MAVEN

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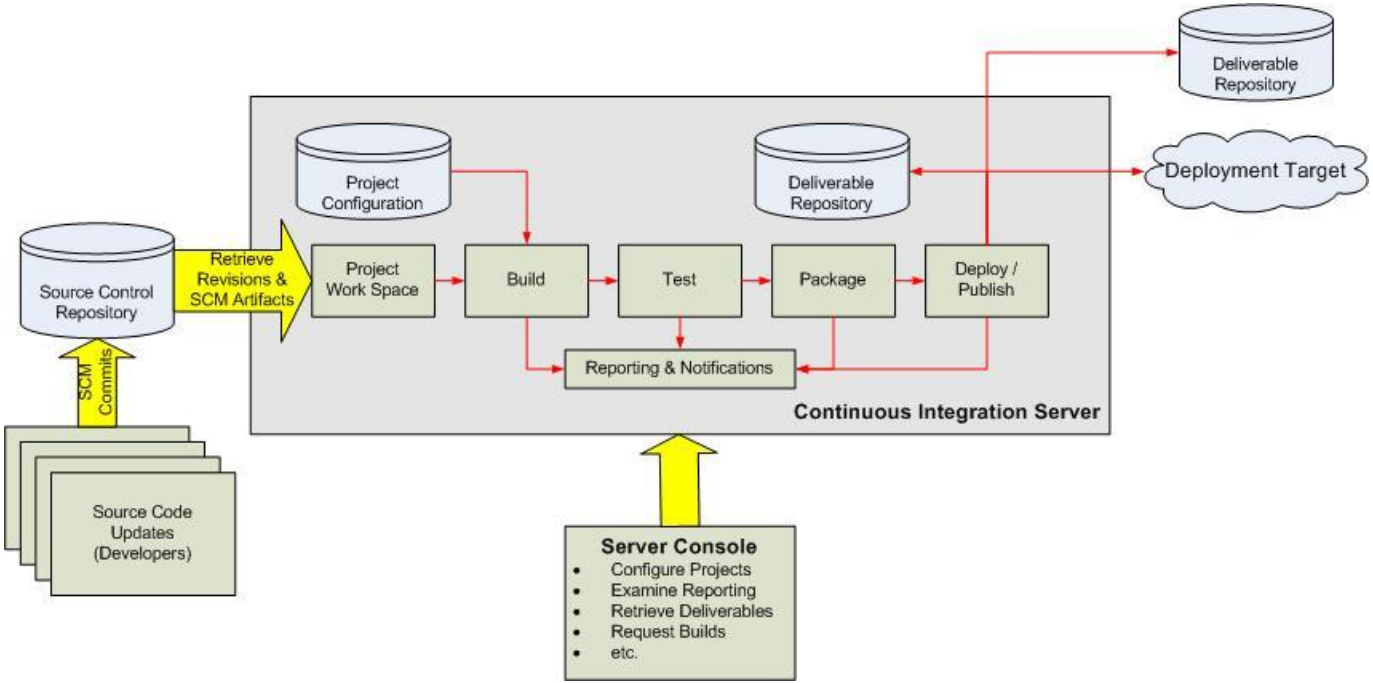
Agenda

1. Maven Introduction
2. Maven POM File & Project Structure
3. Create, Build & Test Maven Project
4. Maven Build Life Cycle
5. Lab/Exercise

Objectives

- Understand the challenges of Project Development Build
- Recognize the need of a tool to automate build process & Managing projects
- Configure Maven and check the set up
- Describe the features of Maven

