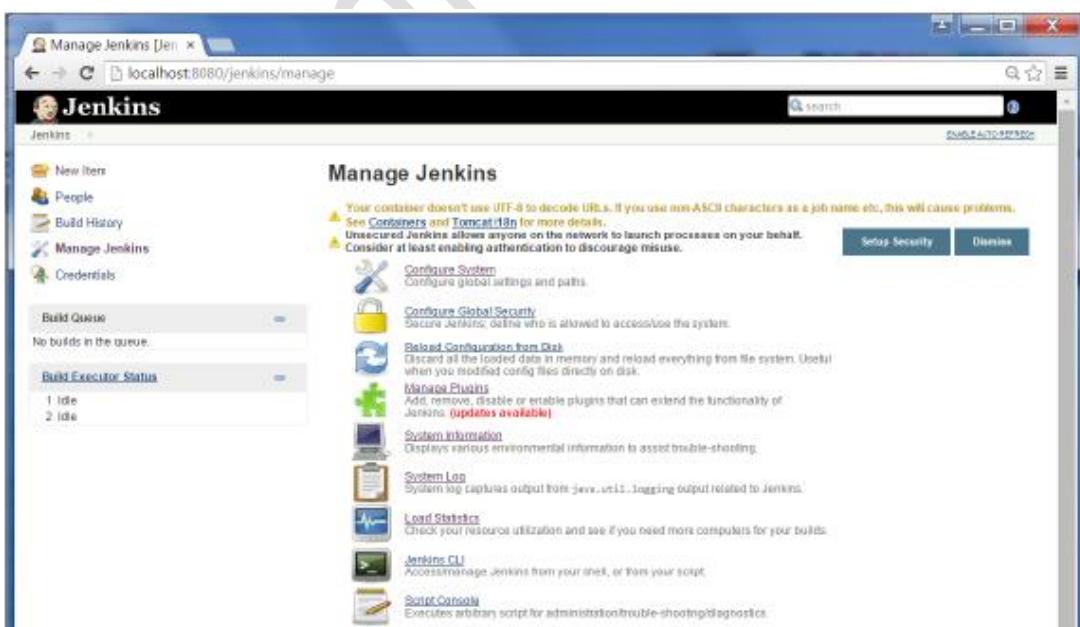


Jenkins - Git Setup

For this exercise, you have to ensure that Internet connectivity is present from the machine on which Jenkins is installed. In your Jenkins Dashboard (Home screen), click the Manage Jenkins option on the left hand side.



In the next screen, click the 'Manage Plugins' option.



In the next screen, click the Available tab. This tab will give a list of plugins which are available for downloading. In the 'Filter' tab type 'Git plugin'

Name	Version
Git Parameter Plug-In	0.4.0
UserContent in Git plugin	1.4
Alternative build chooser	1.1
Team Concert Git Plugin	1.0.10
Tracking Git Plugin	1.0
GIT plugin	2.4.0

The list will then be filtered. Check the Git Plugin option and click on the button 'Install without restart'

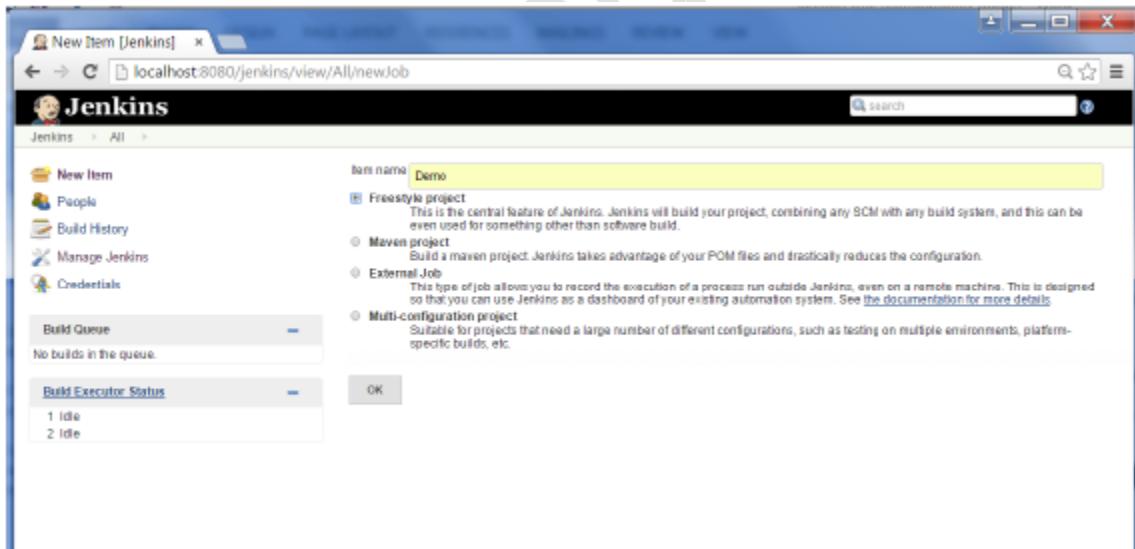
Name	Version
Git Parameter Plug-In	0.4.0
UserContent in Git plugin	1.4
Alternative build chooser	1.1
Team Concert Git Plugin	1.0.10
Tracking Git Plugin	1.0
GIT plugin	2.4.0

The installation will then begin and the screen will be refreshed to show the status of the download.

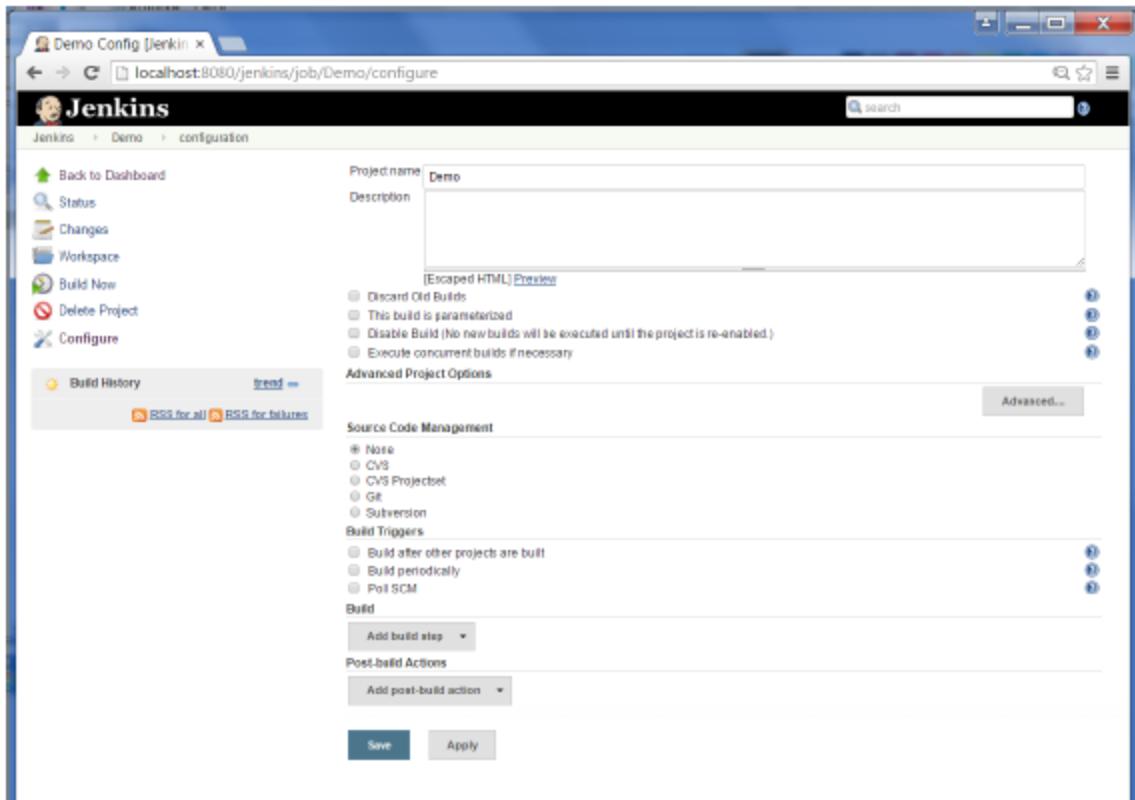


Once all installations are complete, restart Jenkins by issue the following command in the browser. **<http://localhost:8080/jenkins/restart>**

After Jenkins is restarted, Git will be available as an option whilst configuring jobs. To verify, click on New Item in the menu options for Jenkins. Then enter a name for a job, in the following case, the name entered is 'Demo'. Select 'Freestyle project' as the item type. Click the Ok button.



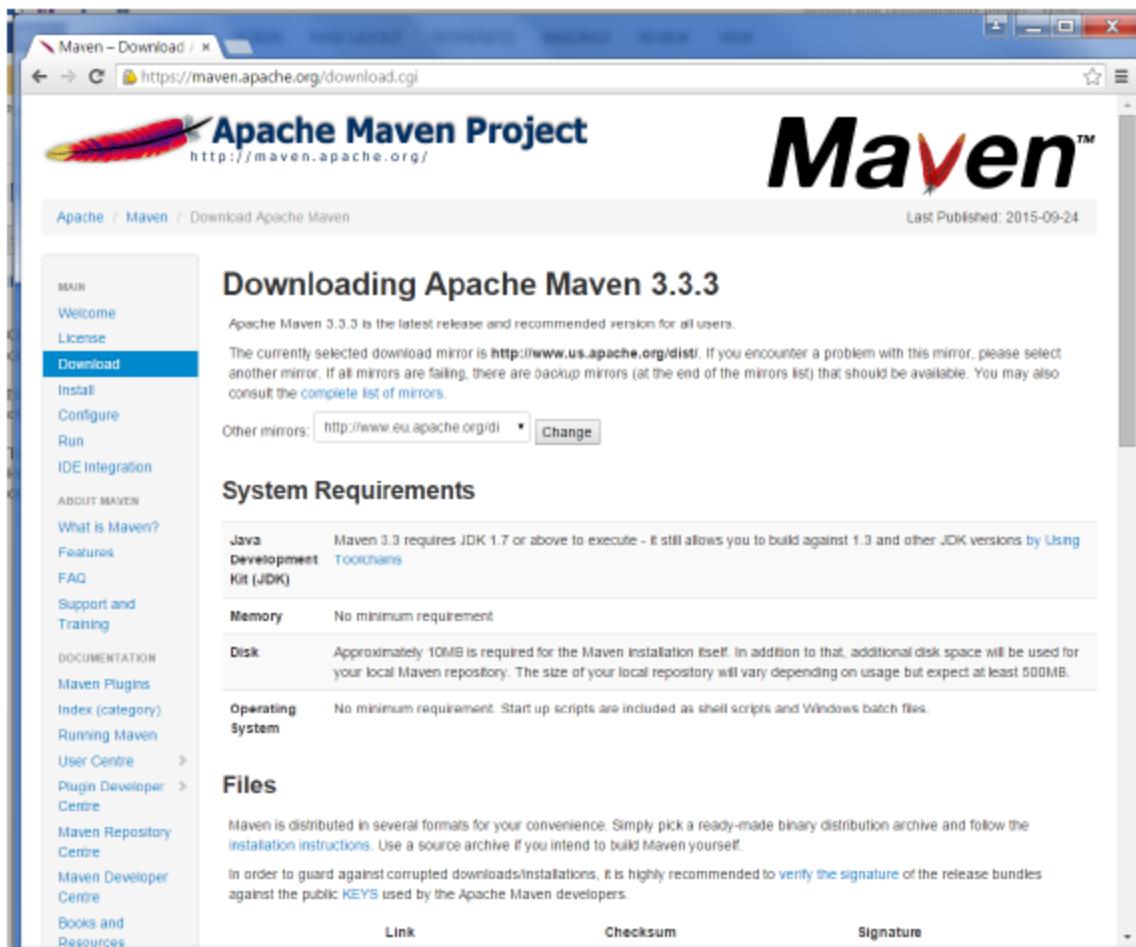
In the next screen, if you browse to the Source code Management section, you will now see 'Git' as an option.



Jenkins – Maven Setup

Step 1: Downloading and Setting Up Maven

The official website for maven is [Apache Maven](#). If you click the given link, you can get the home page of the maven official website as shown below.



While browsing to the site, go to the Files section and download the link to the Binary.zip file.

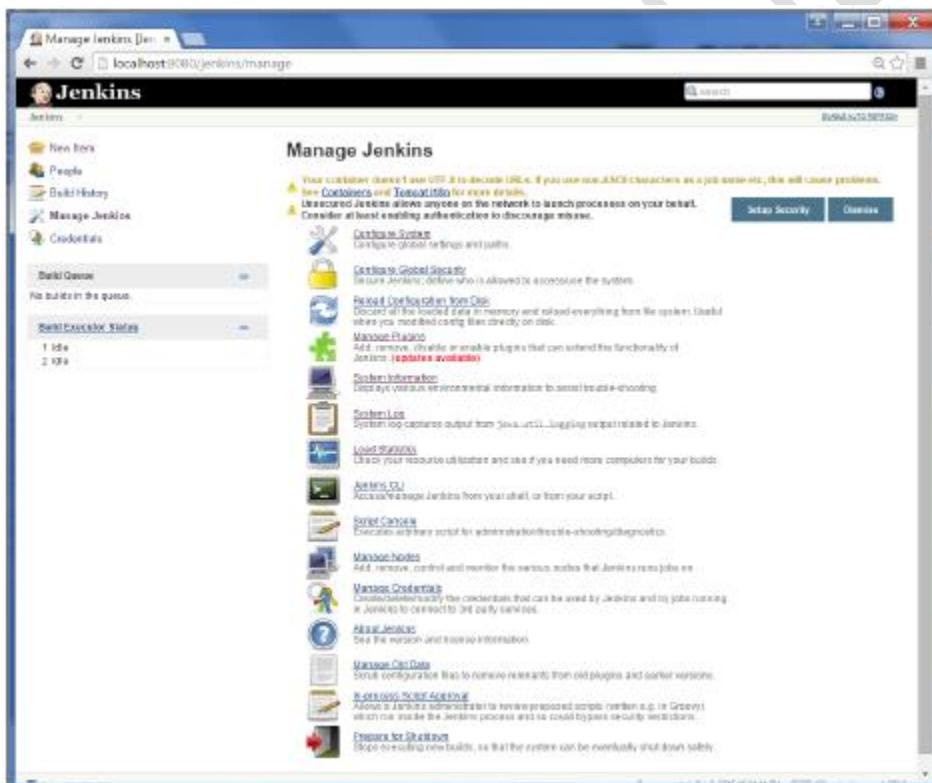
Once the file is downloaded, extract the files to the relevant application folder. For this purpose, the maven files will be placed in E:\Apps\apache-maven-3.3.3.

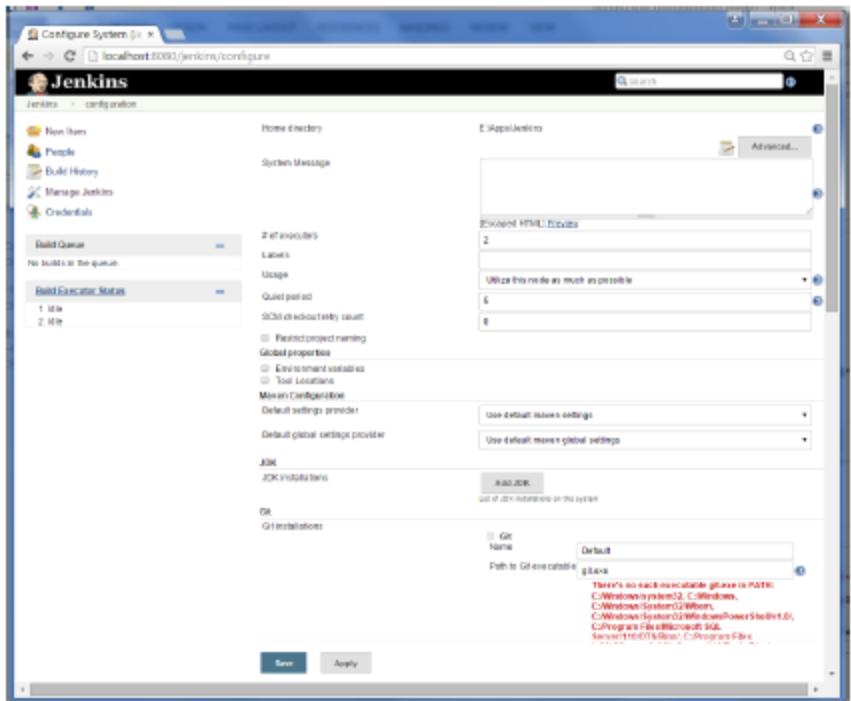
Step 2: Setting up Jenkins and Maven

In the Jenkins dashboard (Home screen), click Manage Jenkins from the left-hand side menu.

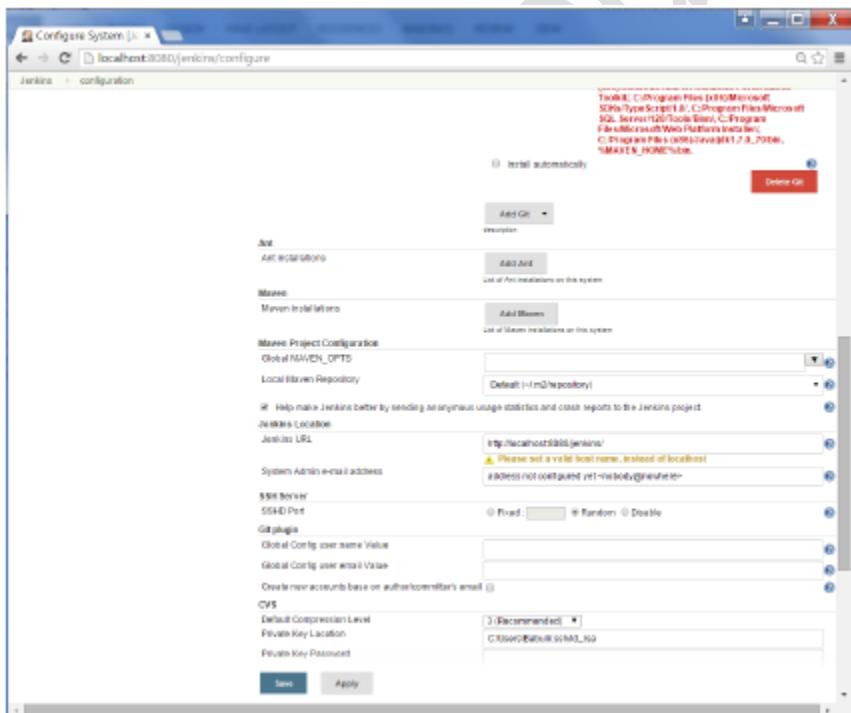


Then, click on 'Configure System' from the right hand side.





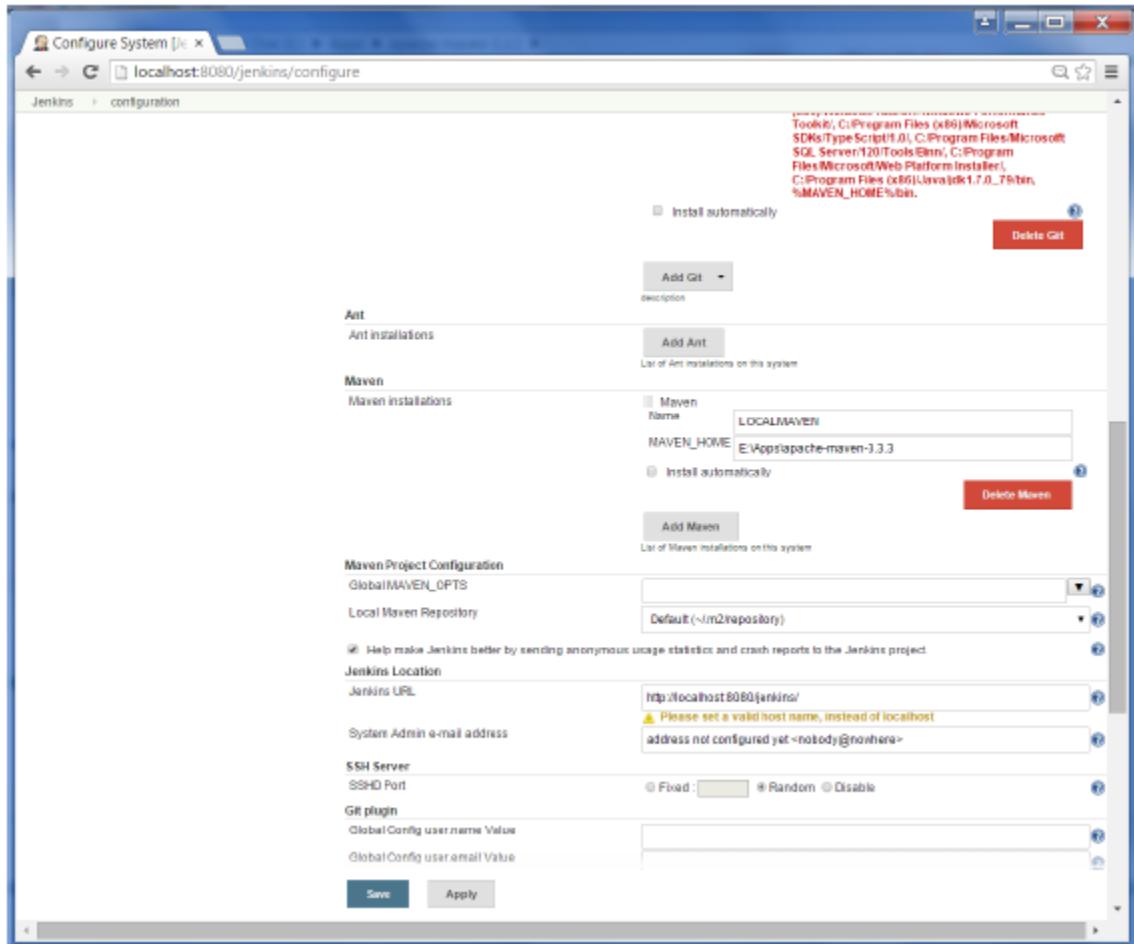
In the Configure system screen, scroll down till you see the Maven section and then click on the 'Add Maven' button.



Uncheck the 'Install automatically' option.

Add any name for the setting and the location of the MAVEN_HOME.

Then, click on the 'Save' button at the end of the screen.



You can now create a job with the 'Maven project' option. In the Jenkins dashboard, click the New Item option.

Dashboard [Jenkins] x

localhost:8080/jenkins/

Jenkins

New Item People Build History Manage Jenkins Credentials

Add description

All	S	W	Name	Last Success	Last Failure	Last Duration
			Demo	N/A	N/A	N/A

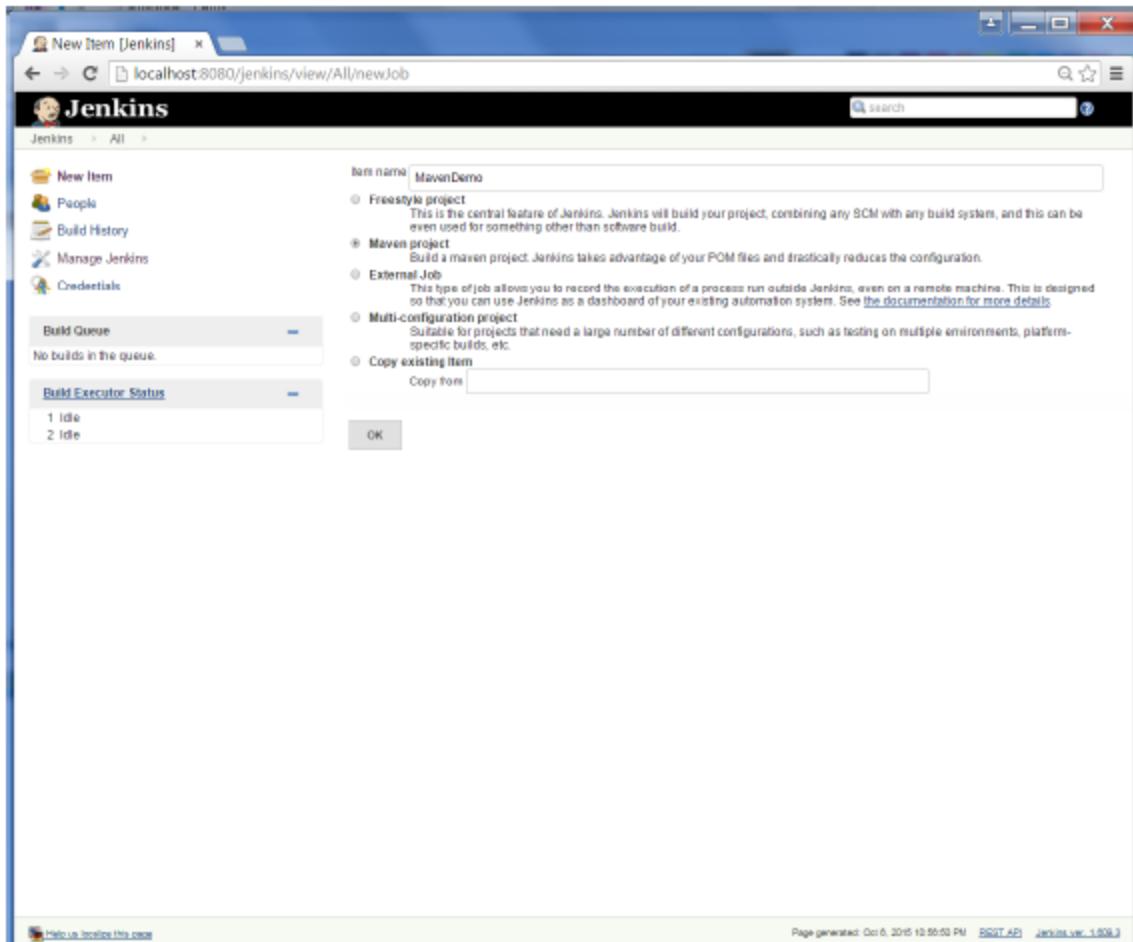
Icon: SML Legend RSS for all RSS for failures RSS for just latest builds

Build Queue - No builds in the queue.

Build Executor Status - 1 Idle, 2 Idle

Help us localize this page Page generated: Oct 6, 2015 12:55:57 PM REST API Jenkins ver. 1.509.3

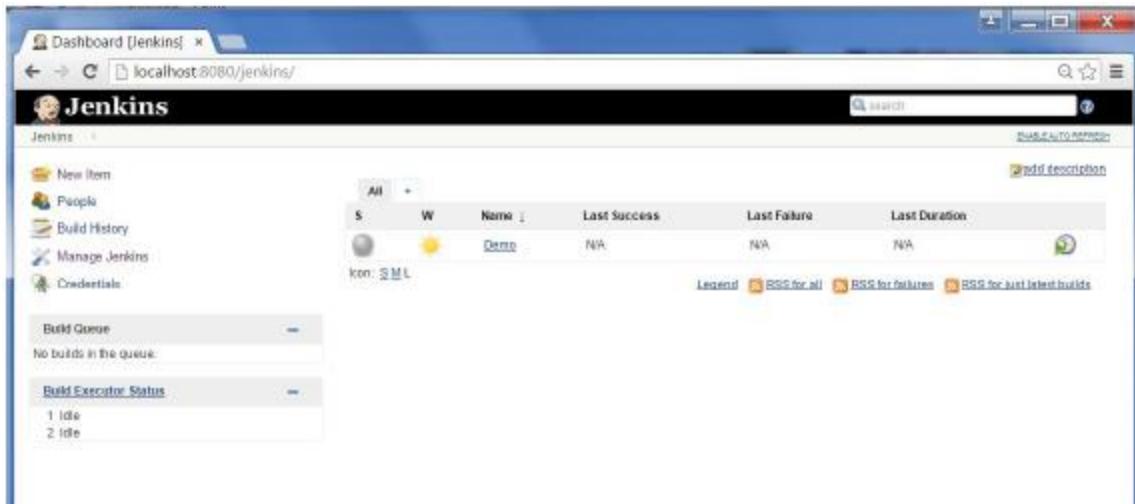
The screenshot shows the Jenkins dashboard at localhost:8080/jenkins/. The left sidebar includes links for New Item, People, Build History, Manage Jenkins, and Credentials. The main area displays a table for the 'Demo' job, which has an icon of a sun and is marked as 'Idle'. Below the table are sections for 'Build Queue' (empty) and 'Build Executor Status' (1 Idle, 2 Idle). A watermark 'Mohammed' is diagonally across the page.



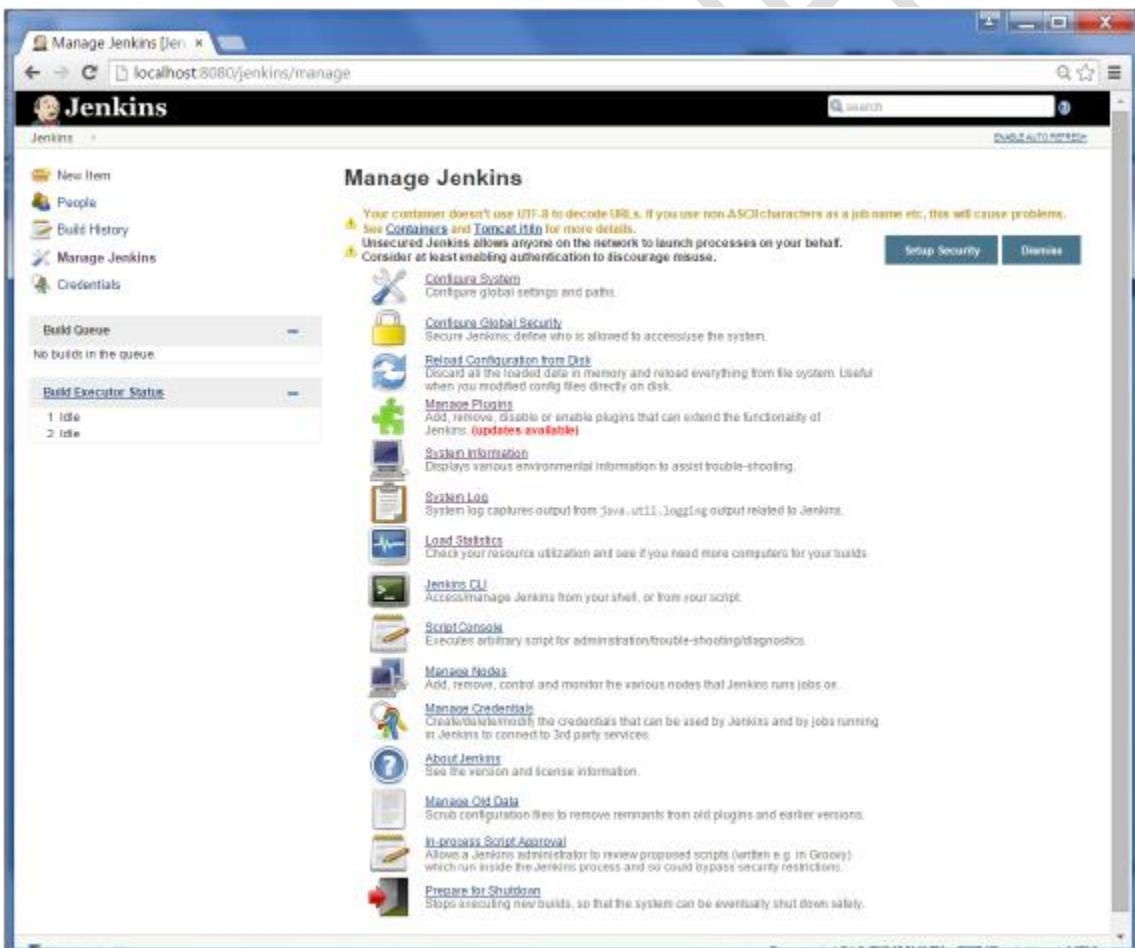
Jenkins - Configuration

You probably would have seen a couple of times in the previous exercises wherein we had to configure options within Jenkins. The following shows the various configuration options in Jenkins.

