KNS INSTITUTE OF TECHNOLOGY BANGALORE

(AFFILIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM)

DEPARTMENT OF

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

DEVOPS LAB

BCSL657D (6th SEM)

ACADEMIC YEAR 20__- 20___

Name of the student_________________________

USN No.___________________________________

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ECE HOD

KNSIT

VISION

To emerge as a world class institution pursuing excellence in the field of Engineering and Technology to serve the society.

Mission

To be a center of Excellence in Technical Education, Research and professional development.
To develop students potential and skills to its fullest extent contributing them for Make in India.

DEPARTMENT

Vision

"To impart knowledge in the field of Electronics and Communication Engineering so as to nurture excellence in Education and Research"

Mission

To provide quality education and training the students to carry out Research and Innovations.
To empower practicing engineers with the state of art technology to meet the growing challenges of the industry.

DEVOPS		Semester	6
Course Code	BCSL657D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	100
Examination type (SEE)	Practical		

Course objectives:

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

Sl.NO	Experiments
1	**Introduction to Maven and Gradle:** Overview of Build Automation Tools, Key Differences Between Maven and Gradle, Installation and Setup
2	**Working with Maven:** Creating a Maven Project, Understanding the POM File, Dependency Management and Plugins
3	**Working with Gradle:** Setting Up a Gradle Project, Understanding Build Scripts (Groovy and Kotlin DSL), Dependency Management and Task Automation
4	**Practical Exercise:** Build and Run a Java Application with Maven**,** Migrate the Same Application to Gradle
5	**Introduction to Jenkins:** What is Jenkins?, Installing Jenkins on Local or Cloud Environment, Configuring Jenkins for First Use
6	**Continuous Integration with Jenkins:** Setting Up a CI Pipeline**,** Integrating Jenkins with Maven/Gradle**,** Running Automated Builds and Tests
7	**Configuration Management with Ansible:** Basics of Ansible: Inventory, Playbooks, and Modules, Automating Server Configurations with Playbooks, Hands-On: Writing and Running a Basic Playbook
8	**Practical Exercise:** Set Up a Jenkins CI Pipeline for a Maven Project, Use Ansible to Deploy Artifacts Generated by Jenkins
9	**Introduction to Azure DevOps:** Overview of Azure DevOps Services, Setting Up an Azure DevOps Account and Project
10	**Creating Build Pipelines:** Building a Maven/Gradle Project with Azure Pipelines, Integrating Code Repositories (e.g., GitHub, Azure Repos), Running Unit Tests and Generating Reports
11	**Creating Release Pipelines:** Deploying Applications to Azure App Services, Managing Secrets and Configuration with Azure Key Vault, Hands-On: Continuous Deployment with Azure Pipelines
12	**Practical Exercise and Wrap-Up:** Build and Deploy a Complete DevOps Pipeline, Discussion on Best Practices and Q&A

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

1. Demonstrate different actions performed through Version control tools like Git.
2. Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
3. Experiment with configuration management using Ansible.
4. Demonstrate Cloud-based DevOps tools using Azure DevOps.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- **SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute**.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- https://www.geeksforgeeks.org/devops-tutorial/
- https://www.javatpoint.com/devops
- https://www.youtube.com/watch?v=2N-59wUIPVI
- https://www.youtube.com/watch?v=87ZqwoFeO88

CYCLE OF EXPERIMENTS

LAB CODE: BCSL657D

List of Experiments	DATE	REMARKS
Cycle I		
1.**Introduction to Maven and Gradle:** Overview of Build Automation Tools, Key Differences Between Maven and Gradle, Installation and Setup 2.**Working with Maven:** Creating a Maven Project, Understanding the POM File, 3.**Working with Gradle:** Setting Up a Gradle Project, Understanding Build Scripts (Groovy and Kotlin DSL), Dependency Management and Task Automation 4.**Practical Exercise:** Build and Run a Java Application with Maven**,** Migrate the Same Application to Gradle 5.**Introduction to Jenkins:** What is Jenkins?, Installing Jenkins on Local or Cloud Environment, Configuring Jenkins for First Use 6.**Continuous Integration with Jenkins:** Setting Up a CI Pipeline**,** Integrating Jenkins with Maven/Gradle**,** Running Automated Builds and Tests 7.**Configuration Management with Ansible: Basics of Ansible:** Inventory,Playbooks, and Modules, Automating Server Configurations with Playbooks, Hands-On: Writing and Running a Basic Playbook 8.**Practical Exercise:** Set Up a Jenkins CI Pipeline for a Maven Project, Use Ansible to Deploy Artifacts Generated by Jenkins 9.**Introduction to Azure DevOps:** Overview of Azure DevOps Services, Setting Up an Azure DevOps Account and Project 10.**Creating Build Pipelines:** Building a Maven/Gradle Project with Azure Pipelines, Integrating Code Repositories (e.g., GitHub, Azure Repos), Running Unit Tests and Generating Reports 11.**Creating Release Pipelines:** Deploying Applications to Azure App Services, Managing Secrets and Configuration with Azure Key Vault, Hands-On: Continuous Deployment with Azure Pipelines 12.**Practical Exercise and Wrap-Up:** Build and Deploy a Complete DevOps Pipeline, Discussion on Best Practices and Q&A		

NOTE: a) SUB GROUP: Not more than 3 students/Group.
b) BATCH: Maximum of 16 students/Batch.

EXPERIMENT NO:1

Introduction to Maven and Gradle

AIM: Overview of Build Automation Tools, Key Differences Between Maven and Gradle, Installation and Setup

SOFTWARE/TOOLS REQUIRED: Java (version jdk 17 or 23), Maven (Version 10), Gradle (Version 10).

Theory:

Overview of Build Automation Tools

Build automation tools help developers streamline the process of building, testing, and deploying software projects. They take care of repetitive tasks like compiling code, managing dependencies, and packaging applications, which makes development more efficient and error-free.

Two popular tools in the Java ecosystem are **Maven** and **Gradle**. Both are great for managing project builds and dependencies, but they have some key differences.

Maven: Maven is a build automation tool primarily used for Java projects. It uses an XML configuration file called `pom.xml` (Project Object Model) to define project settings, dependencies, and build steps.

Features:

- Predefined project structure and lifecycle phases.
- Automatic dependency management through Maven Central.
- Wide range of plugins for things like testing and deployment.
- Supports complex projects with multiple modules.

Gradle: Gradle is a more modern and versatile build tool that supports multiple programming languages, including Java, Groovy, and Kotlin. It uses a domain-specific language (DSL) for build scripts, written in Groovy or Kotlin.

Features:

- Faster builds thanks to task caching and incremental builds.
- Flexible and customizable build scripts.
- Works with Maven repositories for dependency management.
- Excellent support for multi-module and cross-language projects.
- Integrates easily with CI/CD pipelines.

Key Differences Between Maven and Gradle

Aspect	Maven	Gradle
Configuration	XML (`pom.xml`)	Groovy or Kotlin DSL
Performance	Slower	Faster due to caching
Flexibility	Less flexible	Highly customizable
Dependency Management	Uses Maven Central	Compatible with Maven too
Plugin Support	Large ecosystem	Extensible and versatile

Installation and Setup

How to Install Maven:

1. **Download Maven:**
   - Go to the Maven Download Page and download the latest binary ZIP file.
2. **Extract the ZIP File:**
   - Right-click the downloaded ZIP file and select **Extract All…** or use any extraction tool like WinRAR or 7-Zip.
3. **Move the Folder:**
   - After extraction, move the extracted **Maven folder** (usually named **apache-maven-x.x.x**) to a convenient directory like `C:\Program Files\`.
4. **Navigate to the `bin` Folder:**
   - Open the **Maven folder**, then navigate to the **`bin`** folder inside.
   - Copy the path from the File Explorer address bar(e.g., **C:\Program Files\apache-maven-x.x.x\bin**).
5. **Set Environment Variables:**
   - Open the **Start Menu**, search for **Environment Variables**, and select **Edit the system environment variables**.
   - Click **Environment Variables**.
   - Under **System Variables**:
     - Find the **path**, double click on it and click **New**.
     - Paste the full path to the `bin` folder of your Maven directory (e.g., **C:\Program Files\apache-maven-x.x.x\bin**).
6. **Save the Changes:**
   - Click **OK** to close the windows and save your changes.
7. **Verify the Installation:**
   - Open Command Prompt and run: **mvn -v** If Maven is correctly installed, it will display the version number.

How to install Gradle:

1. **Download Gradle:**
Visit the Gradle Downloads Page and download the latest binary ZIP file.
2. **Extract the ZIP File:**
   - Right-click the downloaded ZIP file and select **Extract All…** or use any extraction tool like WinRAR or 7-Zip.
3. **Move the Folder:**
   - After extraction, move the extracted **Gradle folder** (usually named **gradle-x.x.x**) to a convenient directory like `C:\Program Files\`.
4. **Navigate to the `bin` Folder:**
   - Open the **Gradle folder**, then navigate to the **bin** folder inside.
   - Copy the path from the File Explorer address bar (e.g., **`C:\Program Files\gradle-x.x\bin`**).
5. **Set Environment Variables:**
   - Open the **Start Menu**, search for **Environment Variables**, and select **Edit the system environment variables**.
   - Click **Environment Variables**.

- Under **System Variables**:
  - Find the **path**, double click on it and click **New**.
  - Paste the full path to the `bin` folder of your Gradle directory (e.g., **C:\Program Files\gradle-x.x.x\bin**).

6.**Save the Changes:**

- Click **OK** to close the windows and save your changes.

7.**Verify the Installation:**

- Open a terminal or Command Prompt and run: **gradle -v** If it shows the Gradle version, the setup is complete.

Result: Successfully installation and setup is done to build Maven and Gradle Tools

EXPERIMENT NO:02

Working with Maven

AIM: Creating a Maven Project, Understanding the POM File, Dependency Management and Plugins

COMPONENTS REQUIRED: Java (version jdk 17 or 23), Maven (Version 10), Gradle (Version 10).

Theory:

1: Creating a Maven Pro

ject

There are a few ways to create a Maven project, such as using the command line, IDEs like IntelliJ IDEA or Eclipse, or generating it via an archetype.

1. **Using Command Line**:

To create a basic Maven project using the command line, you can use the following command:

```
mvn archetype:generate -DgroupId=com.example -DartifactId=myapp -DarchetypeArtifactId=maven-archetype-quickstart -DinteractiveMode=false
```

- **groupId:** A unique identifier for the group (usually the domain name).
- **artifactId:** A unique name for the project artifact (your project).
- **archetypeArtifactId:** The template you want to use for the project.
- **DinteractiveMode=false:** Disables prompts during project generation.

This will create a basic Maven project with the required directory structure and **pom.xml** file.

2. **Using IDEs**

Most modern IDEs (like IntelliJ IDEA or Eclipse) provide wizards to generate Maven projects. For example, in IntelliJ IDEA:

1. Go to **File** > **New Project**.
2. Choose **Maven** from the list of project types.
3. Provide the **groupId** and **artifactId** for your project.

