



**Academic Year: 2025-26**

**Semester: V**

**Class / Branch: TEIT C**

**Subject: DevOps Lab**

**Name of Instructor: Prof. Sujata Oak**

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### **Experiment No. 6**

**Aim:** To implement Jenkins Master-Slave Architecture with Scaling.

#### **Theory:**

#### **Objective**

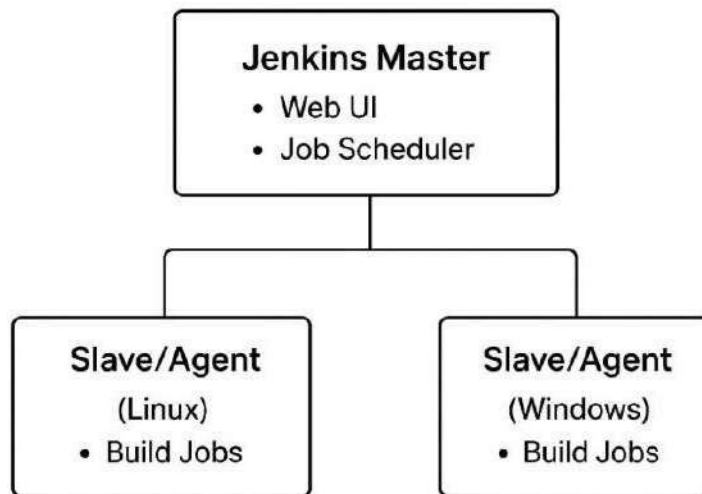
To understand and implement Jenkins' distributed build architecture where a central Jenkins Master (Controller) coordinates tasks and multiple Slave (Agent) nodes execute builds in parallel.

#### **Purpose of Distributed Builds**

- Large projects often require running builds and tests on different operating systems, environments, or hardware.
- A single server can become a bottleneck. Distributed builds increase **scalability**, **speed**, and **fault tolerance**.

#### **Key Roles**

- **Master (Controller):**
  - o Hosts the Jenkins web UI and job configurations.
  - o Schedules jobs, monitors nodes, and aggregates build results.
  - o Decides *what* to build and *where* to build it.
- **Slave (Agent):**
  - o A remote machine (physical/VM/container) where the actual build steps run.
  - o Communicates with the master through an SSH or JNLP (Java Web Start) connection.
  - o Can have specific labels (e.g., linux, windows) to run platform-dependent jobs.



### Jenkins Master and Slave Concept

A Jenkins master comes with the basic installation of Jenkins, and in this configuration, the master handles all the tasks for our build system.

If we are working on multiple projects, we may run multiple jobs on each project. Some projects need to run on some nodes, and in this process, we need to configure slaves. [Jenkins slaves connect to the Jenkins master](#) using the Java Network Launch Protocol (JNLP).

The Jenkins master acts to schedule the jobs, assign slaves, and send builds to slaves to execute the jobs.

It will also monitor the slave state (offline or online) and get back the build result responses from slaves and the display build results on the console output. The workload of building jobs is delegated to multiple **slaves**.

### Advantages

- Parallel execution → faster CI/CD pipeline.
- Flexibility to run jobs on specific environments.
- Load distribution prevents the master from being overloaded.

### Steps to Configure Jenkins Master and Slave Nodes

#### STEP A: Sign-In to AWS MANAGEMENT CONSOLE



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The screenshot shows the 'Connect to Instance' page in the AWS Management Console. The page is for instance 'i-09a1cc0a080e9928a' (Jenkins-MS). The 'Connection type' is set to 'Connect using a Public IP'. The 'Public IPv4 address' is '3.108.196.146'. The 'Username' is 'ubuntu'. A note states: 'Note: In most cases, the default username, ubuntu, is correct. However, read your AMI usage instructions to check if the AMI owner has changed the default AMI username.' The 'Connect' button is highlighted in orange.

Click on Connect

The screenshot shows the 'Instances' page in the AWS Management Console. The table lists the instance 'jenkins-MS' with ID 'i-04d906e26189f029b', which is in the 'Running' state. The instance type is 't2.micro' and it is in the 'ap-south-1b' availability zone. The 'Public IPv4' address is 'ec2-13-20-...'. The 'Status check' shows 'initializing'.

Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4
jenkins-MS	i-04d906e26189f029b	Running	t2.micro	initializing	View alarms	ap-south-1b	ec2-13-20-...



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aws [Search] [Alt+S] Account ID: 5731-7398-7442 Mumbai

EC2 > Instances > i-04d9e6e26189f029b > Connect to instance

### Connect Info

Connect to an instance using the browser-based client.

**EC2 Instance Connect** Session Manager SSH client EC2 serial console

**Instance ID**  
i-04d9e6e26189f029b (jenkins-Ms)

**Connection type**

☒ Connect using a Public IP  
Connect using a public IPv4 or IPv6 address.

☐ Connect using a Private IP  
Connect using a private IP address and a VPC endpoint.

**Public IPv4 address**  
13.201.193.73

☐ IPv6 address

**Username**  
Enter the username defined in the AMI used to launch the instance. If you didn't define a custom username, use the default username, ubuntu.

ubuntu

**Note:** In most cases, the default username, ubuntu, is correct. However, read your AMI usage instructions to check if the AMI owner has changed the default AMI username.

```
aws [Search] [Alt+S] Account ID: 5731-7398-6742 Mumbai Misbah Khan
```

```
Restarting services...
Service restarts being deferred:
systemctl restart networkd-dispatcher.service
systemctl restart unattended-upgrades.service

No containers need to be restarted.

User sessions running outdated binaries:
ubuntu @ session #1: sshd[1054]

No VM guests are running outdated hypervisor (qemu) binaries on this host.
root@ip-172-31-7-85:/home/ubuntu# sudo apt update
Hit:1 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu noble-security InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
1 package can be upgraded. Run 'apt list --upgradable' to see it.
root@ip-172-31-7-85:/home/ubuntu# sudo apt install -y openjdk-17-jdk
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  libice-dev libpthread-stubs0-dev libsm-dev libx11-dev libxau-dev libxcb1-dev libxdmcp-dev libxt-dev openjdk-17-jdk-headless x11proto-dev xorg-sgml-doctools
  xtrans-dev
Suggested packages:
  libice-doc libsm-doc libx11-doc libxcb-doc libxt-doc openjdk-17-demo openjdk-17-source visualvm
The following NEW packages will be installed:
  libice-dev libpthread-stubs0-dev libsm-dev libx11-dev libxau-dev libxcb1-dev libxdmcp-dev libxt-dev openjdk-17-jdk openjdk-17-jdk-headless x11proto-dev
  xorg-sgml-doctools xtrans-dev
```

i-04d9e6e26189f029b (jenkins-Ms)

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```
root@ip-172-31-7-85:/home/ubuntu# curl -fsSL https://pkg.jenkins.io/debian/jenkins.io-2023.key | sudo tee \
/usr/share/keyrings/jenkins-keyring.asc > /dev/null
root@ip-172-31-7-85:/home/ubuntu# echo deb [signed-by=/usr/share/keyrings/jenkins-keyring.asc] \
https://pkg.jenkins.io/debian binary/ | sudo tee \
/etc/apt/sources.list.d/jenkins.list > /dev/null
root@ip-172-31-7-85:/home/ubuntu# sudo apt update
Hit:1 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-backports InRelease
Ign:4 https://pkg.jenkins.io/debian binary/ InRelease
Get:5 https://pkg.jenkins.io/debian binary/ Release [2044 B]
Get:6 https://pkg.jenkins.io/debian binary/ Release.gpg [833 B]
Hit:7 http://security.ubuntu.com/ubuntu noble-security InRelease
Get:8 https://pkg.jenkins.io/debian binary/ Packages [72.4 kB]
Fetched 75.3 kB in 1s (96.3 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
1 package can be upgraded. Run 'apt list --upgradable' to see it.
root@ip-172-31-7-85:/home/ubuntu# sudo apt install -y jenkins
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  net-tools
The following NEW packages will be installed:
  jenkins net-tools
0 upgraded, 2 newly installed, 0 to remove and 1 not upgraded.
```

i-04d9e6e26189f029b (jenkins-Ms)

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```
Building dependency tree... Done
Reading state information... Done
1 package can be upgraded. Run 'apt list --upgradable' to see it.
root@ip-172-31-7-85:/home/ubuntu# sudo apt install -y jenkins
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  net-tools
The following NEW packages will be installed:
  jenkins net-tools
0 upgraded, 2 newly installed, 0 to remove and 1 not upgraded.
Need to get 95.2 MB of archives.
After this operation, 96.3 MB of additional disk space will be used.
Get:1 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 net-tools amd64 2.10-0.1ubuntu4.4 [204 kB]
Get:2 https://pkg.jenkins.io/debian binary/ jenkins 2.527 [95.0 MB]
Fetched 95.2 MB in 3s (32.6 MB/s)
Selecting previously unselected package net-tools.
(Reading database ... 118829 files and directories currently installed.)
Preparing to unpack .../net-tools_2.10-0.1ubuntu4.4_amd64.deb ...
Unpacking net-tools (2.10-0.1ubuntu4.4) ...
Selecting previously unselected package jenkins.
Preparing to unpack .../archives/jenkins_2.527_all.deb ...
Unpacking jenkins (2.527) ...
Setting up net-tools (2.10-0.1ubuntu4.4) ...
Setting up jenkins (2.527) ...
Created symlink /etc/systemd/system/multi-user.target.wants/jenkins.service → /usr/lib/systemd/system/jenkins.service.
Processing triggers for man-db (2.12.0-4build2) ...
Scanning processes...
Scanning candidates...
Scanning linux images...

Pending kernel upgrade!
```