So one can get the various configuration options for Jenkins by clicking the 'Manage Jenkins' option from the left hand menu side.



You will then be presented with the following screen –



Click on Configure system. Discussed below are some of the Jenkins configuration settings which can be carried out.

Jenkins Home Directory

Jenkins needs some disk space to perform builds and keep archives. One can check this location from the configuration screen of Jenkins. By default, this is set to `~/jenkins`, and this location will initially be stored within your user profile location. In a proper environment, you need to change this location to an adequate location to store all relevant builds and archives. One can do this in the following ways

- ⊕ Set "JENKINS_HOME" environment variable to the new home directory before launching the servlet container.
- ⊕ Set "JENKINS_HOME" system property to the servlet container.
- ⊕ Set JNDI environment entry "JENKINS_HOME" to the new directory.

The following example will use the first option of setting the "JENKINS_HOME" environment variable.

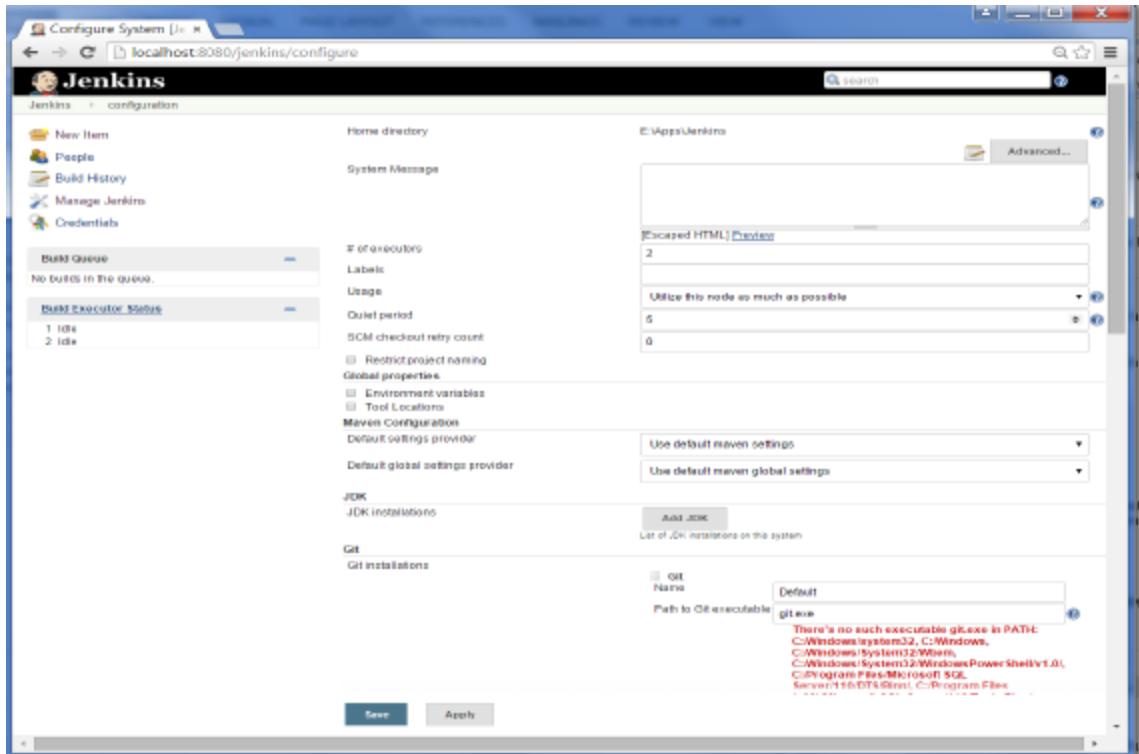
First create a new folder `E:\Apps\Jenkins`. Copy all the contents from the existing `~/jenkins` to this new directory.

Set the `JENKINS_HOME` environment variable to point to the base directory location where Java is installed on your machine. For example,

OS	Output
Windows	Set Environmental variable <code>JENKINS_HOME</code> to you're the location you desire. As an example you can set it to <code>E:\Apps\Jenkins</code>
Linux	<code>export JENKINS_HOME =/usr/local/Jenkins</code> or the location you desire.

In the Jenkins dashboard, click Manage Jenkins from the left hand side menu. Then click on 'Configure System' from the right hand side.

In the Home directory, you will now see the new directory which has been configured.



of executors

This refers to the total number of concurrent job executions that can take place on the Jenkins machine. This can be changed based on requirements. Sometimes the recommendation is to keep this number the same as the number of CPU on the machines for better performance.

Environment Variables

This is used to add custom environment variables which will apply to all the jobs. These are key-value pairs and can be accessed and used in Builds wherever required.

Jenkins URL

By default, the Jenkins URL points to localhost. If you have a domain name setup for your machine, set this to the domain name else overwrite localhost with IP of machine. This will help in setting up slaves and while sending out links using the email as you can directly access the Jenkins URL using the environment variable JENKINS_URL which can be accessed as \${JENKINS_URL}.

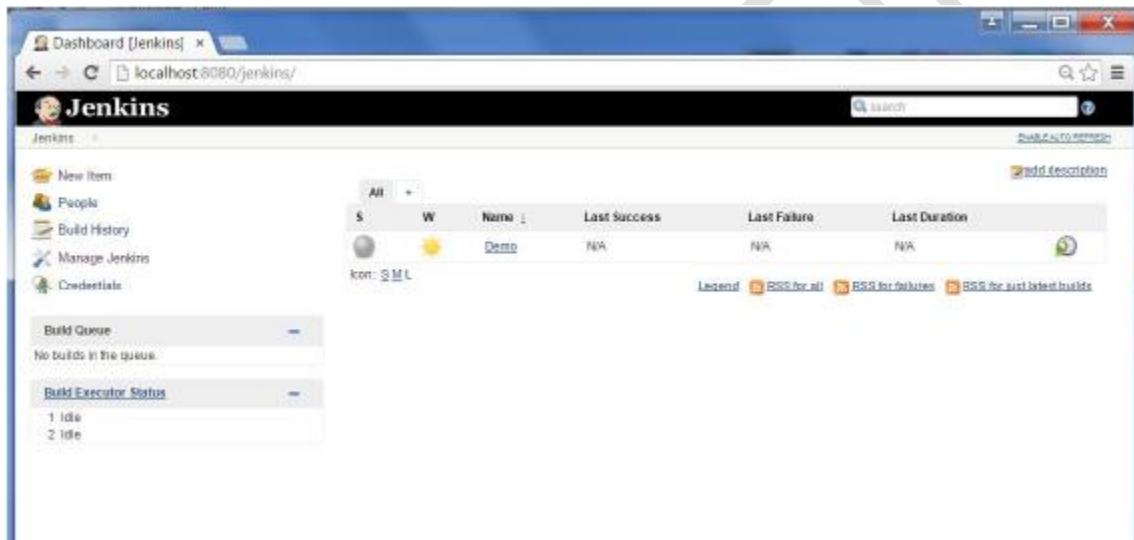
Email Notification

In the email Notification area, you can configure the SMTP settings for sending out emails. This is required for Jenkins to connect to the SMTP mail server and send out emails to the recipient list.

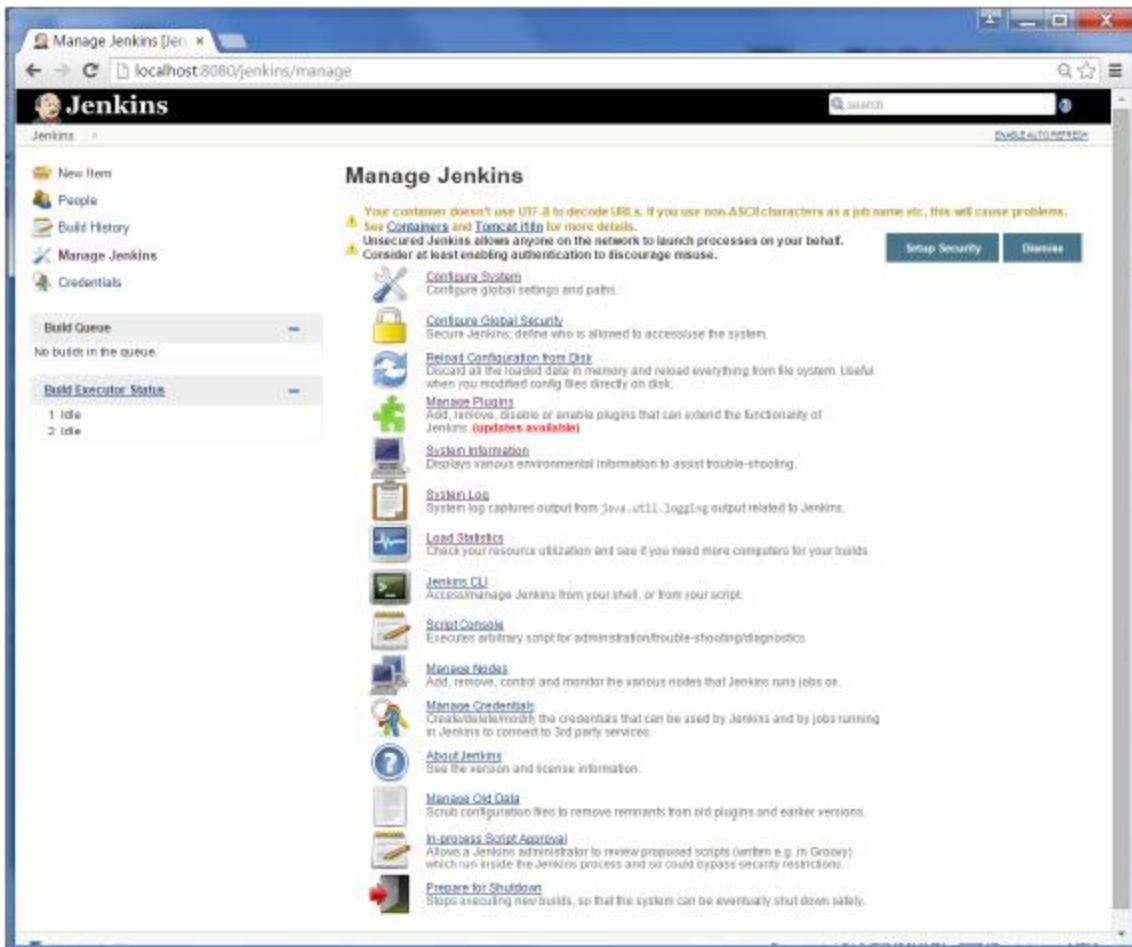
Jenkins - Management

To manage Jenkins, click on the 'Manage Jenkins' option from the left hand menu side.

So one can get the various configuration options for Jenkins by clicking the 'Manage Jenkins' option from the left hand menu side.



You will then be presented with the following screen –



Some of the management options are as follows –

Configure System

This is where one can manage paths to the various tools to use in builds, such as the JDKs, the versions of Ant and Maven, as well as security options, email servers, and other system-wide configuration details. When plugins are installed, Jenkins will add the required configuration fields dynamically after the plugins are installed.

Reload Configuration from Disk

Jenkins stores all its system and build job configuration details as XML files which is stored in the Jenkins home directory. Here also all of the build history is stored. If you are migrating build jobs from one Jenkins instance to another, or archiving old build jobs, you will need to add or remove the corresponding build job directories to Jenkins's builds directory. You don't need to take Jenkins offline to do this—you can simply use

the “Reload Configuration from Disk” option to reload the Jenkins system and build job configurations directly.

Manage Plugin

Here one can install a wide variety of third-party plugins right from different Source code management tools such as Git, Mercurial or ClearCase, to code quality and code coverage metrics reporting. Plugins can be installed, updated and removed through the Manage Plugins screen.

The screenshot shows the Jenkins Manage Plugin interface. The top navigation bar includes links for Back to Dashboard, Manage Jenkins, and the current page, Plugin Manager. Below this is a search bar and a filter button. The main content area has tabs for Updates, Available, Installed, and Advanced, with Updates selected. A table lists various Jenkins plugins:

Name	Version	Installed
CVS Plugin	2.12	2.11
Javadoc Plugin	1.3	1.1
JUnit Plugin	1.9	1.2-beta-4
Maven Authorization Strategy Plugin	1.2	1.1
Maven Project Plugin	1.6	1.4.1
Maven Integration plugin	2.12.1	2.7.1
OWASP Markup Formatter Plugin	1.3	1.1
PAM Authentication plugin	1.2	1.1
Script Security Plugin	1.15	1.13
SSH Slave plugin	1.10	1.9
Subversion Plugin	2.5.3	1.54
Translation Assistance plugin	1.12	1.10
Windows Slave Plugin	1.1	1.0

At the bottom of the table are three buttons: "Download now and install after restart", "Update information obtained: 1 hr 36 min ago", and "Check now". Below the table is a note: "Select All, None. This page lists updates to the plugins you currently use." At the very bottom of the page are links for "Help us localize this page", "Page generated: Oct 6 2018 11:08:05 PM", "BROWSE URL", and "Jenkins ver. 1.859".

System Information

This screen displays a list of all the current Java system properties and system environment variables. Here one can check exactly what version of Java Jenkins is running in, what user it is running under, and so forth.

The following screenshot shows some of the name-value information available in this section.

The screenshot shows the Jenkins System Information page at localhost:8080/jenkins/systemInfo. The left sidebar includes links for New Item, People, Build History, Manage Jenkins, and Credentials. Under Build Queue, it says "No builds in the queue". Under Build Executor Status, there are 1 Idle and 2 Idle executors. The main content area is titled "System Properties" and displays a table of system properties and their values. Some key entries include:

Name	Value
ant.home	sun.awt.windows.WToolkit
catalina.base	E:\Appstromcat7
catalina.home	E:\Appstromcat7
catalina.useNaming	true
common.loader	\$catalina.base\$lib\$\${catalina.base}lib\$jar\$\${catalina.home}lib\$\${catalina.home}lib/*jar
file.encoding	Cp1252
file.encoding.pkg	sun.io
file.separator	\
java.awt.graphicsenv	sun.awt.Win32GraphicsEnvironment
java.awt.printerjob	sun.awt.windows.WPrinterJob
java.class.path	E:\Appstromcat7bin\bootstrap.jar;E:\Appstromcat7bin\jvmcat-all.jar
java.class.version	51.0
java.endorsed.dirs	E:\Appstromcat7endorsed
java.ext.dirs	C:\Program Files (x86)\Java\jdk1.7.0_79\jre\lib\ext
java.home	C:\Program Files (x86)\Java\jdk1.7.0_79\jre
java.io.tmpdir	E:\Appstromcat7tmp
java.library.path	C:\Program Files (x86)\Java\jdk1.7.0_79\bin;C:\Windows\SunJava\bin;C:\Windows\system32;C:\Windows;C:\Windows\system32\Wbem;C:\Windows\system32\Threading\;C:\Windows\System32\Windows Performance Toolkit\;C:\Program Files\Microsoft SQL Server\100\Tools\Binn\;C:\Program Files\Microsoft SQL Server\110\Tools\Binn\;C:\Program Files\Microsoft SQL Server\120\Tools\Binn\;C:\Program Files\Microsoft SQL Server\130\Tools\Binn\;C:\Program Files\Microsoft Visual Studio\10.0\Common7\IDE\PrivateAssemblies\;C:\Program Files\Microsoft SQL Server\110\Tools\Binn\;C:\Program Files\Microsoft SQL Server\120\Tools\Binn\;C:\Program Files\Microsoft SQL Server\130\Tools\Binn\;C:\Program Files\Microsoft Visual Studio\10.0\Common7\IDE\PrivateAssemblies\;C:\Program Files\Microsoft SQL Server\140\Tools\Binn\;C:\Program Files\Microsoft Visual Studio\14.0\Common7\IDE\PrivateAssemblies\;C:\Program Files\Microsoft Visual Studio\15.0\Common7\IDE\PrivateAssemblies\;C:\Program Files\Microsoft Visual Studio\16.0\Common7\IDE\PrivateAssemblies\;C:\Windows\KB\& 1\Windows Performance Toolkit\;C:\Program Files\Microsoft SDKs\TypeScript\1.0\;C:\Program Files\Microsoft SQL Server\120\Tools\Binn\;C:\Program Files\Microsoft\Net Platform Installer\;C:\Program Files\Java\jdk1.7.0_79\bin;%MAVEN_HOME%\bin;
java.naming.factory.initial	org.apache.naming.java.javaURLContextFactory
java.naming.factory.url.pkgs	org.apache.naming
java.runtime.name	Java(TM) SE Runtime Environment
java.runtime.version	1.7_0_79-b15
java.specification.name	Java Platform API Specification
java.specification.vendor	Oracle Corporation
java.specification.version	1.7
java.util.logging.config.file	E:\Appstromcat7conf\logging.properties
java.util.logging.manager	org.apache.juli.ClassLoaderLogManager
java.vendor	Oracle Corporation
java.vendor.url	http://java.oracle.com/
java.vendor.url_bug	http://bugreport.sun.com/bugreport/
java.version	1.7_0_79
java.vm.info	mixed mode, sharing

System Log

The System Log screen is a convenient way to view the Jenkins log files in real time. Again, the main use of this screen is for troubleshooting.

Load Statistics

This page displays graphical data on how busy the Jenkins instance is in terms of the number of concurrent builds and the length of the build queue which gives an idea of how long your builds need to wait before being executed. These statistics can give a good idea of whether extra capacity or extra build nodes is required from an infrastructure perspective.

Script Console

This screen lets you run Groovy scripts on the server. It is useful for advanced troubleshooting since it requires a strong knowledge of the internal Jenkins architecture.

Manage nodes

Jenkins is capable of handling parallel and distributed builds. In this screen, you can configure how many builds you want. Jenkins runs simultaneously, and, if you are using distributed builds, set up build nodes. A build node is another machine that Jenkins can use to execute its builds.

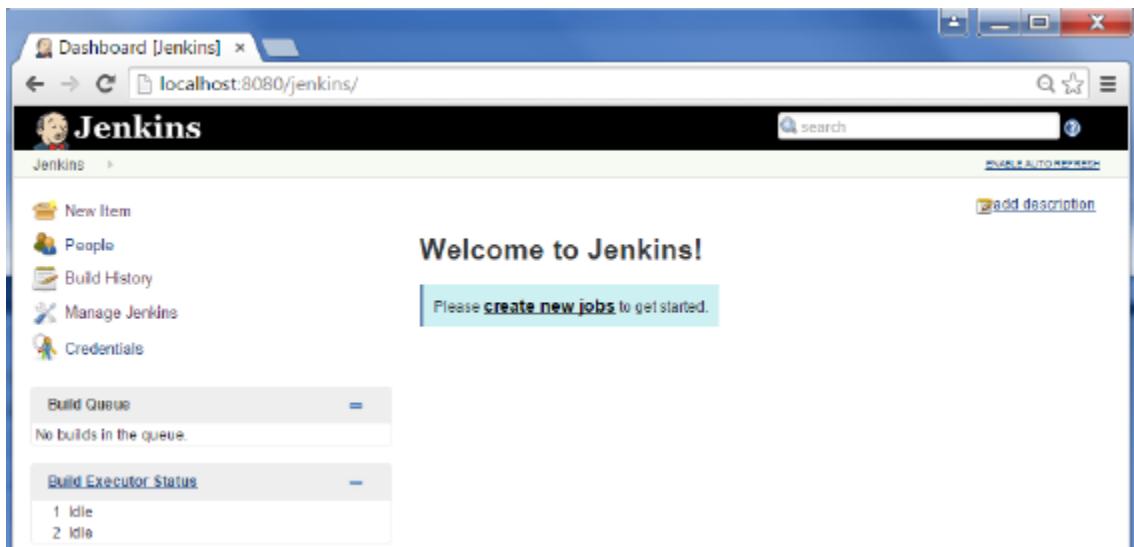
Prepare for Shutdown

If there is a need to shut down Jenkins, or the server Jenkins is running on, it is best not to do so when a build is being executed. To shut down Jenkins cleanly, you can use the Prepare for Shutdown link, which prevents any new builds from being started. Eventually, when all of the current builds have finished, one will be able to shut down Jenkins cleanly.

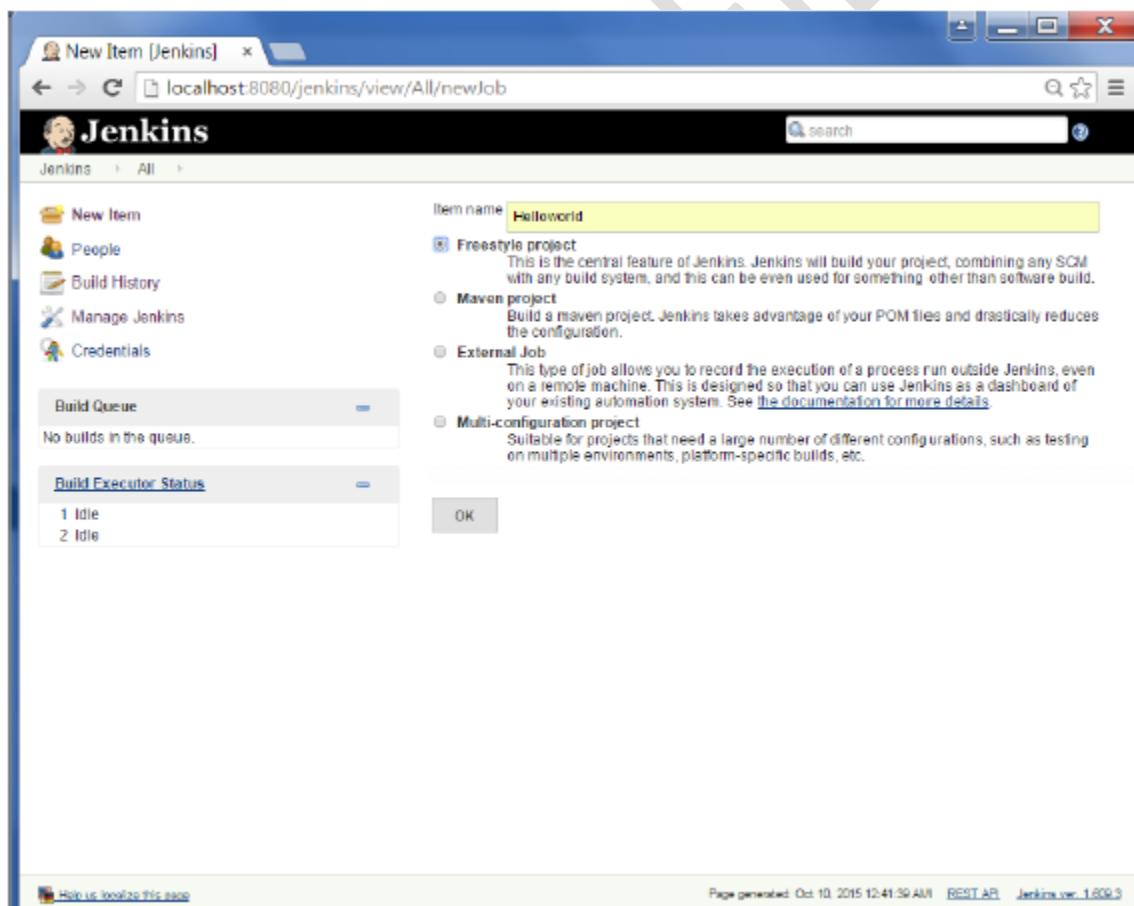
Jenkins - Setup Build Jobs

For this exercise, we will create a job in Jenkins which picks up a simple HelloWorld application, builds and runs the java program.

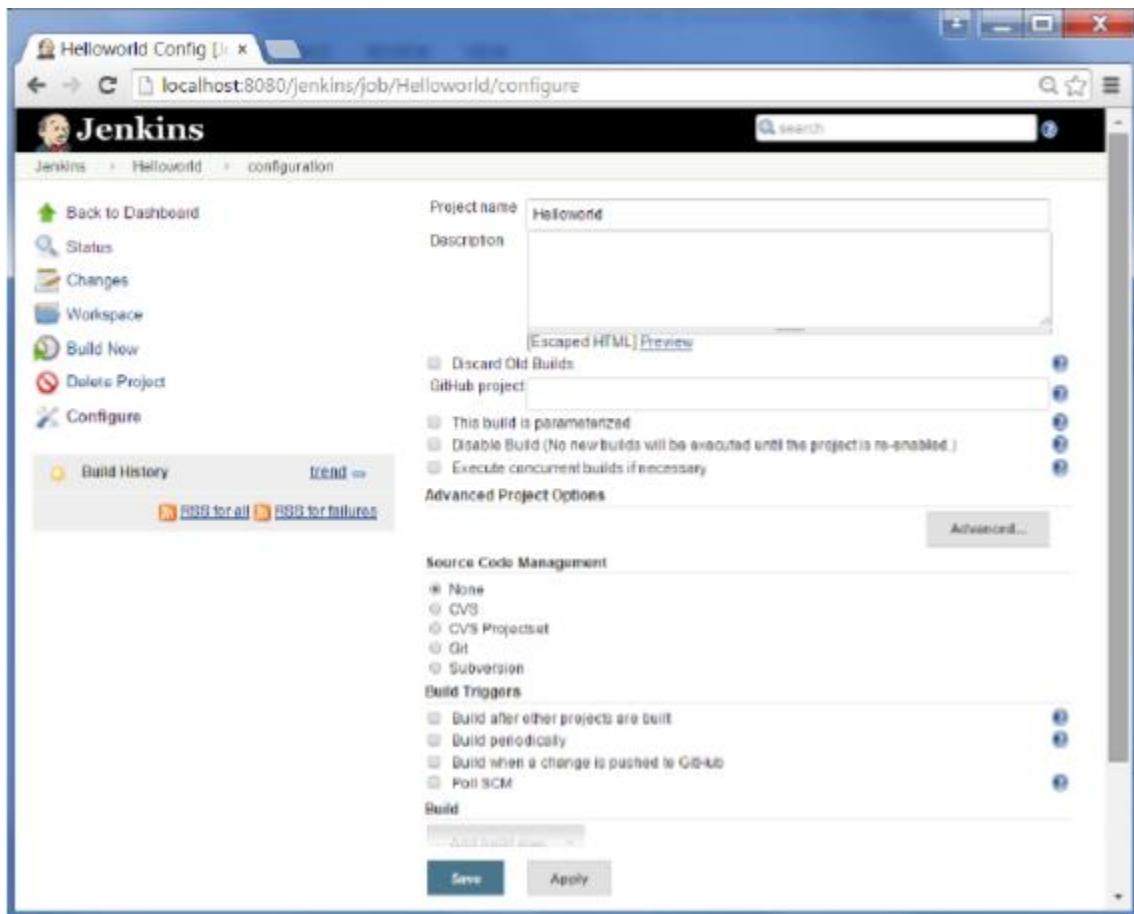
Step 1 – Go to the Jenkins dashboard and Click on New Item



Step 2 – In the next screen, enter the Item name, in this case we have named it Helloworld. Choose the ‘Freestyle project option’

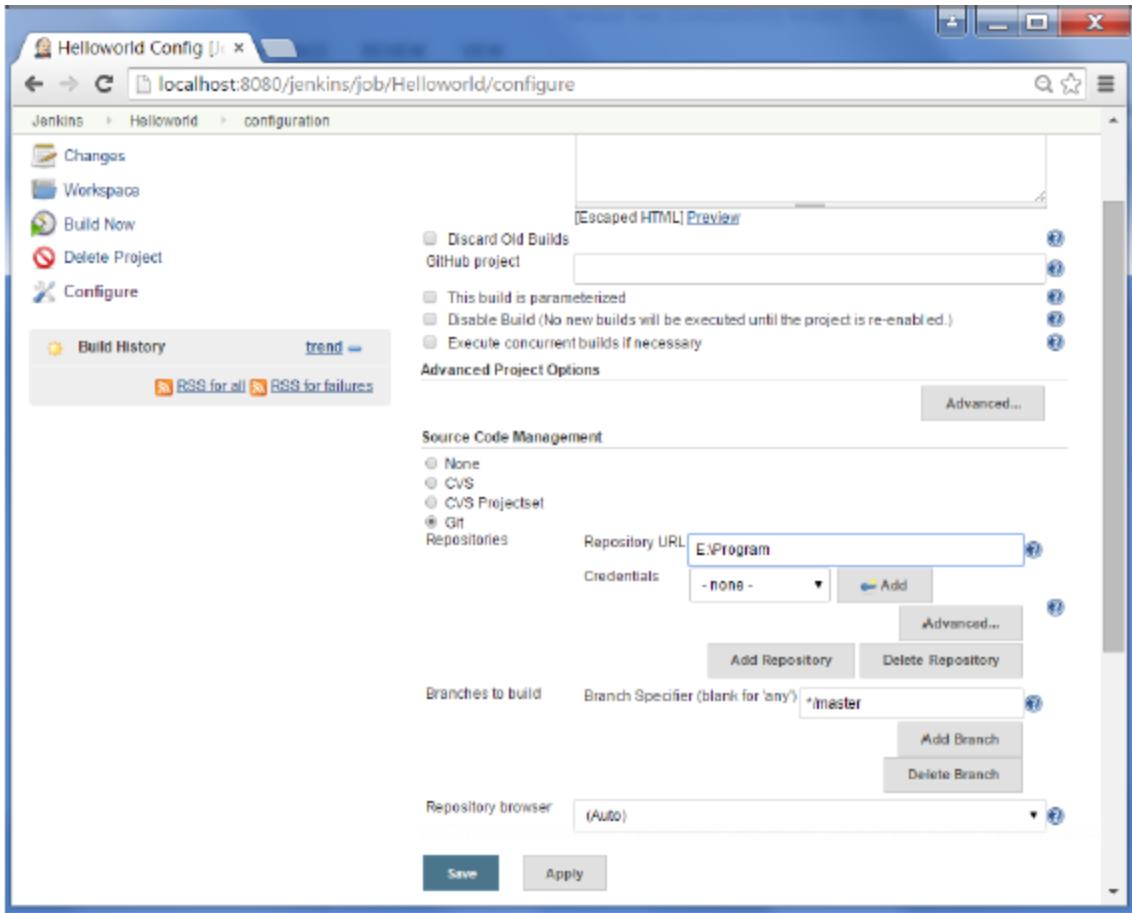


Step 3 – The following screen will come up in which you can specify the details of the job.