2: Understanding the POM File

The **POM (Project Object Model)** file is the heart of a Maven project. It is an XML file that contains all the configuration details about the project. Below is an example of a simple POM file:

A basic **pom.xml** structure looks like this:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://maven.apache.org/POM/4.0.0   http://maven.apache.org/xsd/maven-
4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>

  <groupId>com.example</groupId>
  <artifactId>my-project</artifactId>
  <version>1.0-SNAPSHOT</version>
  <packaging>jar</packaging>

  <dependencies>
    <!-- Dependencies go here -->
  </dependencies>

  <build>
    <plugins>
      <!-- Plugins go here -->
    </plugins>
  </build>
</project>
```

Key element in `pom.xml`:

- **`<groupId>`:** The group or organization that the project belongs to.
- **`<artifactId>`:** The name of the project or artifact.
- **`<version>`:** The version of the project (often follows a format like `1.0-SNAPSHOT`).
- **`<packaging>`:** Type of artifact, e.g., `jar`, `war`, `pom`, etc.
- **`<dependencies>`:** A list of dependencies the project requires.
- **`<build>`:** Specifies the build settings, such as plugins to use.

3: Dependency Management

Maven uses the `<dependencies>` tag in the `pom.xml` to manage external libraries or dependencies that your project needs. When Maven builds the project, it will automatically download these dependencies from a repository (like Maven Central).

Example of adding a dependency:

```xml
<dependencies>
  <dependency>
    <groupId>org.apache.commons</groupId>
    <artifactId>commons-lang3</artifactId>
    <version>3.12.0</version>
  </dependency>
</dependencies>
```

➢**Transitive Dependencies**

- Maven automatically resolves transitive dependencies. For example, if you add a library that depends on other libraries, Maven will also download those.

➢**Scopes**

- Dependencies can have different scopes that determine when they are available:
  - **compile** (default): Available in all build phases.
  - **provided**: Available during compilation but not at runtime (e.g., a web server container).
  - **runtime**: Needed only at runtime, not during compilation.
  - **test**: Required only for testing.

4: Using Plugins

Maven plugins are used to perform tasks during the build lifecycle, such as compiling code, running tests, packaging, and deploying. You can specify plugins within the `<build>` section of your **pom.xml**.

➢**Adding Plugins**

- You can add a plugin to your `pom.xml` like so:

```
<build>
  <plugins>
    <plugin>
      <groupId>org.apache.maven.plugins</groupId>
      <artifactId>maven-compiler-plugin</artifactId>
      <version>3.8.1</version>
      <configuration>
        <source>1.8</source>
        <target>1.8</target>
      </configuration>
    </plugin>
  </plugins>
</build>
```

In this example, the **maven-compiler-plugin** is used to compile Java code and specify the source and target JDK versions.

1. **Common Plugins**
   - **maven-compiler-plugin**: Compiles Java code.
   - **maven-surefire-plugin**: Runs unit tests.
   - **maven-jar-plugin**: Packages the project as a JAR file.
   - **maven-clean-plugin**: Cleans up the `target/` directory.

2. **Plugin Goals** Each plugin consists of goals, which are specific tasks to be executed. For example:
   - **`mvn clean install`:** This will clean the target directory and then install the package in the local repository.
   - **`mvn compile`:** This will compile the source code.

- **`mvn test`:** This will run unit tests.

5: Dependency Versions and Repositories

1. **Version Ranges**
   - You can specify a version range for dependencies, allowing Maven to choose a compatible version automatically. for example:

```
<dependency>
   <groupId>com.google.guava</groupId>
   <artifactId>guava</artifactId>
   <version>[30.0,)</version> <!-- Guava version 30.0 or higher -->
</dependency>
```

2. **Repositories**
   - Maven primarily fetches dependencies from Maven Central, but you can also specify custom repositories. For example:

```
<repositories>
   <repository>
      <id>custom-repo</id>
      <url>https://repo.example.com/maven2</url>
   </repository>
</repositories>
```

Working with Maven Project

Note: Always create separate folder to do any program**.**

- Open command prompt.
- **mkdir program2** – this will create **program2** folder.
- **cd program2** – navigate program2 folder.
- After then follow the below step to working with Maven project.

Step 1: Creating a Maven Project

- You can create a **Maven project** using the **mvn** command (or through your **IDE**, as mentioned earlier). But here, I'll give you the essential **pom.xml** and **Java code**.

- Let's use the **Apache Commons Lang library** as a **dependency** (which provides utilities for **working with strings**, **numbers**, etc.). We will use this in a **simple Java program** to **work with strings**.

```
mvn archetype:generate -DgroupId=com.example -DartifactId=myapp -DarchetypeArtifactId=maven-archetype-quickstart -DinteractiveMode=false
```

Note: See in your terminal below the project folder path showing after executing the cmd manually navigate the path and see the project folder name called **myapp**.

Step 2: Open The `pom.xml` File

- You can manually navigate the **project folder** named call **myapp** and open the file pom.xml and copy the below code and paste it then save it.
- In case if you not getting project folder then type command in your cmd.
    - **cd myapp** – is use to navigate the project folder.
    - **notepad pom.xml** – is use to open pom file in notepad.

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://maven.apache.org/POM/4.0.0   http://maven.apache.org/xsd/maven-
4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>

    <groupId>com.example</groupId>
    <artifactId>myapp</artifactId>
    <version>1.0-SNAPSHOT</version>

    <dependencies>
        <!-- JUnit Dependency for Testing -->
        <dependency>
            <groupId>junit</groupId>
            <artifactId>junit</artifactId>
            <version>4.13.2</version>
            <scope>test</scope>
        </dependency>
    </dependencies>

    <build>
        <plugins>
            <!-- Maven Surefire Plugin for running tests -->
            <plugin>
                <groupId>org.apache.maven.plugins</groupId>
                <artifactId>maven-surefire-plugin</artifactId>
                <version>2.22.2</version>
                <configuration>
                    <redirectTestOutputToFile>false</redirectTestOutputToFile>
                    <useSystemOut>true</useSystemOut>
                </configuration>
            </plugin>
        </plugins>
    </build>
</project>
```

Step 3: Open Java Code (`App.java`) File

- Open a file **App.java** inside the **src/main/java/com/example/** directory.

- After opening the **App.java** copy the below code and paste it in that file then save it.

```
package com.example;

public class App {

    public int add(int a, int b) {
        return a + b;
    }

    public static void main(String[] args) {
        App app = new App();

        int result = app.add(2, 3);
        System.out.println("2 + 3 = " + result);

        System.out.println("Application executed successfully!");
    }
}
```

Step 4: Open Java Code (`AppTest.java`) File

- Open a file **AppTest.java** inside the **src/test/java/com/example/** directory.
- After opening the **AppTest.java** copy the below code and paste it in that file then save it.

```
package com.example;
import org.junit.Assert;
import org.junit.Test;
public class AppTest {

    @Test
    public void testAdd() {
        App app = new App();
        int result = app.add(2, 3);

        System.out.println("Running test: 2 + 3 = " + result);

        Assert.assertEquals(5, result);
    }
}
```

Note: before building the project make sure you are in the project folder if not navigate the project folder type command in your command prompt **`cd myapp`**

Step 4: Building the Project

To build and run this project, follow these steps:

1.**Compile the Project**

```
mvn compile
```

2.**Run the Unit Tests**

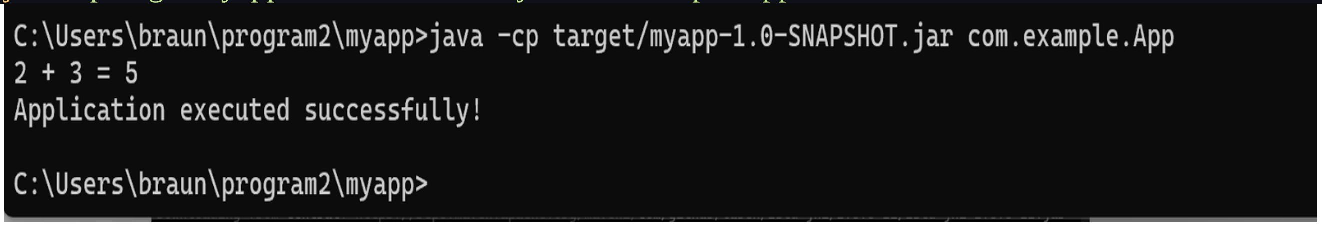
```
mvn test
```

3.**Package the project into a JAR**

```
mvn package
```

4.**Run the application (using JAR)**

```
java -cp target/myapp-1.0-SNAPSHOT.jar com.example.App
```



```
C:\Users\braun\program2\myapp>java -cp target/myapp-1.0-SNAPSHOT.jar com.example.App
2 + 3 = 5
Application executed successfully!

C:\Users\braun\program2\myapp>
```

The above command is used to **run a Java application** from the command line. Here's a breakdown of each part:

- **java**: This is the Java runtime command used to run Java applications.
- **-cp**: This stands for **classpath**, and it specifies the location of the classes and resources that the JVM needs to run the application. In this case, it's pointing to the JAR file where your compiled classes are stored.
- **target/myapp-1.0-SNAPSHOT.jar**: This is the **JAR file** (Java ARchive) that contains the compiled Java classes and resources. It's located in the target directory, which Maven creates after you run mvn package.
- **com.example.App**: This is the **main class** that contains the main() method. When you run this command, Java looks for the main() method inside the App class located in the com.example package and executes it.

<u>Result</u> : successfully created maven project and understood the pom file, dependency management and plugins.

Experiment No: 3

Aim: Working with Gradle: Setting Up a Gradle Project, Understanding Build Scripts (Groovy and Kotlin DSL), Dependency Management and Task Automation.

COMPONENTS/ SOTWARE REQUIRED: Java (version jdk 17 or 23), Gradle (Version 10).

Theory:

1: Setting Up a Gradle Project

- **Install Gradle** (If you haven't already):

Follow Gradle installation Program 1 **click here**

- **Create a new Gradle project**: You can set up a new Gradle project using the Gradle Wrapper or manually. Using the Gradle Wrapper is the preferred approach as it ensures your project will use the correct version of Gradle.

To create a new Gradle project using the command line:

```
gradle init --type java-application
```

This command creates a new Java application project with a sample **build.gradle** file.

2: Understanding Build Scripts

Gradle uses a DSL (Domain-Specific Language) to define the build scripts. Gradle supports two DSLs:

- **Groovy DSL** (default)
- **Kotlin DSL** (alternative)

Groovy DSL: This is the default language used for Gradle build scripts (**build.gradle**). Example of a simple **build.gradle** file (Groovy DSL):

```
plugins {
   id 'java'
}

repositories {
   mavenCentral()
}

dependencies {
   implementation 'org.springframework.boot:spring-boot-starter-web:2.5.4'
}

task customTask {
    doLast {
        println 'This is a custom task'
    }
}
```

Kotlin DSL: Gradle also supports Kotlin for its build scripts (**build.gradle.kts**). Example of a simple **build.gradle.kts** file (Kotlin DSL):

```
plugins {
    kotlin("jvm") version "1.5.21"
}

repositories {
    mavenCentral()
}

dependencies {
    implementation("org.springframework.boot:spring-boot-starter-web:2.5.4")
}

tasks.register("customTask") {
    doLast {
        println("This is a custom task")
    }
}
```

Difference between Groovy and Kotlin DSL:

- **Syntax**: Groovy uses a more concise, dynamic syntax, while Kotlin offers a more structured, statically-typed approach.
- **Error handling**: Kotlin provides better error detection at compile time due to its static nature.

Task Block: Tasks define operations in Gradle, and they can be executed from the command line using gradle **<task-name>**.

In Groovy DSL:

```
task hello {
    doLast {
        println 'Hello, Gradle!'
    }
}
```

In Kotlin DSL:

```
tasks.register("hello") {
   doLast {
      println("Hello, Gradle!")
   }
}
```

3: Dependency Management

Gradle provides a powerful dependency management system. You define your project's dependencies in the dependencies block.

1. **Adding dependencies**:

- Gradle supports various dependency scopes such as implementation, compileOnly, testImplementation, and others.

Example of adding a dependency in **build.gradle** (**Groovy DSL**):

```
dependencies {
   implementation 'com.google.guava:guava:30.1-jre'
   testImplementation 'org.junit.jupiter:junit-jupiter-api:5.7.1'
}
```

Example in **build.gradle.kts** (**Kotlin DSL**):

```
dependencies {
   implementation("com.google.guava:guava:30.1-jre")
   testImplementation("org.junit.jupiter:junit-jupiter-api:5.7.1")
}
```

2. **Declaring repositories**: To resolve dependencies, you need to specify repositories where Gradle should look for them. Typically, you'll use Maven Central or JCenter, but you can also configure private repositories.

Example (Groovy):

```
repositories {
   mavenCentral()
}
```

Example (Kotlin):

```
repositories {
   mavenCentral()
}
```

4: Task Automation

Gradle tasks automate various tasks in your project lifecycle, like compiling code, running tests, and creating builds.

1. **Using predefined tasks**: Gradle provides many predefined tasks for common activities, such as:

- **build** – compiles the project, runs tests, and creates the build output.
- **test** – runs tests.
- **clean** – deletes the build output.

Example of running the build task:

```
gradle build
```

3. **Creating custom tasks**: You can define your own tasks to automate specific actions. For example, creating a custom task to print a message.

- **Example Groovy DSL:**

```
task printMessage {
   doLast {
      println 'This is a custom task automation'
   }
}
```

- **Example Kotlin DSL:**

```
tasks.register("printMessage") {
   doLast {
      println("This is a custom task automation")
   }
}
```

5: Running Gradle Tasks

To run a task, use the following command in the terminal:

```
gradle <task-name>
```

For example:

- To run the build task: **gradle build**
- To run a custom task: **gradle printMessage**

6: Advanced Automation

You can define task dependencies and configure tasks to run in a specific order. Example of task dependency:

```
task firstTask {
   doLast {
      println 'Running the first task'
   }
}

task secondTask {
   dependsOn firstTask
   doLast {
      println 'Running the second task'
   }
}
```

In this case, **secondTask** will depend on the completion of **firstTask** before it runs.