i-04d9e6e26189f029b (jenkins-Ms)

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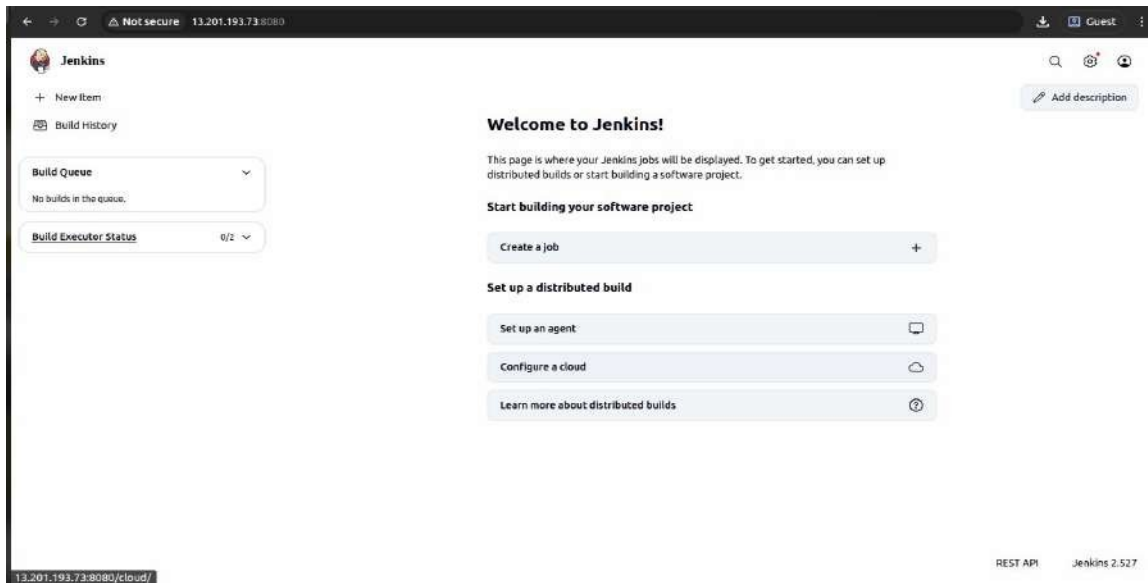