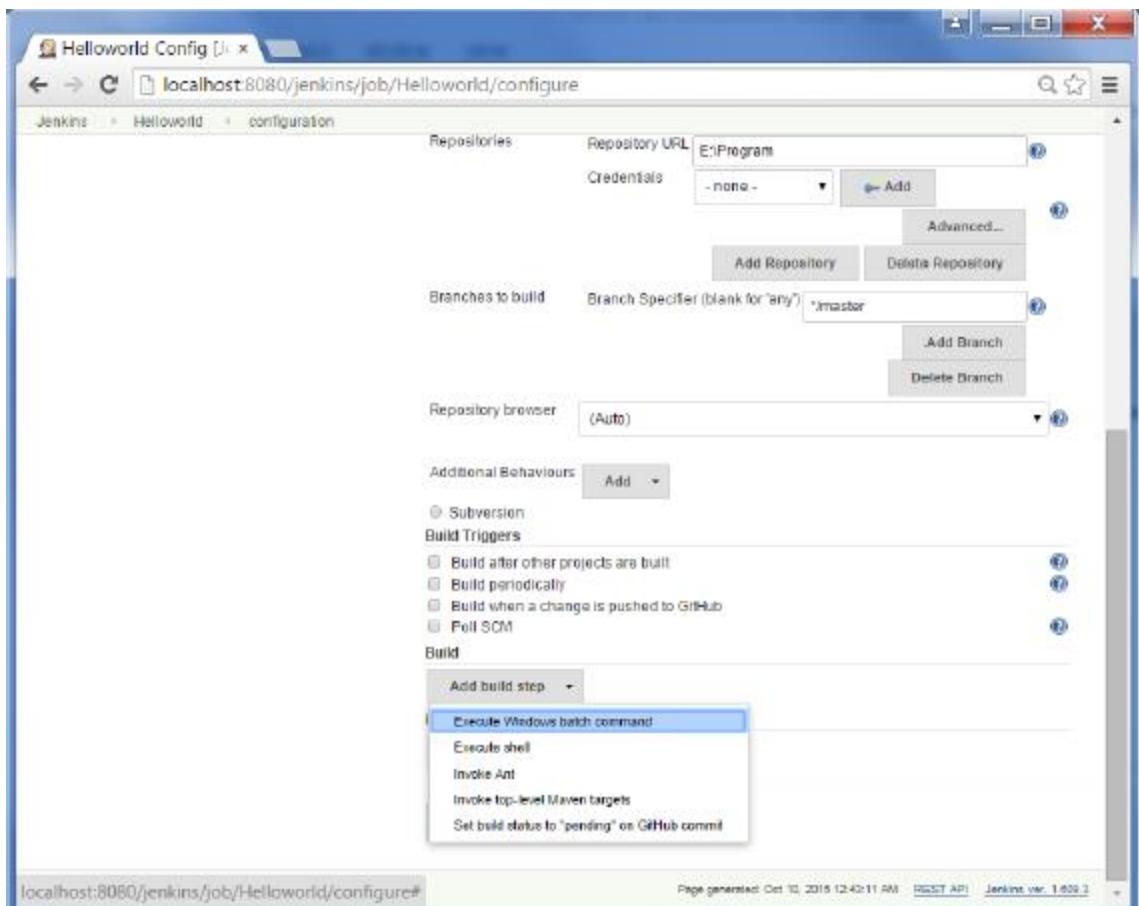


Step 4 – We need to specify the location of files which need to be built. In this example, we will assume that a local git repository(E:\Program) has been setup which contains a 'HelloWorld.java' file. Hence scroll down and click on the Git option and enter the URL of the local git repository.

Note – If your repository is hosted on Github, you can also enter the url of that repository here. In addition to this, you would need to click on the Add button for the credentials to add a user name and password to the github repository so that the code can be picked up from the remote repository.

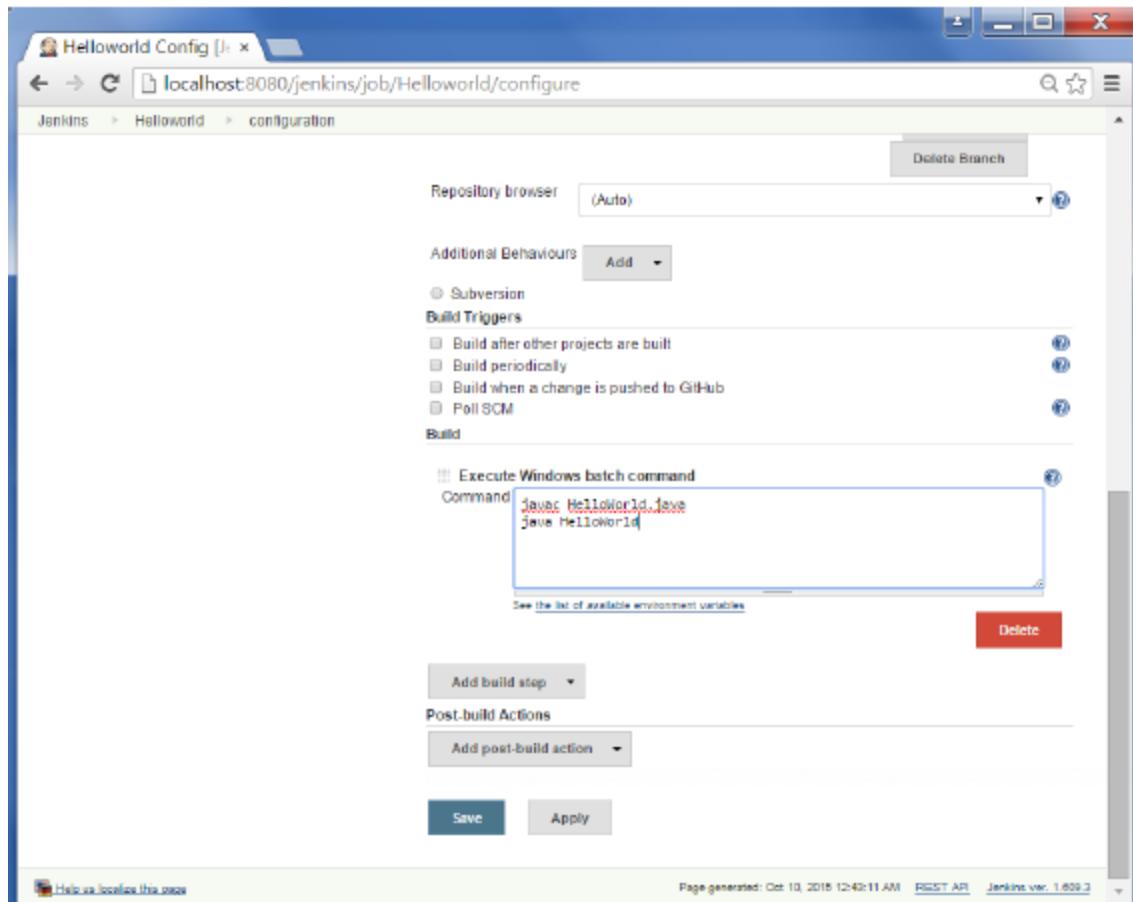


Step 5 – Now go to the Build section and click on Add build step → Execute Windows batch command



Step 6 – In the command window, enter the following commands and then click on the Save button.

```
Javac HelloWorld.java  
Java HelloWorld
```



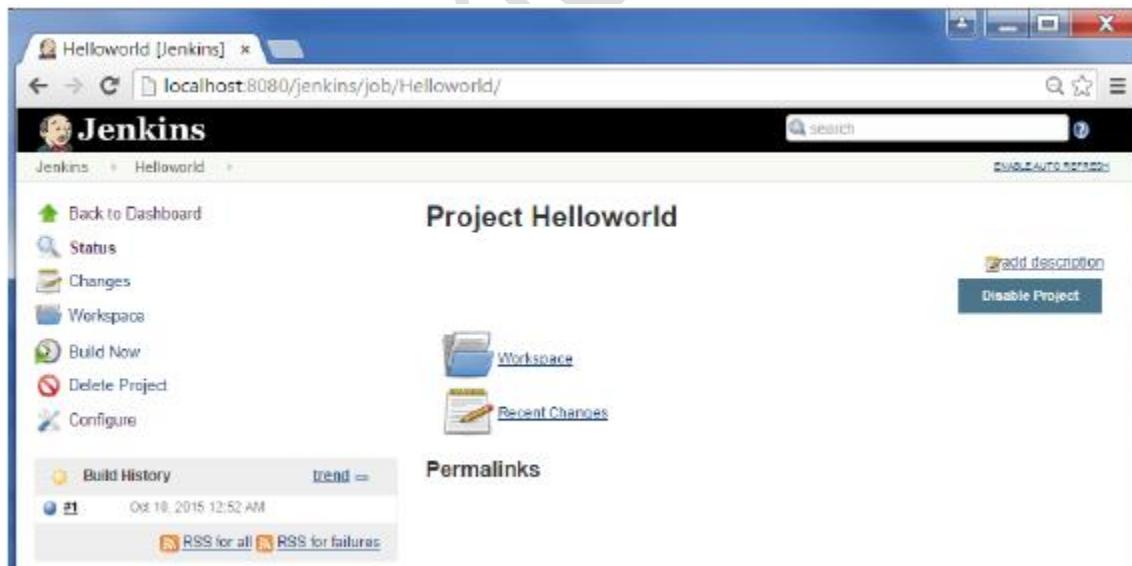
Step 7 – Once saved, you can click on the Build Now option to see if you have successfully defined the job.



Step 8 – Once the build is scheduled, it will run. The following Build history section shows that a build is in progress.



Step 9 – Once the build is completed, a status of the build will show if the build was successful or not. In our case, the following build has been executed successfully. Click on the #1 in the Build history to bring up the details of the build.



Step 10 – Click on the Console Output link to see the details of the build

The screenshot displays two Jenkins job pages. The top window shows 'Build #1 (Oct 10, 2015 12:52:50 AM)' with a status of 'No changes' and started by 'anonymous'. The bottom window shows the 'Console Output' for 'Helloworld #12' with the following log:

```

Started by user anonymous
Building in workspace E:\Jenkins\jobs\Helloworld\workspace
> C:\Program Files\Git\bin\git.exe rev-parse --is-inside-work-tree # timeout=10
Fetching changes from the remote Git repository
> C:\Program Files\Git\bin\git.exe config remote.origin.url E:\Program #
timeout=10
Fetching upstream changes from E:\Program
> C:\Program Files\Git\bin\git.exe --version # timeout=10
> C:\Program Files\Git\bin\git.exe -c core.askpass=true fetch --tags --progress
E:\Program +refs/heads/* refs/remotes/origin/*
> C:\Program Files\Git\bin\git.exe rev-parse
"refs/remotes/origin/master^{commit}" # timeout=10
> C:\Program Files\Git\bin\git.exe rev-parse
"refs/remotes/origin/master^{commit}" # timeout=10
Checking out Revision 42f9a82ffadd86fb5c3a9d9ae40e731a907f5c8f
(refs/remotes/origin/master)
> C:\Program Files\Git\bin\git.exe config core.sparsecheckout # timeout=10
> C:\Program Files\Git\bin\git.exe checkout -f
42f9a82ffadd86fb5c3a9d9ae40e731a907f5c8f
> C:\Program Files\Git\bin\git.exe rev-list
42f9a82ffadd86fb5c3a9d9ae40e731a907f5c8f # timeout=10
[workspace] $ cmd /c call E:\Apps\tomcat7\temp\nudsom19284786077504681.bat

E:\Jenkins\jobs\Helloworld\workspace>javac HelloWorld.java
E:\Jenkins\jobs\Helloworld\workspace>java HelloWorld
Hello World

E:\Jenkins\jobs\Helloworld\workspace>exit 0
Finished: SUCCESS

```

Apart from the steps shown above there are just so many ways to create a build job, the options available are many, which what makes Jenkins such a fantastic continuous deployment tool.

Jenkins - Unit Testing

Jenkins provides an out of box functionality for Junit, and provides a host of plugins for unit testing for other technologies, an example being MSTest for .Net Unit tests. If you go to the link <https://wiki.jenkins-ci.org/display/JENKINS/xUnit+Plugin> it will give the list of Unit Testing plugins available.

The screenshot shows the Jenkins xUnit Plugin page. The left sidebar has links for Home, Mailing lists, Source code, Bugtracker, Security Advisories, Events, Donation, Commercial Support, Wiki Site Map, and Documents. The 'Documents' section is currently selected. The main content area has a title 'xUnit Plugin' with a small icon. Below it, a message says 'Added by Gregory Boissinot, last edited by Gregory Boissinot on Oct 08, 2015 (view change)'. A 'Plugin Information' table is shown with columns for Plugin ID (xunit), Changes (In Latest Release, Since Latest Release), Source Code (GitHub), Issue Tracking (Open Issues, Pull Requests), and Maintainer(s) (Gregory Boissinot). A 'Usage' section contains a line graph titled 'xunit - installations' showing the number of installations from October 2014 to September 2015. The graph shows a steady increase from approximately 11,692 to 13,563. Below the graph, a note says 'This plugin makes it possible to publish the test results of an execution of a testing tool in Jenkins.' At the bottom, there's a preview of a Jenkins build output window with a yellow bar labeled 'CppUnit output'.

Example of a Junit Test in Jenkins

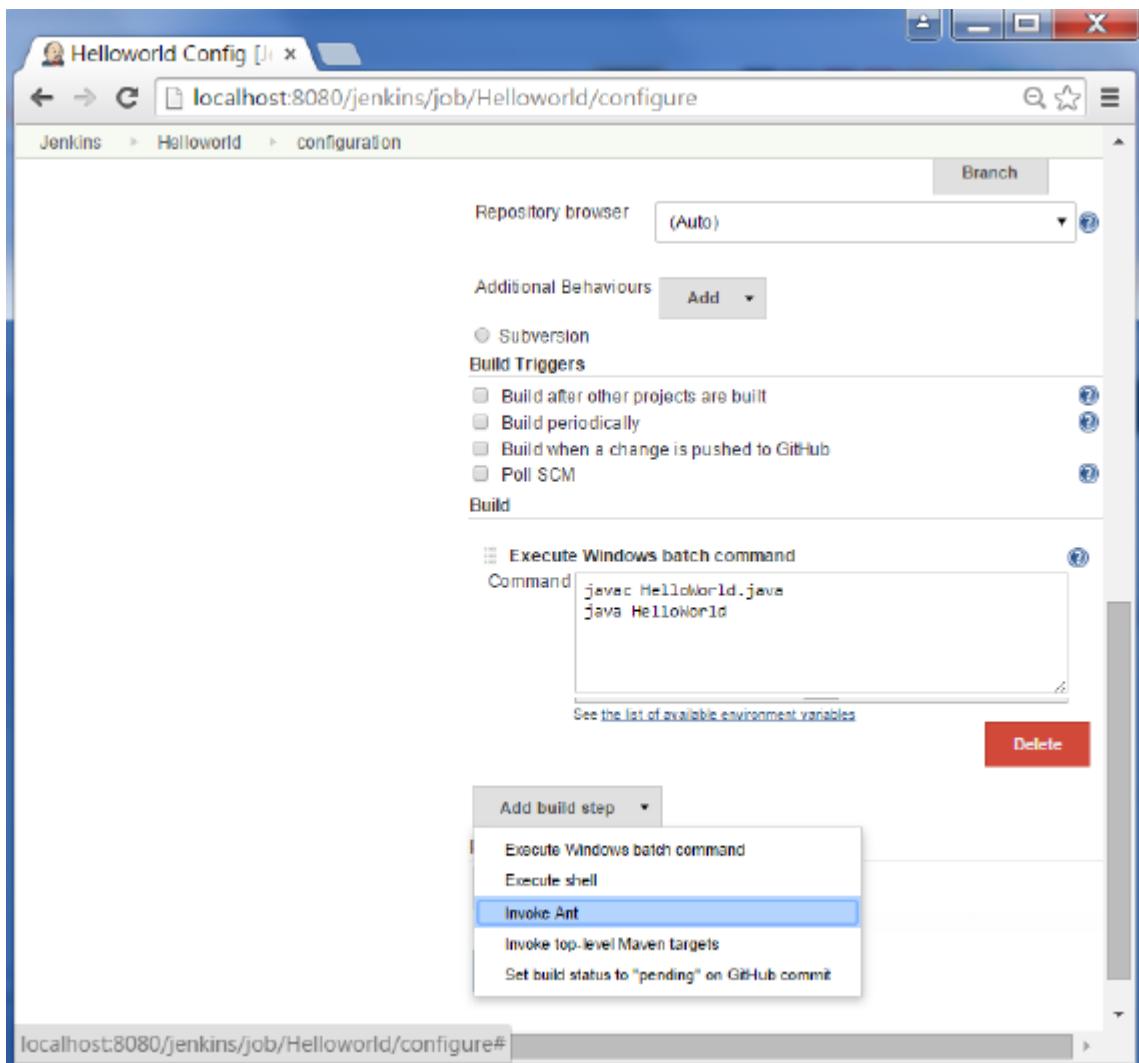
The following example will consider

- A simple HelloWorldTest class based on Junit.
- Ant as the build tool within Jenkins to build the class accordingly.

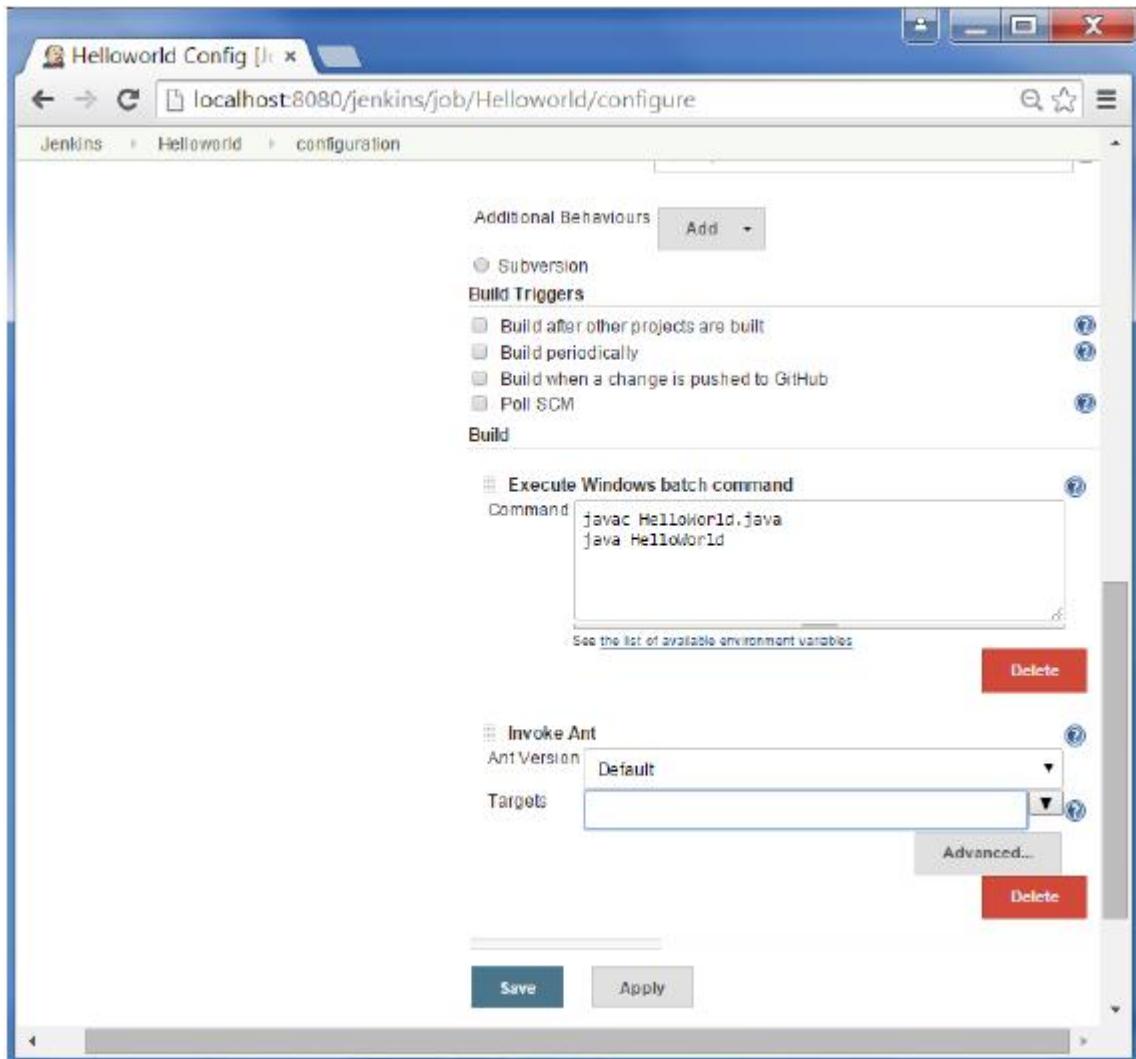
Step 1 – Go to the Jenkins dashboard and Click on the existing HelloWorld project and choose the Configure option

The screenshot shows the Jenkins dashboard at localhost:8080/jenkins/. On the left, there's a sidebar with links like 'New Item', 'People', 'Build History', 'Manage Jenkins', and 'Credentials'. Below that are sections for 'Build Queue' (empty) and 'Build Executor Status' (showing 'master' with 1 idle and 2 idle, and 'build_slave' as offline). The main area displays a table of projects. A context menu is open over the 'HelloWorld' project, which has the following options: 'Changes', 'Workspace', 'Build Now', 'Delete Project', and 'Configure' (which is highlighted in blue).

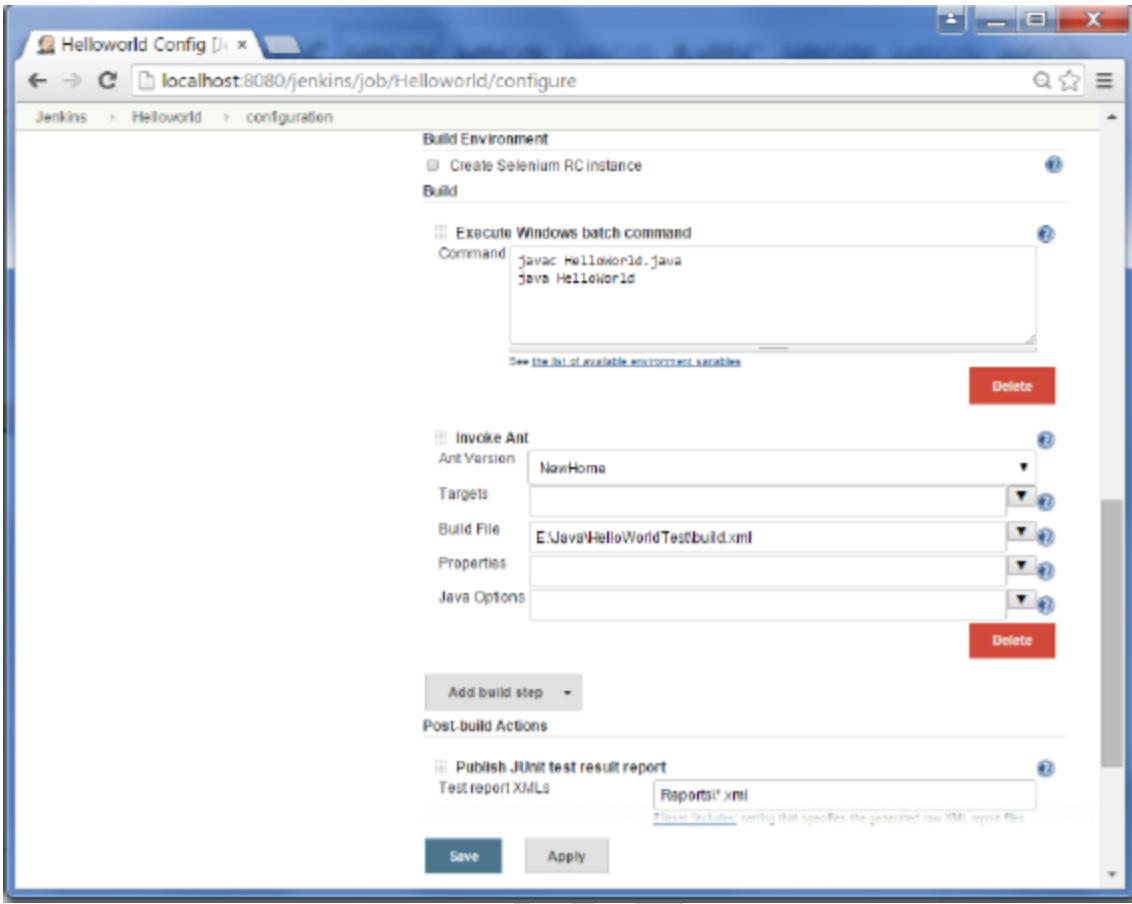
Step 2 – Browse to the section to Add a Build step and choose the option to Invoke Ant.



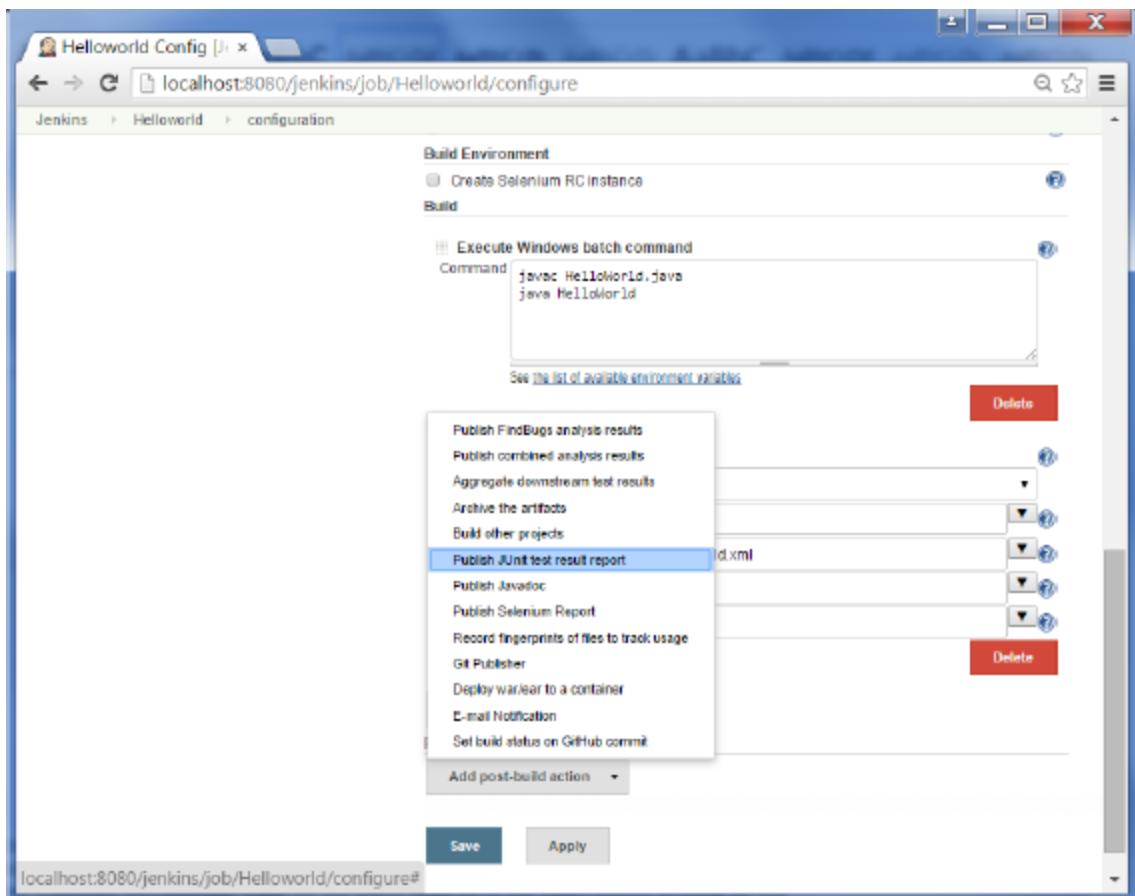
Step 3 – Click on the Advanced button.



Step 4 – In the build file section, enter the location of the build.xml file.