Working with Gradle Project (Groovy DSL):

Step 1: Create a new Project

```
gradle init --type java-application
```

- while creating project it will ask necessary requirement:
- **Enter target Java version (min: 7, default: 21):** 17
- **Project name (default: program3-groovy):** groovyProject
- **Select application structure:**
- 1: Single application project
- 2: Application and library project
- **Enter selection (default: Single application project) [1..2]** 1
- **Select build script DSL:**
- 1: Kotlin
- 2: Groovy
- **Enter selection (default: Kotlin) [1..2]** 2

Select test framework:

- 1: JUnit 4
- 2: TestNG
- 3: Spock
- 4: JUnit Jupiter

- **Enter selection (default: JUnit Jupiter) [1..4]** 1
- **Generate build using new APIs and behavior (some features may change in the next minor release)? (default: no) [yes, no]**
- no

Step 2: build.gradle (Groovy DSL)

```
plugins {
    id 'application'
}

application {
    mainClass = 'com.example.AdditionOperation'
}

repositories {
    mavenCentral()
}

dependencies {
    testImplementation 'junit:junit:4.13.2'
}

test {
    outputs.upToDateWhen { false }

    testLogging {
        events "passed", "failed", "skipped"
        exceptionFormat "full"
        showStandardStreams = true
    }
}
```

Step 3: AdditionOperation.java(Change file name and update below code)

- After creating project **change the file name**.
- Manually navigate the folder path like **src/main/java/org/example/**
- Change the file name **App.java** to **AdditionOperation.java**
- After then open that file and copy the below code and past it, save it.

```
package com.example;

public class AdditionOperation {
    public static void main(String[] args) {
        double num1 = 5;
        double num2 = 10;

        double sum = num1 + num2;

        System.out.printf("The sum of %.2f and %.2f is %.2f%n", num1, num2, sum);
    }
}
```

Step 4: AdditionOperationTest.java (JUnit Test) (Change file name and update below code)

- After creating project **change the file name**.
- Manually navigate the folder path like **src/test/java/org/example/**
- Change the file name **AppTest.java** to **AdditionOperationTest.java**
- After then open that file and copy the below code and past it, save it.

```
package com.example;

import org.junit.Test;
import static org.junit.Assert.*;

public class AdditionOperationTest {

    @Test
    public void testAddition() {
        double num1 = 5;
        double num2 = 10;
        double expectedSum = num1 + num2;

        double actualSum = num1 + num2;

        assertEquals(expectedSum, actualSum, 0.01);
    }
}
```

Step 5: Run Gradle Commands

- To **build** the project:

```
gradle build
```

- To **run** the project:

```
gradle run
```

- To **test** the project:

```
gradle test
```

Working with Gradle Project (Kotlin DSL):

Step 1: Create a new Project

```
gradle init --type java-application
```

- while creating project it will ask necessary requirement:
- **Enter target Java version (min: 7, default: 21):** 17
- **Project name (default: program3-kotlin):** kotlinProject
- **Select application structure:**
- 1: Single application project
- 2: Application and library project
- **Enter selection (default: Single application project) [1..2]** 1
- **Select build script DSL:**
- 1: Kotlin
- 2: Groovy
- **Enter selection (default: Kotlin) [1..2]** 1
- **Select test framework:**
- 1: JUnit 4
- 2: TestNG
- 3: Spock
- 4: JUnit Jupiter
- **Enter selection (default: JUnit Jupiter) [1..4]** 1
- **Generate build using new APIs and behavior (some features may change in the next minor release)? (default: no) [yes, no]**
- no

Step 2: build.gradle.kts (Kotlin DSL)

```
plugins {
    kotlin("jvm") version "1.8.21"
    application
}

repositories {
    mavenCentral()
}

dependencies {
    implementation(kotlin("stdlib"))
    testImplementation("junit:junit:4.13.2")
}
```

```
application {
   mainClass.set("com.example.MainKt")
}

tasks.test {
   useJUnit()

   testLogging {
      events("passed", "failed", "skipped")
      exceptionFormat = org.gradle.api.tasks.testing.logging.TestExceptionFormat.FULL
      showStandardStreams = true
   }

   outputs.upToDateWhen { false }
}

java {
   toolchain {
      languageVersion.set(JavaLanguageVersion.of(17))
   }
}
```

Step 3: Main.kt (Change file name and update below code)

- After creating project **change the file name**.
- Manually navigate the folder path like **src/main/java/org/example/**
- Change the file name **App.java** to **Main.kt**
- After then open that file and copy the below code and past it, save it.

```
package com.example

fun addNumbers(num1: Double, num2: Double): Double {
   return num1 + num2
}

fun main() {
   val num1 = 10.0
   val num2 = 5.0
   val result = addNumbers(num1, num2)
   println("The sum of $num1 and $num2 is: $result")
}
```

Step 4: MainTest.kt (JUnit Test) (Change file name and update below code)

- After creating project **change the file name**.
- Manually navigate the folder path like **src/test/java/org/com/example/**
- Change the file name **MainTest.java** to **MainTest.kt**

- After then open that file and copy the below code and past it, save it.

```
package com.example

import org.junit.Assert.*
import org.junit.Test

class MainTest {

    @Test
    fun testAddNumbers() {
        val num1 = 10.0
        val num2 = 5.0

        val result = addNumbers(num1, num2)

        assertEquals("The sum of $num1 and $num2 should be 15.0", 15.0, result, 0.001)
    }
}
```

Step 5: Run Gradle Commands

- To **build** the project:

```
gradle build
```

To **run** the project:

```
gradle run
```

To **test** the project:

```
gradle test
```

<u>Result</u>: Successfully completed the setting Up of a Gradle Project, Understanding Build Scripts and also Dependency Management and Task Automation

EXPERIMENT NO: 04

Practical Exercise

Aim: Build and Run a Java Application with Maven, Migrate the Same Application to Gradle.

COMPONENTS/SOFTWARE REQUIRED: Java (version jdk 17 or 23), Maven (Version 10), Gradle (Version 10).

Theory:

Step 1: Creating a Maven Project

You can create a **Maven project** using the **mvn** command (or through your **IDE**, as mentioned earlier). But here, I'll give you the essential **pom.xml** and **Java code**.

- **I'm Using Command Line:**
  - To create a basic Maven project using the command line, you can use the following command:

```
mvn archetype:generate -DgroupId=com.example -DartifactId=maven-example -DarchetypeArtifactId=maven-archetype-quickstart -DinteractiveMode=false
```

Step 2: Open The pom.xml File

- You can manually navigate the **project folder** named call **maven-example** and open the file pom.xml and copy the below code and paste it then save it.
- In case if you not getting project folder then type command in your cmd.
  - **cd maven-example** – is use to navigate the project folder.
  - **notepad pom.xml** – is use to open pom file in notepad.

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>

    <groupId>com.example</groupId>
    <artifactId>maven-example</artifactId>
    <version>1.0-SNAPSHOT</version>

    <dependencies>
        <dependency>
            <groupId>junit</groupId>
            <artifactId>junit</artifactId>
            <version>4.12</version>
            <scope>test</scope>
        </dependency>
    </dependencies>

    <build>
        <plugins>
            <plugin>
                <groupId>org.apache.maven.plugins</groupId>
                <artifactId>maven-compiler-plugin</artifactId>
                <version>3.8.1</version>
                <configuration>
                    <source>1.8</source>
                    <target>1.8</target>
                </configuration>
            </plugin>
        </plugins>
    </build>
</project>
```

Step 3: Open Java Code (App.java) File

- Open a file **App.java** inside the **src/main/java/com/example/** directory.
- After opening the **App.java** copy the below code and paste it in that file then save it.

```
package com.example;

public class App {
    public static void main(String[] args) {
        System.out.println("Hello, Maven");
        System.out.println("This is the simple realworld example....");

        int a = 5;
        int b = 10;
        System.out.println("Sum of " + a + " and " + b + " is " + sum(a, b));
    }

    public static int sum(int x, int y) {
        return x + y;
    }
}
```

Note: before building the project make sure you are in the project folder if not navigate the project folder type command in your command prompt **cd maven-example**.

Step 4: Run the Project

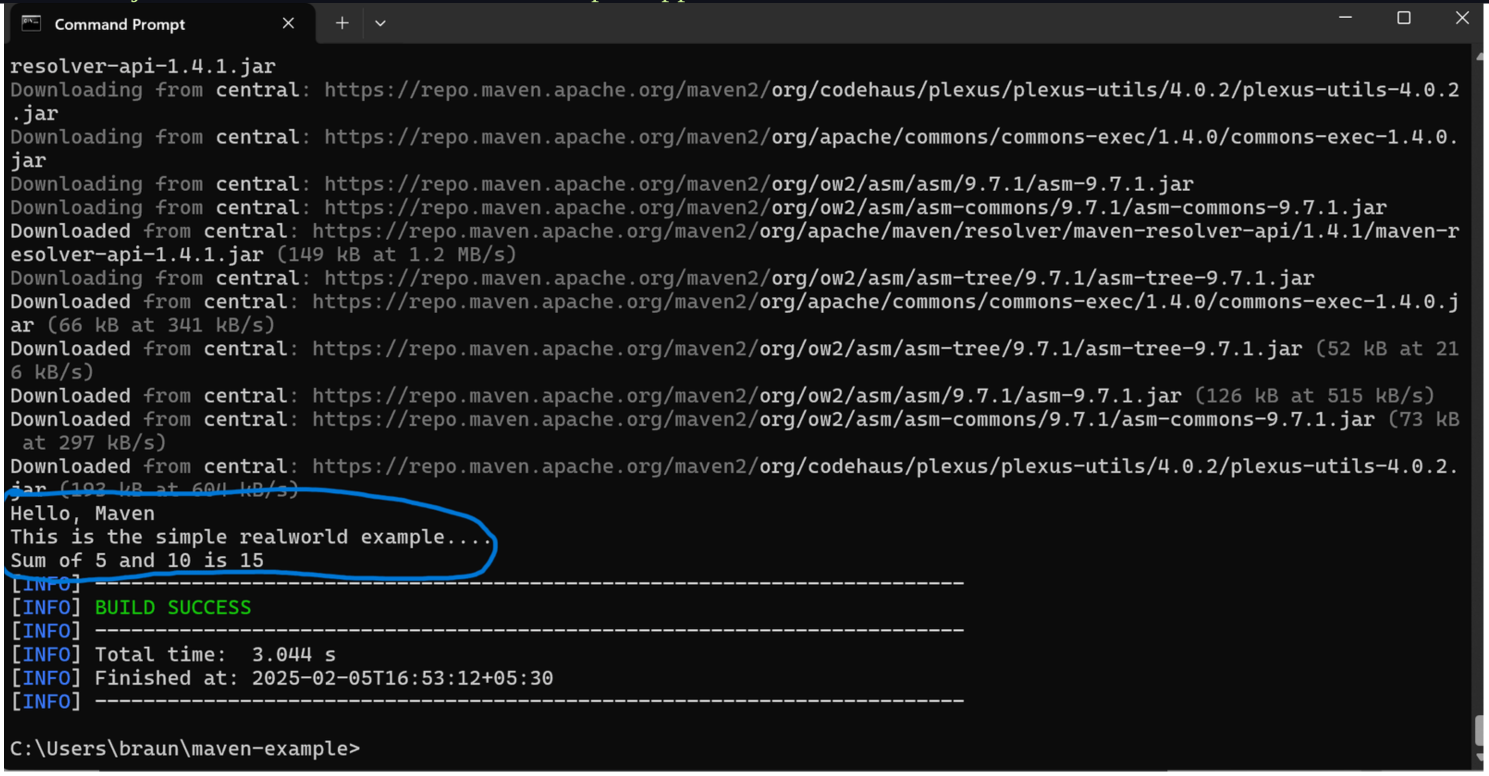
To build and run this project, follow these steps:

- Open the terminal in the project directory and run the following command to build the project.