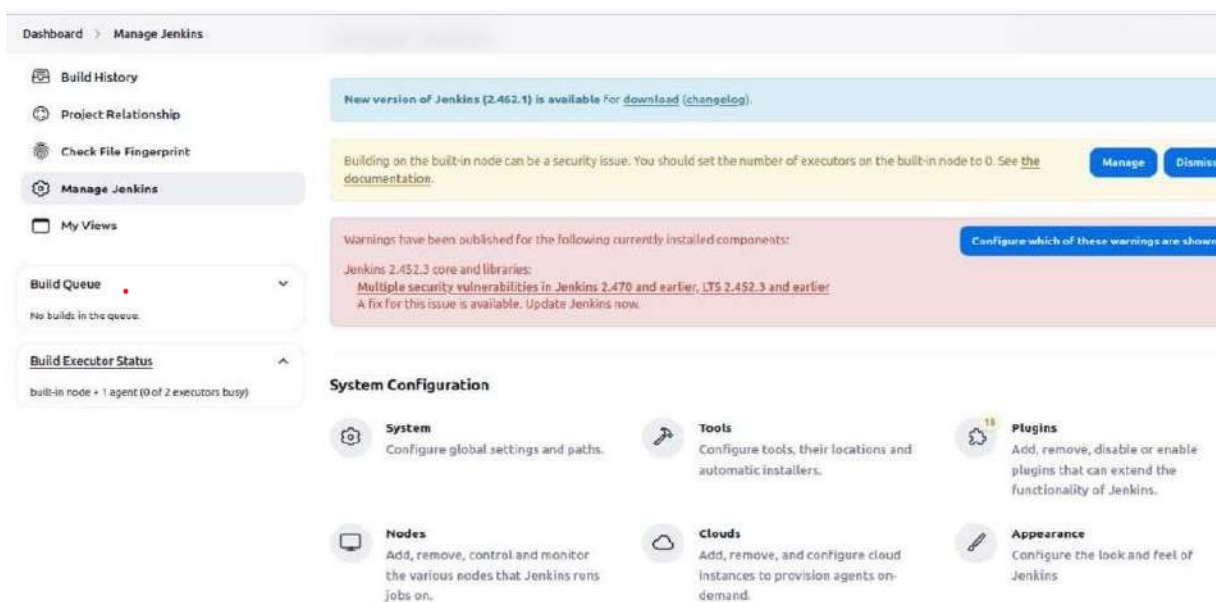
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## STEP B: Install Jenkins



## STEP1: In Jenkins Dashboard Click on Manage Jenkins -> Manage Nodes





**STEP 2: Select New Node and enter the name of the node in the Node Name field.**

Select Permanent Agent and click the OK button. Initially, you will get only one

option,

“Permanent Agent.” Once we have one or more slaves you will get the “Copy Existing Node” option. Click Create

**STEP3: Configure node with below details:**

Jenkins / Manage Jenkins / Nodes / New node

### New node

Node name

agent

Type

☒ Permanent Agent

Adds a plain, permanent agent to Jenkins. This is called "permanent" because Jenkins doesn't provide higher level of integration with these agents, such as dynamic provisioning. Select this type if no other agent types apply — for example such as when you are adding a physical computer, virtual machines managed outside Jenkins, etc.

Create

```
sujata@Ubuntu:~/Desktop/JENKINS_LAB$ pwd  
/home/sujata/Desktop/JENKINS_LAB
```

#find / -type f -name java

```
sujata@Ubuntu:~/Desktop/JENKINS_LAB$ su root  
Password:  
root@Ubuntu:/home/sujata/Desktop/JENKINS_LAB# find / -type f -name java
```

```
/usr/lib/jvm/java-11-openjdk-amd64/bin/java
```



Jenkins / Manage Jenkins / Nodes

Name ?  
agent

Description ?  
  
Plain text Preview

Number of executors ?  
1

Remote root directory ?  
/home/ubuntu

Labels ?

Usage ?  
Use this node as much as possible

Save

Under 'Node Properties', provide jdk path.

Jenkins / Manage Jenkins / Nodes

Node Properties

☐ Disable deferred wipeout on this node ?  
☐ Disk Space Monitoring Thresholds  
☒ Environment variables  
List of variables ?

Name  
java\_home

Value  
/usr/lib/jvm/java-17-openjdk-amd64/bin/java

+ Add

☐ Tool Locations

Save

REST API Jenkins 2.527





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Jenkins / Manage Jenkins / Nodes

**Nodes** [+ New Node](#) [Configure Monitors](#) [Share](#)

S	Name	Architecture	Clock Difference	Free Disk Space	Free Swap Space	Free Temp Space	Response Time
	Built-in Node	Linux (amd64)	In sync	3.72 GiB	0 B	3.72 GiB	0ms
	last checked	18 min	18 min	18 min	18 min	18 min	18 min

Icon: ☐ S ☐ M ☒ L Legend

REST API Jenkins 2.527



**STEP4:** On click of 'Save' will display the below page with error message. Here Jenkins connect with Slave node using Java Web Start and it needs a port to establish the connection.