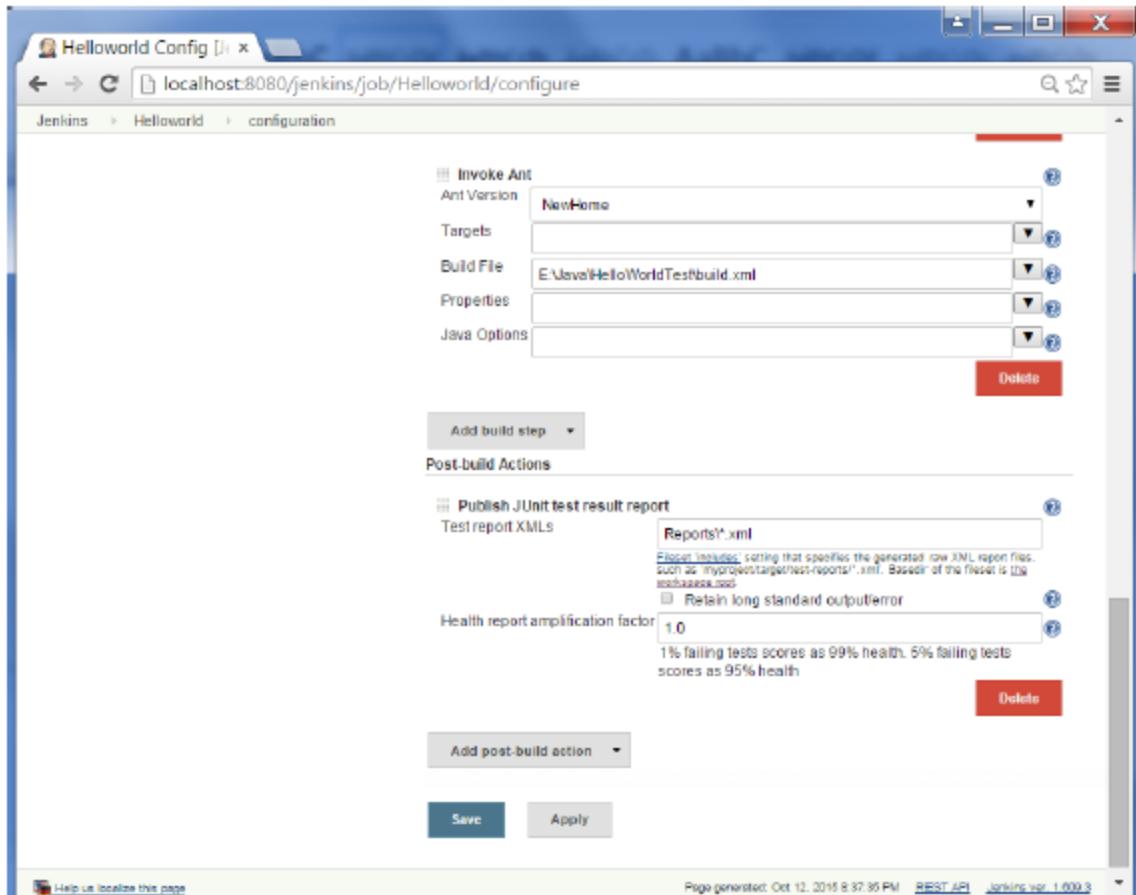


Step 5 – Next click the option to Add post-build option and choose the option of “Publish Junit test result report”



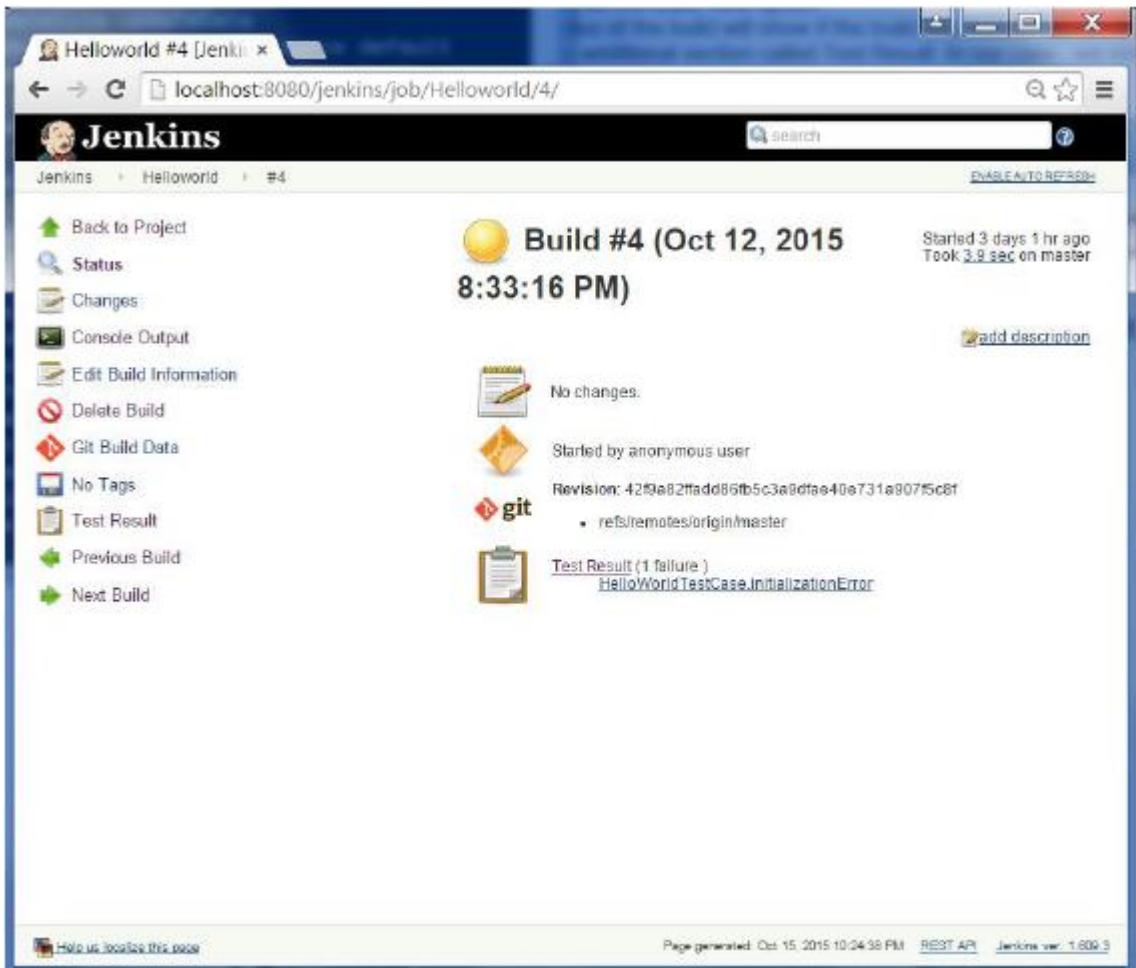
Step 6 – In the Test reports XML's, enter the location as shown below. Ensure that Reports is a folder which is created in the HelloWord project workspace. The “*.xml” basically tells Jenkins to pick up the result xml files which are produced by the running of the Junit test cases. These xml files which then be converted into reports which can be viewed later.

Once done, click the Save option at the end.



Step 7 – Once saved, you can click on the Build Now option.

Once the build is completed, a status of the build will show if the build was successful or not. In the Build output information, you will now notice an additional section called Test Result. In our case, we entered a negative Test case so that the result would fail just as an example.



A screenshot of a web browser displaying a Jenkins job details page. The URL is `localhost:8080/jenkins/job/Helloworld/4/`. The page title is "Helloworld #4 [Jenkin]". The main content area shows "Build #4 (Oct 12, 2015 8:33:16 PM)". It includes a yellow status icon, a timestamp, and a "No changes." message. It also shows the build was started by an anonymous user and the revision is `429a82ffadd86fb5c3e8dfae40e731a8075c8f`, which points to `refs/remotes/origin/master`. A "Test Result" section indicates 1 failure: `HelloWorldTestCase.InitializationError`. On the left, a sidebar lists navigation links: Back to Project, Status, Changes, Console Output, Edit Build Information, Delete Build, Git Build Data, No Tags, Test Result, Previous Build, and Next Build.

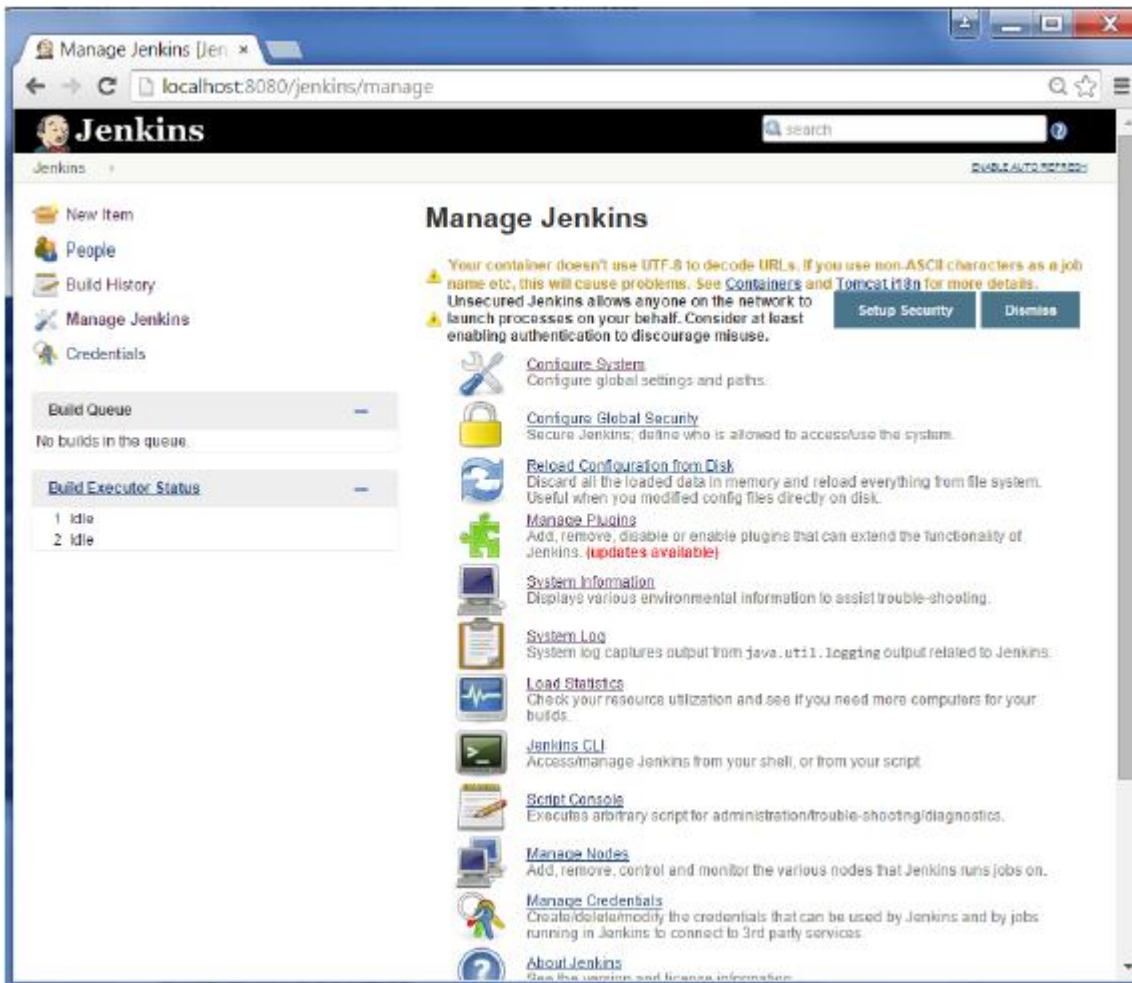
One can go to the Console output to see further information. But what's more interesting is that if you click on Test Result, you will now see a drill down of the Test results.

The screenshot shows a Jenkins test results page for a build named 'Helloworld #4'. The main title is 'Test Result' with a subtitle '1 failures'. A red bar indicates the failure count. Below this, there's a section for 'All Failed Tests' with a single entry: 'HelloWorldTestCase initializationError' (Duration: 10 ms, Age: 1). Another section, 'All Tests', shows a table with one row for 'root' (Duration: 10 ms, Fail: 1, Skip: +1, Pass: 0, Total: 1). The left sidebar contains links for Back to Project, Status, Changes, Console Output, Edit Build Information, History, Git Build Data, No Tags, Test Result, and Previous Build.

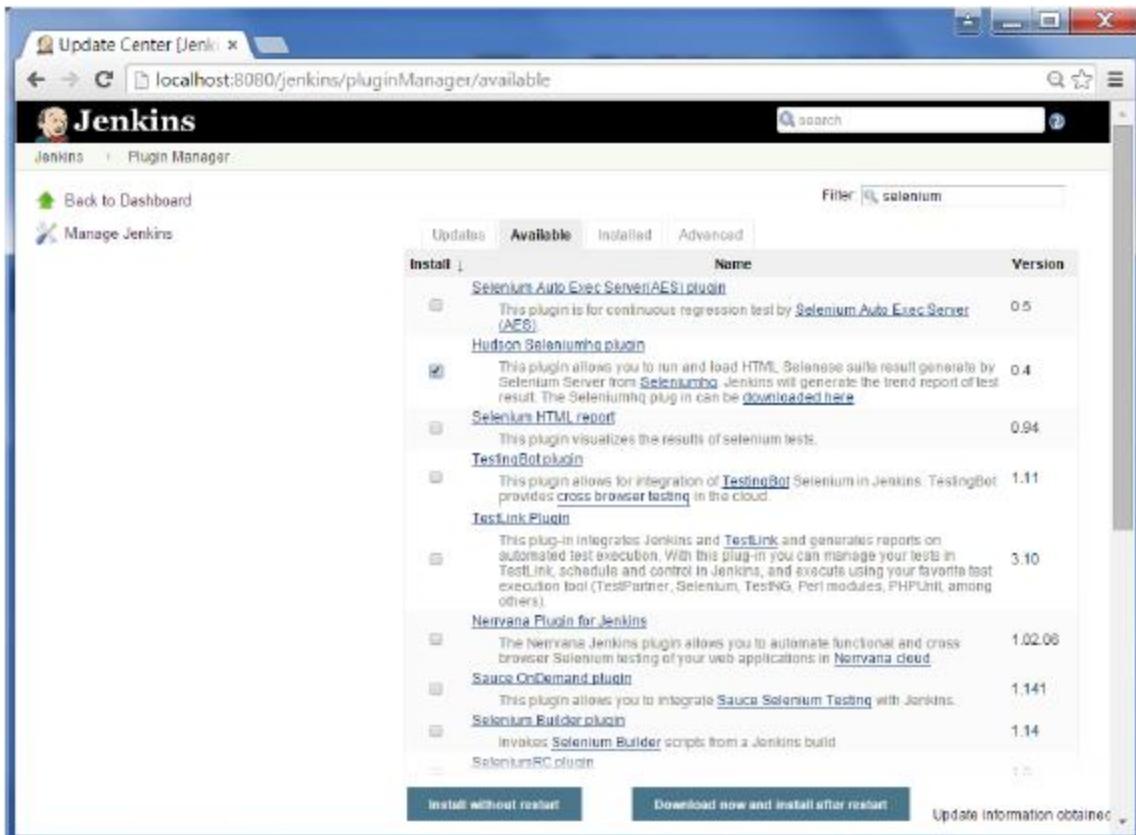
Jenkins - Automated Testing

One of the basic principles of Continuous Integration is that a build should be verifiable. You have to be able to objectively determine whether a particular build is ready to proceed to the next stage of the build process, and the most convenient way to do this is to use automated tests. Without proper automated testing, you find yourself having to retain many build artifacts and test them by hand, which is hardly in the spirit of Continuous Integration. The following example shows how to use Selenium to run automated web tests.

Step 1 – Go to Manage Plugins.



Step 2 – Find the Hudson Selenium Plugin and choose to install. Restart the Jenkins instance.



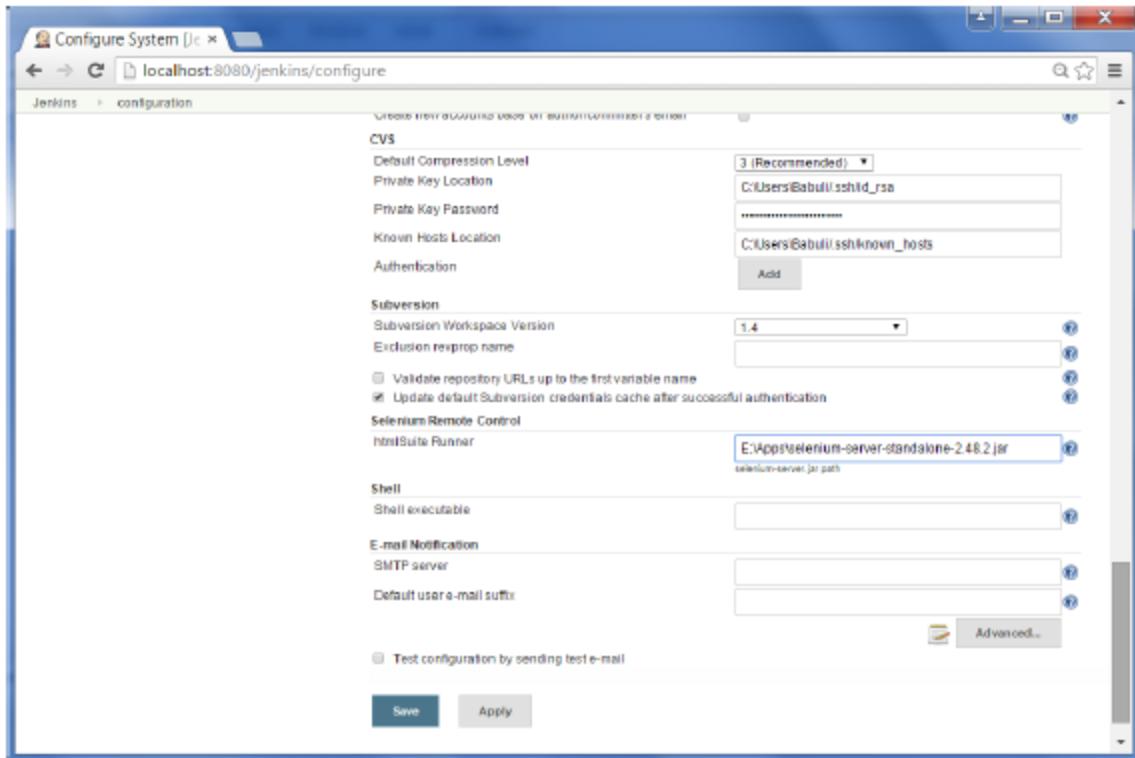
Step 3 – Go to Configure system.

The screenshot shows the Jenkins Manage Jenkins interface. On the left, there's a sidebar with links like 'New Item', 'People', 'Build History', 'Manage Jenkins', and 'Credentials'. The main area is titled 'Manage Jenkins' and contains several configuration options with icons:

- Configure System**: Configure global settings and paths.
- Configure Global Security**: Secure Jenkins; define who is allowed to access the system.
- Reload Configuration from Disk**: Discard all the loaded data in memory and reload everything from file system. Useful when you modified config files directly on disk.
- Manage Plugins**: Add, remove, disable or enable plugins that can extend the functionality of Jenkins. (updates available)
- System Information**: Displays various environmental information to assist trouble-shooting.
- System Log**: System log captures output from `java.util.logging` related to Jenkins.
- Load Statistics**: Check your resource utilization and see if you need more computers for your builds.
- Jenkins CLI**: Access/manage Jenkins from your shell, or from your script.
- Script Console**: Executes arbitrary script for administration/trouble-shooting/diagnostics.
- Manage Nodes**: Add, remove, control and monitor the various nodes that Jenkins runs jobs on.

At the top right, there are 'Setup Security' and 'Dismiss' buttons. A search bar is at the top center, and a 'ENABLE AUTO REFRESH' link is at the top right.

Step 4 – Configure the selenium server jar and click on the Save button.



Note – The selenium jar file can be downloaded from the location [SeleniumHQ](#)

Click on the download for the Selenium standalone server.

The screenshot shows a web browser window displaying the SeleniumHQ download page at www.seleniumhq.org/download/. The page has a blue header bar with the SeleniumHQ logo and navigation links for Projects, Download, Documentation, Support, and About. A sidebar on the left contains links for Selenium Downloads, Latest Releases, Previous Releases, Source Code, and Maven Information. The main content area is titled 'Downloads' and includes sections for 'Selenium Standalone Server', 'The Internet Explorer Driver Server', and 'Selenium Client & WebDriver Language Bindings'. It also features a 'Donate to Selenium' section with a PayPal button and a 'BrowserStack' logo.

Step 5 – Go back to your dashboard and click on the Configure option for the HelloWorld project.

The screenshot shows the Jenkins dashboard at localhost:8080/jenkins/. On the left, there's a sidebar with links like 'New Item', 'People', 'Build History', 'Manage Jenkins', and 'Credentials'. The main area displays a table of jobs. The 'HelloWorld' job is listed with the following details:

S	W	Name	Last Success	Last Failure	Last Duration
Icon: Blue circle	Icon: Cloud	HelloWorld	23 hr - #12	23 hr - #10	3.7 sec

Below the table, there's a legend with three items: 'RSS for all', 'RSS for failures', and 'RSS for just latest builds'. A context menu is open over the 'HelloWorld' row, showing options: 'Changes', 'Workspace', 'Build Now', and 'Delete Project'. At the bottom right of the table area, there's a 'Configure' button.

Step 6 – Click on Add build step and choose the optin of “SeleniumHQ htmlSuite Run”

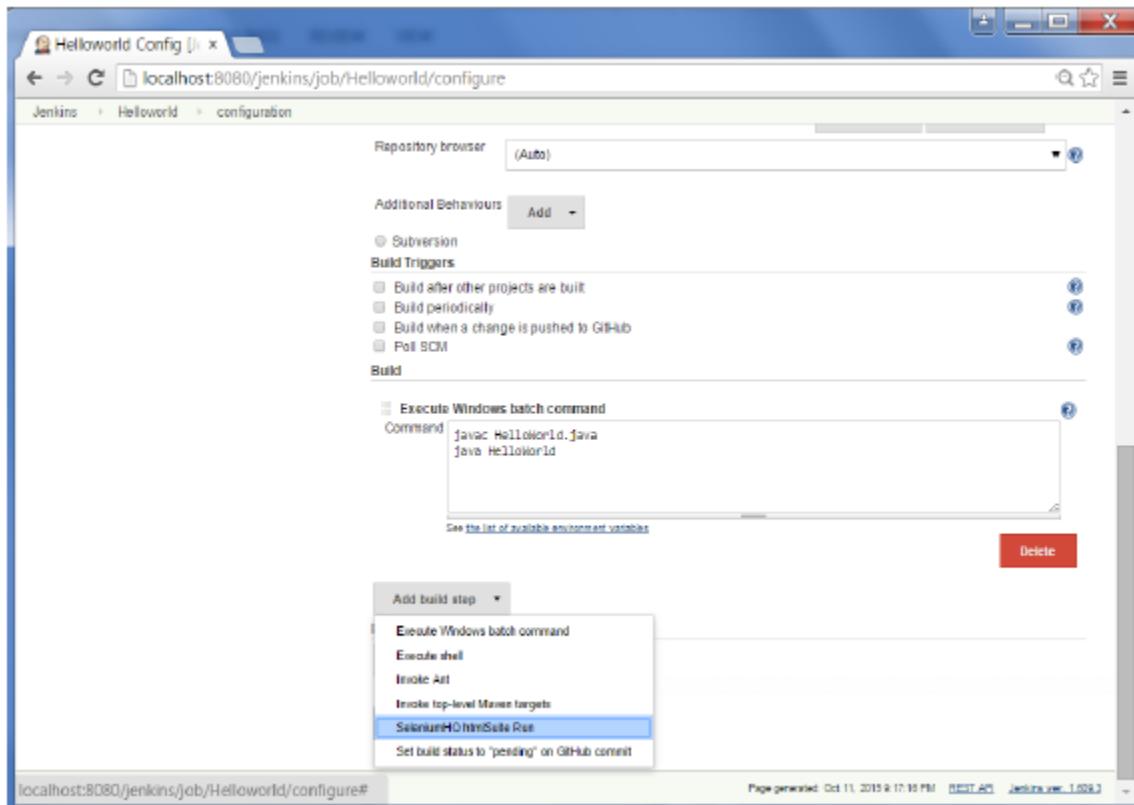
The screenshot shows the configuration page for the 'HelloWorld' job at localhost:8080/jenkins/job/HelloWorld/configure. The page has a header 'Jenkins > HelloWorld > configuration'.

The configuration section includes:

- Build**:
 - 'Create Selenium RC Instance' checkbox (unchecked)
 - 'Execute Windows batch command':
 - Command: `javac HelloWorld.java
java HelloWorld`
 - Link: [See the list of available environment variables](#)
 - 'Delete' button
- SeleniumHQ htmlSuite Run**:
 - browser: `firefox`
 - startURL: `https://www.google.es`
 - suiteFile: `E:\App\NewSample.html`
 - resultFile: `E:\Jenkins\jobs\HelloWorld\workspace\Reports\Results.html`
 - other:
 - 'Delete' button

At the bottom, there are buttons for 'Add build step' (dropdown), 'Post-build Actions' (dropdown), 'Save', and 'Apply'.

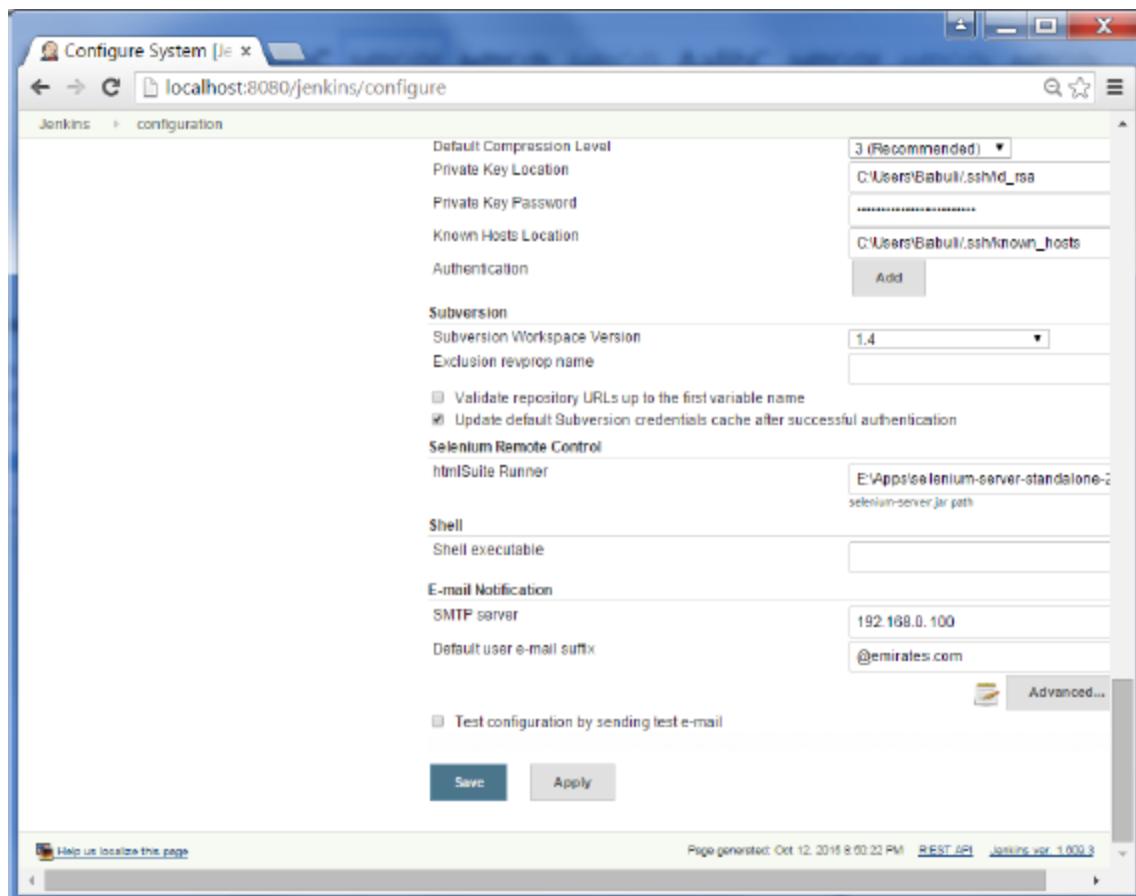
Step 7 – Add the necessary details for the selenium test. Here the suiteFile is the TestSuite generated by using the Selenium IDE. Click on Save and execute a build. Now the post build will launch the selenium driver, and execute the html test.



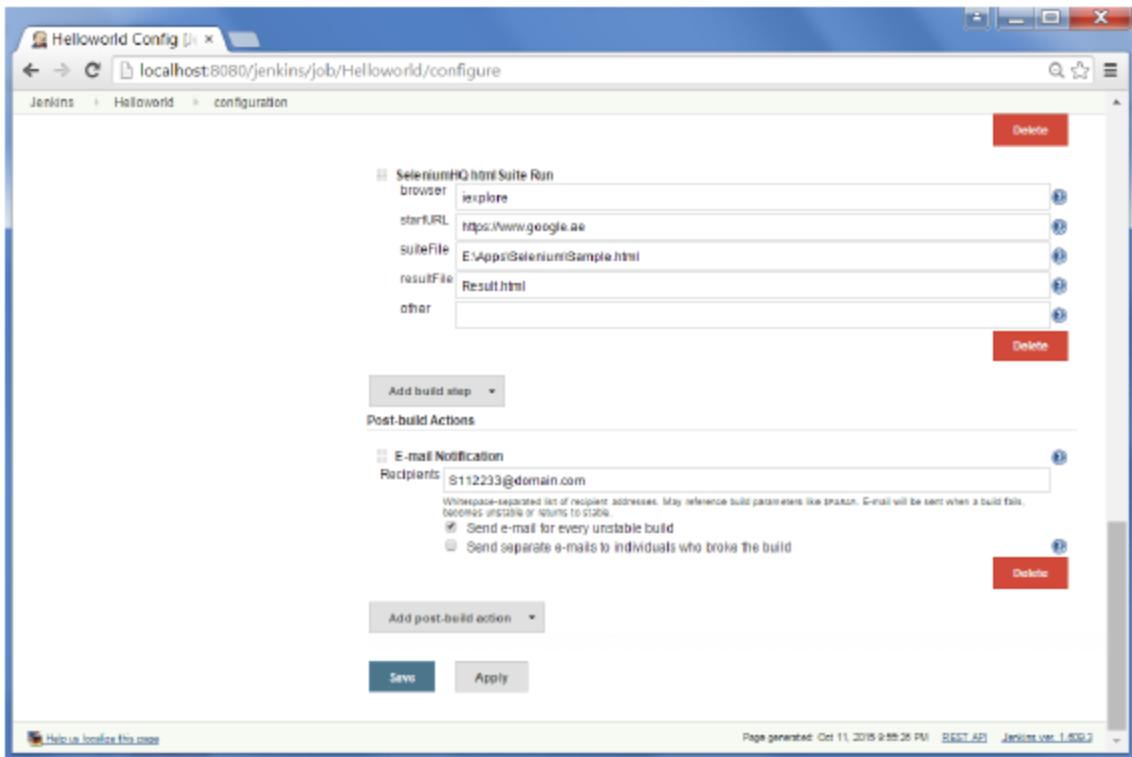
Jenkins - Notification

Jenkins comes with an out of box facility to add an email notification for a build project.

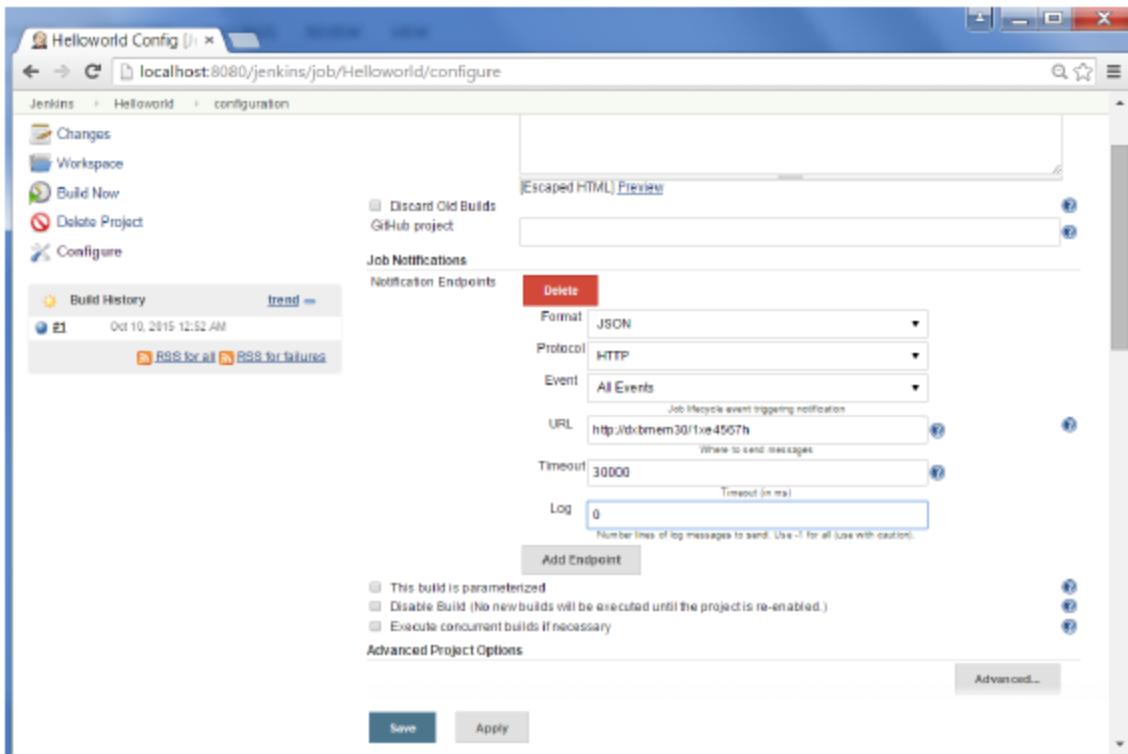
Step 1 – Configuring an SMTP server. Goto Manage Jenkins → Configure System. Go to the E-mail notification section and enter the required SMTP server and user email-suffix details.