```
mvn clean install
```

- Run the program with below command:

```
mvn exec:java -Dexec.mainClass="com.example.App"
```



```
resolver-api-1.4.1.jar
Downloading from central: https://repo.maven.apache.org/maven2/org/codehaus/plexus/plexus-utils/4.0.2/plexus-utils-4.0.2
.jar
Downloading from central: https://repo.maven.apache.org/maven2/org/apache/commons/commons-exec/1.4.0/commons-exec-1.4.0.
jar
Downloading from central: https://repo.maven.apache.org/maven2/org/ow2/asm/asm/9.7.1/asm-9.7.1.jar
Downloading from central: https://repo.maven.apache.org/maven2/org/ow2/asm/asm-commons/9.7.1/asm-commons-9.7.1.jar
Downloaded from central: https://repo.maven.apache.org/maven2/org/apache/maven/resolver/maven-resolver-api/1.4.1/maven-r
esolver-api-1.4.1.jar (149 kB at 1.2 MB/s)
Downloading from central: https://repo.maven.apache.org/maven2/org/ow2/asm/asm-tree/9.7.1/asm-tree-9.7.1.jar
Downloaded from central: https://repo.maven.apache.org/maven2/org/apache/commons/commons-exec/1.4.0/commons-exec-1.4.0.j
ar (66 kB at 341 kB/s)
Downloaded from central: https://repo.maven.apache.org/maven2/org/ow2/asm/asm-tree/9.7.1/asm-tree-9.7.1.jar (52 kB at 21
6 kB/s)
Downloaded from central: https://repo.maven.apache.org/maven2/org/ow2/asm/asm/9.7.1/asm-9.7.1.jar (126 kB at 515 kB/s)
Downloaded from central: https://repo.maven.apache.org/maven2/org/ow2/asm/asm-commons/9.7.1/asm-commons-9.7.1.jar (73 kB
 at 297 kB/s)
Downloaded from central: https://repo.maven.apache.org/maven2/org/codehaus/plexus/plexus-utils/4.0.2/plexus-utils-4.0.2.
jar (193 kB at 604 kB/s)
Hello, Maven
This is the simple realworld example....
Sum of 5 and 10 is 15
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  3.044 s
[INFO] Finished at: 2025-02-05T16:53:12+05:30
[INFO] ------------------------------------------------------------------------

C:\Users\braun\maven-example>
```

Step 5: Migrate the Maven Project to Gradle

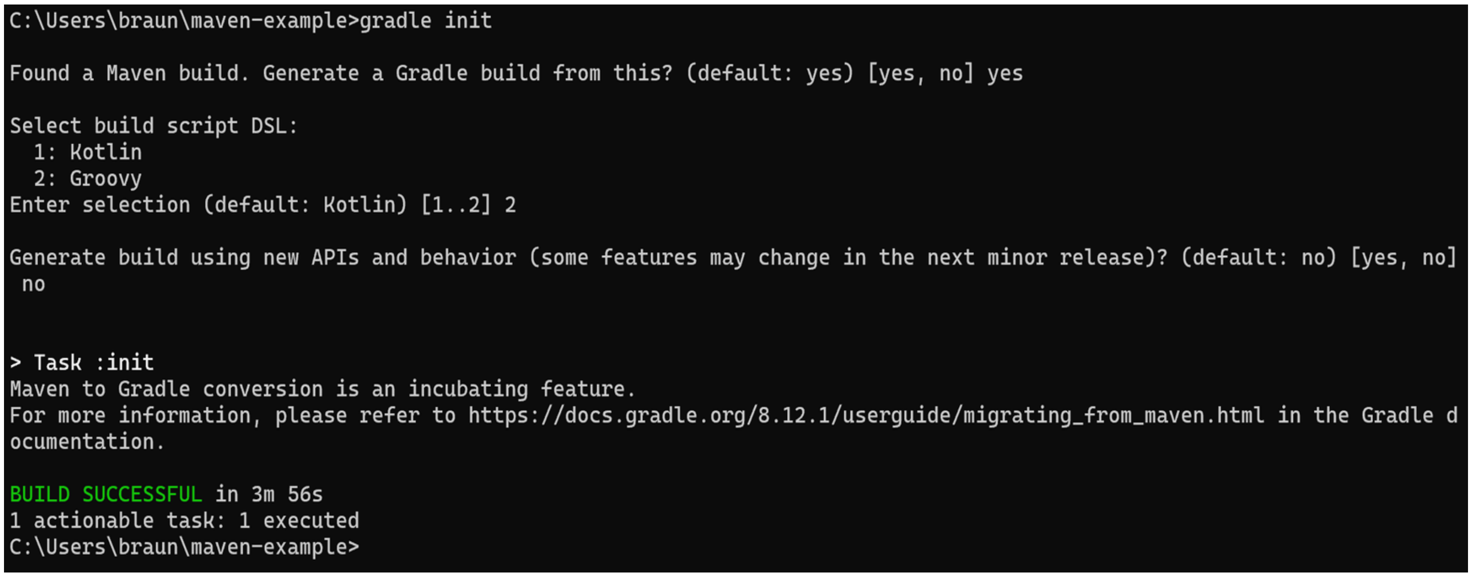
1. **Initialize Gradle**: Navigate to the project directory (**gradle-example**) and run:

```
gradle init
```

- It will ask **Found a Maven build. Generate a Gradle build from this? (default: yes) [yes, no]**
  - Type **Yes**

- **Select build script DSL:**
  - 1: Kotlin
  - 2: Groovy
  - Enter selection (default: Kotlin) [1..2]
    - Type **2**

- **Generate build using new APIs and behavior (some features may change in the next minor release)? (default: no) [yes, no]**
  - Type **No**



```
C:\Users\braun\maven-example>gradle init

Found a Maven build. Generate a Gradle build from this? (default: yes) [yes, no] yes

Select build script DSL:
  1: Kotlin
  2: Groovy
Enter selection (default: Kotlin) [1..2] 2

Generate build using new APIs and behavior (some features may change in the next minor release)? (default: no) [yes, no]
 no


> Task :init
Maven to Gradle conversion is an incubating feature.
For more information, please refer to https://docs.gradle.org/8.12.1/userguide/migrating_from_maven.html in the Gradle d
ocumentation.

BUILD SUCCESSFUL in 3m 56s
1 actionable task: 1 executed
C:\Users\braun\maven-example>
```

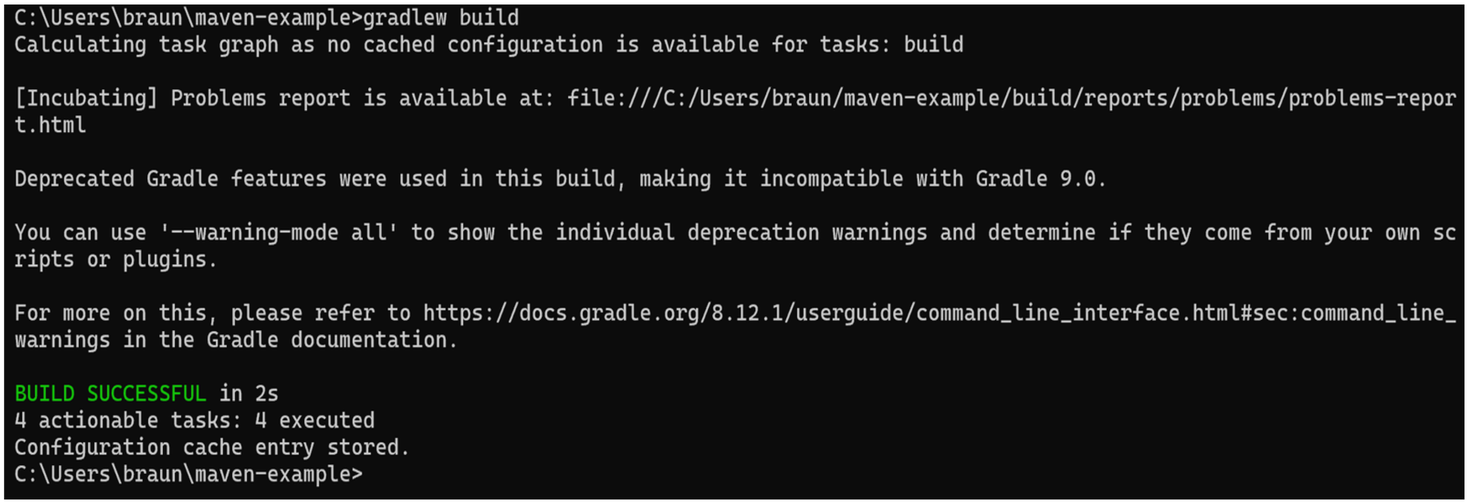
2. Navigate the project folder and open **build.gradle** file then add the below code and save it.

```
plugins {
   id 'java'
}

group = 'com.example'
version = '1.0-SNAPSHOT'

repositories {
   mavenCentral()
}

dependencies {
   testImplementation 'junit:junit:4.12'
}

task run(type: JavaExec) {
   main = 'com.example.App'
   classpath = sourceSets.main.runtimeClasspath
}
```

Step 6: Run the Gradle Project

- **Build the Project**: In the project directory (gradle-example), run the below command to build the project:

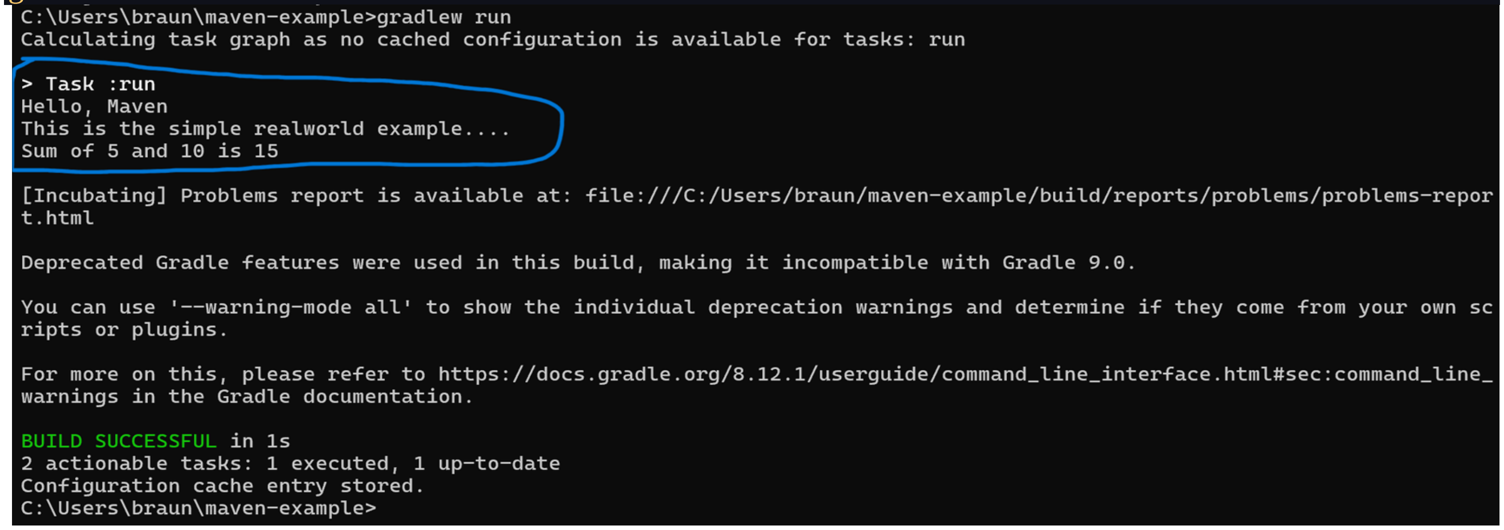
```
gradlew build
```



```
C:\Users\braun\maven-example>gradlew build
Calculating task graph as no cached configuration is available for tasks: build

[Incubating] Problems report is available at: file:///C:/Users/braun/maven-example/build/reports/problems/problems-repor
t.html

Deprecated Gradle features were used in this build, making it incompatible with Gradle 9.0.

You can use '--warning-mode all' to show the individual deprecation warnings and determine if they come from your own sc
ripts or plugins.

For more on this, please refer to https://docs.gradle.org/8.12.1/userguide/command_line_interface.html#sec:command_line_
warnings in the Gradle documentation.

BUILD SUCCESSFUL in 2s
4 actionable tasks: 4 executed
Configuration cache entry stored.
C:\Users\braun\maven-example>
```

- **Run the Application**: Once the build is successful, run the application using below command:

```
gradlew run
```



```
C:\Users\braun\maven-example>gradlew run
Calculating task graph as no cached configuration is available for tasks: run

> Task :run
Hello, Maven
This is the simple realworld example....
Sum of 5 and 10 is 15

[Incubating] Problems report is available at: file:///C:/Users/braun/maven-example/build/reports/problems/problems-repor
t.html

Deprecated Gradle features were used in this build, making it incompatible with Gradle 9.0.

You can use '--warning-mode all' to show the individual deprecation warnings and determine if they come from your own sc
ripts or plugins.

For more on this, please refer to https://docs.gradle.org/8.12.1/userguide/command_line_interface.html#sec:command_line_
warnings in the Gradle documentation.