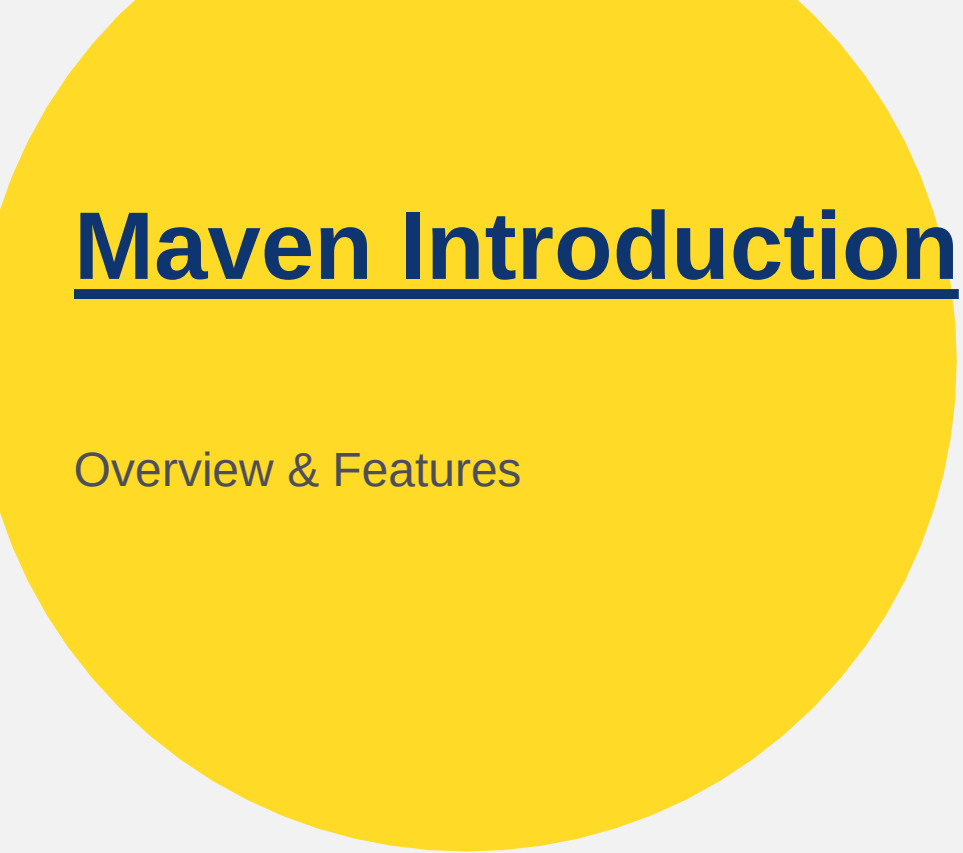
Continuous Integration Overview



source: http://www.javaworld.com/javaworld/jw-12-2008/images/CIOverview.jpg

Maven Introduction

Overview & Features



Challenges while Building a Project

- **Lack of Uniform directory Structure**: The team needs a uniform directory structure of the Project while working in a project

- **Too many dependencies on Jar file:** During integration injecting proper dependency and jar files would always be a challenge as it is difficult to assess transitive dependency at first place.

- **Building and deploying Project:** Even though build tools like ant can solve this problem in a limited way, a proper life cycle management of Build has been the need of the hour.

Maven Overview

- Maven is a Java build tool
  - It is a project management & comprehension tool
  - It used for building & managing any Java-based project.
  - It stores libraries & plugins in a Maven central repository
  - Maven Home Page URL: https://maven.apache.org. One can find the reference documentation for Maven & the core Plugins

