**Program 1**

1. **Introduction to Maven and Gradle: Overview of Build Automation Tools, Key Differences Between Maven and Gradle, Installation and Setup.**

**Introduction to Maven and Gradle**

**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**

* **What is 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.
* **Main 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**

* **What is 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.
* **Main 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 |
| **Learning Curve** | Easier to pick up | Slightly steeper |
| **Script Size** | Verbose | More concise |
| **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](https://maven.apache.org/download.cgi) 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**:
     + Click on new, In variable name type MAVEN\_HOME, Variable value paste path (e.g., **C:\Program Files\apache-maven-x.x.x**).
     + Click on new, In variable name type M2\_HOME, Variable value paste path (e.g., **C:\Program Files\apache-maven-x.x.x**).
     + 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](https://gradle.org/releases/) 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**:
   * Click on new, In variable name type GRADLE\_HOME, Variable value paste path (e.g., **C:\Program Files\gradle--x.x.x**).
     + 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.