BUILD SUCCESSFUL in 1s
2 actionable tasks: 1 executed, 1 up-to-date
Configuration cache entry stored.
C:\Users\braun\maven-example>
```

Step 7: Verify the Migration

- **Compare the Output:** Make sure that both the **Maven** and **Gradle** builds produce the same output:
  - **Maven Output**:

```
Hello, Maven
This is the simple realworld example....
Sum of 5 and 10 is 15
```

- **Gradle Output**:

```
Hello, Maven
This is the simple realworld example....
Sum of 5 and 10 is 15
```

Result: Successfully Build and Run a Java Application with Maven, Migrate the Same Application to Gradle.

EXPERIMENT NO:05

Introduction to Jenkins

AIM: Installing Jenkins on Local or Cloud Environment, Configuring Jenkins for First Use

Components required: Java (version jdk 17 or 23 and 21), Maven (Version 10), Gradle (Version 10). Jenkins

Theory**:**

Introduction to Jenkins: Jenkins is an open-source automation server widely used in the field of Continuous Integration (CI) and Continuous Delivery (CD). It allows developers to automate the building, testing, and deployment of software projects, making the development process more efficient and reliable.

Key features of Jenkins:

CI/CD: Jenkins supports Continuous Integration and Continuous Deployment, allowing developers to integrate code changes frequently and automate the deployment of applications.

Plugins: Jenkins has a vast library of plugins that can extend its capabilities. These plugins integrate Jenkins with version control systems (like Git), build tools (like Maven or Gradle), testing frameworks, deployment tools, and much more.

Pipeline as Code: Jenkins allows the creation of pipelines using Groovy-based DSL scripts or YAML files, enabling version-controlled and repeatable pipelines.

Cross-platform: Jenkins can run on various platforms such as Windows, Linux, macOS, and others.

Installing Jenkins

Jenkins can be installed on local machines, on a cloud environment, or even in containers. Here's how you can install Jenkins in Window local System environments:
1. **Installing Jenkins Locally**

Step-by-Step Guide (Window):

1.**Prerequisites:**
- Ensure that J**ava (JDK) is installed** on your system. **Jenkins requires Java 21**. If not then **click here**.
- You can check if Java is installed by running **java -version** in the terminal.

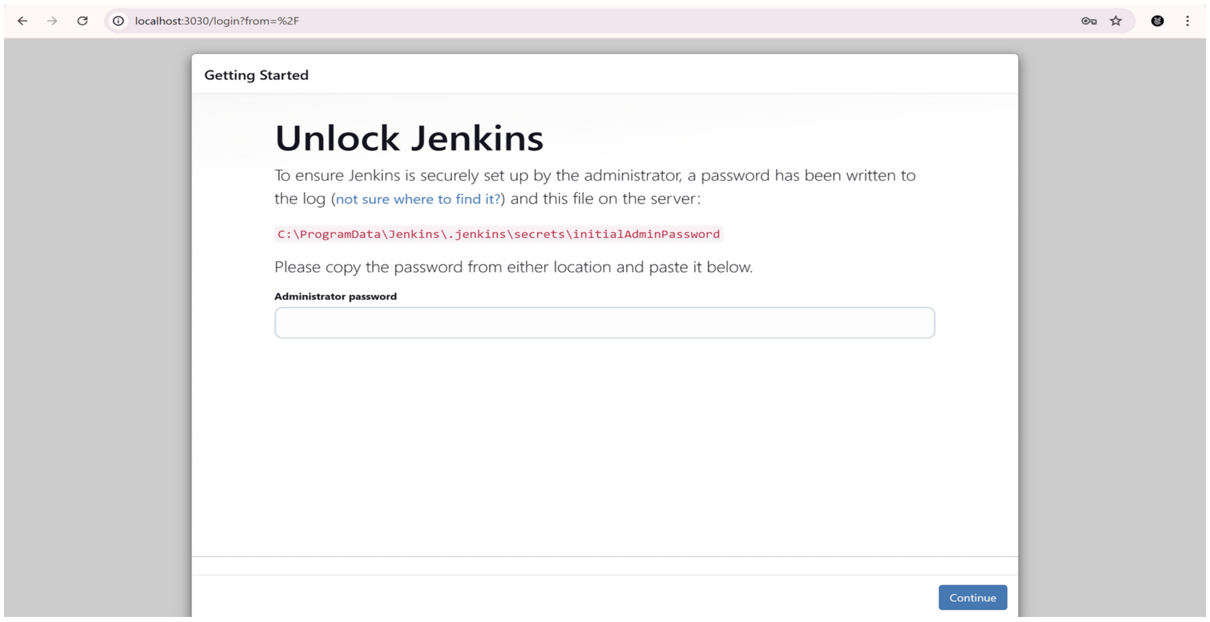
2.**Install Jenkins on Window System):**
- Download the Jenkins Windows installer from the official Jenkins website.
- Run the installer and follow the on-screen instructions. While installing choose **login system**: **run service as LocalSystem (not recommended)**.

- After then use **default port** or you can **configure you own port like I'm using port 3030** then **click on test** and **next**.
- After then **change the directory** and choose **java jdk-21** path look like **C:\Program Files\Java\jdk-21\**.

•After then **click next, next** and then it will **ask permission click on yes** and it will start installing.
•After successfully installed, Jenkins will be **running on port either default port** or **chosen port** like i choose **port 3030** by default (you can access it in your browser at **http://localhost:8080**) or **`http://localhost:3030`**.

2. Jenkins Setup in browser:

•After opening browser by visiting your local address the browser should look like below screenshot.


localhost:3030/login?from=%2F

Getting Started

Unlock Jenkins

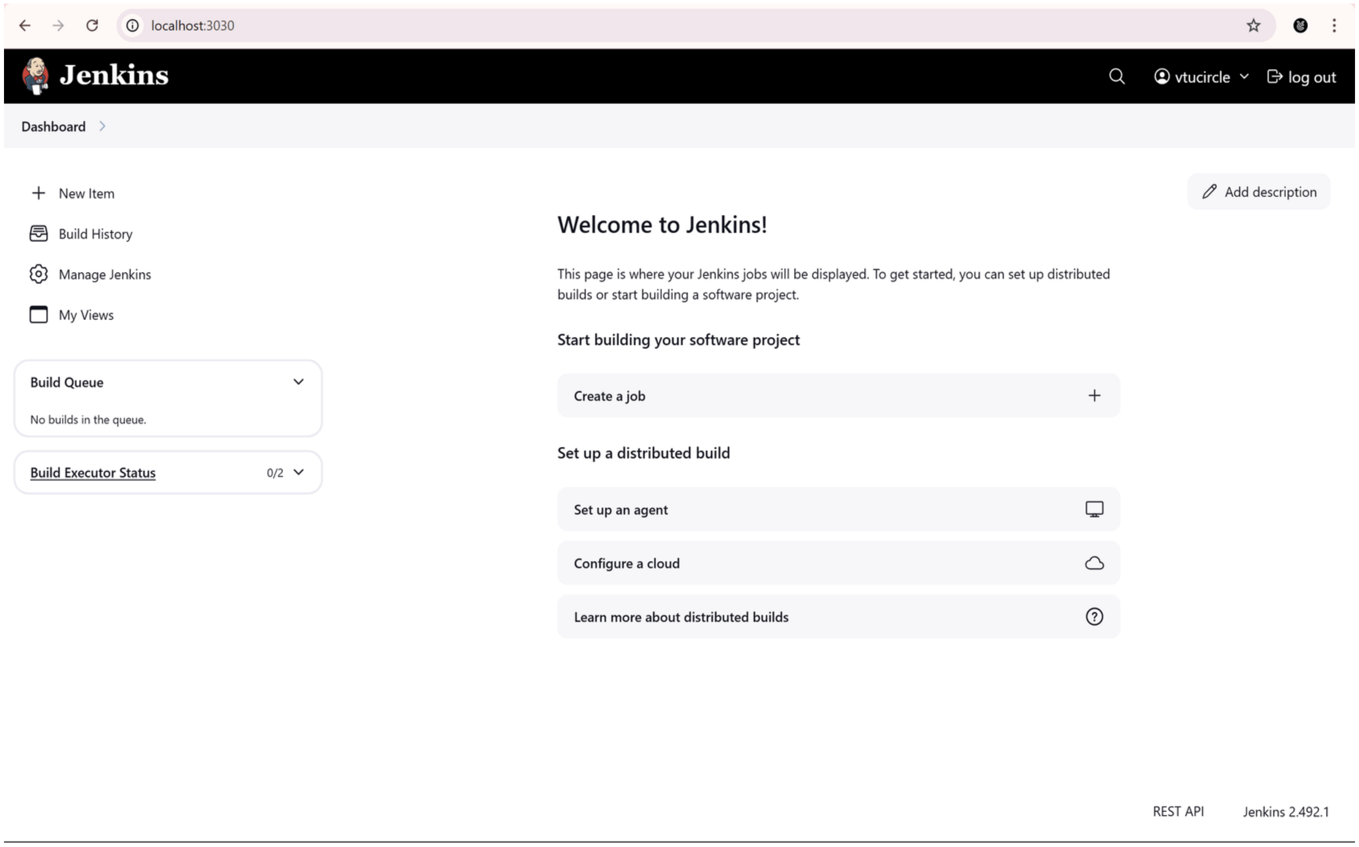
To ensure Jenkins is securely set up by the administrator, a password has been written to the log (not sure where to find it?) and this file on the server:

`C:\ProgramData\Jenkins\.jenkins\secrets\initialAdminPassword`

Please copy the password from either location and paste it below.

Administrator password

•It will ask administrator password so you have to navigate the above highlighted path and open that `initial Admin Password` in notepad or any software to see the password.
•Just copy that password and paste it and click on continue.
•It will ask to customize Jenkins so click on install suggested plugin it will automatically install all required plugin.
•After then create admin profile by filling all details then click on save and continue after then save and finish after then click on start using Jenkin.



No builds in the queue.

Welcome to Jenkins!

This page is where your Jenkins jobs will be displayed. To get started, you can set up distributed builds or start building a software project.

Start building your software project

Set up a distributed build

RESULT: Successfully installed Jenkins and configured Jenkins for the first use.

EXPERIMENT No:06

Continuous Integration with Jenkins

Aim: Setting Up a CI Pipeline, Integrating Jenkins with Maven/Gradle, Running Automated Builds and Tests

Components required: Java (version jdk 17 or 23 and 21), Maven (Version 10), Gradle (Version 10). Jenkins

Theory: Sampling theorem for strictly band limited signals of finite energy into two equivalent parts:

Step 1: Install Jenkins:
1. Download Jenkins:
   - Visit the [Jenkins download page](https://www.jenkins.io/download/) and choose the version suitable for your operating system.
   - Follow the installation instructions for your platform.

2. Start Jenkins:
   - After installation, Jenkins typically runs on http://localhost:8080 by default.
   - Open a web browser and access the Jenkins dashboard.

Step 2: Set Up Jenkins (Initial Configuration)
1. Unlock Jenkins:
   - After installation, Jenkins will provide an unlock key. Open the `jenkins` folder and retrieve the key from secrets/initialAdminPassword`.

2. Install Suggested Plugins:
   - Once logged in, Jenkins will ask if you want to install suggested plugins. Click on Install suggested plugins.

3. Create an Admin User:
   - You'll be prompted to create an admin user. Provide an username, password, and full name.

4. Jenkins Dashboard:
   - After setup, you will be redirected to the Jenkins dashboard where you can create and configure jobs.

Step 3: Install Required Plugins
To integrate Jenkins with Maven or Gradle, you need to install the respective plugins:
1. Maven Plugin:
   - Go to Manage Jenkins > Manage Plugins.
   - In the Available tab, search for Maven Integration Plugin and install it.

2. Gradle Plugin:
   - In the same Manage Plugins section, search for Gradle Plugin and install it.

3. JUnit Plugin:
   - If you're using JUnit for automated testing, make sure the JUnit Plugin is installed for reporting purposes.

Step 4: Configure Jenkins for Maven/Gradle

Maven Integration:

1. Install Maven:
   - If Maven is not installed on your Jenkins server, you can install it globally or point Jenkins to an existing Maven installation.
   - Go to Manage Jenkins > Global Tool Configuration.
   - Under Maven, click Add Maven and specify the Maven version or path to your Maven installation.

2. Configure Maven in Jenkins:
   - In your Jenkins project configuration, specify Maven as the build tool by selecting Invoke Maven under Build section.
   - Provide the goals, such as `clean install` or `clean deploy`.

Gradle Integration:

1. Install Gradle:
   - Similarly, install Gradle by going to Manage Jenkins > Global Tool Configuration.
   - Under Gradle, click Add Gradle and specify the Gradle version or path to the installation.

2. Configure Gradle in Jenkins:
   - In your Jenkins project configuration, choose Invoke Gradle script under the Build section.
   - Specify Gradle tasks like `clean build`.

Step 5: Create a Jenkins Pipeline/Job

1. Create a New Job:
   - From the Jenkins dashboard, click on New Item.
   - Choose Freestyle project or Pipeline depending on your needs.

2. Freestyle Project Configuration (Basic):
   - Source Code Management: Set up Git or another source control system to fetch the code (e.g., GitHub, Bitbucket).
   - Build Environment: Configure the environment, e.g., for Maven, you'll configure Maven goals (e.g., `clean install`).
   - Build: In the Build section, you can specify the build commands, such as:
     - For Maven: `mvn clean install`
     - For Gradle: `gradle build`
   - Post-build Actions: You can set up post-build actions to publish test results or deploy to servers.

3. Pipeline Project Configuration (Advanced):
   - In the case of a Pipeline, you define your CI/CD pipeline in a 'Jenkinsfile' (which is a script).
   - Example Jenkinsfile for Maven:

```
“groovy”
pipeline {
    agent any
    stages {
        stage('Checkout') {
            steps {
                git 'https://github.com/your-repository.git'
            }
        }
```

```
            stage('Build') {
                steps {
                    script {
                        sh 'mvn clean install'
                    }
                }
            }
            stage('Test') {
                steps {
                    script {
                        sh 'mvn test'
                    }
                }
            }
        }
    }
    ```
```

- For Gradle, you would use:

```
    ```groovy
    pipeline {
        agent any
        stages {
            stage('Checkout') {
                steps {
                    git 'https://github.com/your-repository.git'
                }
            }
            stage('Build') {
                steps {
                    script {
                        sh './gradlew clean build'
                    }
                }
            }
            stage('Test') {
                steps {
                    script {
                        sh './gradlew test'
                    }
                }
            }
        }
    }
    ```
```

4. Run Automated Tests:
   - You can configure Jenkins to run tests automatically as part of the build.
   - For JUnit, specify the test report location to view the results under Post-build Actions.
   - Example configuration for Maven:

```
    “groovy”
    junit '/target/test-.xml'
```
```

Step 6: Triggering Builds

1. Automatic Trigger:
   - You can configure Jenkins to trigger builds automatically on changes to your source code repository. Under Build Triggers, enable GitHub hook trigger for GITScm polling or Poll SCM depending on your setup.