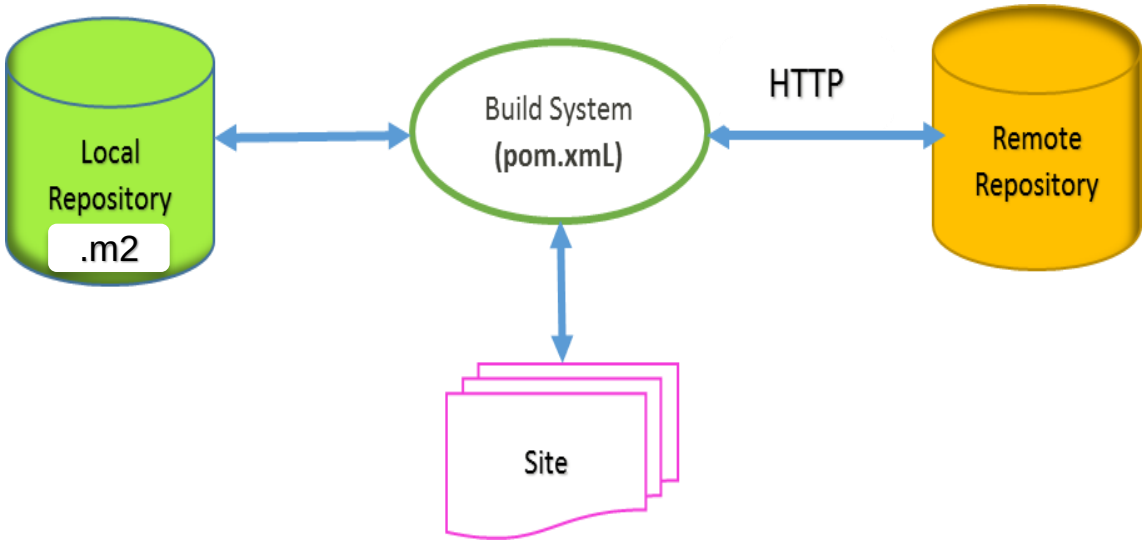
- Why Maven?
  - Fairly large software projects generally contain many projects/modules
  - Build process without automation in such projects, is challenging to understand and maintain it with in stipulated time.

Features of Maven

- Easier configuration
  - Consistent project structure
  - Provides project templates known as archetypes.
- Dependency Management
  - Multi-module builds
  - Build model can be sliced and diced
  - During Maven build process the dependencies are resolved
- Repository
  - Project dependencies can be accessed from local file system and/or from central or from public repositories.
- Plugin oriented - Extensible via plug-ins
  - This feature helps to keep Maven core small with basic functionalities
    - E.g. Maven core doesn't know how to compile the available Java source code. Compilation is handled by compiler plug-in
  - Additional features can be easily linked with suitable plug -ins
- Maven Central
  - Maven central repository is an open repository.
  - Maven's central repository hosts libraries. These libraries can be used in your build.
  - Maven build uses by default the central library to search for required libraries.

Build Process

- Maven **P**roject **O**bject **M**odel (POM) is a fundamental unit of work in Maven
  - POM is an XML file.
  - This XML file contains information about project & configuration details



Lab 1: Environment Setup

Objectives

- Install and set environment variables for using Java & Maven

Step 1: Java Configuration

- System Requirement
  - JDK version: 1.5 or above
  - Memory / Disk Space : no minimum requirement.
- Set JAVA Environment
  - Set environment variable
    - **JAVA_HOME** – This variable points to the base directory location
      E.g. JAVA_HOME = C:\Program Files\Java\jdk1.x.x
    - Append location of Java compiler System variable ‘Path’
      E.g. Path = %path%;C:\Program Files (x86)\Java\jdk1.8\bin
- Verify Java & your settings on your machine
  - C:\Users\avitepa>java -version

    java version "1.8.0_121"

    Java(TM) SE Runtime Environment (build 1.8.0_121-b13)

    Java HotSpot(TM) Client VM (build 25.121-b13, mixed mode)
  - C:\Users\avitepa>path
  - C:\Users\avitepa>echo %classpath%

Step 2: Maven Setup

- Download Maven - http://maven.apache.org/download.cgi
  - Windows: apache-maven-<<Version>>-bin.zip
- Extract/ Unzip => apache-maven-<<Version>>--bin.zip
  - C:\avitepa\apache-maven-<<Version>>
- Include bin directory of the just created directory to ‘PATH’ environment variable
- Verify Maven installation => C:\Users\avitepa>mvn -v

```
Apache Maven 3.3.9 (bb52d8502b132ec0a5a3f4c09453c07478323dc5;2015-11-10T22:11:47 + 05:30)
Maven home: C:\apache-maven-3.3.9
Java version:1.8.0_121, vendor: Oracle Corporation
Java home:C:\Program Files (x86)\Java\jdk 1.8.0_121\jre
Default locale:en_US, platform encoding: Cp1252
OS name:"windows 8", version: "6.2", arch: "x86", family: "windows"
```

