PW SKILLS | DevOps and Cloud Computing

Advanced Jenkins

Objective

- Manage files, plugins, and jobs in Jenkins.
- Understand upstream and downstream job dependencies.
- Apply CI best practices for efficient pipeline execution.
- Scale Jenkins workloads to improve performance and reliability

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Explain Jenkins job types (Freestyle, Pipeline, Multibranch).

Jenkins Job Type

Jenkins supports several job types, each suited to specific use cases in continuous integration and deployment workflows. Below is a summary of the key job types:

1. Freestyle Project

- Description: A basic and versatile job type that allows you to define simple build steps.
- Use Cases: Execute shell or batch commands, integrate with source code management (SCM), trigger builds, and run build tools like Ant, Maven, or Gradle.
- Flexibility: Ideal for simple automation tasks but lacks advanced features like scripting or branching logic.

Jenkins Job Type

2. Pipeline

- Description: A more advanced job type that uses a script (written in Groovy) to define the entire build process as code.
- Use Cases: Automating complex workflows, including building, testing, deploying, and integrating with tools like Docker.
- Key Feature: Uses a Jenkinsfile stored in the project's SCM to define the pipeline steps, enabling version control of the build process.
- Advantages: Supports sequential and parallel execution, error handling, and reusable code.

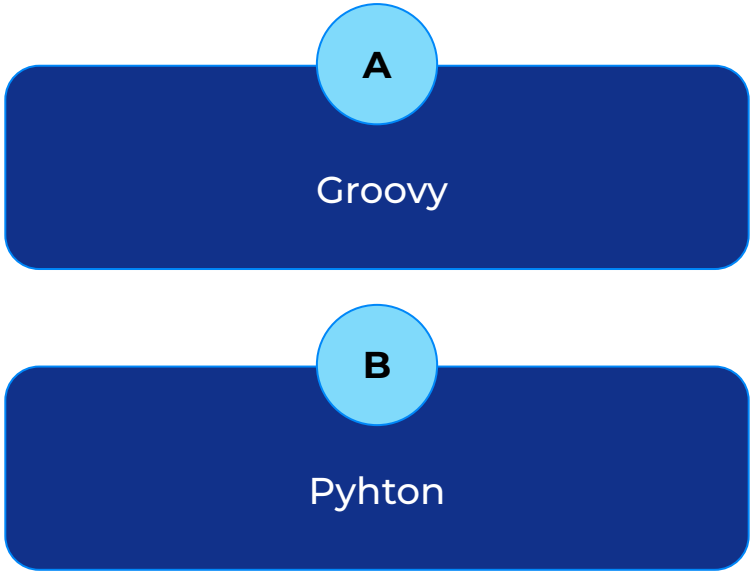
Jenkins Job Type

3. Multibranch Pipeline

- Description: A specialized pipeline job that automatically creates and manages pipelines for all branches in a repository.
- Use Cases: Useful for projects with multiple branches where each branch has its own Jenkinsfile.
- Key Feature: Automatically detects new branches and applies the pipeline configuration without manual intervention.
- Advantages: Simplifies CI/CD for repositories with multiple active development branches.

Pop Quiz

Q. What scripting language is used to define a Jenkins Pipeline?



Pop Quiz

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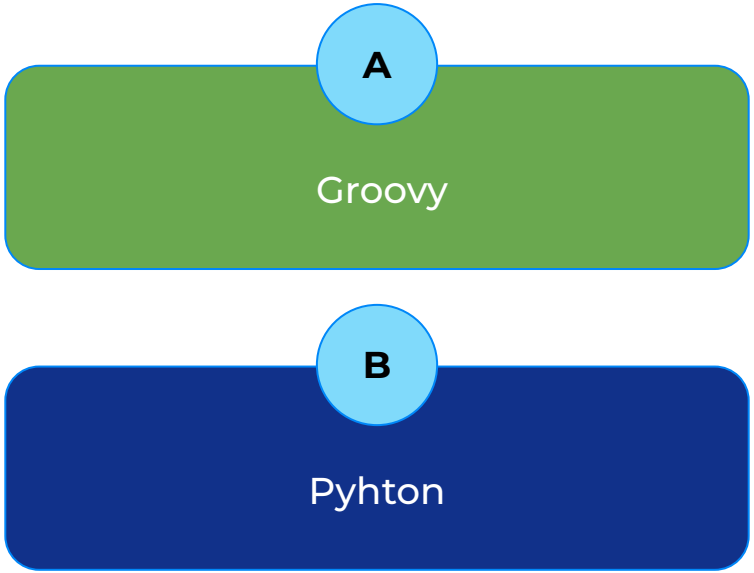

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Discuss Jenkins file structure and configuration files (config.xml)

Let’s Discuss

Jenkins uses specific files and structures to manage its configurations and pipelines. Here's a concise overview.