To configure JNLP port in global security. Now goto Manage Jenkins -> Security

This port has to be allowed to access across firewall, so from Master terminal run the below command,



***sudo ufw allow 50000/tcp***

This command will allow port 50000 to listen for request.

```
root@Ubuntu:/home/sujata/Desktop/JENKINS_LAB# sudo ufw allow 50000/tcp
Rule added
Rule added (v6)
```

**STEP5:** Again coming back to Jenkins and navigate to Nodes -> agent2 which will display two ways to connect with Agent node.



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Jenkins / Manage Jenkins / Nodes / agent

Status Agent agent

Delete Agent

Configure

Build History

Load Statistics

Log

Run from agent command line: (Unix)

```
curl -s0 http://13.201.193.73:8080/jnlpJars/agent.jar
java -jar agent.jar -url http://13.201.193.73:8080/ -secret 81e4966d412353081d358f13724f6eaac29ffa36ba1a7b711fb1eb4cc9b70121 -
name agent -webSocket -workDir "/home/ubuntu"
```

Run from agent command line: (Windows)

Build Executor Status

agent (offline)

To establish connection, run the below command

```
root@Ubuntu:/home/sujata/Desktop/JENKINS_LAB# curl -s0 http://127.0.0.1:8080/jnlpJars/agent.jar

root@Ubuntu:/home/sujata/Desktop/JENKINS_LAB# java -jar agent.jar -url http://127.0.0.1:8080/ -secret cacd8d769874ea4f1a2a28392
ffe62d08add0eeb0ea463cced99fa1f707fad0 -name agent2 -workDir "/home/sujata/Desktop/JENKINS_LAB"
```

OUTPUT:

```
ubuntu@ip-172-31-7-85:~$ curl -s0 http://13.201.193.73:8080/jnlpJars/agent.jar
ubuntu@ip-172-31-7-85:~$ java -jar agent.jar -url http://13.201.193.73:8080/ -secret 81e4966d412353081d358f13724f6eaac29ffa36ba1a7b711fb1eb4cc9b70121 -name agent -w
ebSocket -workDir "/home/ubuntu"
Sep 17, 2025 6:03:49 AM org.jenkinsci.remoting.engine.WorkDirManager initializeWorkDir
INFO: Using /home/ubuntu/remoting as a remoting work directory
Sep 17, 2025 6:03:49 AM org.jenkinsci.remoting.engine.WorkDirManager setupLogging
INFO: Both error and output logs will be printed to /home/ubuntu/remoting
Sep 17, 2025 6:03:49 AM hudson.remoting.Launcher createEngine
INFO: Setting up agent: agent
Sep 17, 2025 6:03:49 AM hudson.remoting.Engine startEngine
INFO: Using Remoting version: 3327.v868139a_d00e0
Sep 17, 2025 6:03:49 AM org.jenkinsci.remoting.engine.WorkDirManager initializeWorkDir
INFO: Using /home/ubuntu/remoting as a remoting work directory
Sep 17, 2025 6:03:49 AM hudson.remoting.Launcher$CuiListener status
INFO: WebSocket connection open
Sep 17, 2025 6:03:49 AM hudson.remoting.Launcher$CuiListener status
INFO: Connected
```

i-04d9e6e26189f029b (jenkins-Ms)

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This will establish connection with the configured Slave node.