Step 3: Maven Configuration

- set M2_HOME=C:\ avitepa \apache-maven-<<Version>>
  - M2 is the variable defined while setting Maven environment variables
  - Append string %M2% to end of system variable ‘PATH’

- verify settings with ‘set M’ command to list environment variables starting with 'M'

```
C:\Users\avitepa>set M
M2_HOME=C:\apache-maven-3.3.9
MAVEN_HOME=C:\apache-maven-3.3.9
MAVEN_OPTS=Xms256m -Xmx1G -XX:PermSize = 512m –noverify
```

Note: If you get "out of memory" errors when running your projects, the specified memory settings can be changed as required.

Understanding Environment Variables

- JAVA_HOME stores the path of the directory in which JDK can be found.
- M2_HOME stores the path of top directory in which MAVEN is "installed" (or unzipped).
- The M2 directory indicates to maven application (mvn) regarding where the required maven repositories are found
- MAVEN_OPTS - Specify Java command line arguments which will be in effect for the execution of Maven itself
  - -Xms – initial heap size
  - -Xmx - maximum heap size

Quiz

1. Command to check if Maven is properly installed is

a) java –version

b) mvn –v

c) mvn – version

2. Which of the following environment variable points to top directory in which maven is installed:

a) JAVA_HOME

b) MAVEN_HOME

c) M2_HOME

Quiz

3) POM is a

a) XML file
b) Word doc
c) Excel file

POM

Objectives

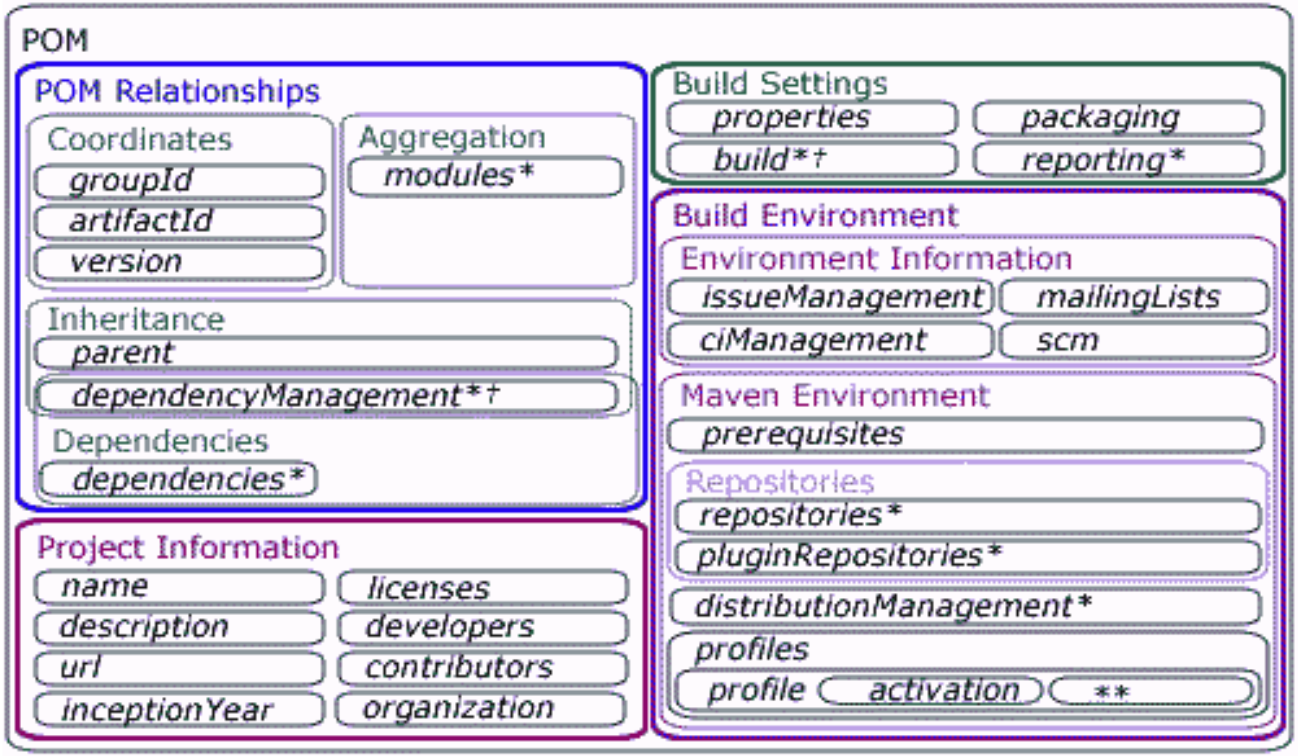
At the end of this module you would be able to