Step 2 – Configure the recipients in the Jenkins project - When you configure any Jenkins build project, right at the end is the ability to add recipients who would get email notifications for unstable or broken builds. Then click on the Save button.



Apart from the default, there are also notification plugin's available in the market. An example is the notification plugin from Tikal Knowledge which allows sending Job Status notifications in JSON and XML formats. This plugin enables end-points to be configured as shown below.



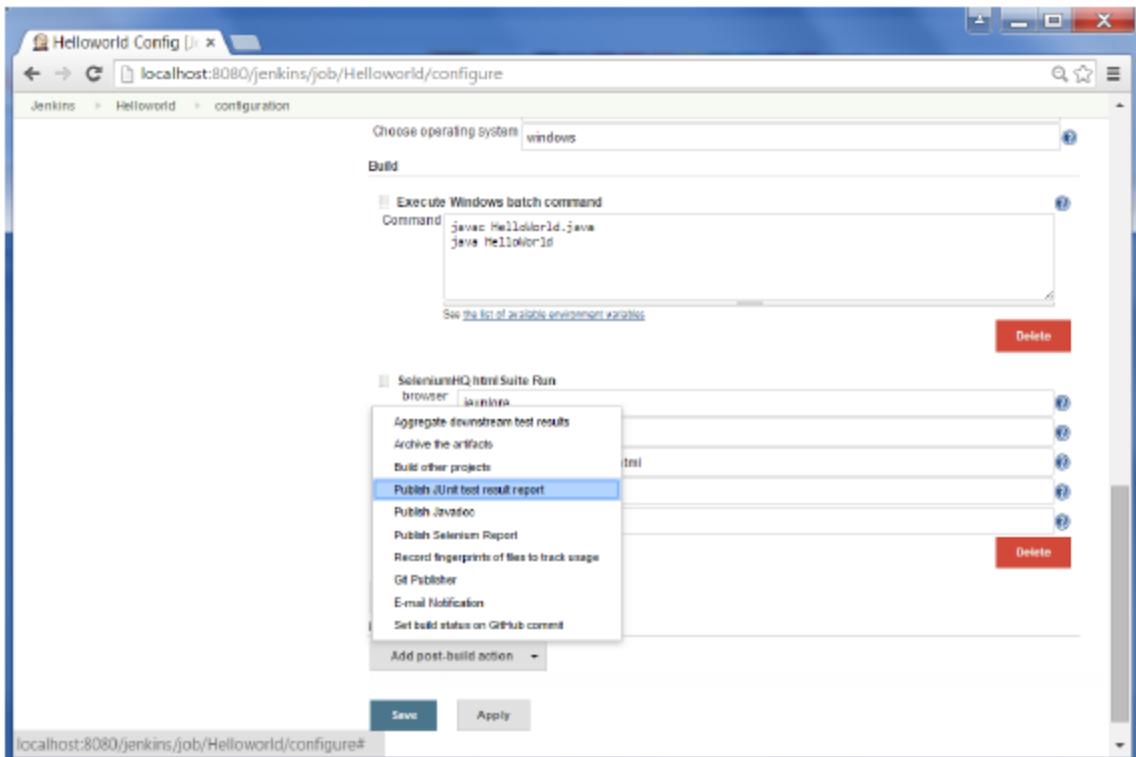
Here are the details of each option –

- **"Format"** – This is the notification payload format which can either be JSON or XML.
- **"Protocol"** – protocol to use for sending notification messages, HTTP, TCP or UDP.
- **"Event"** – The job events that trigger notifications: Job Started, Job Completed, Job Finalized or All Events (the default option).
- **"URL"** – URL to send notifications to. It takes the form of "<http://host>" for HTTP protocol, and "host:port" for TCP and UDP protocols.
- **"Timeout"** – Timeout in milliseconds for sending notification request, 30 seconds by default.

Jenkins - Reporting

As demonstrated in the earlier section, there are many reporting plugins available with the simplest one being the reports available for jUnit tests.

In the Post-build action for any job, you can define the reports to be created. After the builds are complete, the Test Results option will be available for further drill-down.



Jenkins - Code Analysis

Jenkins has a host of Code Analysis plugin. The various plugins can be found at <https://wiki.jenkins-ci.org/display/JENKINS/Static+Code+Analysis+Plugins>

The screenshot shows the Jenkins Static Code Analysis Plug-ins page. On the left, there's a sidebar with links like Home, Mailing Lists, Source code, Bugtracker, Security Advisories, Events, Donation, Commercial Support, and Wiki Site Map. The main content area has a header "Static Code Analysis Plug-ins" with a sub-header "Plugin Information". It shows details for the "analysis-core" plugin, including its ID, latest release (1.74), latest release date (Sep 07, 2015), required core version (1.506.1), dependencies (aer, token-magic, maven-plugin, matrix-project, dashboard-view), and GitHub links for source code, issue tracking, pull requests, and maintainers (Ulf Hafner). Below this is a "Usage" section with a chart titled "analysis-core - installations" showing a steady increase from October 2014 to September 2015. The chart has a Y-axis from 0 to 25000 and an X-axis from Oct 14 to Sep 15. The data points are: (Oct 14, ~25000), (Nov 14, ~25000), (Dec 14, ~25000), (Jan 15, ~25000), (Feb 15, ~25000), (Mar 15, ~25000), (Apr 15, ~25000), (May 15, ~25000), (Jun 15, ~25000), (Jul 15, ~25000), (Aug 15, ~25000), (Sep 15, ~25000).

This plugin provides utilities for the static code analysis plugins. Jenkins can parse the results file from various Code Analysis tools such as CheckStyle, FindBugs, PMD etc. For each corresponding code analysis tool, a plugin in Jenkins needs to be installed.

Additionally the add-on plugin [Static Analysis Collector](#) is available that combines the individual results of these plugins into a single trend graph and view.

The plugins can provide information such as

- The total number of warnings in a job
- A showing of the new and fixed warnings of a build
- Trend Reports showing the number of warnings per build
- Overview of the found warnings per module, package, category, or type
- Detailed reports of the found warnings optionally filtered by severity (or new and fixed)

Jenkins - Distributed Builds

Sometimes many build machines are required if there are instances wherein there are a larger and heavier projects which get built on a regular basis. And running all of these builds on a central machine may not be the best option. In such a scenario, one can configure other Jenkins machines to be slave machines to take the load off the master Jenkins server.

Sometimes you might also need several different environments to test your builds. In this case using a slave to represent each of your required environments is almost a must.

A slave is a computer that is set up to offload build projects from the master and once setup this distribution of tasks is fairly automatic. The exact delegation behavior depends on the configuration of each project; some projects may choose to "stick" to a particular machine for a build, while others may choose to roam freely between slaves.

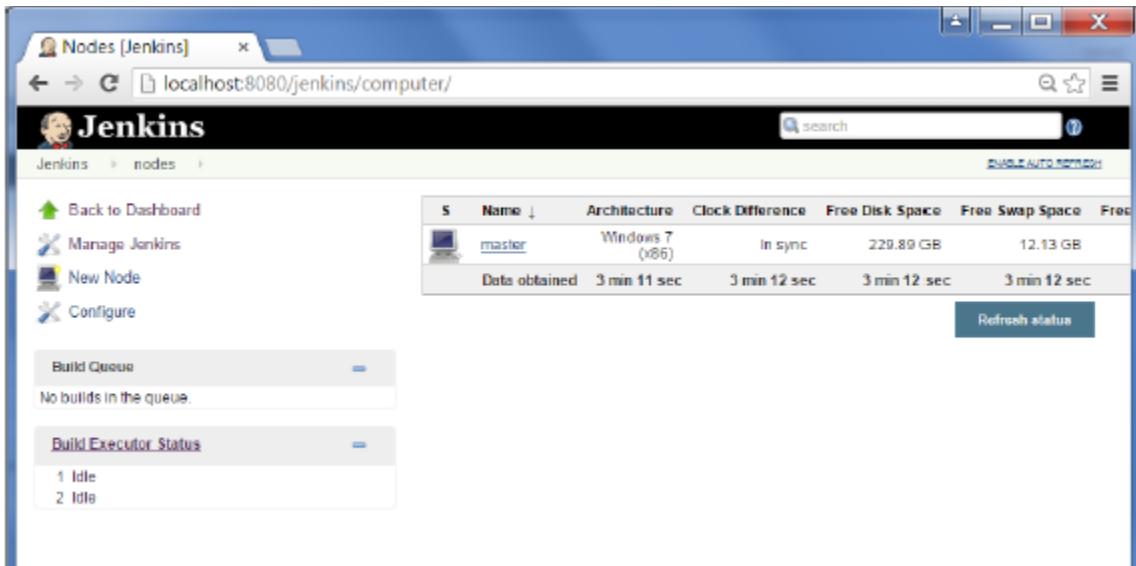
Since each slave runs a separate program called a "slave agent" there is no need to install the full Jenkins (package or compiled binaries) on a slave. There are various ways to start slave agents, but in the end the slave agent and Jenkins master needs to establish a bi-directional communication link (for example a TCP/IP socket.) in order to operate.

To set up slaves/nodes in Jenkins follow the steps given below.

Step 1 – Go to the Manage Jenkins section and scroll down to the section of Manage Nodes.

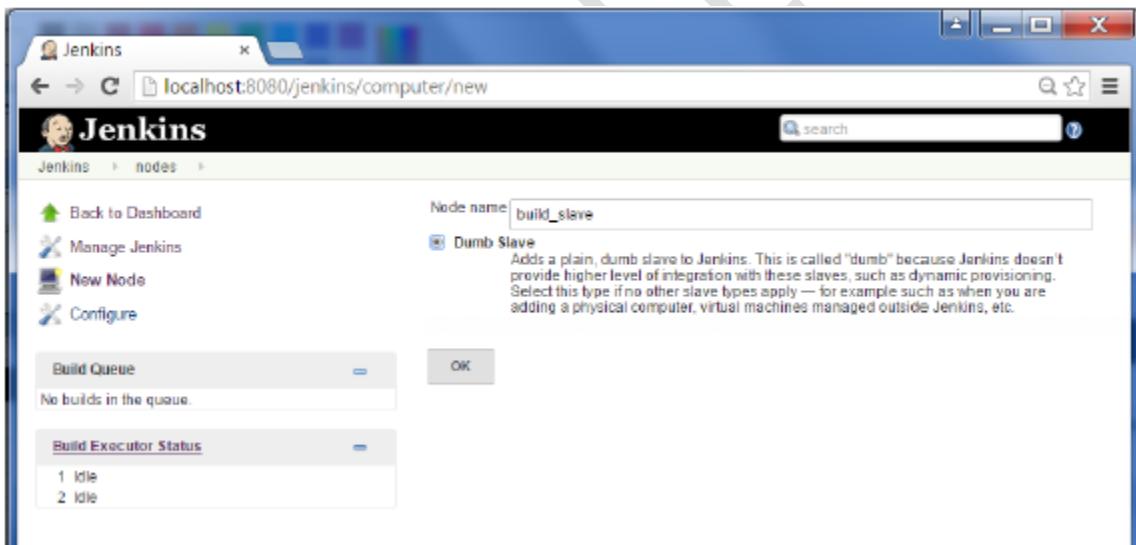


Step 2 – Click on New Node



The screenshot shows the Jenkins 'Nodes' page. In the left sidebar, under the 'nodes' section, there is a link labeled 'New Node'. The main content area displays a table of existing nodes. One node, named 'master', is listed with the following details: Architecture: Windows 7 (x86), Clock Difference: In sync, Free Disk Space: 229.89 GB, Free Swap Space: 12.13 GB, and Data obtained: 3 min 11 sec. A 'Refresh status' button is located at the bottom right of the table.

Step 3 – Give a name for the node, choose the Dumb slave option and click on Ok.



The screenshot shows the 'New Node' configuration dialog. In the 'Node name' field, the value 'build_slave' is entered. Below it, the 'Dumb Slave' radio button is selected. A tooltip provides a description: 'Adds a plain, dumb slave to Jenkins. This is called "dumb" because Jenkins doesn't provide higher level of integration with these slaves, such as dynamic provisioning. Select this type if no other slave types apply — for example such as when you are adding a physical computer, virtual machines managed outside Jenkins, etc.' At the bottom right of the dialog, there is an 'OK' button.

Step 4 – Enter the details of the node slave machine. In the below example, we are considering the slave machine to be a windows machine, hence the option of “Let Jenkins control this Windows slave as a Windows service” was chosen as the launch method. We also need to add the necessary details of the slave node such as the node name and the login credentials for the node machine. Click the Save button. The Labels for which the name is entered as “New_Slave” is what can be used to configure jobs to use this slave machine.

The screenshot shows the Jenkins 'build_slave' configuration page. The left sidebar includes links for Back to List, Status, Delete Slave, Configure, Build History, Load Statistics, and Log. The main form fields are:

- Name:** build_slave
- Description:** (empty)
- # of executors:** 1
- Remote root directory:** D:\Jenkins
- Labels:** New_Slave
- Usage:** Utilize this node as much as possible
- Launch method:** Let Jenkins control this Windows slave as a Windows service

A note below the launch method states: "This launch method relies on DCOM and is often associated with subtle problems. Consider using Launch slave agents using Java Web Start instead, which also permits installation as a Windows service but is generally considered more reliable."

Below the launch method are fields for:

- Administrator user name:** admin
- Password:** (redacted)
- Host:** dbmm30
- Run service as:** Use Local System User

An **Advanced...** button is available. The **Availability** dropdown is set to "Keep this slave on-line as much as possible".

Node Properties section includes checkboxes for Environment variables and Tool Locations.

A **Save** button is at the bottom.

Once the above steps are completed, the new node machine will initially be in an offline state, but will come online if all the settings in the previous screen were entered correctly. One can at any time make the node slave machine as offline if required.

The screenshot shows the Jenkins 'Nodes' page. The left sidebar includes links for Back to Dashboard, Manage Jenkins, New Node, and Configure. The main area displays a table of nodes:

S	Name	Architecture	Clock Difference	Free Disk Space	Free Swap Space	Free Temp S
1	build_slave		N/A	N/A	N/A	
2	master	Windows 7 (x86)	In sync	229.89 GB	12.13 GB	229.8

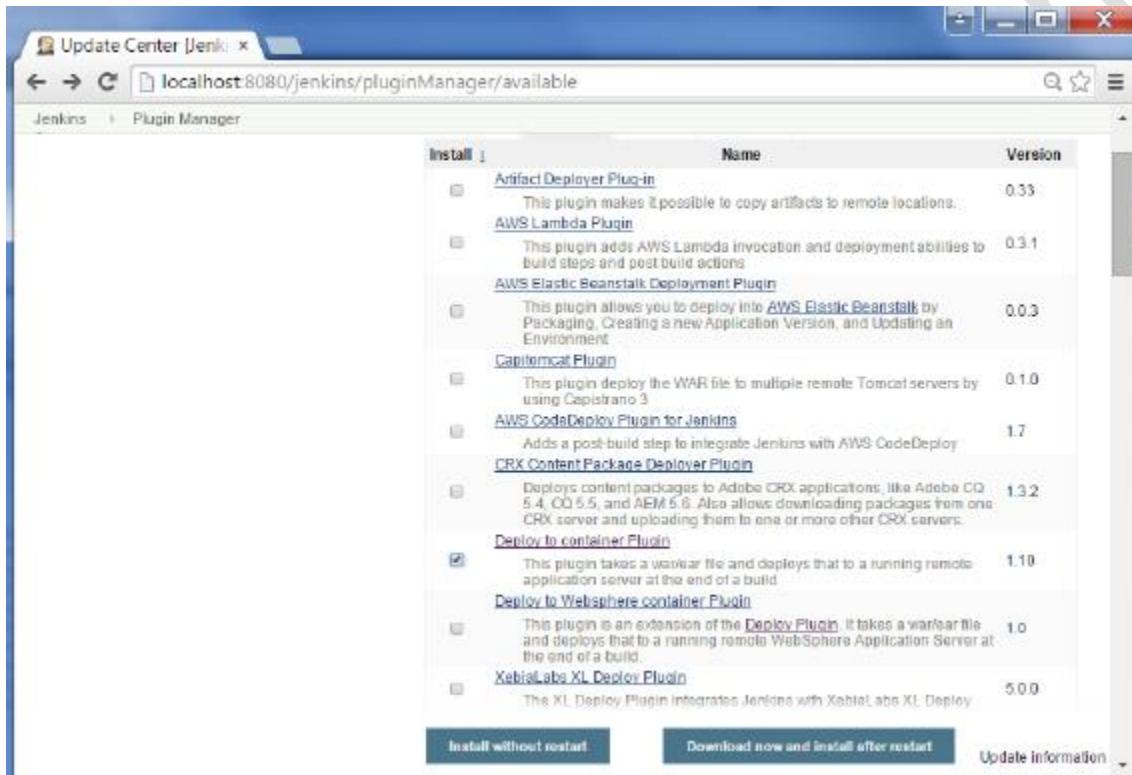
Below the table, it says "Data obtained" and shows times: 3 ms, 2 ms, 1 ms, 11 min. A **Refresh status** button is present.

The sidebar also shows a **Build Queue** section stating "No builds in the queue." and a **Build Executor Status** section showing "master" with 1 idle and 2 idle, and "build_slave" as (offline).

Jenkins - Automated Deployment

There are many plugins available which can be used to transfer the build files after a successful build to the respective application/web server. One example is the “Deploy to container Plugin”. To use this follow the steps given below.

Step 1 – Go to Manage Jenkins → Manage Plugins. Go to the Available section and find the plugin “Deploy to container Plugin” and install the plugin. Restart the Jenkins server.



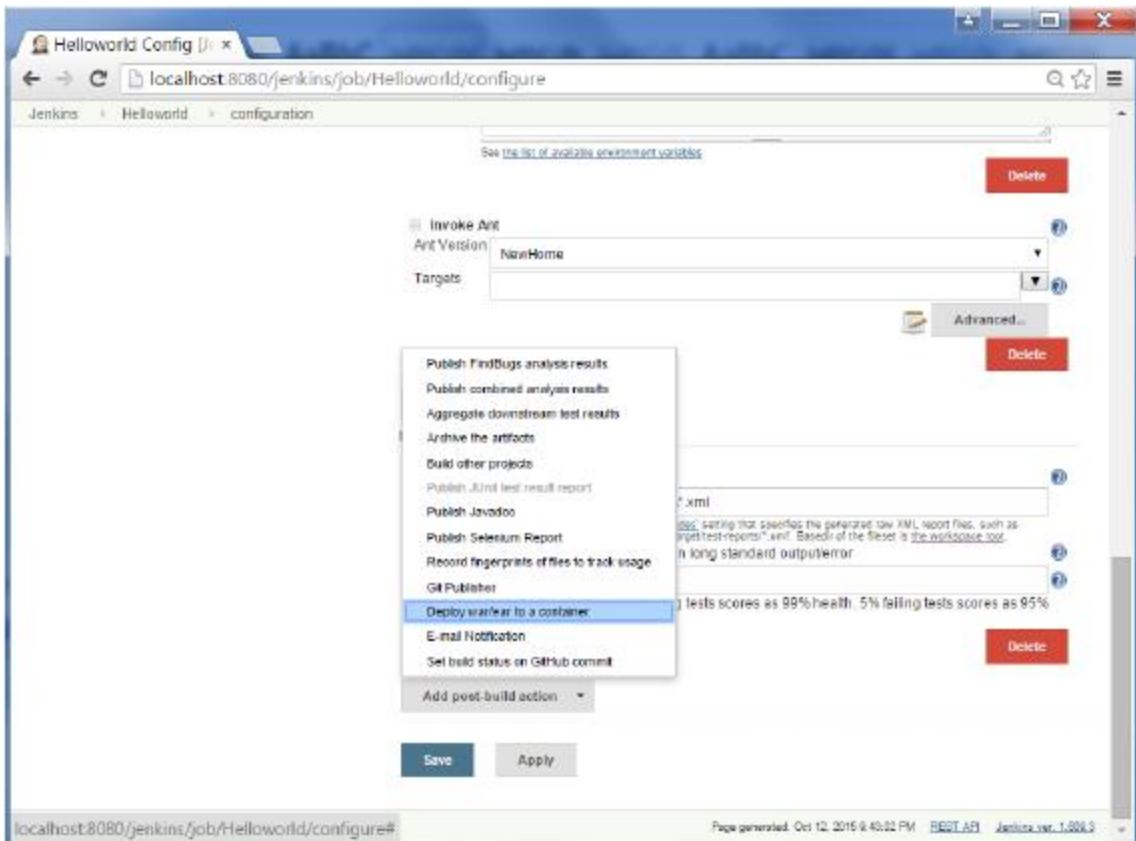
This plugin takes a war/ear file and deploys that to a running remote application server at the end of a build.

Tomcat 4.x/5.x/6.x/7.x

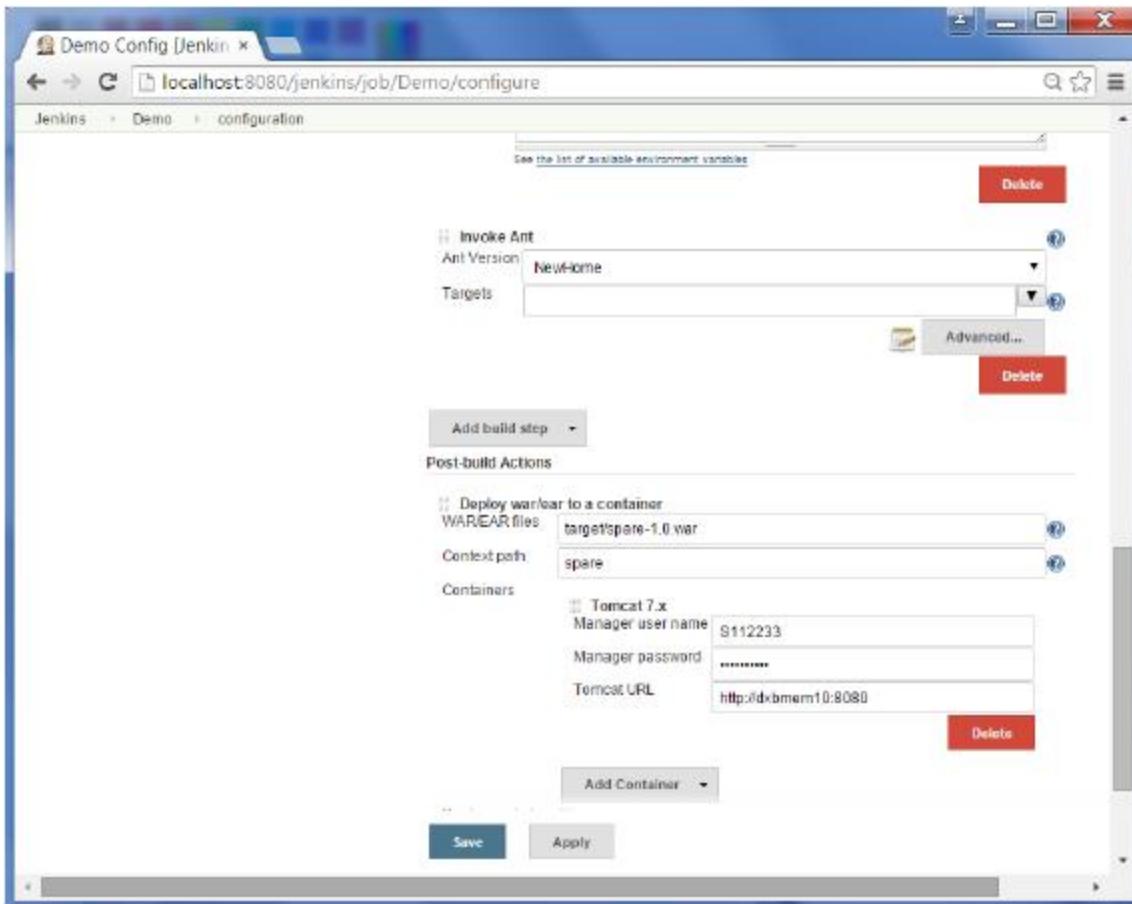
JBoss 3.x/4.x

Glassfish 2.x/3.x

Step 2 – Go to your Build project and click the Configure option. Choose the option “Deploy war/ear to a container”



Step 3 – In the Deploy war/ear to a container section, enter the required details of the server on which the files need to be deployed and click on the Save button. These steps will now ensure that the necessary files get deployed to the necessary container after a successful build.



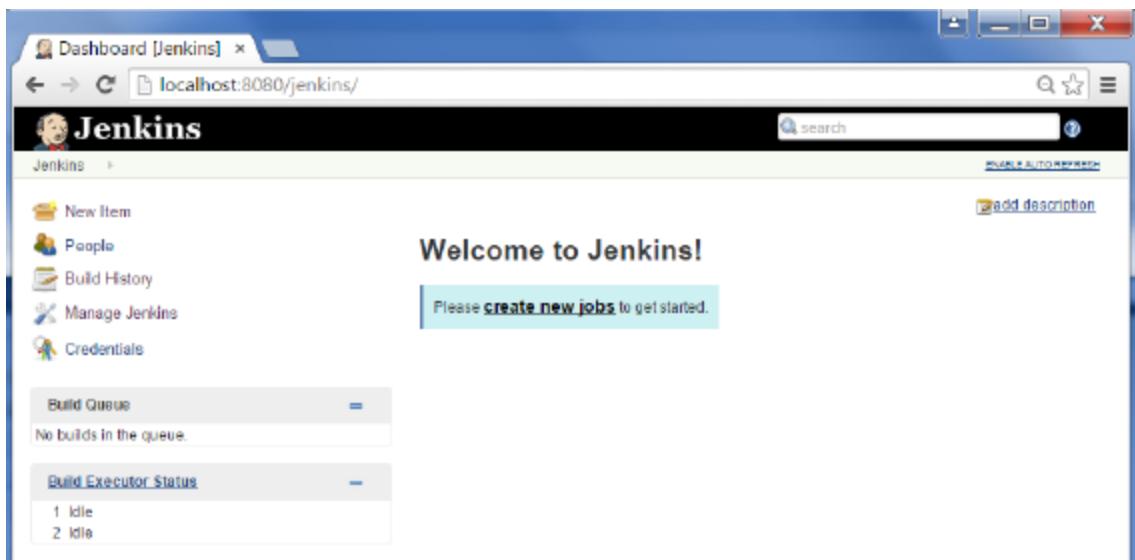
Jenkins - Metrics & Trends

There are various plugins which are available in Jenkins to showcase metrics for builds which are carried out over a period of time. These metrics are useful to understand your builds and how frequently they fail/pass over time. As an example, let's look at the 'Build History Metrics plugin'.

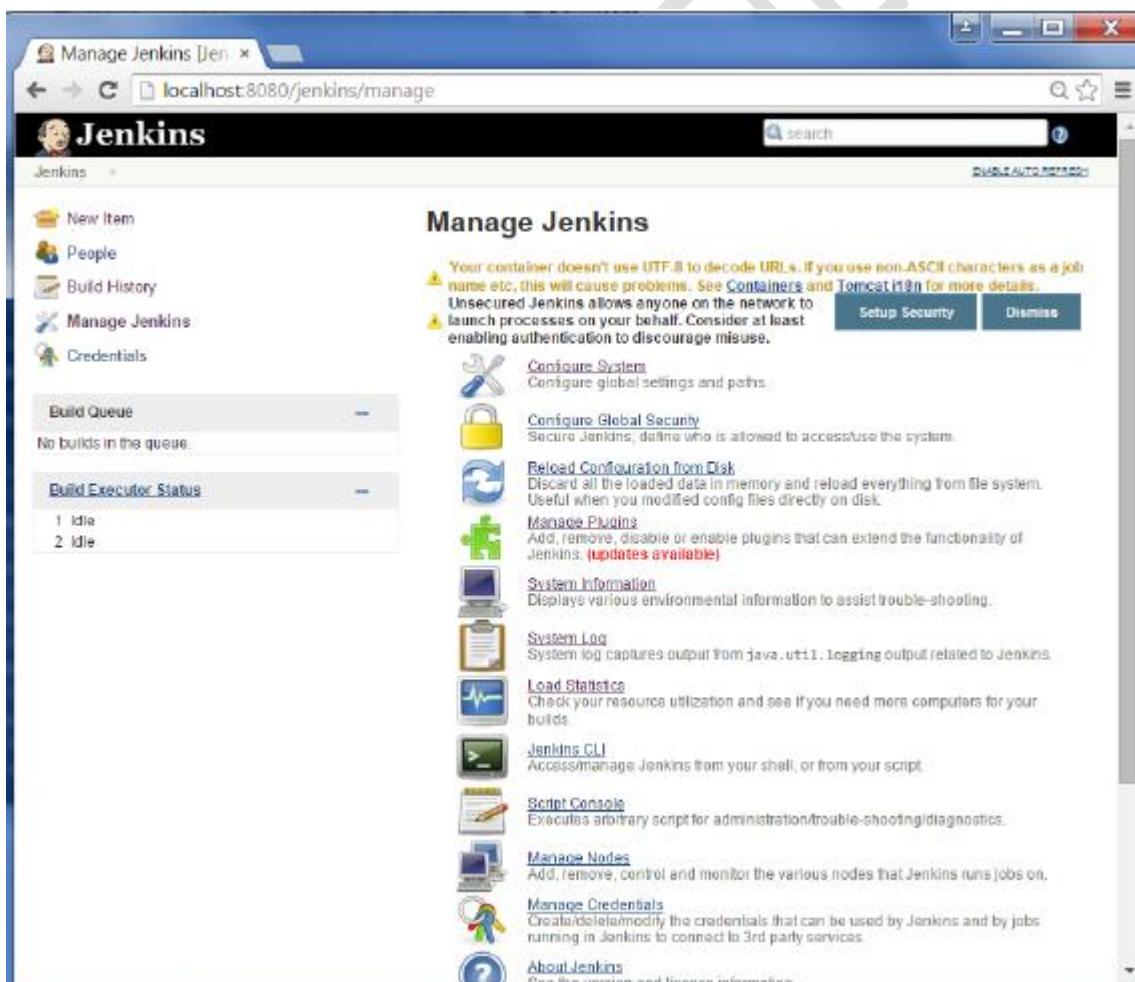
This plugin calculates the following metrics for all of the builds once installed

- Mean Time To Failure (MTTF)
- Mean Time To Recovery (MTTR)
- Standard Deviation of Build Times

Step 1 – Go to the Jenkins dashboard and click on Manage Jenkins



Step 2 – Go to the Manage Plugins option.



Step 3 – Go to the Available tab and search for the plugin ‘Build History Metrics plugin’ and choose to ‘install without restart’.