Jenkinsfile

Purpose: Defines the pipeline as code using Groovy-based Domain-Specific Language (DSL).

Structure:

- Pipeline Block
- Agent
- Stages
- Steps
- Post Actions

Formats:

- Declarative: Structured and user-friendly, recommended for most use cases.
- Scripted: Offers flexibility but is less readable for complex pipelines.

Configuration Files (config.xml)

- Found in various directories under ‘JENKINS_HOME’.

- **Global Configurations:**

Located at ‘JENKINS_HOME/config.xml’.

Stores system-wide settings like security, plugins, and global environment variables.

- **Job-Specific Configurations:**

Each job has its own ‘config.xml’ in ‘JENKINS HOME/jobs/[JOBNAME]/config.xml’.

Defines job-specific settings like triggers, SCM configurations, and build steps.

- **Folder Configurations:**

Folders have their own ‘config.xml’ to manage nested jobs.

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Introduce plugins and their role in extending Jenkins functionality

Plugins & their Role

Plugins in Jenkins are extensions that enhance its core functionality, making it highly adaptable for diverse CI/CD workflows. Here's a brief overview:

Role of Plugins in Jenkins:

1. Integration
2. Customization
3. Automation
4. Ease of Use

Examples of Popular Plugins:

- Git Plugin
- Pipeline Plugin
- Docker Plugin
- Kubernetes Plugin

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Demonstrate managing plugins via the Jenkins UI

Let’s do it

Managing plugins via the Jenkins UI is straightforward and can be done through the "Manage Jenkins" > "Plugins" page. Here's a brief overview of the process:

1. Installing Plugins
2. Updating Plugins
3. Uninstalling Plugins
4. Disabling Plugins
5. Manually Uploading Plugins

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Explain job dependencies and how to chain jobs

Job Dependencies

- Definition: Dependencies ensure that one job runs after another or only if a preceding job succeeds.
- Use Cases: Building, testing, and deploying applications in sequential steps.

Chaining Jobs

1. Using "Build Other Projects"
2. Using Pipelines:

   Define dependencies and chaining directly in a ‘Jenkinsfile’ using pipeline syntax.

Example:

```
pipeline {
    stages {
        stage('Build') {
            steps {
                echo 'Building...'
            }
        }
        stage('Test') {
            steps {
                echo 'Testing...'
            }
        }
    }
}
```

3. Parameterized Trigger Plugin
4. Multibranch Pipelines

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Demonstrating setting up: Upstream & Downstream jobs

Let’s do it

Here’s a concise demonstration of setting up upstream and downstream jobs in Jenkins:

1. Upstream Job: Triggered by Another Job

Steps:

1. Create a new job (e.g., "Upstream Job").
2. Configure the job with build steps (e.g., shell commands or scripts).
3. Save the configuration.

Let’s do it

2. Downstream Job: Runs After Upstream Job

Steps:

1. Create another job (e.g., "Downstream Job").
2. In the "Upstream Job" configuration:

- Go to Post-build Actions.
- Select Build other projects.
- Enter the name of the downstream job (e.g., "Downstream Job").
- Optionally, set conditions (e.g., trigger on success).

Save the configuration.

3. Passing Parameters

4. Viewing Dependencies

Pop Quiz

Q. What is an upstream job in Jenkins?

A

A job triggered after another job completes

B

A job that triggers other jobs based on its status

Pop Quiz

Q. What is an upstream job in Jenkins?

A

A job triggered after another job completes

B

A job that triggers other jobs based on its status

Pop Quiz

Q. What is a downstream job in Jenkins?

A

A job triggered by an upstream job's complication

B

A job that triggers other jobs

Pop Quiz

Q. What is a downstream job in Jenkins?

A

A job triggered by an upstream job's complication

B

A job that triggers other jobs

Take A 5-Minute Break!

- Stretch and relax
- Hydrate
- Clear your mind
- Be back in 5 minutes

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Discuss CI best practices

CI Best Practices

1. Keeping Pipelines Modular and Reusable

- Break pipelines into smaller, reusable components (e.g., separate build, test, and deploy stages) to simplify maintenance and improve flexibility.
- Use shared libraries or templates for common tasks to avoid duplication.

2. Reducing Build Times with Caching

- Implement caching mechanisms for dependencies, artifacts, and Docker layers to avoid redundant downloads or builds.
- Tools like Jenkins, GitLab CI, and CircleCI support caching to speed up builds.

CI Best Practices

3. Parallelizing Builds for Efficiency

- Split tests or tasks into parallel jobs to utilize multiple agents or runners, reducing overall pipeline execution time.
- Example: Run unit tests, integration tests, and UI tests concurrently.