2. Manual Trigger:
   - You can trigger builds manually from the Jenkins dashboard.

Step 7: Monitor and Analyze Builds

- Build History: Jenkins keeps a history of your builds, and you can access logs and other build artifacts.
- Test Reports: If you're using JUnit or another testing framework, you can access test reports to view failed tests and debug information.

Step 8: (Optional) Deploy to a Server

- After a successful build and test, you can configure Jenkins to deploy the build to a test/staging server or even production.
- This can be done via Post-build Actions or in the pipeline script with a `deploy` stage.

RESULT: With these steps, you can successfully set up a CI pipeline in Jenkins using Maven or Gradle. By integrating source control, build tools, and automated testing, you create a fully automated pipeline that ensures consistent and rapid development workflows.

EXPERIMENT No:07

Configuration Management with Ansible

Aim: Basics of Ansible: Inventory, Playbooks, and Modules, Automating Server Configurations with Playbooks, Hands-On: Writing and Running a Basic Playbook

Components required: Java (version jdk 17 or 23 and 21), Ansible

Thoery :
Ansible is a powerful automation tool used for IT tasks such as configuration management, application deployment, and orchestration. It uses simple, human-readable YAML files to define automation tasks. Below are the key concepts of Ansible: inventory, playbooks, modules, and automating server configurations with playbooks.

1. Inventory

An **inventory** in Ansible is a file that contains information about the servers or machines you want to manage. It defines the hosts that Ansible will interact with. This file is often in **INI** or **YAML** format.

- **INI-style example**:

```
Ini

[web_servers]
web1.example.com
web2.example.com

[db_servers]
db1.example.com
db2.example.com
```

- **YAML-style example**::

```
yaml
    all:
children:
  web_servers:
    hosts:
      web1.example.com:
      web2.example.com:
  db_servers:
    hosts:
      db1.example.com:
db2.example.com:
```

2. Playbooks

A **playbook** is a YAML file that defines a series of tasks to be executed on one or more hosts. Playbooks can define multiple **plays**, where each play is a set of tasks run on a group of hosts.

- **Structure of a Playbook**:
  - **Hosts**: Define the target hosts (defined in the inventory).
  - **Tasks**: Define the actions to be executed (like installing software, creating files, etc.).
  - **Variables**: You can define variables to be used within the playbook.
  - **Handlers**: Special tasks that only run when notified by other tasks.
  - **Roles**: Reusable sets of tasks, handlers, and variables.

- **Basic Playbook Example**:

yaml

```
---
- name: Install Apache and start service
  hosts: web_servers
  become: yes

  tasks:
    - name: Install Apache
      apt:
        name: apache2
        state: present
        update_cache: yes

    - name: Start Apache service
      service:
        name: apache2
        state: started
        enabled: yes
```

3. Modules

Ansible modules are the building blocks of Ansible tasks. Each module performs a specific function (e.g., install packages, copy files, start services).

Some common Ansible modules:

- **apt**: Manages packages for Debian/Ubuntu systems.
- **yum**: Manages packages for RHEL/CentOS systems.

- **service**: Manages services (start, stop, restart).
- **copy**: Copies files from the local machine to the remote machine.
- **file**: Manages file properties like permissions.

Example of a **module** in a playbook:

yaml

```
- name: Install Nginx
  apt:
    name: nginx
    state: present
    update_cache: yes
```

4. Automating Server Configurations with Playbooks

You can use playbooks to automate server configurations. For example, automating the installation and configuration of software packages, setting up users, managing services, and more.

Here's an example of automating server configuration to install Apache and configure it with a custom configuration file:

Example Playbook for Server Configuration:

yaml

```
---
- name: Configure web server
  hosts: web_servers
  become: yes

  tasks:
    - name: Install Apache2
      apt:
        name: apache2
        state: present

    - name: Copy custom Apache config file
      copy:
        src: /local/path/to/apache2.conf
        dest: /etc/apache2/apache2.conf
        owner: root
        group: root
        mode: '0644'
    - name: Ensure Apache is running
      service:
        name: apache2
        state: started
        enabled: yes
```

In this example:

- **Apache** is installed.
- A **custom configuration file** is copied from the local machine to the server.
- **Apache service** is started and enabled to start on boot.

NOTE:

- **Inventory** is a list of managed hosts.
- **Playbooks** define what tasks should be run on which hosts.
- **Modules** provide the functionality to perform tasks (like installing software, managing services, etc.).
- You can **automate server configurations** by writing playbooks that include necessary tasks for the desired configuration.

With Ansible, you can automate server setups, configurations, and management in a repeatable, scalable way. It also allows version-controlled, auditable configurations across your infrastructure.

Writing and running a basic playbook:

Let's walk through writing and running a basic Ansible playbook step-by-step. This example will demonstrate how to set up a basic Apache web server on remote hosts using a playbook.

Prerequisites

- You have Ansible installed on your local machine.
- You have one or more remote hosts (e.g., virtual machines or cloud instances) where you have SSH access and Ansible can run commands.
- You know the IP addresses or hostnames of your remote hosts.
- Ensure SSH keys are set up or passwords are configured for authentication.

Step 1: Setup Your Inventory File

First, you need to create an **inventory file** that lists your remote servers.

1. Create a file called hosts.ini (or use hosts.yml if you prefer YAML format).

Example of hosts.ini:

ini

```
 [web_servers]
192.168.1.10
192.168.1.11
```

Here, we have two remote servers (192.168.1.10 and 192.168.1.11) under the web_servers group.

Step 2: Write the Playbook

Next, create a playbook that will be responsible for setting up Apache on the remote servers.

1. Create a file called install_apache.yml (or any name you prefer).

Example of install_apache.yml Playbook:

yaml

```
---
- name: Install and configure Apache web server
  hosts: web_servers   # Targets the hosts defined under the "web_servers" group
  become: yes          # Use sudo privileges for tasks that require admin access

  tasks:
    - name: Install Apache
      apt:
        name: apache2       # Package to be installed
        state: present      # Ensures that Apache is installed
        update_cache: yes   # Update apt cache before installing

    - name: Start Apache service
      service:
        name: apache2       # Apache service name
        state: started      # Ensures the service is running
        enabled: yes        # Ensures Apache starts on boot

    - name: Ensure the Apache homepage is available
      copy:
        content: "<html><body><h1>Welcome to the Apache Server!</h1></body></html>"
        dest: /var/www/html/index.html  # The default location for the Apache homepage
        mode: '0644'
```

This playbook does the following:

- Installs Apache on the remote servers.
- Starts and enables the Apache service.
- Deploys a simple HTML page to /var/www/html/index.html.

Step 3: Run the Playbook

Now that you've created your inventory and playbook, it's time to run it.

Use the following command to run the playbook:

bash

```
ansible-playbook -i hosts.ini install_apache.yml
```

This command will:

- Use the hosts.ini inventory to identify which servers to target.
- Execute the tasks in install_apache.yml on those remote servers.

Step 4: Verify the Setup

Once the playbook completes successfully, you can verify the setup by:

1. Opening a web browser and navigating to the IP address of one of the remote servers (e.g., http://192.168.1.10).
2. You should see the message Welcome to the Apache Server! displayed.

Alternatively, you can SSH into the remote servers and verify Apache is running:

bash

```
systemctl status apache2
```

This will show if Apache is active and running.

Troubleshooting

- If Ansible reports an error or task failure, check the logs for details on what went wrong. Common issues include missing sudo privileges or package manager issues (e.g., wrong package name or unavailability of repositories).
- Ensure the apt module is appropriate for the target operating system (Ubuntu/Debian). For RHEL-based systems, you may need to use the yum module instead.

Note:

- We created an inventory file (hosts.ini) with remote server IP addresses.
- We wrote a basic playbook (install_apache.yml) to install and configure Apache.

- We ran the playbook with the ansible-playbook command to execute tasks on remote servers.

Result: Successfully Written and run a basic playbook**.**

EXPERIMENT NO:08

Practical Exercise

AIM: Set Up a Jenkins CI Pipeline for a Maven Project, Use Ansible to Deploy Artifacts Generated by Jenkins.

COMPONENTS REQUIRED: Java (version jdk 17 or 23 and 21), Maven (Version 10), Ansible, Jenkins.

THEORY:

Let's break it down into smaller tasks**:**

1. Set Up Jenkins for Continuous Integration (CI)
2. Create a Maven Project in Jenkins
3. Configure Jenkins Build Pipeline (CI Pipeline)
4. Use Ansible to Deploy Artifacts from Jenkins

Step 1: Set Up Jenkins for Continuous Integration

1. **Install Jenkins**:
   - If Jenkins is not yet installed, you can follow the official installation guide for your OS: Jenkins Installation Guide.
   -
2. **Install Required Plugins**:
   - Open the Jenkins dashboard.
   - Go to **Manage Jenkins** > **Manage Plugins**.
   - Install the following plugins:
     - **Maven Integration Plugin**: For Maven support.
     - **Ansible Plugin**: For Ansible integration.
     - **Git Plugin**: To clone repositories from GitHub or other Git services.
   -
3. **Configure Global Tools in Jenkins**:
   - Go to **Manage Jenkins** > **Global Tool Configuration**.
   - Set up **JDK** (if needed) and **Maven** (ensure Maven is installed on Jenkins).
     - **JDK**: Configure the JDK that will be used to build your Maven project.
     - **Maven**: Specify the installation of Maven.
   -
4. **Set up Ansible on Jenkins (if not already installed)**:
   - Ansible must be installed on the Jenkins server or the nodes where the deployment will happen.
   - You can set up Ansible globally under **Manage Jenkins** > **Global Tool Configuration**.
     - Set the **Ansible** path on the Jenkins server.

Step 2: Create a Maven Project in Jenkins

1. **Create a New Job in Jenkins**:
   - From the Jenkins dashboard, click **New Item**.
   - Select **Freestyle project** (or **Pipeline** if you want to use pipeline scripts).
   - Give the job a name (e.g., maven-build-project).
   -
2. **Configure Git Repository**:
   - Under **Source Code Management**, select **Git**.
   - Provide the repository URL (e.g., GitHub, GitLab).
   - Optionally, provide credentials if your repository is private.
   -
3. **Add Build Step for Maven**:
   - Under **Build**, select **Invoke top-level Maven targets**.
   - Set the **Goals** to clean install to clean the project and build the .jar (or .war, .ear) file.
   - Ensure the **Maven Version** is set to the one configured earlier.

Example:

Bash

```
clean install
```

4. **Add Post-Build Actions**:
   - You can configure post-build actions to archive the build artifacts (JAR/WAR file) so they can be used later in the pipeline.

Example:

- Archive the artifact (e.g., target/*.jar or target/*.war).
- Select **Archive the artifacts** in the **Post-build Actions** section.
  - In **Files to archive**, specify target/*.jar (or the appropriate artifact type).