The screenshot shows the Jenkins Update Center interface. The title bar says 'Update Center [Jenkins]'. The address bar shows 'localhost:8080/jenkins/pluginManager/available'. The main area has a 'Jenkins' logo and 'Plugin Manager' text. Below it are links for 'Back to Dashboard' and 'Manage Jenkins'. There are tabs for 'Updates', 'Available' (which is selected), 'Installed', and 'Advanced'. A search bar at the top right contains the text 'build-history-metrics-plugin'. A table lists the plugin: Name is 'Build History Metrics plugin', Version is '1.2', and the description is 'Provides build metrics that encompass the history of all the runs'. Below the table are two buttons: 'Install without restart' (highlighted in blue) and 'Download now and install after restart'. At the bottom right, it says 'Update information obtained: 2 mi'.

Step 4 – The following screen shows up to confirm successful installation of the plugin. Restart the Jenkins instance.

The screenshot shows the Jenkins node configuration page for 'build_slave'. The title bar says 'build_slave Configuration [Jenkins]'. The address bar shows 'localhost:8080/jenkins/computer/build_slave/configure'. The left sidebar has links for 'Back to List', 'Status', 'Delete Slave', 'Configure', 'Build History', 'Load Statistics', and 'Log'. The main form has fields for 'Name' (build_slave), 'Description' (empty), '# of executors' (1), 'Remote root directory' (D:\Jenkins), 'Labels' (New_Slave), 'Usage' (Utilize this node as much as possible), and 'Launch method' (Let Jenkins control this Windows slave as a Windows service). A note below the launch method says: 'This launch method relies on DCOM and is often associated with subtle problems. Consider using Launch slave agents using Java Web Start instead, which also permits installation as a Windows service but is generally considered more reliable.' It also shows fields for 'Administrator user name' (admin), 'Password' (redacted), 'Host' (dbmm30), and 'Run service as' (Use Local System User). There is an 'Advanced...' button. The 'Availability' section has a dropdown set to 'Keep this slave on-line as much as possible'. The 'Node Properties' section includes 'Environment variables' and 'Tool Locations'. At the bottom is a 'Save' button.

When you go to your Job page, you will see a table with the calculated metrics. Metric's are shown for the last 7 days, last 30 days and all time.

The screenshot shows the Jenkins Project Helloworld dashboard. On the left, there's a sidebar with links: Back to Dashboard, Status, Changes, Workspace, Build Now, Delete Project, and Configure. Below that is the Build History table:

	trend →
#12	Oct 24, 2015 3:57 PM
#11	Oct 15, 2015 10:22 PM
#10	Oct 12, 2015 10:50 PM
#9	Oct 12, 2015 10:48 PM
#8	Oct 12, 2015 10:40 PM
#7	Oct 12, 2015 10:39 PM
#6	Oct 12, 2015 10:31 PM
#5	Oct 12, 2015 10:29 PM
#4	Oct 12, 2015 8:33 PM
#3	Oct 11, 2015 11:04 PM
#2	Oct 11, 2015 10:51 PM
#1	Oct 11, 2015 10:48 PM

At the bottom of the sidebar are RSS links for all and failures.

On the right, there are three tables for MTTR, MTTF, and Standard Deviation:

	Last 7 Days	0 ms
MTTR	Last 30 Days	23 hr
	All Time	23 hr

	Last 7 Days	0 ms
MTTF	Last 30 Days	2 days 4 hr
	All Time	2 days 4 hr

	Last 7 Days	0 ms
Standard Deviation	Last 30 Days	52 sec
	All Time	52 sec

Below these tables is a section for Permalinks:

- Last build (#12), 5.5 sec ago
- Last stable build (#11), 8 days 17 hr ago
- Last successful build (#11), 8 days 17 hr ago
- Last failed build (#12), 5.5 sec ago
- Last unstable build (#4), 11 days ago
- Last unsuccessful build (#12), 5.5 sec ago

At the bottom of the page are links for Help us localize this page, Page generated: Oct 24, 2015 3:57:19 PM, REST API, Jenkins ver. 1.600.3, and a search bar.

To see overall trends in Jenkins, there are plugins available to gather information from within the builds and Jenkins and display them in a graphical format. One example of such a plugin is the 'Hudson global-build-stats plugin'. So let's go through the steps for this.

Step 1 – Go to the Jenkins dashboard and click on Manage Jenkins

The screenshot shows the Jenkins dashboard at localhost:8080/jenkins/. The left sidebar includes links for New Item, People, Build History, Manage Jenkins, and Credentials. The main area features a "Welcome to Jenkins!" message with a link to "create new jobs". Below this are sections for "Build Queue" (No builds in the queue) and "Build Executor Status" (1 Idle, 2 Idle).

Step 2 – Go to the Manage Plugins option

The screenshot shows the Manage Jenkins page at localhost:8080/jenkins/manage. The left sidebar is identical to the dashboard. The main area is titled "Manage Jenkins" and lists several management options. A warning message at the top right states: "Your container doesn't use UTF-8 to decode URLs. If you use non-ASCII characters as a job name etc, this will cause problems. See [Containers](#) and [TomcatI18n](#) for more details." Below this are buttons for "Setup Security" and "Dismiss". The "Manage Plugins" option is highlighted with a red box.

Step 3 – Go to the Available tab and search for the plugin ‘Hudson global-build-stats plugin’ and choose to ‘install without restart’.

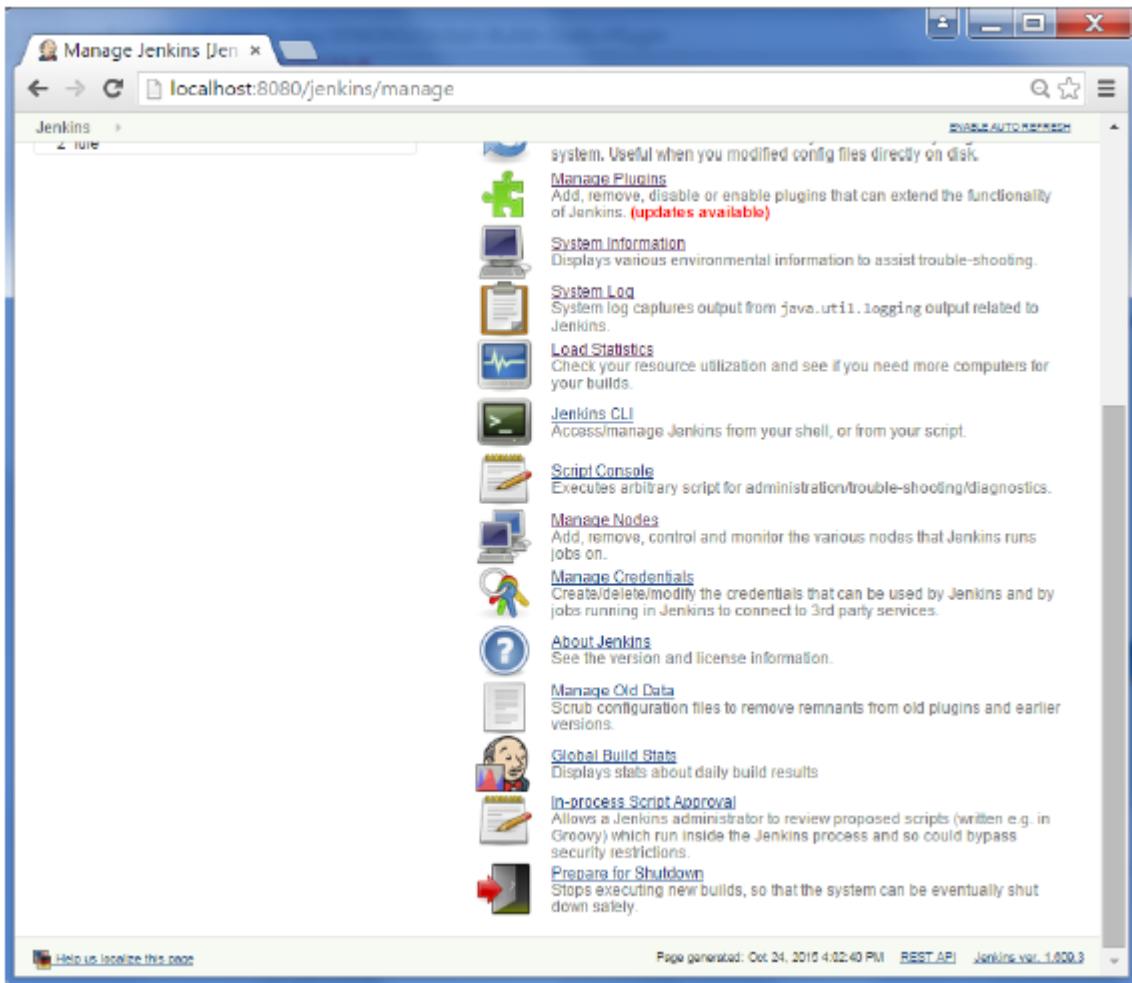
The screenshot shows the Jenkins Plugin Manager interface. The 'Available' tab is selected. A search bar at the top right contains the text 'global-build-stats'. Below it is a table with columns 'Name', 'Version', and 'Description'. One row in the table is highlighted for the 'Hudson global-build-stats plugin' version 1.3. The description for this plugin states: 'Global build stats plugin will allow to gather and display global build result statistics. It is a useful tool allowing to display global hudson build trend over time.' At the bottom of the table are three buttons: 'Install without restart' (which is blue and highlighted), 'Download now and install after restart', and 'Update information'.

Step 4 – The following screen shows up to confirm successful installation of the plugin. Restart the Jenkins instance.

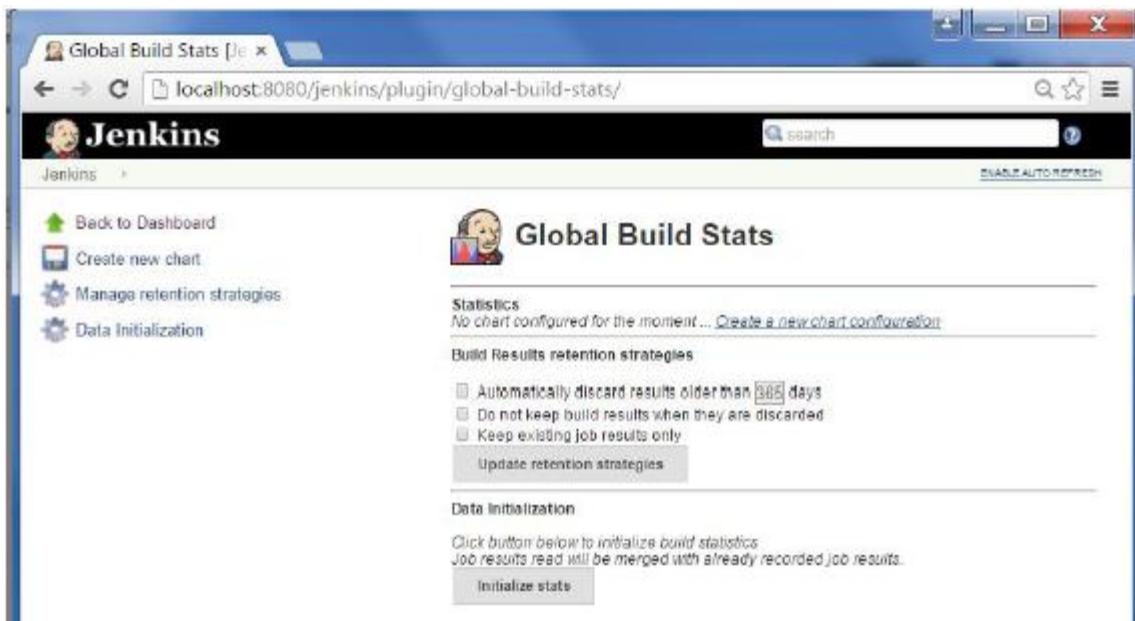
The screenshot shows the Jenkins Update Center page titled 'Installing Plugins/Upgrades'. It displays the status of the 'Hudson global-build-stats plugin' as 'Success'. Below this, there are two links: 'Go back to the top page (you can start using the installed plugins right away)' and 'Restart Jenkins when installation is complete and no jobs are running'.

To see the Global statistics, please follow the Step 5 through 8.

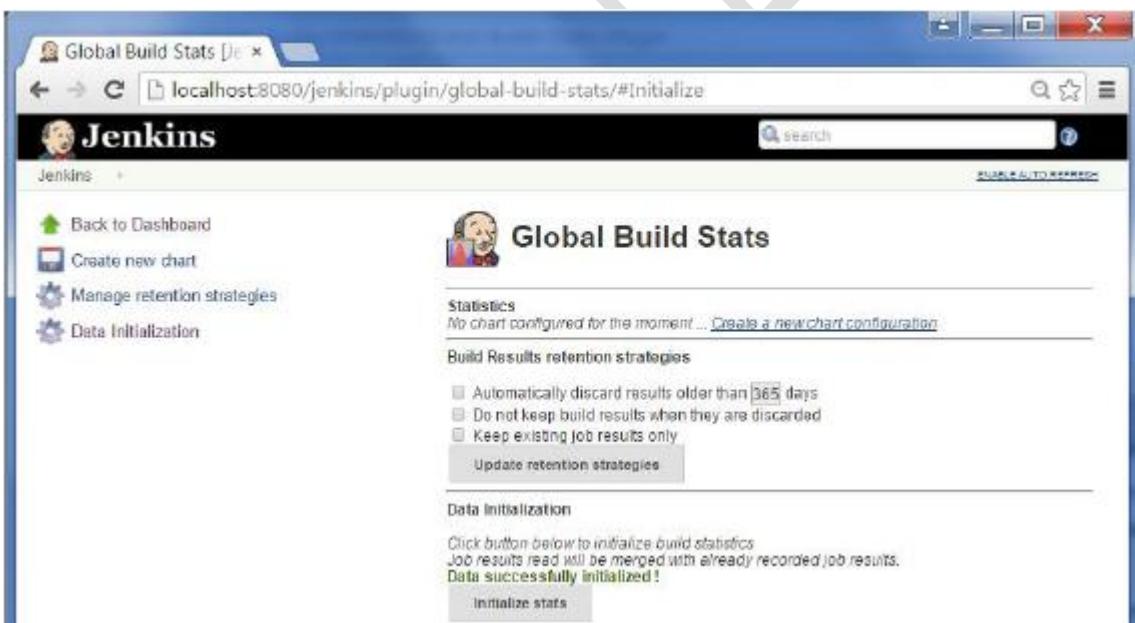
Step 5 – Go to the Jenkins dashboard and click on Manage Jenkins. In the Manage Jenkins screen, scroll down and now you will now see an option called ‘Global Build Stats’. Click on this link.



Step 6 – Click on the button ‘Initialize stats’. What this does is that it gathers all the existing records for builds which have already been carried out and charts can be created based on these results.



Step 7 – Once the data has been initialized, it's time to create a new chart. Click on the 'Create new chart' link.

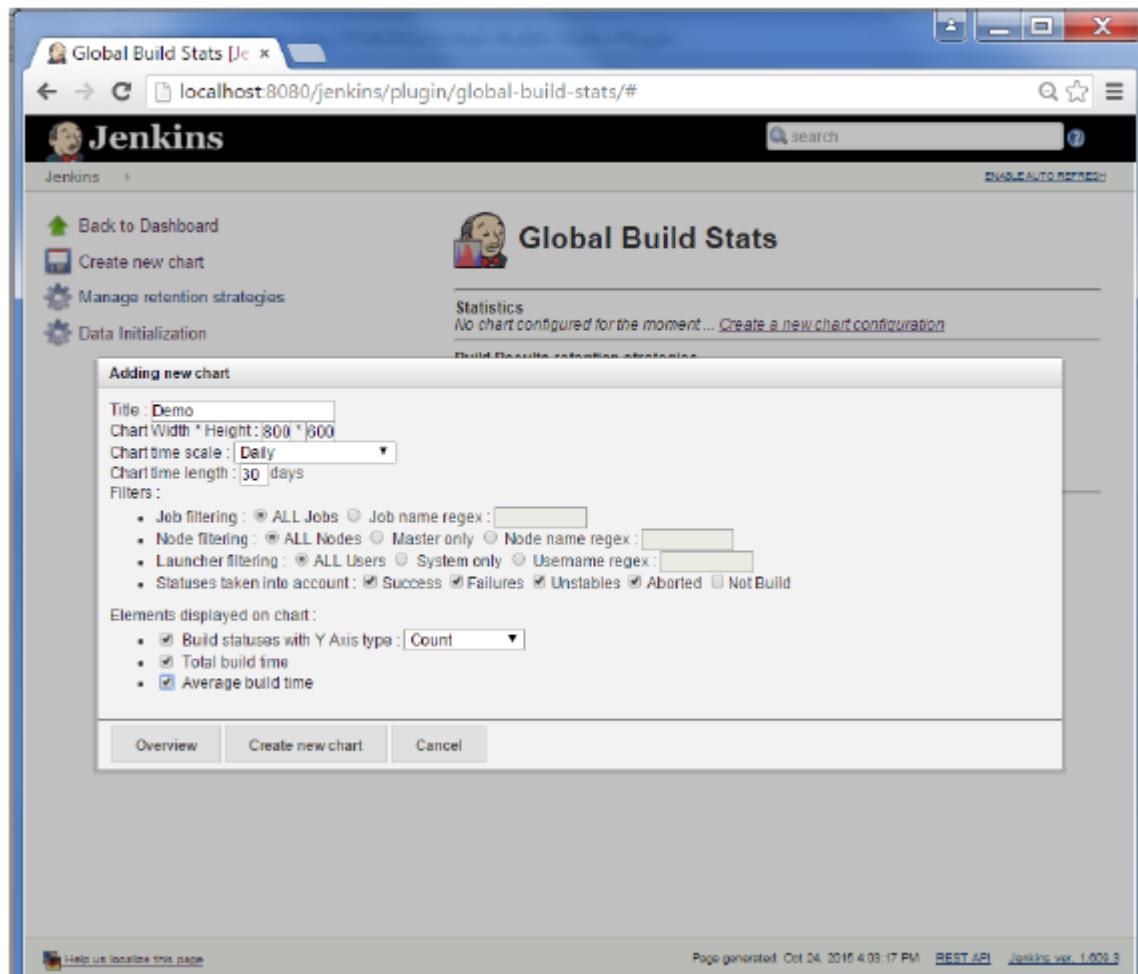


Step 8 – A pop-up will come to enter relevant information for the new chart details. Enter the following mandatory information

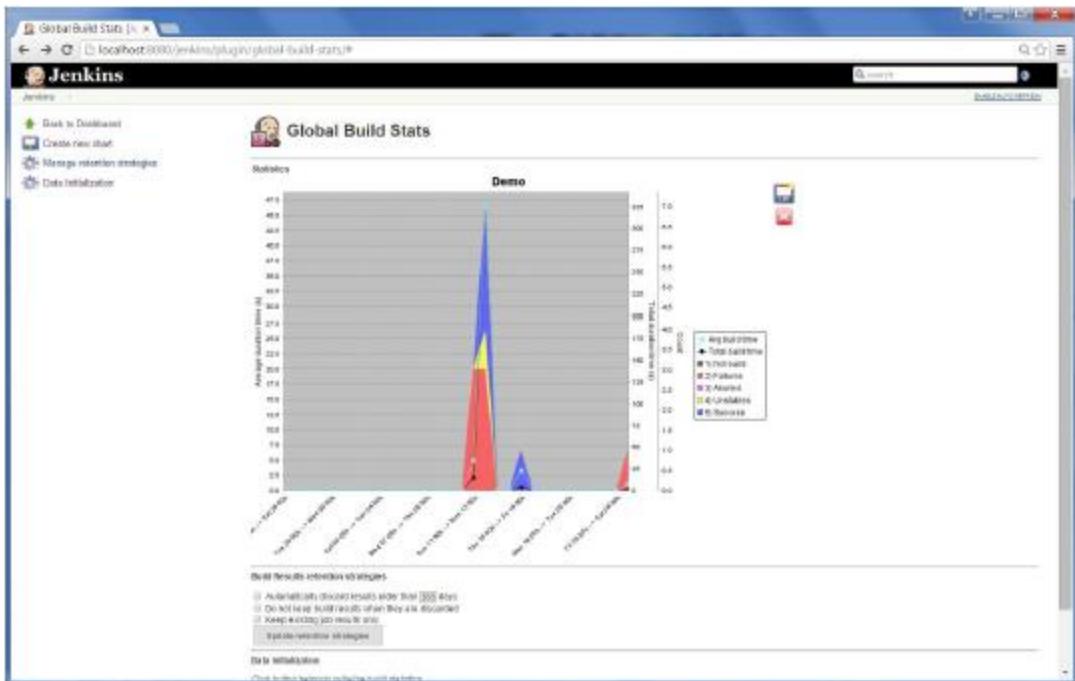
- ⊕ Title – Any title information, for this example is given as 'Demo'
- ⊕ Chart Width – 800
- ⊕ Chart Height – 600
- ⊕ Chart time scale – Daily

- Chart time length – 30 days

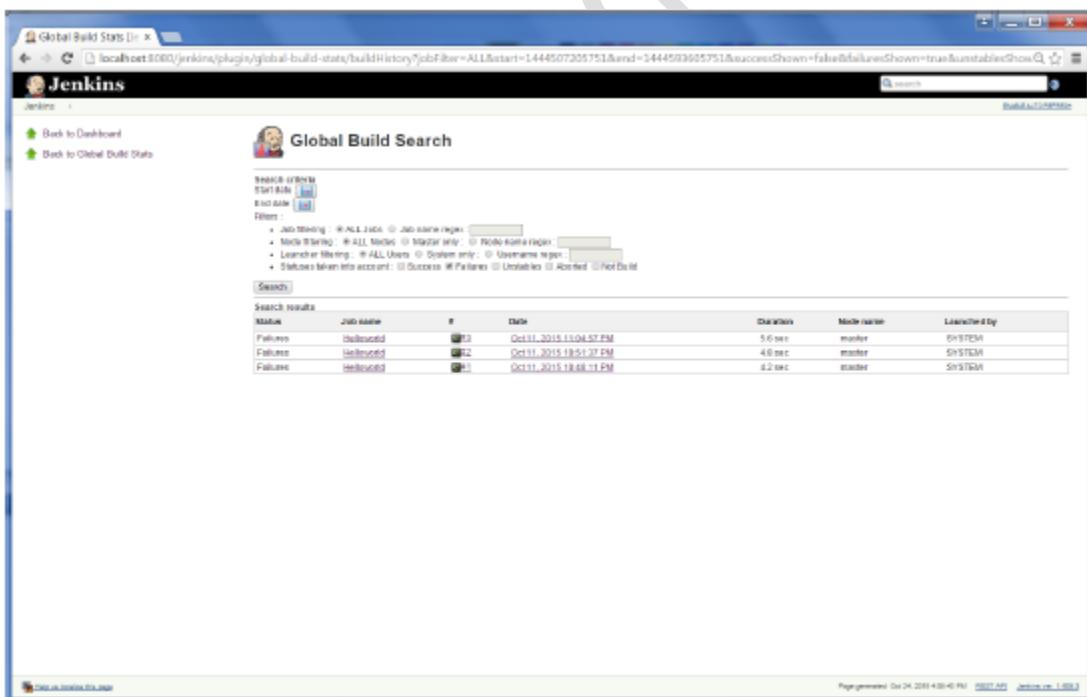
The rest of the information can remain as it is. Once the information is entered, click on Create New chart.



You will now see the chart which displays the trends of the builds over time.



If you click on any section within the chart, it will give you a drill down of the details of the job and their builds.



Jenkins - Server Maintenance

The following are some of the basic activities you will carry out, some of which are best practices for Jenkins server maintenance

URL Options

The following commands when appended to the Jenkins instance URL will carry out the relevant actions on the Jenkins instance.

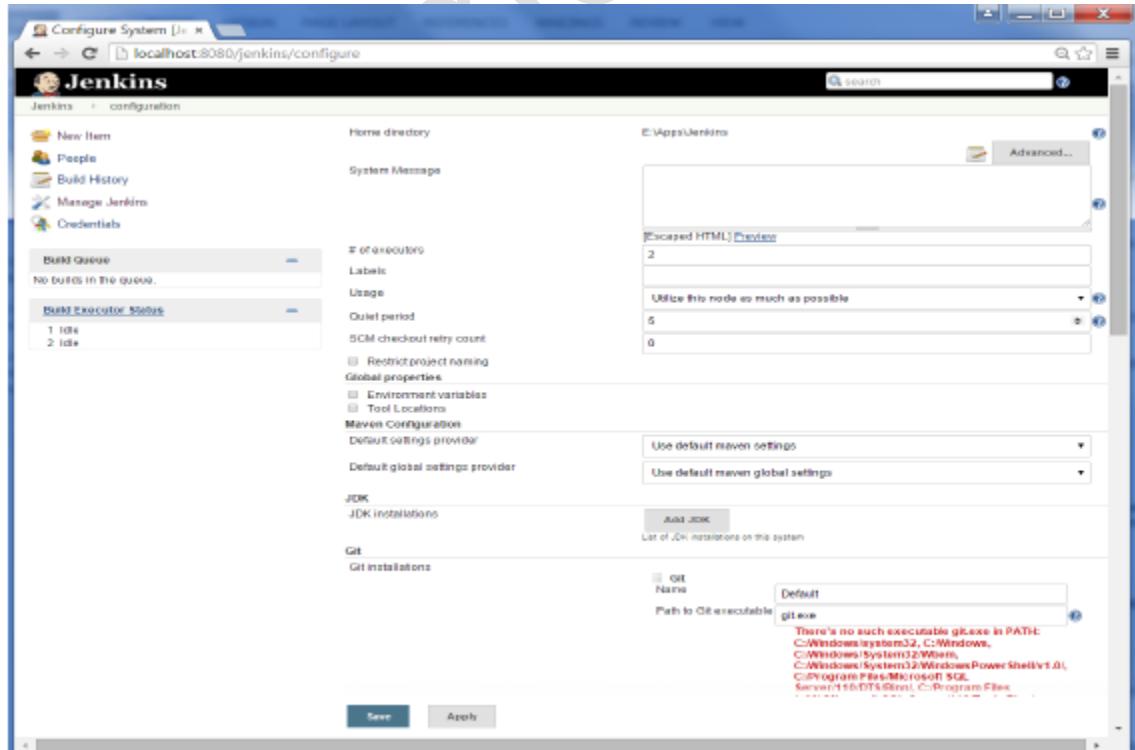
http://localhost:8080/jenkins/exit – shutdown jenkins

http://localhost:8080/jenkins/restart – restart jenkins

http://localhost:8080/jenkins/reload – to reload the configuration

Backup Jenkins Home

The Jenkins Home directory is nothing but the location on your drive where Jenkins stores all information for the jobs, builds etc. The location of your home directory can be seen when you click on Manage Jenkins → Configure system.

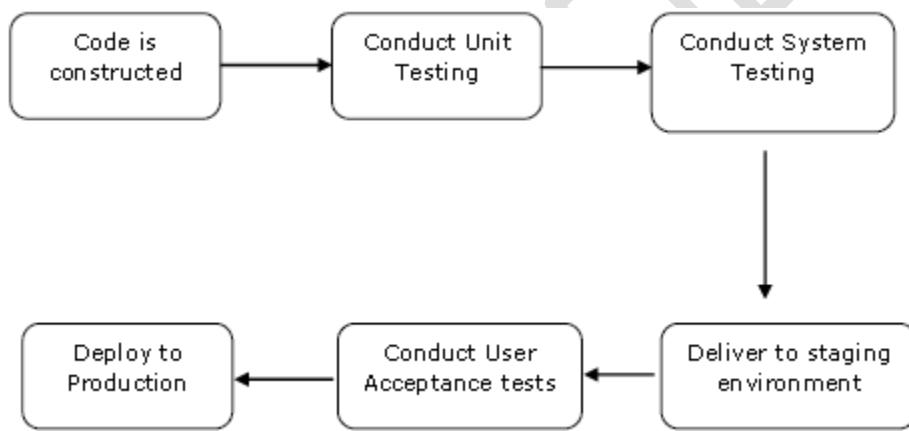


Set up Jenkins on the partition that has the most free disk-space – Since Jenkins would be taking source code for the various jobs defined and doing continuous builds, always ensure that Jenkins is setup on a drive that has enough hard disk space. If you hard disk runs out of space, then all builds on the Jenkins instance will start failing.

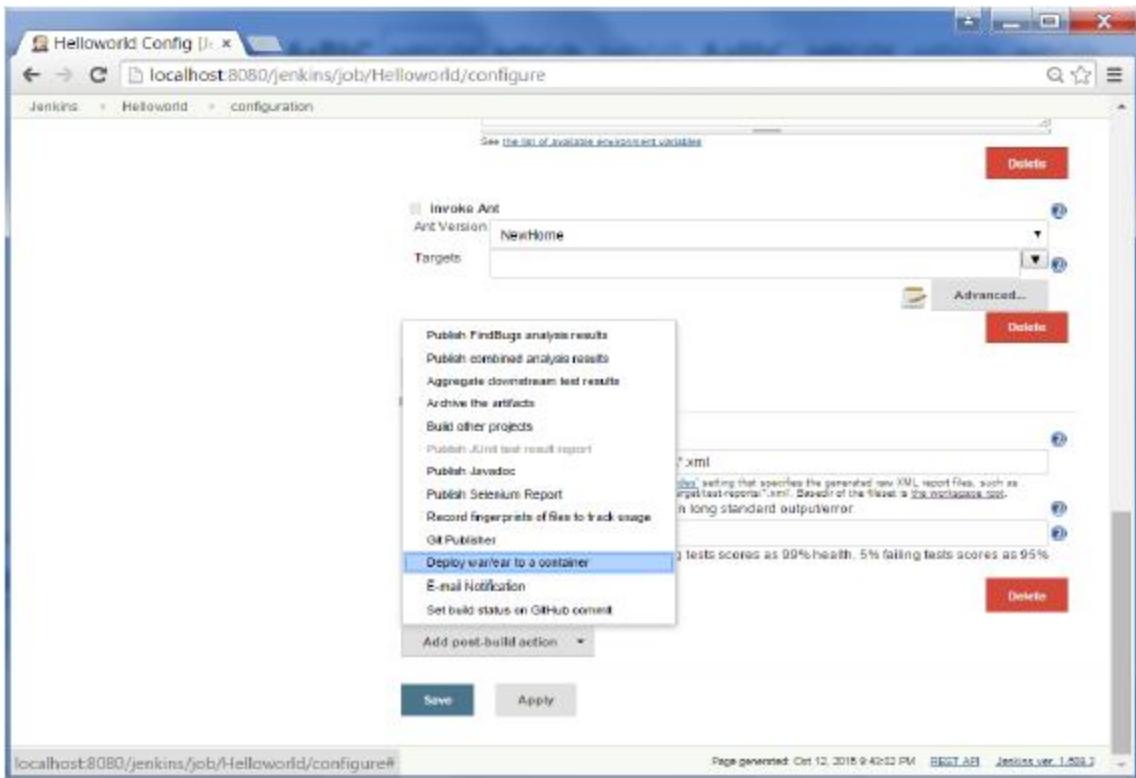
Another best practice is to write cron jobs or maintenance tasks that can carry out clean-up operations to avoid the disk where Jenkins is setup from becoming full.

Jenkins - Continuous Deployment

Jenkins provides good support for providing continuous deployment and delivery. If you look at the flow of any software development through deployment, it will be as shown below.