4. Implementing Automated Rollbacks on Failure

- Configure pipelines to automatically revert deployments if a failure is detected during post-deployment checks.
- Use tools like Kubernetes or feature flags to enable quick rollbacks without downtime.

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Demonstrating pipeline optimization techniques

Let’s do it

Here’s a demonstration of optimization techniques using both Scripted and Declarative Pipelines:

1. Parallelizing Stages

Goal: Reduce execution time by running independent tasks concurrently.

Declarative Pipeline Example:

```
pipeline {
    agent any
    stages {
        stage('Parallel Tasks') {
            parallel {
                stage('Build') {
                    steps {
                        echo 'Building...'
                    }
                }
                stage('Test') {
                    steps {
                        echo 'Testing...'
                    }
                }
            }
        }
    }
}
```

Let’s do it

Scripted Pipeline Example:

```
node {
    parallel(
        build: {
            echo 'Building...'
        },
        test: {
            echo 'Testing...'
        }
    )
}
```

2. Caching Artifacts

Goal: Save time by reusing previously built artifacts or dependencies.

Let’s do it

Declarative Pipeline Example:

```
pipeline {
    agent any
    stages {
        stage('Build') {
            steps {
                stash name: 'build-artifacts',
includes: '**/target/*.jar'
            }
        }
        stage('Deploy') {
            steps {
                unstash 'build-artifacts'
                echo 'Deploying...'
            }
        }
    }
}
```

Let’s do it

Scripted Pipeline Example:

```
node {
    stage('Build') {
        stash name: 'build-artifacts', includes: '**/target/*.jar'
    }
    stage('Deploy') {
        unstash 'build-artifacts'
        echo 'Deploying...'
    }
}
```

3. Conditional Execution

Goal: Skip unnecessary stages based on conditions.

Let’s do it

Declarative Pipeline Example:

```
pipeline {
    agent any
    stages {
        stage('Conditional Stage') {
            when { branch 'main' }
            steps {
                echo 'Running on main branch...'
            }
        }
    }
}
```

Scripted Pipeline Example:

```
node {
    if (env.BRANCH_NAME == 'main') {
        stage('Conditional Stage') {
            echo 'Running on main branch...'
        }
    }
}
```

Let’s do it

4. Incremental Builds

Goal: Rebuild only the changed components to save time.

Declarative Pipeline Example:

```
pipeline {
    agent any
    stages {
        stage('Incremental Build') {
            steps {
                script {
                    if (fileExists('changed-files.txt')) {
                        echo 'Building only changed files...'
                    } else {
                        echo 'Full build required.'
                    }
                }
            }
        }
    }
}
```

Pop Quiz

Q. What is a key advantage of using declarative pipelines over scripted pipelines?

A

Simpler syntax and better readability for maintainability

B

Greater flexibility for complex workflows

Pop Quiz

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Explain why Jenkins needs scaling for large workloads

Let’s See

Jenkins needs scaling for large workloads to ensure performance, efficiency, and reliability in CI/CD pipelines. Here's why:

1. Handling Increased Workloads
2. Reducing Bottlenecks
3. Improving Resilience
4. Optimizing Resource Utilization

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Discuss strategies to scale Jenkins

Strategies

1. Master-Agent Architecture for Distributed Builds

- Description: This architecture separates the Jenkins controller (master) from the build execution nodes (agents). The master handles job scheduling, while agents perform the builds.
- Benefits: Allows horizontal scaling by adding more agents as needed, reducing the load on the master and improving parallelism.
- Implementation: Use cloud services like AWS or Azure to provision agents dynamically.
-

Strategies

2. Using Kubernetes and Jenkins Agents for Dynamic Scaling

- Description: Kubernetes enables dynamic scaling of Jenkins agents based on workload demands. Jenkins can automatically adjust the number of pods running agents.
- Benefits: Ensures optimal resource utilization and handles peak loads efficiently.
- Implementation: Use the Jenkins Kubernetes plugin to integrate with Kubernetes clusters.

3. Running Jenkins in Docker Containers for Isolated Environments

- Description: Containerizing Jenkins allows for isolated environments that are easy to manage and scale.
- Benefits: Provides immutable build environments, simplifies agent setup, and supports rapid deployment.
- Implementation: Use Docker to create Jenkins images and manage containers for build agents.

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Demonstrate setting up a Jenkins agent node for workload distribution

Let’s do it

Steps to Set Up a Jenkins Agent Node for Workload Distribution:

1. Prepare the Agent Machine:
2. Add a New Node in Jenkins UI
3. Configure the Node
4. Set Launch Method
5. Start the Agent
6. Verify Connection

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Time for Case Study

Important

- Complete the post-class assessment
- Complete assignments (if any)
- Practice the concepts and techniques taught in this session
- Review your lecture notes
- Note down questions and queries regarding this session and consult the teaching assistants

Thanks !