The screenshot shows the Jenkins 'Nodes' page. On the left, there's a sidebar with 'Nodes' and 'Clouds' sections. The 'Build Queue' shows 'No builds in the queue.' and 'Build Executor Status' shows 'built-in node + 2 agents (0 of 2 executors busy)'. The main table lists three nodes:

S	Name	Architecture	Clock Difference	Free Disk Space	Free Swap Space	Free Temp Space	Response Time
1	agent1		N/A	5.88 GiB	N/A	5.88 GiB	Timed out for last 1 attempts
2	agent2	Linux (amd64)	14 sec behind	5.88 GiB	923.26 MiB	5.88 GiB	30003ms
3	Built-in Node	Linux (amd64)	In sync	5.88 GiB	923.26 MiB	5.88 GiB	0ms
Data obtained		1 min 13 sec	1 min 13 sec	1 min 13 sec	1 min 13 sec	1 min 13 sec	1 min 13 sec

Now Jenkins Slave node is ready to run any job. This node's label name should be mentioned in the corresponding Job configuration as below:

#### STEP 6: Create a New Job in Jenkins dashboard

The screenshot shows the 'New Item' page in Jenkins. The 'Enter an Item name' field contains 'master\_slave\_jenkins'. Under 'Select an item type', several options are listed:

- Freestyle project**: Classic, general-purpose job type that checks out from up to one SCM, executes build steps serially, followed by post-build steps like archiving artifacts and sending email notifications.
- Pipeline**: Orchestrates long-running activities that can span multiple build agents. Suitable for building pipelines (formerly known as workflows) and/or organizing complex activities that do not easily fit in free-style job type.
- Multi-configuration project**: Suitable for projects that need a large number of different configurations, such as testing on multiple environments, platform-specific builds, etc.
- Folder**: Creates a container that stores nested items in it. Useful for grouping things together. Unlike view, which is just a filter, a folder creates a separate namespace, so you can have multiple things of the same name as long as they are in different folders.
- Multibranch Pipeline**: Creates a set of Pipeline projects according to detected branches in one SCM repository.

An 'OK' button is visible at the bottom left.



## STEP 7: Configure the page with following:

Jenkins / master\_slave\_jenkins / Configuration

**Configure**

- General
- Source Code Management
- Triggers
- Environment
- Build Steps
- Post-build Actions

Plain text [Preview](#)

☐ Discard old builds ?

☐ GitHub project

☐ This project is parameterised ?

☐ Throttle builds ?

☐ Execute concurrent builds if necessary ?

☒ Restrict where this project can be run ?

Label Expression ?

agent

Label agent matches 1 node. Permissions or other restrictions provided by plugins may further reduce that list.

Advanced ▾

**Source Code Management**

Connect and manage your code repository to automatically pull the latest code for your builds.

Save Apply

Jenkins / master\_slave\_jenkins / Configuration

**Configure**

- General
- Source Code Management
- Triggers
- Environment
- Build Steps
- Post-build Actions

☐ Use secret text(s) or file(s) ?

☐ Add timestamps to the Console Output

☐ Inspect build log for published build scans

☐ Terminate a build if it's stuck

☐ With Ant ?

**Build Steps**

Automate your build process with ordered tasks like code compilation, testing, and deployment.

Execute shell ?

Command

See the list of available environment variables

echo "Hello Students, Welcome to session on MASTER SLAVE SESSION"

Advanced ▾

Save Apply





Click on Build-Now, Console Output

Jenkins / master\_slave\_jenkins / #2 / Console Output

Status  
Changes  
Console Output  
Edit Build Information  
Delete build '#2'  
Timings  
Previous Build

Console Output

Download Copy View as plain text

```
Started by user admin
Running as SYSTEM
Building remotely on agent in workspace /home/ubuntu/workspace/master_slave_jenkins
[master_slave_jenkins] $ /bin/sh -xe /tmp/jenkins5686358984489395107.sh
+ echo Hello Students, Welcome to session on MASTER SLAVE SESSION
Hello Students, Welcome to session on MASTER SLAVE SESSION
Finished: SUCCESS
```

STEP 8: Goto Jenkins Dashboard->Manage Jenkins->Nodes->agent2

Jenkins / Manage Jenkins / Nodes / agent

Status  
Delete Agent  
Configure  
Build History  
Load Statistics  
Script Console  
Log  
System Information  
Disconnect

Agent agent

Agent is connected.

Monitoring Data

Projects tied to agent

S	W	Name	Last Success	Last Failure	Last Duration
✓	⚠	master_slave_jenkins	10 min #2	N/A	0.18 sec

Build Executor Status: 0/1

Icon: S M L

**Conclusion:** Jenkins Master-Slave (Controller-Agent) architecture allows scalable, parallel, and environment-specific builds. It is essential for real-world CI/CD pipelines where multiple teams and platforms are involved.