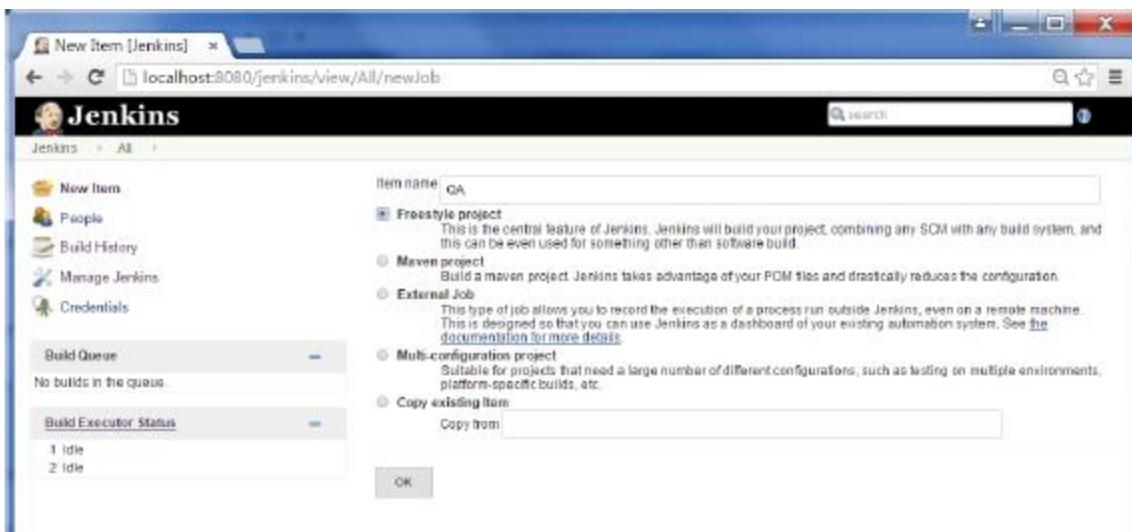
The main part of Continuous deployment is to ensure that the entire process which is shown above is automated. Jenkins achieves all of this via various plugins, one of them being the “Deploy to container Plugin” which was seen in the earlier lessons.



There are plugins available which can actually give you a graphical representation of the Continuous deployment process. But first lets create another project in Jenkins, so that we can see best how this works.

Let's create a simple project which emulates the QA stage, and does a test of the Helloworld application.

Step 1 – Go to the Jenkins dashboard and click on New Item. Choose a 'Freestyle project' and enter the project name as 'QA'. Click on the Ok button to create the project.



Step 2 – In this example, we are keeping it simple and just using this project to execute a test program for the Helloworld application.

The screenshot shows the Jenkins configuration interface for the 'QA' job. Under the 'Build' section, there is a 'Build' step configured with the command:

```
java HelloWorldTest.java  
java HelloWorldTest
```

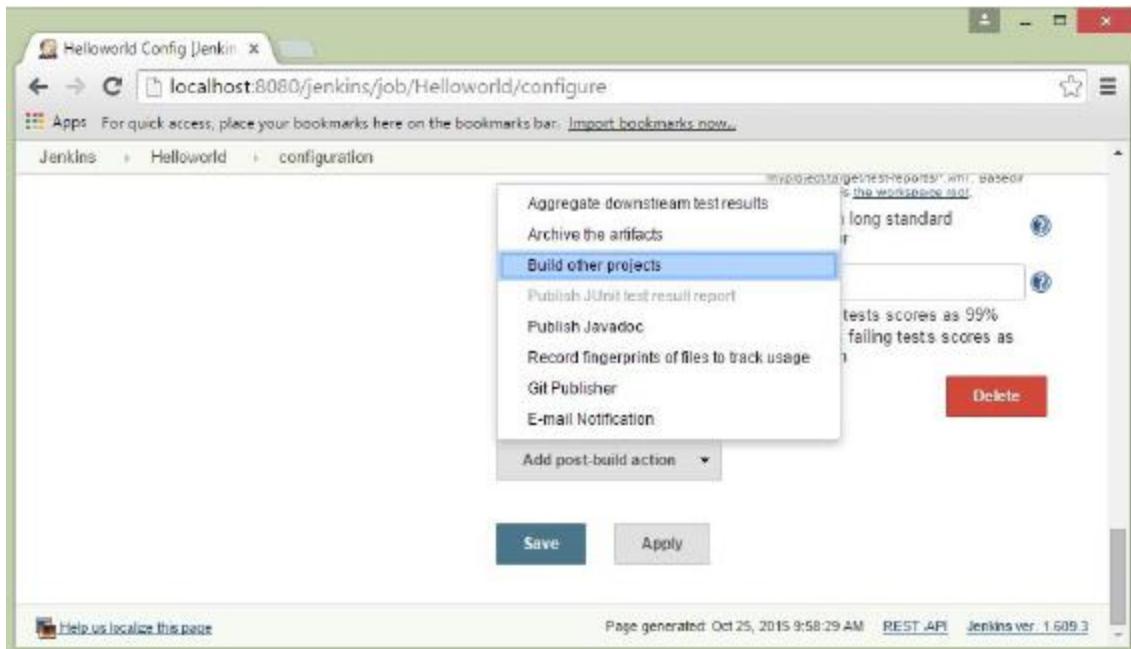
So our project QA is now setup. You can do a build to see if it builds properly.

The screenshot shows the Jenkins Project QA page for a job named 'QA'. The left sidebar includes links for Back to Dashboard, Status, Changes, Workspace, Build Now, Delete Project, and Configure. The main content area is titled 'Project QA' and contains sections for 'Build History' (listing four builds from Oct 24, 2015), 'Recent Changes' (empty), and three tables for MTTR, MTTF, and Standard Deviation metrics. At the bottom are 'Permalinks' for the last build and stable build.

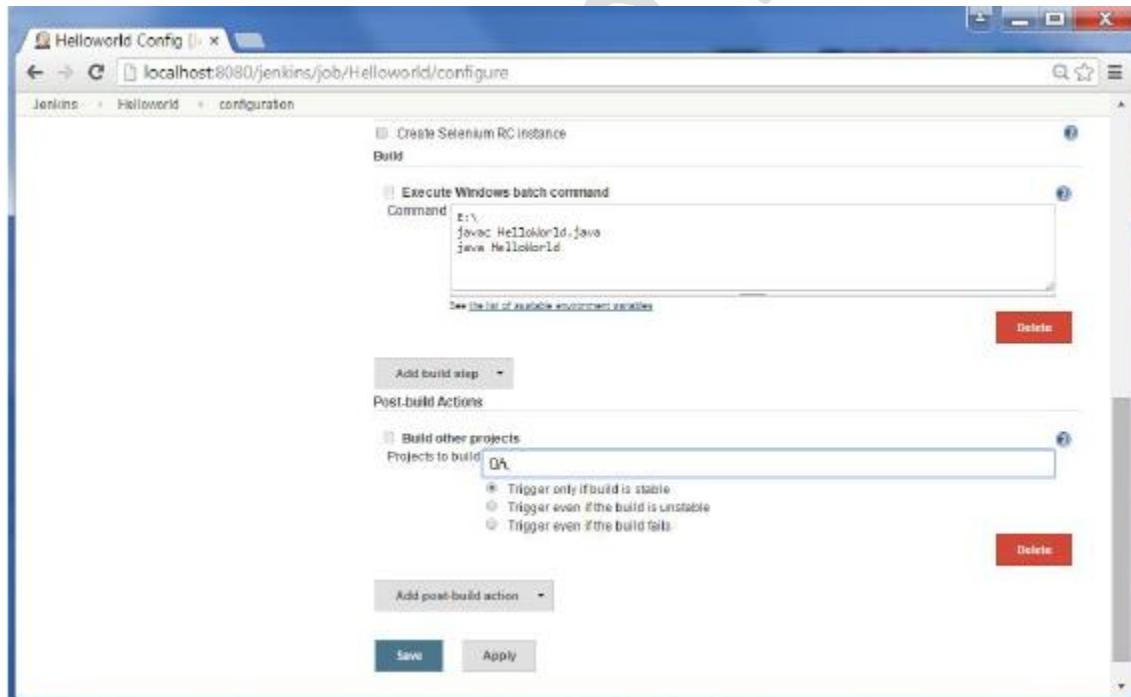
Step 3 – Now go to your Helloworld project and click on the Configure option

The screenshot shows the Jenkins Dashboard. The left sidebar lists New Item, People, Build History, Manage Jenkins, and Credentials. The main area displays a table of projects, with 'Helloworld' selected. A context menu for 'Helloworld' is open, showing options like Changes, Workspace, Build Now, Delete Project, and Configure. The 'Configure' option is highlighted with a blue box.

Step 4 – In the project configuration, choose the 'Add post-build action' and choose 'Build other projects'



Step 5 – In the ‘Project to build’ section, enter QA as the project name to build. You can leave the option as default of ‘Trigger only if build is stable’. Click on the Save button.



Step 6 – Build the Helloworld project. Now if you see the Console output, you will also see that after the Helloworld project is successfully built, the build of the QA project will also happen.

```

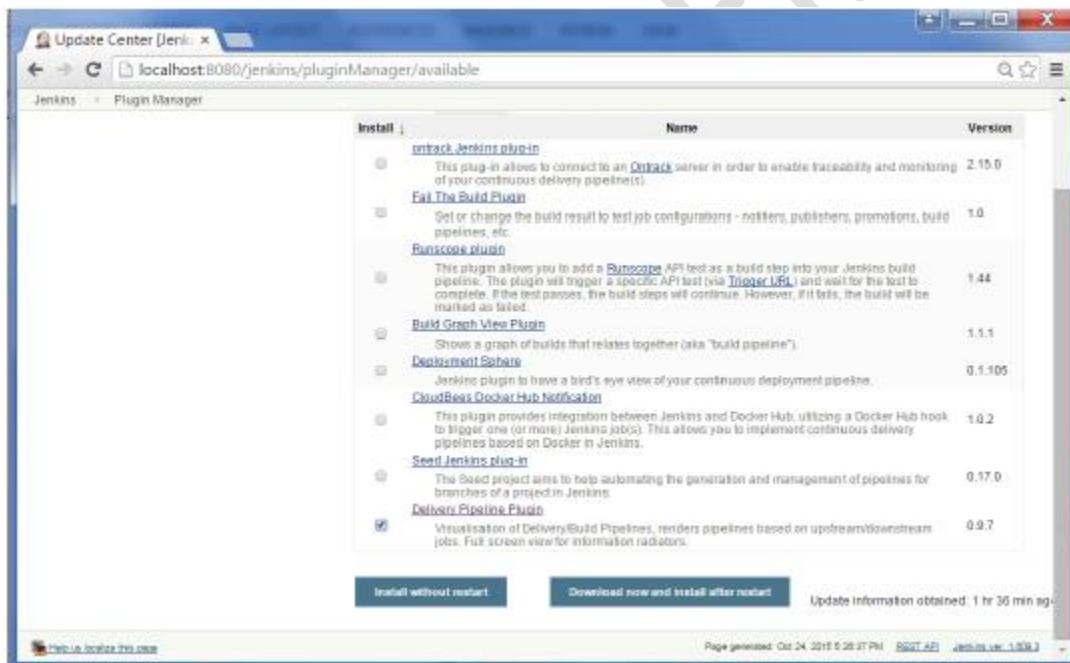
Started by user anonymous
Building in workspace E:\Jenkins\jobs\HelloWorld\workspace
[workspace] $ cmd /c call E:\Apache\tomcat7\temp\hudson3970874123969689633.bat
E:\Jenkins\jobs\HelloWorld\workspace\bin\
'bin' is not recognized as an internal or external command,
operable program or batch file.

E:\Jenkins\jobs\HelloWorld\workspace>javac HelloWorld.java
E:\Jenkins\jobs\HelloWorld\workspace>java HelloWorld
Hello World

E:\Jenkins\jobs\HelloWorld\workspace>exit 0
Warning: you have no plugins providing access control for builds, so falling back to legacy behavior of permitting any downstream builds to be triggered
Triggering a new build of QA
Finished: SUCCESS

```

Step 7 – Let now install the Delivery pipeline plugin. Go to Manage Jenkins → Manage Plugin's. In the available tab, search for 'Delivery Pipeline Plugin'. Click On Install without Restart. Once done, restart the Jenkins instance.



Step 8 – To see the Delivery pipeline in action, in the Jenkins Dashboard, click on the + symbol in the Tab next to the 'All' Tab.

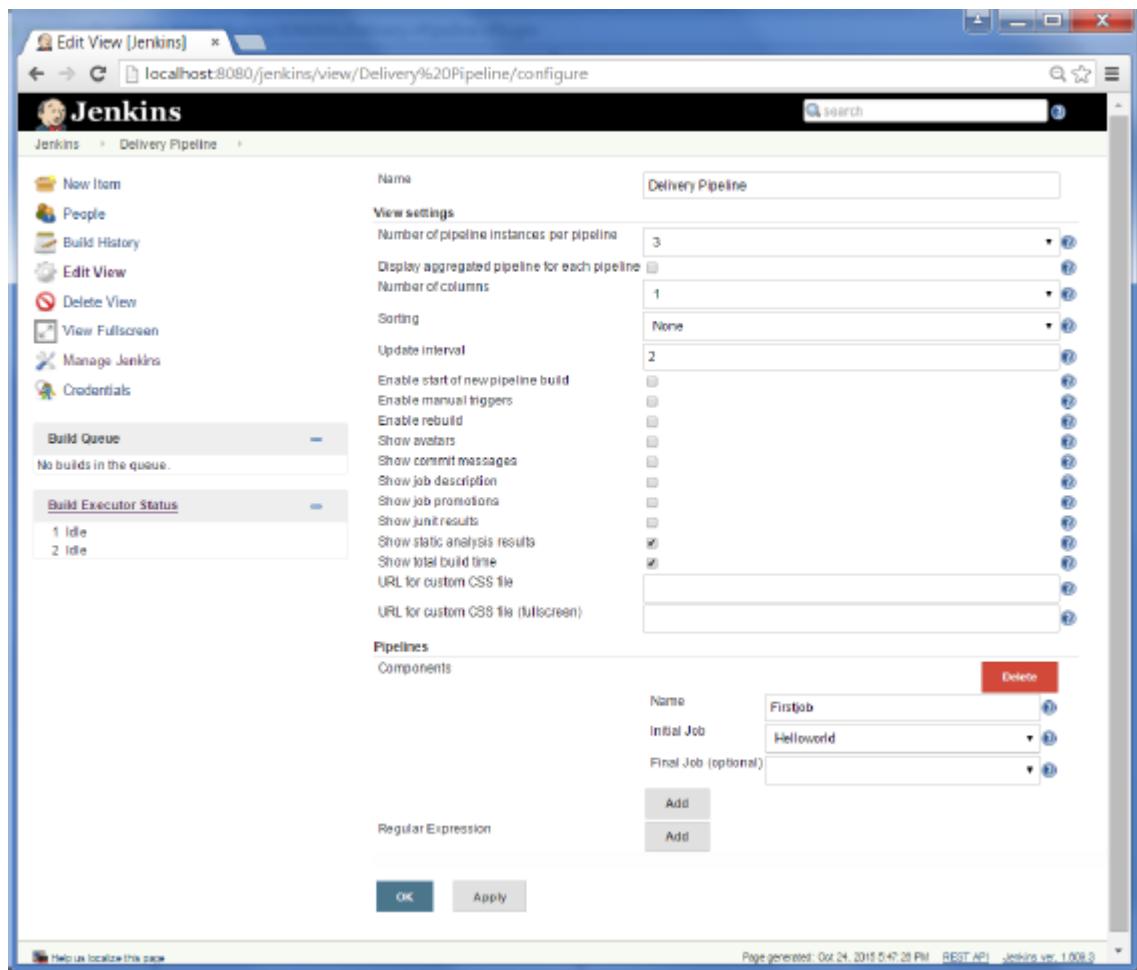
The screenshot shows the Jenkins dashboard at localhost:8080/jenkins/. The left sidebar includes links for New Item, People, Build History, Manage Jenkins, and Credentials. The main area displays a table of build items with columns: S, W, Name, Last Success, Last Failure, and Last Duration. Two items are listed: 'Helloworld' (Last Success: 25 min - #14, Last Failure: 1 hr 40 min - #12, Last Duration: 1.4 sec) and 'Q6' (Last Success: 25 min - #5, Last Failure: 28 min - #2, Last Duration: 1.4 sec). A legend at the bottom indicates colors for R99 for all, R99 for failures, and R99 for just latest builds.

Step 9 – Enter any name for the View name and choose the option ‘Delivery Pipeline View’.

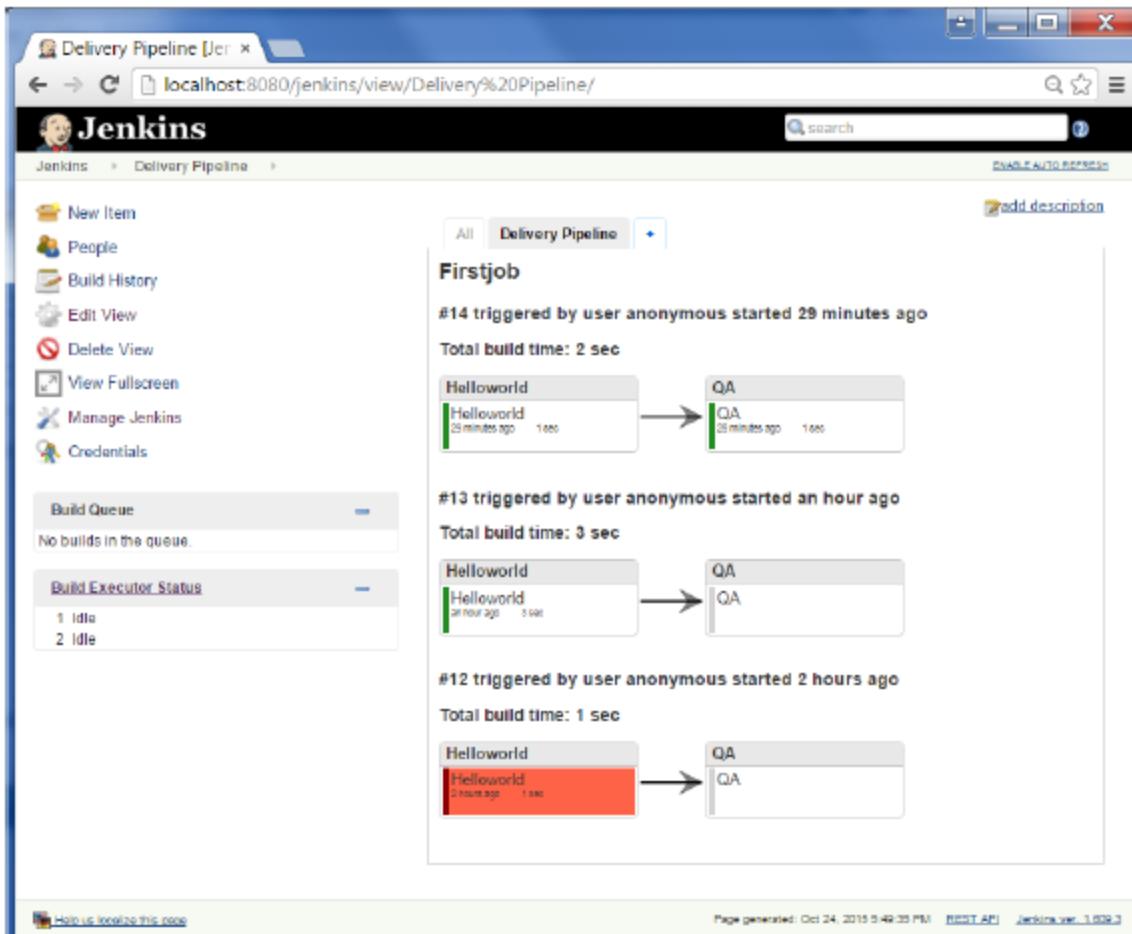
The screenshot shows the 'New View' configuration dialog at localhost:8080/jenkins/newView. The 'View name' field is set to 'Delivery Pipeline'. The 'Delivery Pipeline View' option is selected, with a description: 'Shows the jobs in a build pipeline view. The complete pipeline of jobs that a version propagates through are shown as a row in the view.' Other options like 'Build Pipeline View' and 'List View' are also listed. The 'OK' button is visible at the bottom right.

Step 10 – In the next screen, you can leave the default options. One can change the following settings –

- ⊕ Ensure the option ‘Show static analysis results’ is checked.
- ⊕ Ensure the option ‘Show total build time’ is checked.
- ⊕ For the Initial job – Enter the Helloworld project as the first job which should build.
- ⊕ Enter any name for the Pipeline
- ⊕ Click the OK button.



You will now see a great view of the entire delivery pipeline and you will be able to see the status of each project in the entire pipeline.



Another famous plugin is the **build pipeline plugin**. Let's take a look at this.

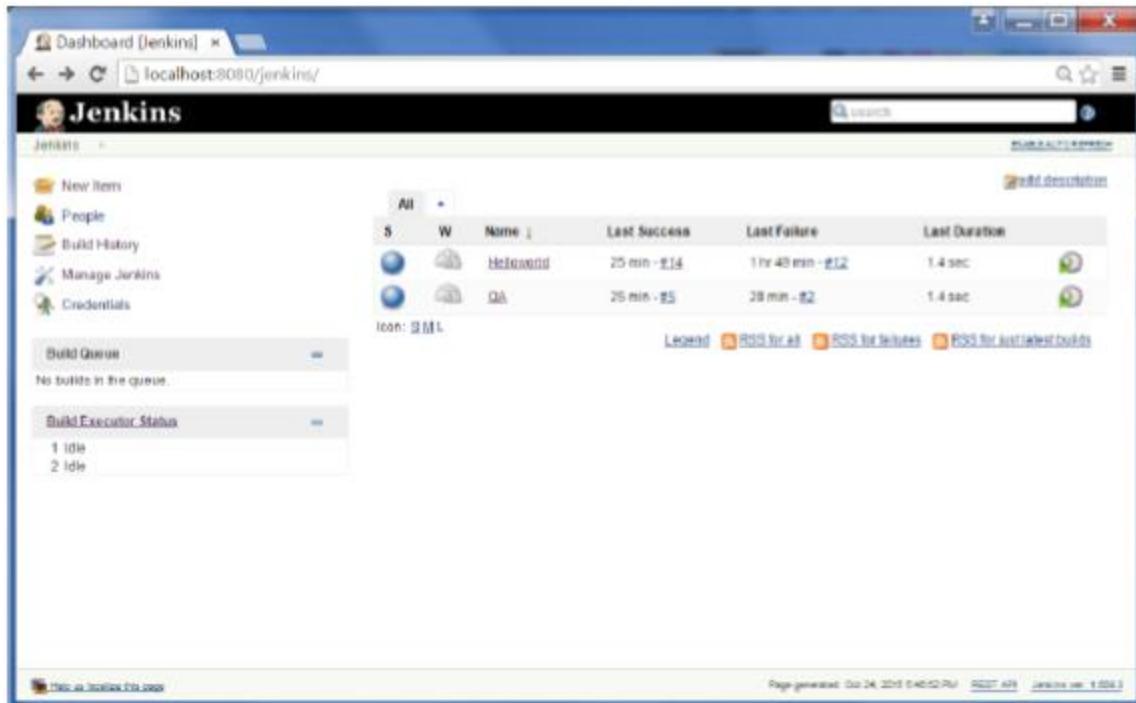
Step 1 – Go to Manage Jenkins → Manage Plugin's. In the available tab, search for 'Build Pipeline Plugin'. Click On Install without Restart. Once done, restart the Jenkins instance.

The screenshot shows the Jenkins Update Center interface. The title bar says "Update Center [Jenkins]". The address bar shows "localhost:8080/jenkins/pluginManager/available". The main content area is titled "Plugin Manager" with a "Available" tab selected. A search bar at the top right contains the text "Build pipeline". Below the tabs is a table with columns: "Name", "Version", and "Description". The table lists five plugins:

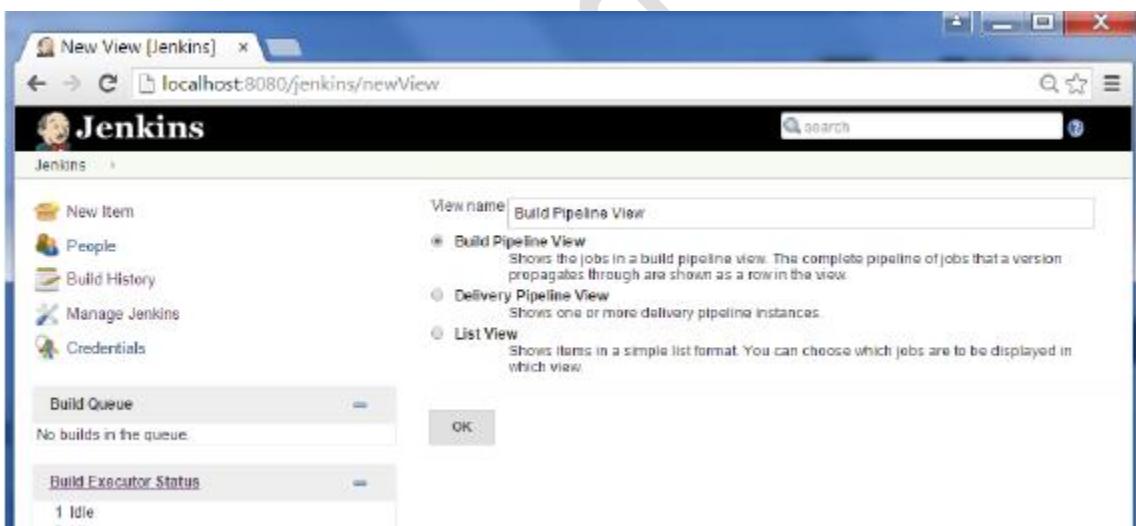
Name	Version
Build Pipeline Plugin	1.4.8
Fail The Build Plugin	1.0
Runscope plugin	1.44
Build Graph View Plugin	1.1.1
Delivery Pipeline Plugin	0.9.7

Below the table are three buttons: "Install without restart", "Download now and install after restart", and "Update info". At the bottom left is a link "Help us localize this page". At the bottom right is the text "Page generated: Oct 24, 2015 4:49:09 PM REST API Jenkins ver. 1.609.3".

Step 2 – To see the Build pipeline in action, in the Jenkins Dashboard, click on the + symbol in the Tab next to the 'All' Tab.



Step 3 – Enter any name for the View name and choose the option ‘Build Pipeline View’.



Step 4 – Accept the default settings, just in the Selected Initial job, ensure to enter the name of the Helloworld project. Click on the Ok button.

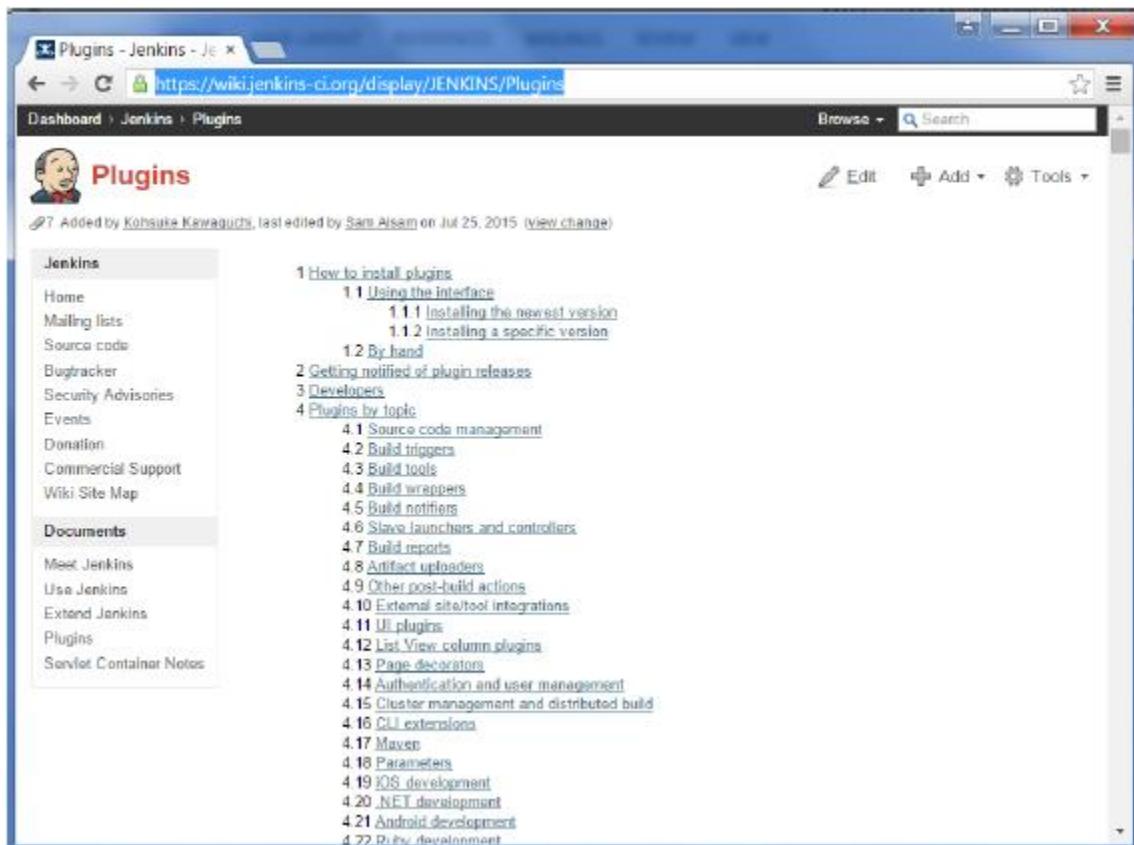
The screenshot shows the Jenkins 'Edit View [Jenkins]' configuration page for 'Build Pipeline View'. The left sidebar includes links for New Item, People, Build History, Edit View, Delete View, Manage Jenkins, and Credentials. Under 'Build Queue', it says 'No builds in the queue.' Under 'Build Executor Status', there are two entries: '1 Idle' and '2 Idle'. The main configuration area has sections for Name (Build Pipeline View), Description, Filter build queue, Filter build executors, Build Pipeline View Title, Layout (set to 'Based on upstream/downstream relations'), and Select Initial Job (set to 'HelloWorld'). There are also options for No Of Displayed Builds (set to 1), Restrict triggers to most recent successful builds (radio buttons for Yes and No), Always allow manual trigger on pipeline steps (radio buttons for Yes and No), Show pipeline project headers (radio buttons for Yes and No), Show pipeline parameters in project headers (radio buttons for Yes and No), Show pipeline parameters in revision box (radio buttons for Yes and No), Refresh frequency (in seconds) (set to 3), URL for custom CSS files, and Console Output Link Style (set to Lightbox). At the bottom are OK and Apply buttons.

You will now see a great view of the entire delivery pipeline and you will be able to see the status of each project in the entire pipeline.