Step 3: Configure Jenkins Build Pipeline (CI Pipeline)

1. **Add Build Steps for Jenkins Pipeline (Optional)**:
   - If you want to use a more advanced CI pipeline using a Jenkins **Pipeline Script**, select **Pipeline** instead of **Freestyle Project** when creating a new job.
   -
2. **Configure the Pipeline Script**:
   - In the **Pipeline** section, you can define the Jenkinsfile (pipeline script) directly in Jenkins or store it in the Git repository.

Example Jenkinsfile (Declarative Pipeline):

groovy

```
pipeline {
    agent any
    tools {
        maven 'Maven-3.6.3'  // Make sure Maven version is configured in Jenkins global tools
    }
    environment {
        DEPLOY_SERVER = "deploy@your-server.com"
    }
    stages {
        stage('Checkout') {
            steps {
                git 'https://github.com/your/repo.git'
            }
        }
        stage('Build') {
            steps {
                sh 'mvn clean install'  // Build the Maven project
            }
        }
        stage('Archive Artifacts') {
            steps {
                archiveArtifacts artifacts: 'target/*.jar', allowEmptyArchive: true
            }
        }
        stage('Deploy') {
            steps {
                ansiblePlaybook playbook: 'deploy.yml', inventory: 'inventory.ini' // Run the Ansible
playbook
            }
        }
    }
    post {
        success {
            echo 'Build and deploy completed successfully!'
        }
        failure {
            echo 'Build failed!'
        }
    }
}
```

Step 4: Use Ansible to Deploy Artifacts from Jenkins

1. **Create an Ansible Playbook**: Ansible will be used to deploy the artifact generated by Jenkins (e.g., a .jar file) to the target server(s).

Create a file called deploy.yml (Ansible playbook) to deploy the artifact:

yaml

```
---
- name: Deploy artifact to server
  hosts: web_servers
  become: yes

  tasks:
    - name: Copy the artifact to the remote server
      copy:
        src: /path/to/your/artifact/target/my-app.jar   # Jenkins workspace path
        dest: /opt/myapp/my-app.jar                    # Destination on the server

    - name: Start the application service
      systemd:
        name: myapp
        state: restarted
        enabled: yes

    - name: Ensure the application is running
      uri:
        url: "http://localhost:8080"
        status_code: 200
```

- This playbook copies the artifact (e.g., .jar file) to the remote server, restarts the application service, and checks if the application is running.
-

2. **Create an Ansible Inventory File**: Define the hosts where the artifacts will be deployed. Create a file called inventory.ini (or inventory.yml if using YAML format):

ini

```
 [web_servers]
192.168.1.10
192.168.1.11
```

3. **Configure Ansible in Jenkins**:
   - In Jenkins, configure the **Ansible Plugin** with the path to your Ansible installation.
   - You can specify the inventory.ini file in the pipeline and ensure Jenkins can run the playbook.

Step 5: Run the Pipeline

- Now, you can trigger the pipeline manually or set up a webhook for automatic builds.
- Jenkins will:
  1. Checkout your project from Git.
  2. Build the Maven project and generate the artifact.
  3. Archive the artifact.
  4. Use Ansible to deploy the artifact to the remote servers.

RESULT: We have successfully created a **Jenkins CI pipeline** to build a **Maven project** then uses **Ansible** to deploy the generated artifact (e.g., .jar) to the target server. With this setup, we have a fully automated Continuous Integration and Continuous Deployment (CI/CD) pipeline.

EXPERIMENT No: 09

Introduction to Azure DevOps

AIM: Overview of Azure DevOps Services, Setting Up an Azure DevOps Account and Project.

COMPONENTS REQUIRED: Java (version jdk 17 or 23 and 21), Maven (Version 10), Gradle (Version 10). Jenkins.

THEORY:

Azure DevOps is a cloud-based suite of development tools provided by Microsoft to support the complete software development lifecycle (SDLC). It includes a set of services that helps teams plan, develop, test, and deliver applications efficiently. Azure DevOps is designed to support both continuous integration (CI) and continuous delivery (CD), and it integrates seamlessly with various development platforms.

Overview of Azure DevOps Services

Azure DevOps offers several key services, each catering to different parts of the software development lifecycle:

1. Azure Repos: A set of version control tools (Git or Team Foundation Version Control - TFVC) that enables you to manage your code repositories, track changes, and collaborate with your team.

2. Azure Pipelines: A continuous integration and continuous delivery (CI/CD) service that automates the process of building, testing, and deploying code to different environments (e.g., development, staging, production).

3. Azure Boards: A tool for agile project management that allows teams to plan, track, and discuss work. It includes features like Kanban boards, Scrum boards, user stories, and backlog management.

4. Azure Test Plans: Provides tools for manual and exploratory testing. It helps in tracking defects and managing test cases to ensure high-quality code.

5. Azure Artifacts: A service that enables teams to host and share packages (like NuGet, npm, and Maven) within their organization, promoting reuse and easier dependency management.

6. Azure DevOps Services for Collaboration: Features like dashboards, Wikis, and collaboration tools help teams work together effectively by providing visibility into the status of projects and workflows.

Setting Up an Azure DevOps Account

1. Create an Azure DevOps Account:
   - Visit the [Azure DevOps portal](https://dev.azure.com/).
   - If you don't have an existing Microsoft account, create one. If you have a Microsoft account (e.g., Outlook, Hotmail, or Office 365), you can sign in directly.

- After signing in, you'll be asked to set up your Azure DevOps organization. Choose a unique name for your organization and the region where you want to host your data.

2. Create an Azure DevOps Project:
   - After logging in, you'll be redirected to the Azure DevOps dashboard.
   - Click on New Project.
   - Enter a name for your project, which will help identify your work in Azure DevOps.
   - Choose the visibility of your project:
     - Private: Only invited users can access the project.
     - Public: The project is accessible by anyone.
   - Select the version control system you want to use (either Git or TFVC).
   - Choose the process template (Agile, Scrum, or CMMI) to manage your project's workflow.
   - Click Create to set up the project.

Project Organization and Access Management

Once your project is created, you can:

1. Manage Users: You can add team members to your project and assign roles and permissions. Permissions can be fine-tuned to control access to various Azure DevOps services (e.g., repositories, pipelines, boards).

2. Set Up Repositories: In the Repos section, you can create Git repositories where you can store your project code, collaborate with your team, and manage branches.

3. Create Pipelines: Under Pipelines, you can configure Continuous Integration (CI) and Continuous Delivery (CD) workflows, defining the steps for building, testing, and deploying your application.

4. Plan Work: Using Azure Boards, you can create work items, user stories, and tasks, and organize them into sprints or iterations.

RESULT: Azure DevOps is a comprehensive suite of tools that helps teams manage and automate the development lifecycle efficiently. From version control and CI/CD to project management and testing, Azure DevOps provides everything a development team needs to deliver high-quality software. The first steps in using Azure DevOps involve setting up an account, creating a project, and configuring repositories, pipelines, and agile workflows.

EXPERIMENT No: 10

Creating Build Pipelines

Aim: Building a Maven/Gradle Project with Azure Pipelines, Integrating Code Repositories (e.g., GitHub, Azure Repos), Running Unit Tests and Generating Reports

Components required: Java (version jdk 17 or 23 and 21), Maven (Version 10), Gradle (Version 10). Jenkins, Azure account, Git

Theory:

1. Create an Azure DevOps Project

First, make sure you have an Azure DevOps account and a project set up. If you haven't done that already:

- Go to Azure DevOps.
- Create a new project.

2. Integrate Your Code Repository (GitHub or Azure Repos)

Integrate GitHub Repo

- Go to your Azure DevOps project.
- Click on Pipelines in the left-hand menu.
- Click New Pipeline.
- Choose GitHub as the source and authorize Azure DevOps to access your GitHub repository.
- Select the repository where your project is located.

Integrate Azure Repos

- Go to your Azure DevOps project.
- Click on Pipelines.
- Click New Pipeline.
- Choose Azure Repos Git and select the repository.

3. Define Pipeline Configuration (YAML)

You can configure your pipeline using a YAML file, which is placed in the root of your repository. If you're working with Maven or Gradle, the general structure of the YAML file will be different, but both follow a similar flow.

For Maven (Java) Project:

yaml

```
trigger:
  branches:
    include:
      - main  # Trigger pipeline on main branch (or your default branch)

pool:
  vmImage: 'ubuntu-latest'  # You can choose another image like 'windows-latest' or 'macos-latest'

steps:
- task: UseJavaToolInstaller@1
  inputs:
    versionSpec: '1.8'  # You can specify the Java version you are using

- task: Maven@3
  inputs:
    mavenPomFile: 'pom.xml'  # Path to your pom.xml file
    goals: 'clean install'  # You can use other Maven goals as required
    options: '-X'  # Optional: Additional Maven options

- task: PublishTestResults@2
  inputs:
    testResultsFiles: '**/target/test-*.xml'  # Path to the test reports
    testRunTitle: 'Maven Unit Tests'

- task: PublishBuildArtifacts@1
  inputs:
    pathToPublish: '$(Build.ArtifactStagingDirectory)'  # Directory to publish
    artifactName: 'drop'  # Artifact name
    publishLocation: 'Container'
```

For Gradle (Java) Project:

yaml

```
trigger:
  branches:
    include:
      - main

pool:
  vmImage: 'ubuntu-latest'

steps:
- task: UseJavaToolInstaller@1
  inputs:
    versionSpec: '1.8'  # Your Java version

- task: Gradle@2
  inputs:
    gradleWrapperFile: './gradlew'  # Path to Gradle wrapper (or use gradle if not using wrapper)
    options: 'clean build'
    workingDirectory: '$(Build.SourcesDirectory)'  # Working directory for the build

- task: PublishTestResults@2
  inputs:
    testResultsFiles: '**/build/test-*.xml'  # Path to test results for Gradle
    testRunTitle: 'Gradle Unit Tests'

- task: PublishBuildArtifacts@1
  inputs:
    pathToPublish: '$(Build.ArtifactStagingDirectory)'
    artifactName: 'drop'
    publishLocation: 'Container'
```

4. Run Unit Tests and Generate Reports

Maven Testing

Maven typically generates test reports in the target directory. The PublishTestResults@2 task picks up these reports and publishes them to Azure DevOps. You can also customize the location if needed.

Gradle Testing

Similarly, Gradle generates test results in the build directory. You can configure the pipeline to look for these test result files and publish them.

5. Publish Build Artifacts

Both Maven and Gradle projects can produce build artifacts (e.g., .jar, .war, .zip, or any other files). You can use the PublishBuildArtifacts@1 task to upload these artifacts as build outputs. These artifacts can later be used in release pipelines.

6. Configure Reporting and Test Results in Azure DevOps

Once the pipeline is triggered and unit tests are executed, Azure DevOps will show detailed test reports and status for each test case. The PublishTestResults@2 task ensures these results are uploaded for analysis.

You can also configure test reporting on the Azure DevOps dashboard for easy tracking of the test execution and coverage.

7. Trigger Pipeline

The pipeline will be triggered when changes are pushed to the repository. You can specify different branch conditions or even manual triggers. Here's an example of how you can trigger the pipeline only when a change is pushed to the main branch:

yaml

```
trigger:
  branches:
    include:
      - main  # Trigger only on changes to 'main' branch
```

8. Run and Monitor the Pipeline

Once you commit and push the YAML file to your repository, the pipeline will automatically trigger. You can monitor the build process from the Azure DevOps portal:

- Go to Pipelines.
- Click on the running pipeline to see the status, logs, and results.

NOTE:

 Azure Pipelines lets you automate the build, test, and deployment of your Maven or Gradle projects.

- The key tasks are setting up the pipeline with correct tools (Java, Maven/Gradle), running unit tests, and generating test reports.
- Reports and build artifacts can be automatically published, and the entire process can be triggered on GitHub or Azure Repos pushes.

RESULT: Successfully Integrated our Java project with Azure Pipelines, running unit tests, and generating reports.

Experiment No: 11

Creating Release Pipelines

Aim: Deploying Applications to Azure App Services, Managing Secrets and Configuration with Azure Key Vault, Hands-On: Continuous Deployment with Azure Pipelines

Components required: A repository (GitHub, Azure Repos, etc.) containing your code.

Theory:

Deploying Applications to Azure App Services

Azure App Services is a fully managed platform for building, deploying, and scaling web apps. To deploy an application to Azure App Services, you can follow these steps:

Steps:

- **Create an App Service**:
  - Go to the Azure portal and navigate to "App Services."
  - Click on "Create" and select the appropriate configurations for your app (e.g., subscription, resource group, app name, runtime stack).

- **Deploy the Application**:
  - You can deploy your application in several ways:
    - **GitHub Actions / Azure Pipelines**: Set up continuous deployment to automatically deploy when changes are pushed to a repository.
    - **Azure CLI**: Use the Azure command line to push code to the app service.
    - **Visual Studio**: Directly deploy from Visual Studio if you are using .NET

- **Monitor and Scale**:
  - Monitor the application's performance through the Azure portal and scale the application if needed.

2. Managing Secrets and Configuration with Azure Key Vault

Azure Key Vault is a service to securely store and manage sensitive information like keys, secrets, certificates, and configuration settings. It's a critical tool for securing credentials and managing app secrets.

Steps:

- **Create a Key Vault**:
  - In the Azure portal, search for and select "Key Vaults."

  - Create a new Key Vault, provide a name, select a resource group, and configure the access policies.
- **Add Secrets**:
  - Once the Key Vault is created, you can add secrets by going to "Secrets" and clicking "Generate/Import." You can store passwords, API keys, connection strings, etc.
-
- **Integrating Key Vault with Azure App Services**:
  - Go to the Application Settings for your Azure App Service.
  - Use the reference syntax @Microsoft.KeyVault(SecretUri=<Secret URI>) to reference the secrets stored in Key Vault.
  - Alternatively, you can use the Key Vault to pull secrets into your application via SDKs (like Azure SDK for Python, .NET, etc.).

3. Continuous Deployment with Azure Pipelines

Azure Pipelines is part of Azure DevOps and enables continuous integration (CI) and continuous deployment (CD) to automate your build and release workflows.

Steps:

- **Create a Pipeline**:
  - Go to Azure DevOps and create a project if you don’t have one.
  - Navigate to the Pipelines section and create a new pipeline.
  - Connect your GitHub or Azure Repos repository.
  - Define your build pipeline (e.g., build and test your app). You can use YAML or the visual editor.
  -
- **Configure Continuous Deployment**:
  - Once the build pipeline is created, you can set up a release pipeline.
  - Choose Azure App Service as the target and configure the settings for deployment (e.g., resource group, app name).
  -
- **Deploy Automatically**:
  - Set up triggers to deploy whenever a commit is made to your repository or after a successful build.
  -
- **Monitor Pipelines**:
  - After deploying, you can view the logs, track issues, and monitor the status of your deployment.

Example Workflow:

1. **Push Code**: A developer pushes code to a repository (GitHub or Azure Repos).
2. **Build Pipeline**: Azure Pipelines runs the build pipeline to compile, test, and prepare the application.

3. **Deploy with Release Pipeline**: Once the build is successful, the release pipeline deploys the app to Azure App Service.
4. **Secrets Management**: During deployment, the application pulls secrets from Azure Key Vault for secure configurations.

Prerequisites:

- An Azure account (with an App Service already created).
- A repository (GitHub, Azure Repos, etc.) containing your code.
- A basic understanding of YAML and Azure DevOps.

Steps for Continuous Deployment with Azure Pipelines

Step 1: Create a Project in Azure DevOps

1. **Sign in to Azure DevOps**:
   - Go to Azure DevOps and log in with your Azure account.
   -
2. **Create a New Project**:
   - Click on "New Project" and give it a name (e.g., MyAppProject).
   - Select visibility (Public or Private), then click "Create."

Step 2: Connect Your Repository to Azure Pipelines

1. **Navigate to Pipelines**:
   - In your new project, go to the **Pipelines** section in the left-hand sidebar.
   -
2. **Create a New Pipeline**:
   - Click **New Pipeline**.
   - Choose where your code is stored: GitHub, Azure Repos, etc.
   - For this example, we'll use **GitHub**.
   -
3. **Authenticate and Select Your Repository**:
   - If you choose GitHub, authenticate your GitHub account and select the repository where your application code is stored
   - .
4. **Configure Your Pipeline**:
   - After selecting your repository, Azure Pipelines will automatically attempt to detect your project type.
   - You can either select a pre-configured template or manually configure your pipeline.

For a **.NET Core** app, select the **ASP.NET Core** template, or you can create a custom YAML file.

Step 3: Define the Build Pipeline (CI)

Here’s an example of a basic YAML build pipeline for a .NET Core application:

```
yaml

trigger:
  branches:
    include:
      - main  # Change this to the branch you want to deploy from (e.g., main or master)

pool:
  vmImage: 'windows-latest'  # Or use ubuntu-latest for Linux apps

steps:
- task: UseDotNet@2
  inputs:
    packageType: 'sdk'
    version: '6.x'  # Choose the version based on your app
    installationPath: $(Agent.ToolsDirectory)/dotnet

- task: Restore@2
  inputs:
    restoreSolution: '**/*.sln'

- task: Build@1
  inputs:
    solution: '**/*.sln'
    buildPlatform: 'Any CPU'
    buildConfiguration: 'Release'

- task: Publish@1
  inputs:
    publishWebProjects: true
    connectionString: '$(build.artifactstagingdirectory)/_PublishedWebsites'
    zipAfterPublish: true
```

1. This pipeline will:
   - Trigger on changes to the main branch (or whichever branch you choose).
   - Use a Windows-based image to build your application.
   - Restore dependencies, build the solution, and publish the artifacts.
   -
2. **Save and Run**:
   - Commit the YAML file and push it to your repository. Azure Pipelines will run the build process when code is pushed to the main branch.

Step 4: Create a Release Pipeline for Continuous Deployment

Once your build pipeline is working, set up a release pipeline to deploy the application to **Azure App Service**.

1. **Navigate to the Releases Section**:
   - Go to **Pipelines** > **Releases** in Azure DevOps.
   -
2. **Create a New Release Pipeline**:
   - Click on **New Pipeline**.
   - Choose the **Artifact** (the output of the build pipeline) from the "Artifacts" section. Select the build pipeline you created earlier.
   -
3. **Add a Deployment Stage**:
   - Click on the "+" sign to add a stage.
   - Select **Azure App Service** as the target for deployment.
   -
4. **Configure Deployment to App Service**:
   - Choose your Azure Subscription (authenticate if needed).
   - Select the **App Service** you want to deploy to.
   - Select the **Slot** (if you have different deployment slots for staging, production, etc.).
   - Set the deployment settings for the **package** produced by the build pipeline.

Step 5: Automate Deployment with Continuous Deployment (CD)

1. **Configure Continuous Deployment Trigger**:
   - Go to the **Triggers** section in your release pipeline.
   - Enable **Continuous Deployment Trigger**, so it will automatically deploy your application to Azure App Service after a successful build.
   -
2. **Save and Queue the Pipeline**:
   - Save the release pipeline.
   - Now, every time your build pipeline finishes successfully, it will automatically trigger the release pipeline, deploying the latest version of your app to Azure App Service.

Step 6: Monitor and Manage Deployments

Once the pipeline is configured, you can monitor your deployments:

1. **Check the Deployment Logs**:

   .Under the **Pipelines** > **Releases** section, you can view detailed logs of each deployment.

2. **Rollback to Previous Versions**:

.If needed, you can rollback to a previous version of your application in case something goes wrong.

3. **Monitor App Service**:

.In the **Azure Portal**, navigate to your **App Service** and monitor its performance, errors, and logs.

RESULT: Successfully deployed an Applications to Azure App Services, Managing Secrets and Configuration with Azure Key Vault and Continuous Deployment with Azure Pipelines.

Experiment No: 12

Practical Exercise and Wrap-Up

Aim: Build and Deploy a Complete DevOps Pipeline, Discussion on Best Practices and Q&A

Components required: Java (version jdk 17 or 23 and 21), Maven (Version 10), Gradle (Version 10). Jenkins.

Theory:

1. Build the Pipeline
A DevOps pipeline typically includes several stages like code integration, testing, deployment, and monitoring. Here's how you can create and deploy a complete pipeline:

Step 1: Source Code Repository
- Tool: GitHub, GitLab, Bitbucket, etc.
- Action: Developers commit code to a Git repository. The code base could be in any programming language, such as Java, Python, or Node.js.

Step 2: Continuous Integration (CI)
- Tool: Jenkins, GitLab CI, CircleCI, Travis CI
- Action: On every code push, a CI tool picks up the changes and automatically runs the build. If the build passes, it triggers unit tests to check code quality and ensure everything is functioning as expected.
- Best Practice: Run the build frequently, ideally on every commit or at least on every pull request. Use automated tests (unit tests, integration tests) for validation.

Step 3: Continuous Testing
- Tool: Selenium, JUnit, Cypress, SonarQube
- Action: Run automated tests after the code build to validate the integrity of the software.
- Best Practice: Implement test-driven development (TDD) and ensure comprehensive test coverage.

Step 4: Continuous Deployment (CD)
- Tool: Jenkins, GitLab CI, AWS CodePipeline, Azure DevOps
- Action: The next step is deploying the code into various environments. First, deploy it to a staging environment for further tests (integration tests, load tests), then move it to production once it's verified.
- Best Practice: Use blue-green deployment or canary releases to minimize risk during deployment. Have rollback plans in place.

Step 5: Infrastructure as Code (IaC)
- Tool: Terraform, AWS CloudFormation, Ansible, Puppet, Chef
- Action: Define the infrastructure using code, so it can be version-controlled and automated, ensuring consistency across environments.
- Best Practice: Automate the creation and provisioning of resources, including network, storage, and compute instances.

Step 6: Monitoring and Logging
- Tool: Prometheus, Grafana, ELK Stack (Elasticsearch, Logstash, Kibana), Datadog
- Action: After deployment, monitor the health and performance of the application. Collect logs and

metrics to identify issues proactively.
- Best Practice: Set up alerts for any anomalies. Use monitoring tools to get real-time feedback.

2. Deployment Example
Let’s use GitHub Actions and AWS for simplicity.

Example CI/CD Pipeline Using GitHub Actions:
1. Create .github/workflows/main.yml:
```
“yaml”
name: CI/CD Pipeline

on:
  push:
    branches:
      - main

jobs:
  build:
    runs-on: ubuntu-latest

    steps:
    - name: Checkout Code
      uses: actions/checkout@v2

    - name: Set up Node.js
      uses: actions/setup-node@v2
      with:
        node-version: '14'

    - name: Install Dependencies
      run: npm install

    - name: Run Tests
      run: npm test

    - name: Build the Application
      run: npm run build

  deploy:
    runs-on: ubuntu-latest
    needs: build

    steps:
    - name: Deploy to AWS
      uses: aws-actions/configure-aws-credentials@v1
      with:
        aws-access-key-id: ${{ secrets.AWS_ACCESS_KEY_ID }}
        aws-secret-access-key: ${{ secrets.AWS_SECRET_ACCESS_KEY }}
        aws-region: 'us-west-2'

    - name: Deploy to EC2 or S3
      run: |
        # Example for EC2 deployment:
        ssh -i my-key.pem ec2-user@my-ec2-instance 'bash deploy.sh'
```

This pipeline checks out code, installs dependencies, runs tests, and deploys the app to AWS.

3. Best Practices

1. Automate Everything: Automation is the core of DevOps. Automate build, tests, deployments, and even infrastructure setup.
2. Version Control: Keep all the code, including infrastructure code (IaC), in version control systems.
3. Monitor and Log: Always monitor your applications and log the performance to spot issues early.
4. Continuous Testing: Implement automated testing (unit, integration, end-to-end) and run them regularly.
5. Security: Incorporate security scanning into the pipeline (e.g., using tools like Snyk) to ensure the code is secure.
6. Rollback Strategy: Always have a plan to roll back failed deployments quickly.

4. Wrap-Up Discussion

- Challenges: Some common challenges include dealing with configuration drift, balancing speed with quality, managing complex multi-cloud environments, and maintaining security throughout the pipeline.
- Tools: While Jenkins is one of the most widely used tools, it's important to select the right tools based on the use case. For example, GitLab CI and CircleCI might offer more modern UI and integration options compared to traditional Jenkins setups.
- Cultural Aspects: DevOps isn't just about tools. It's a cultural shift towards collaboration, automation, and continuous improvement. Teams should be aligned on goals and practices for DevOps to be successful.
- Scaling Pipelines: As teams grow, it's important to ensure the pipeline scales effectively by modularizing the pipeline and ensuring the infrastructure can support the increased demand.

Q&A

1. What is the difference between CI and CD?
   - CI (Continuous Integration) is the practice of automatically integrating code into the main branch frequently. CD (Continuous Deployment) refers to automatically deploying changes to production after successful tests.

2. What if a deployment fails?
   - Have an automated rollback strategy and an alerting system in place to notify the team of issues.

3. How do I handle sensitive data in the pipeline?
   - Use secret management tools (like AWS Secrets Manager, HashiCorp Vault) and keep sensitive data out of source code repositories.

RESULT:
This exercise and discussion should provide a comprehensive view of how to implement a DevOps pipeline.