The screenshot shows the Jenkins 'Build Pipeline View' page. The top navigation bar shows 'Build Pipeline View'. The main content area is titled 'Build Pipeline' and displays three stages: 'Pipeline #14' (grey), '#54 HelloWorld' (green), and '#55 QA' (green). Each stage has a progress bar and some text below it. The Jenkins logo and navigation links are visible at the top.

Jenkins - Managing Plugins

To get the list of all plugins available within Jenkins, one can visit the link –
<https://wiki.jenkins-ci.org/display/JENKINS/Plugins>



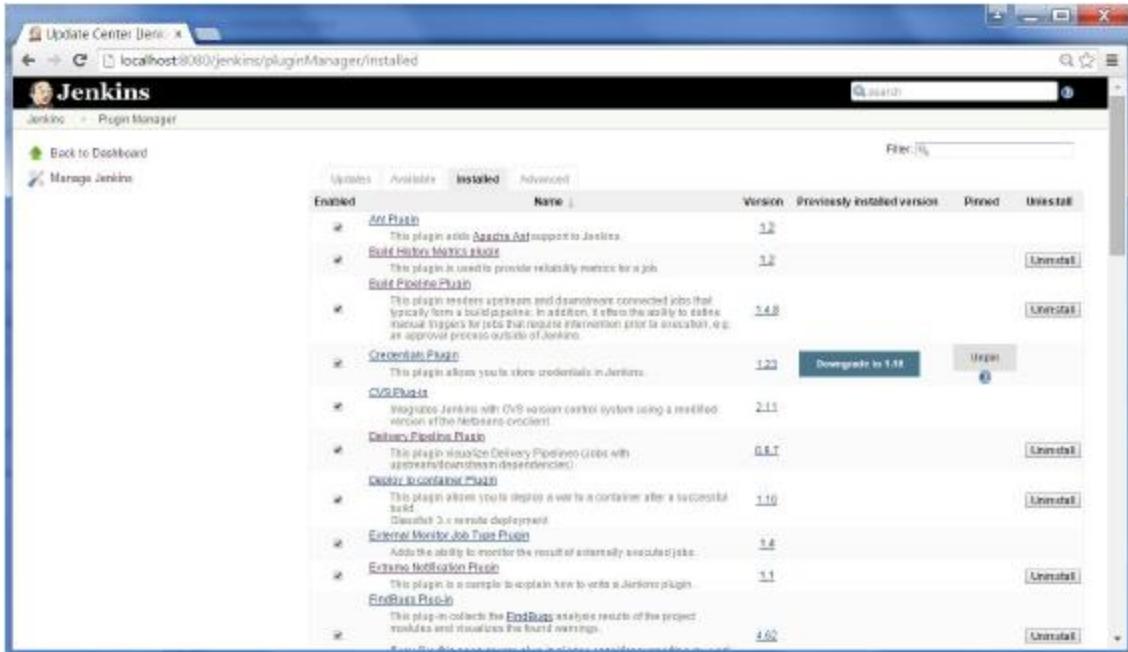
The screenshot shows a web browser window with the title "Plugins - Jenkins - Jenkins". The URL in the address bar is <https://wiki.jenkins-ci.org/display/JENKINS/Plugins>. The page content is titled "Plugins" and includes a sidebar with links to Jenkins Home, Mailing lists, Source code, Bugtracker, Security Advisories, Events, Donation, Commercial Support, and Wiki Site Map. The main content area lists various plugin categories and their sub-topics:

- 1 How to install plugins
 - 1.1 Using the interface
 - 1.1.1 Installing the newest version
 - 1.1.2 Installing a specific version
 - 1.2 By hand
- 2 Getting notified of plugin releases
- 3 Developers
- 4 Plugins by topic
 - 4.1 Source code management
 - 4.2 Build triggers
 - 4.3 Build tools
 - 4.4 Build wrappers
 - 4.5 Build notifiers
 - 4.6 Slave launchers and controllers
 - 4.7 Build reports
 - 4.8 Artifact upenders
 - 4.9 Other post-build actions
 - 4.10 External site/tool integrations
 - 4.11 UI plugins
 - 4.12 List View column plugins
 - 4.13 Page decorators
 - 4.14 Authentication and user management
 - 4.15 Cluster management and distributed build
 - 4.16 CLI extensions
 - 4.17 Maven
 - 4.18 Parameters
 - 4.19 iOS development
 - 4.20 .NET development
 - 4.21 Android development
 - 4.22 Java development

We've already seen many instances for installing plugins, let's look at some other maintenance tasks with regards to plugins

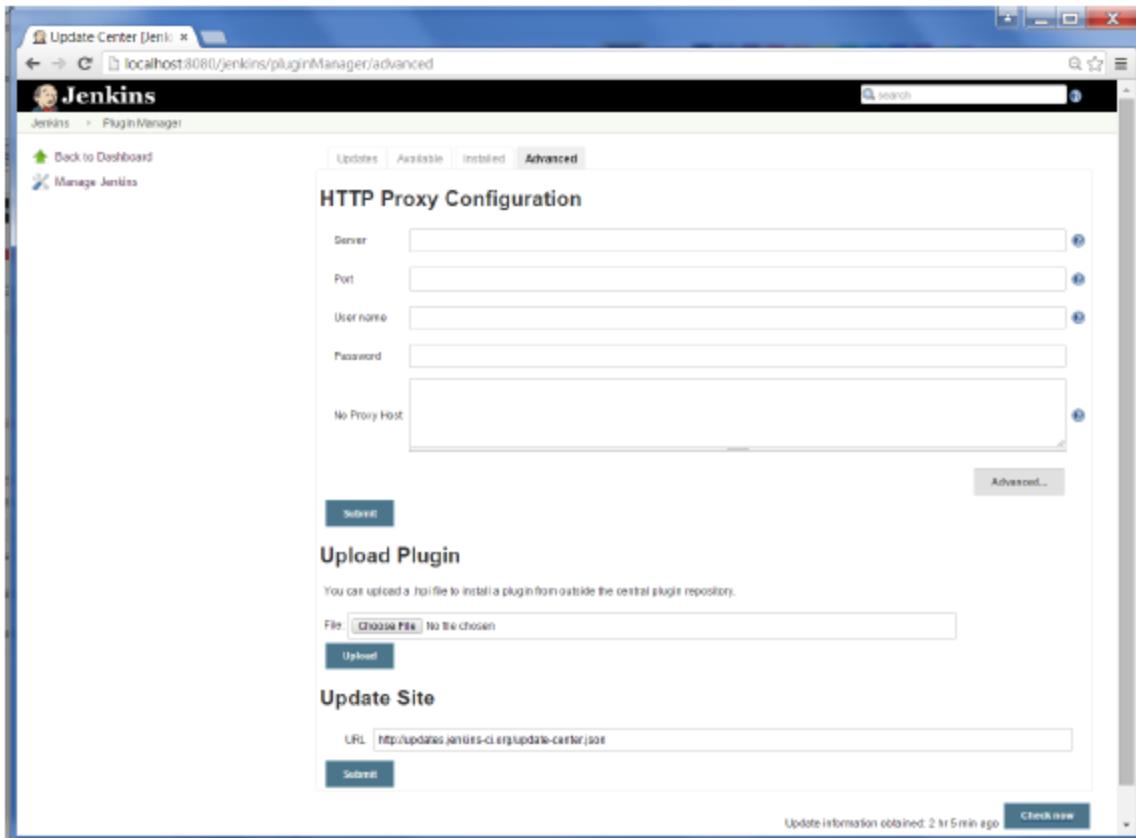
Uninstalling Plugins

To uninstall a plugin, Go to Manage Jenkins → Manage plugins. Click on the Installed tab. Some of the plugins will have the Uninstall option. You can click these buttons to uninstall the plugins. Ensure to restart your Jenkins instance after the uninstallation.



Installing another Version of a Plugin

Sometimes it may be required to install an older version of a plugin, in such a case, you can download the plugin from the relevant plugin page on the Jenkins web site. You can then use the **Upload** option to upload the plugin manually.

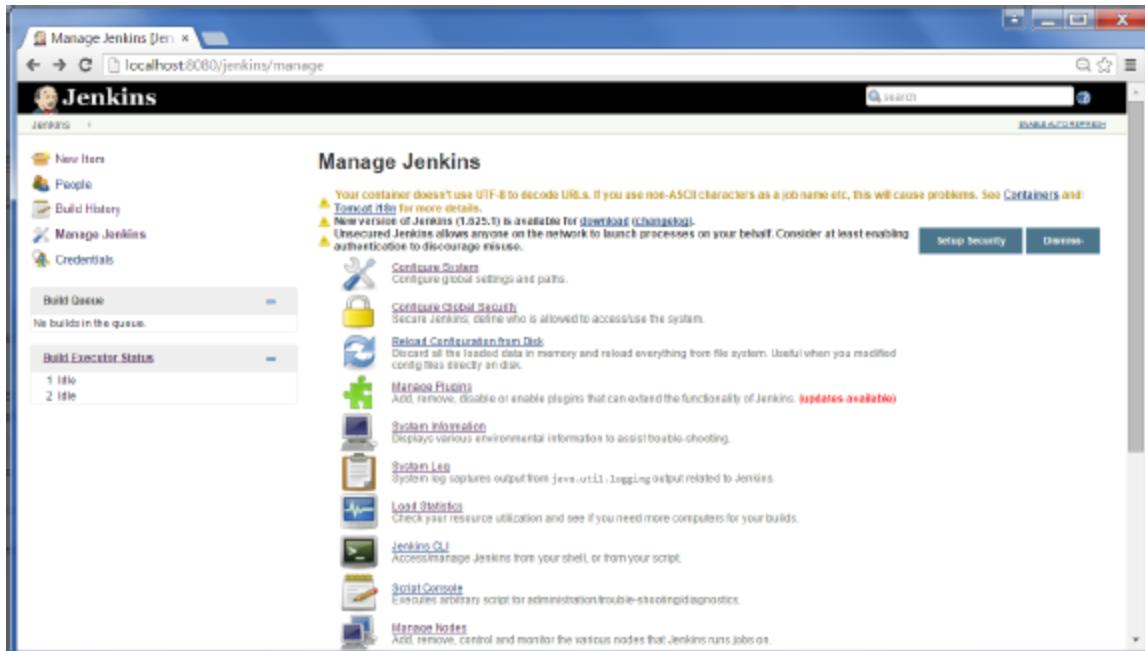


Jenkins - Security

In Jenkins you have the ability to setup users and their relevant permissions on the Jenkins instance. By default you will not want everyone to be able to define jobs or other administrative tasks in Jenkins. So Jenkins has the ability to have a security configuration in place.

To configure Security in Jenkins, follow the steps given below.

Step 1 – Click on Manage Jenkins and choose the 'Configure Global Security' option.



Step 2 – Click on Enable Security option. As an example, let's assume that we want Jenkins to maintain its own database of users, so in the Security Realm, choose the option of 'Jenkins' own user database'.

By default you would want a central administrator to define users in the system, hence ensure the 'Allow users to sign up' option is unselected. You can leave the rest as it is for now and click the Save button.



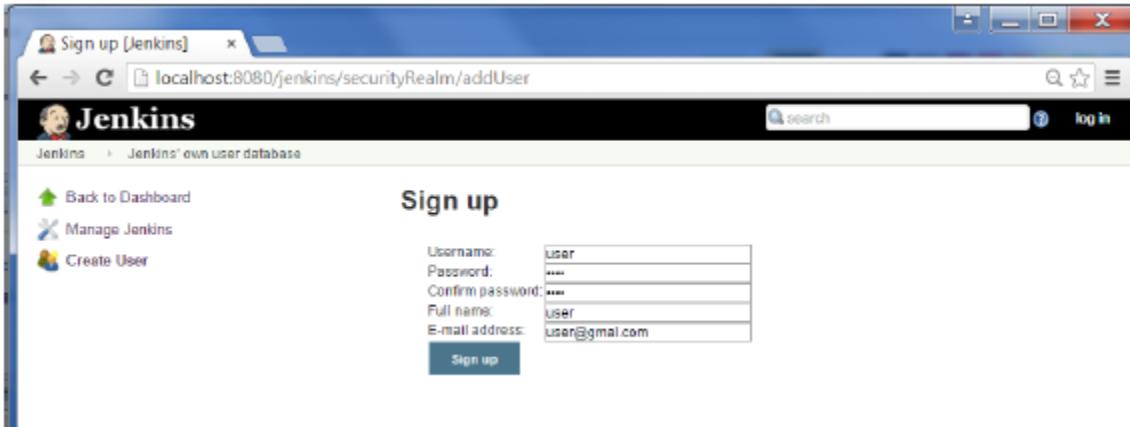
Step 3 – You will be prompted to add your first user. As an example, we are setting up an admin users for the system.

The screenshot shows a web browser window for the Jenkins 'Sign up' page. The URL is `localhost:8080/jenkins/securityRealm/firstUser`. The page has a header with the Jenkins logo and a search bar. On the left, there's a sidebar with links: 'Back to Dashboard', 'Manage Jenkins', and 'Create User'. The main content area is titled 'Sign up' and contains fields for 'Username' (admin), 'Password' (****), 'Confirm password' (****), 'Full name' (Administrator), and 'E-mail address' (al@gmail.com). A blue 'Sign up' button is at the bottom.

Step 4 – It's now time to setup your users in the system. Now when you go to Manage Jenkins, and scroll down, you will see a 'Manage Users' option. Click this option.

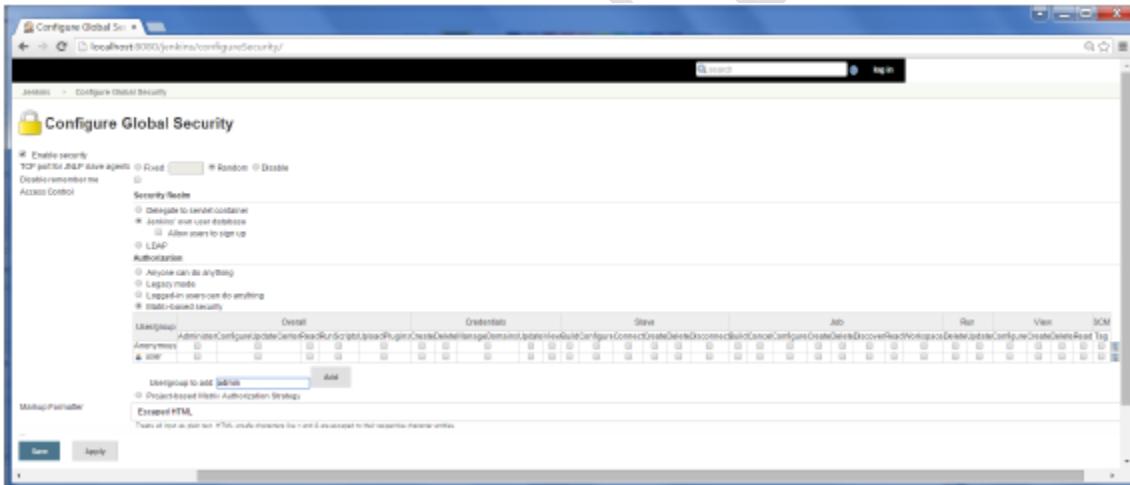
The screenshot shows a web browser window for the Jenkins 'Manage Jenkins' page. The URL is `localhost:8080/jenkins/manage`. The left sidebar lists various management options: '1 Idle', '2 Idle', 'Available Plugins' (with a link to 'updates'), 'System Information', 'System Log', 'Load Statistics', 'Jenkins CLI', 'Script Console', 'Manage Nodes', 'Manage Credentials', 'About Jenkins', 'Manage Old Data', 'Global Build Stats', 'Manage Users' (which is highlighted in blue), 'In-process Script Approval', and 'Prepare for Shutdown'. The main content area is currently empty.

Step 5 – Just like you defined your admin user, start creating other users for the system. As an example, we are just creating another user called ‘user’.



Step 6 – Now it's time to setup your authorizations, basically who has access to what. Go to Manage Jenkins → Configure Global Security.

Now in the Authorization section, click on 'Matrix based security'



Step 7 – If you don't see the user in the user group list, enter the user name and add it to the list. Then give the appropriate permissions to the user.

Click on the Save button once you have defined the relevant authorizations.

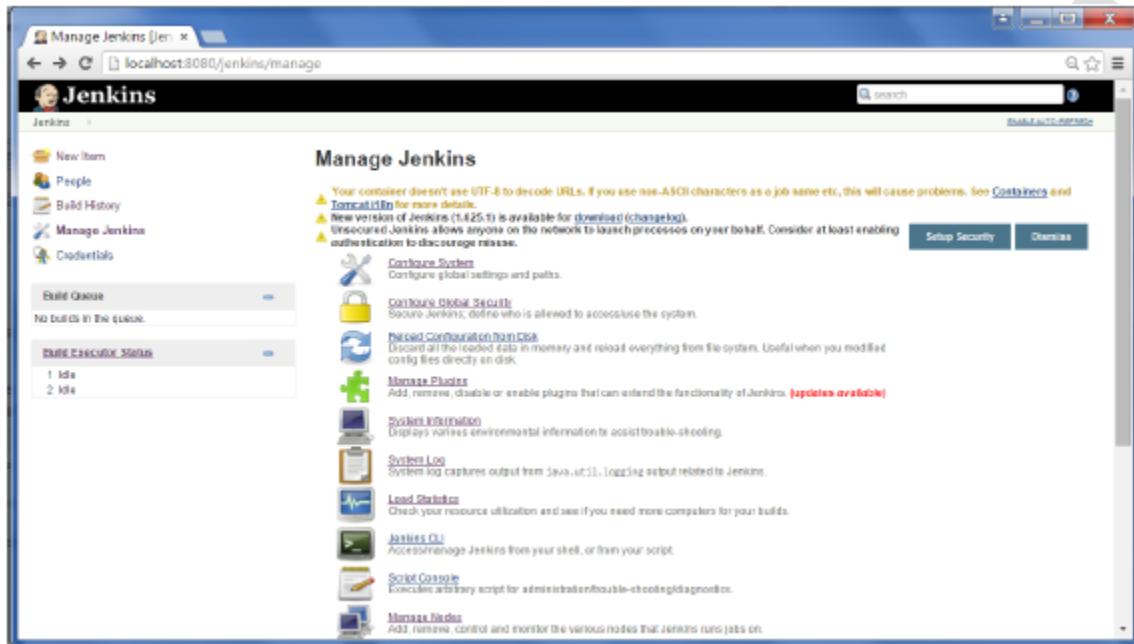
Your Jenkins security is now setup.

Note – For Windows AD authentication, one has to add the Active Directory plugin to Jenkins.

Jenkins - Backup Plugin

Jenkins has a backup plugin which can be used to backup critical configuration settings related to Jenkins. Follow the steps given below to have a backup in place.

Step 1 – Click on Manage Jenkins and choose the ‘Manage Plugins’ option.



Step 2 – In the available tab, search for ‘Backup Plugin’. Click On Install without Restart. Once done, restart the Jenkins instance

The screenshot shows the Jenkins Plugin Manager interface. The 'Available' tab is selected, and a search bar at the top right is set to 'backup'. Below the search bar, there's a table with columns: 'Install', 'Name', and 'Version'. The table lists several backup-related plugins:

Install	Name	Version
Backup plugin	Backup plugin allows archiving and restoring your Jenkins (and Hudson) home directory.	1.6.1
Backup and restore job plugin	Backup up and restore running jobs.	1.0
Insta! CloudBees Jenkins Enterprise	This plugin converts an OSS installation to a CloudBees Jenkins Enterprise (CBE) installation. CBE has 20+ plugins that address issues in enterprise installations. Plugins include folders, validate merges, templates, roles-based access control, backup plugins and others. (complete list) . Additionally, you can use the HA component to make Jenkins highly available. <i>Note:</i> As part of the installation process, you will require a valid license to use the CloudBees Jenkins Enterprise plugins.	15.06.1
CloudBees Free Enterprise Plugins	This plugin installs free enterprise plugins from CloudBees. The following plugins are automatically installed: "Folders," easily organize your jobs; "Backup to Cloud," backup your Jenkins into CloudBees cloud; "Wasted Minutes," find out if you are short of slaves and need to add capacity to speed up builds; "CloudBees Status," find out how much of the free CloudBees Jenkins capacity in the cloud is available for your use "today." You will be asked to register for a free CloudBees account to use these plugins (this plugin was formerly known as the CloudBees Plugin Gateway plugin).	5.0
Periodic Backup	This plugin simply backs up the global and job specific configurations (not the archive of the workspace).	1.3
ThinBackup	This plugin simply backs up the global and job specific configurations (not the archive of the workspace).	1.7.4

At the bottom of the page are three buttons: 'Install without restart', 'Download now and install after restart', and 'Update information'.

The screenshot shows the Jenkins Update Center page titled 'Installing Plugins/Upgrades'. The page displays two sections: 'Preparation' and 'Backup plugin'.

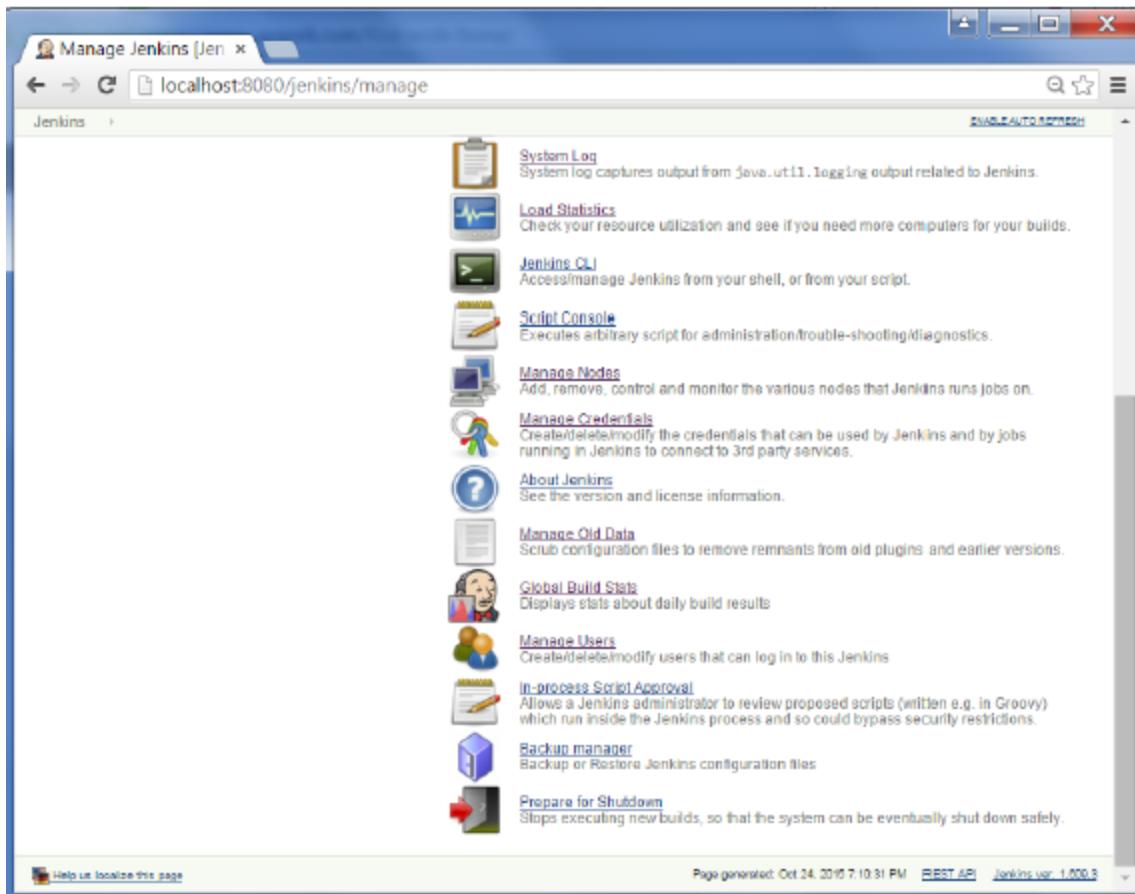
Preparation
• Checking internet connectivity
• Checking update center connectivity
• Success

Backup plugin Success

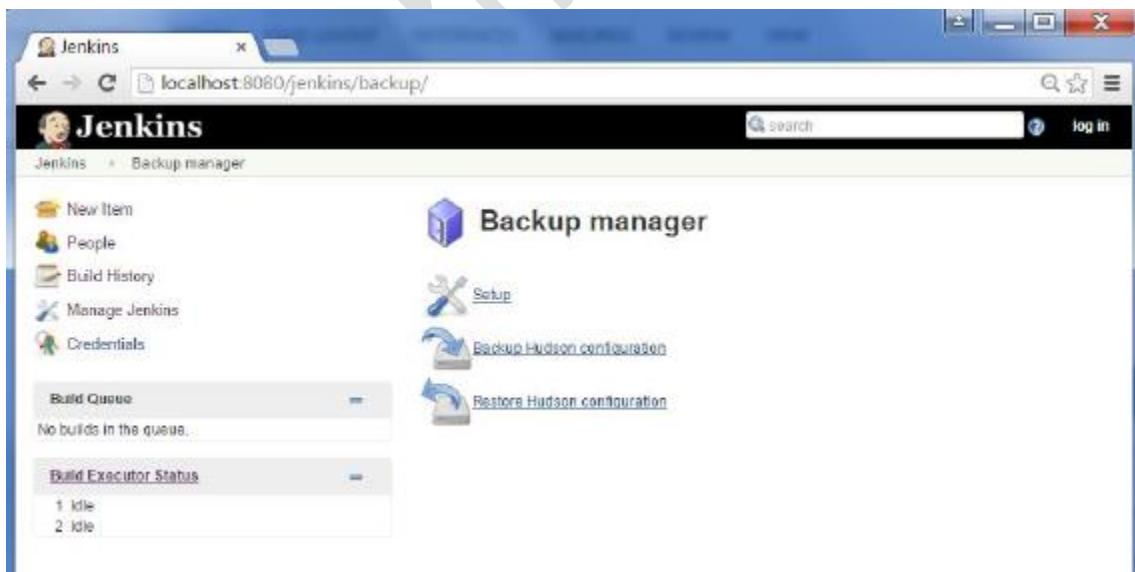
Two green checkmark icons provide instructions:
• Go back to the top page (you can start using the installed plugins right away)
• Restart Jenkins when installation is complete and no jobs are running

At the bottom of the page, there are links for 'Help us localize this page', 'Page generated: Oct 24, 2015 8:26:30 PM', 'REST API', and 'Jenkins ver. 1.691'.

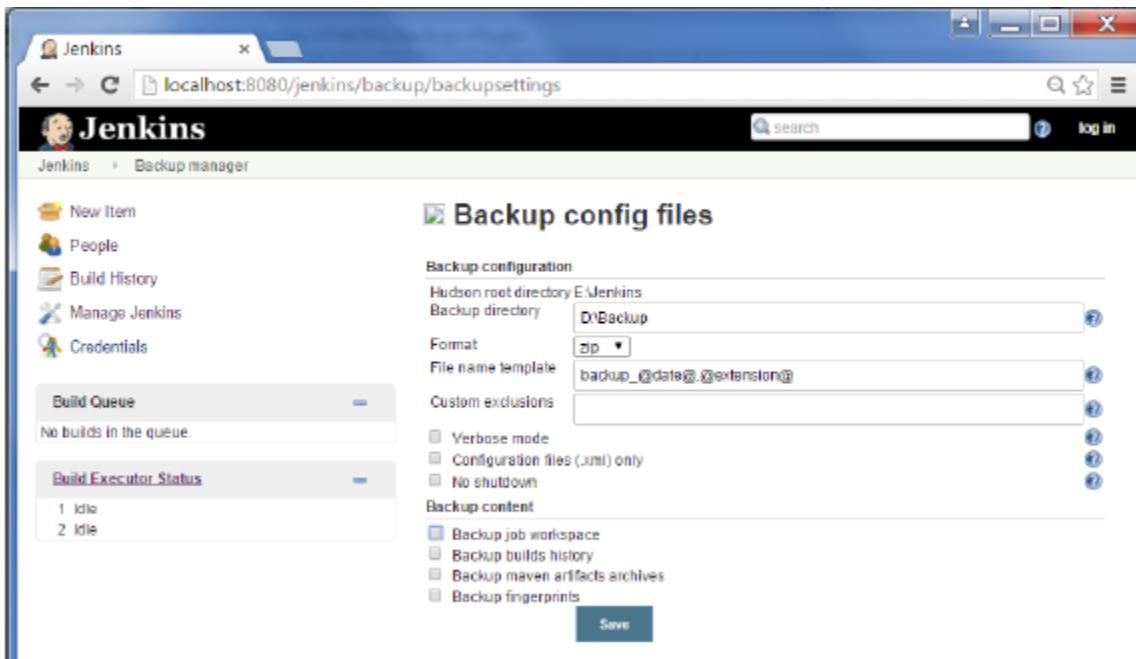
Step 3 – Now when you go to Manage Jenkins, and scroll down you will see 'Backup Manager' as an option. Click on this option.



Step 4 – Click on Setup.



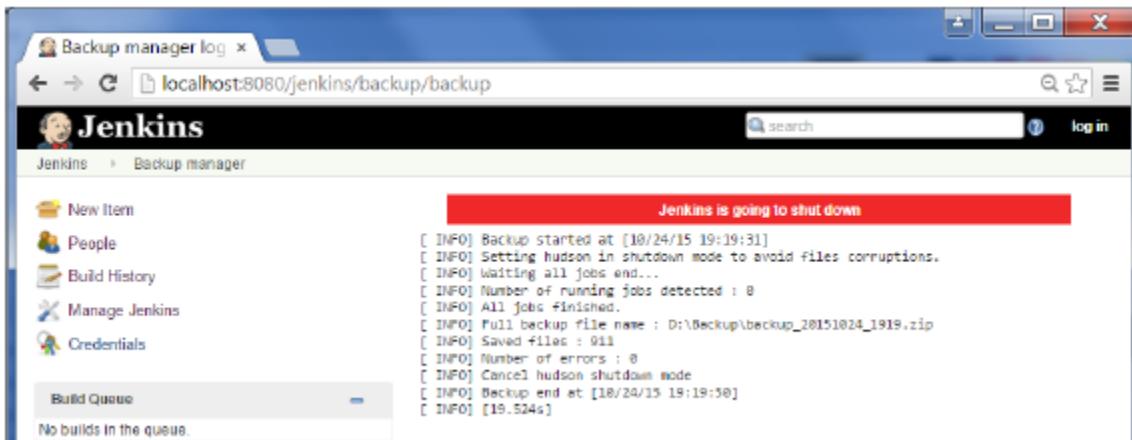
Step 5 – Here, the main field to define is the directory for your backup. Ensure it's on another drive which is different from the drive where your Jenkins instance is setup. Click on the Save button.



Step 6 – Click on the 'Backup Hudson configuration' from the Backup manager screen to initiate the backup.



The next screen will show the status of the backup



To recover from a backup, go to the Backup Manager screen, click on Restore Hudson configuration.



The list of backup's will be shown, click on the appropriate one to click on Launch Restore to begin the restoration of the backup.



Resources

<https://www.jenkins.io/>

<https://www.jenkins.io/doc/>

<https://www.jenkins.io/doc/book/system-administration/>

<https://www.tutorialandexample.com/jenkins-tutorial/>