- Recognize POM structure
- Describe mandatory fields of POM
- Create a Project Structure
- Understand the hierarchy of the folders

Maven POM

- **P**roject **O**bject **M**odel (POM)
  - pom.xml describes a project in terms of its,
    - Name and Version
    - Artifact Type
    - Source Code Locations
    - Dependencies
    - Plugins
    - Commands (goals) that can be executed
    - Profiles (Alternate build configurations)
- POM uses standard build order, directories and plugins
- Pom.xml identifies the dependencies provides uniformity and enables the build process easier
- A POM can call it’s child POMs

POM - Structure



Mandatory Fields -POM

- groupId

- A Maven project has a group ID.
- This ID is Unique amongst Organization
- It represents the id for group project.

- artifactId

- artifactId is the id of the project i.e. the name of Project

- Version

- It gives information whether it is a development version or release version etc. For example: 1.0-SNAPSHOT signifies it is development version.

POM - Example

```
<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/maven-v4_0_0.xsd">
    <modelVersion>4.0.0</modelVersion>
    <groupId>com.avitepa.FirstProject</groupId>
    <artifactId>FirstProject</artifactId>
    <packaging>jar</packaging>
    <version>1.0-SNAPSHOT</version>
    <name>FirstProject</name>
    <url>http://maven.apache.org</url>
    <dependencies>
        <dependency>
            <groupId>junit</groupId>
            <artifactId>junit</artifactId>
            <version>3.8.1</version>
            <scope>test</scope>
        </dependency>
    </dependencies>
</project>
```

groupId: Id of Project group

artifactId: Id of project

version: version of project

Note: **Project Notation in repository -** groupId:artifactId:version

Lab 2: Create & Build Maven Project

Objectives

- Build a java project by creating a simple Maven project
- Perform Compile, unit test & package the result

Maven Project Structure Creation

- Maven provides "standardized" folder structure for different kinds of software projects.
- Create a maven project by using archetype plugin and by specifying suitable goal
  - Maven generation process switches into interactive mode to make relevant settings If goals are not specified,
  - Maven provides archetypes from a Java app to a complex web app

  E.g.: mvn archetype:generate
  - maven-archetype-quickstart: It generates a sample Maven project.
  - maven-archetype-simple: It generates a simple Maven project.
  - maven-archetype-webapp: It generates a sample Maven Webapp project.

  For more information on archetype, visit https://maven.apache.org/guides/introduction/introduction-to-archetypes.html

Maven Project Creation & Execution

1. Create Maven Project
   a) mvn archetype:generate -DgroupId=com.avitepa.FirstProject -DartifactId=FirstProject -DarchetypeArtifactId=maven-archetype-quickstart -DinteractiveMode=false
   b) Go through the generated project
   c) Go through the generated POM

2. Make Maven Project as an Eclipse project

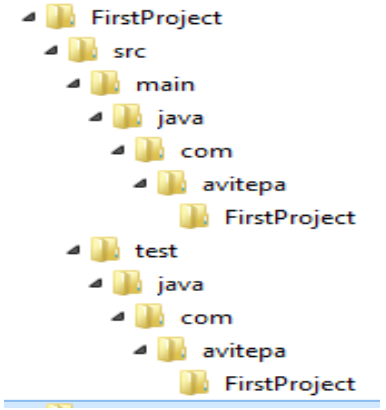
   Go to the Project folder created in the above step & then run - mvn eclipse:eclipse

site/clean, clean package

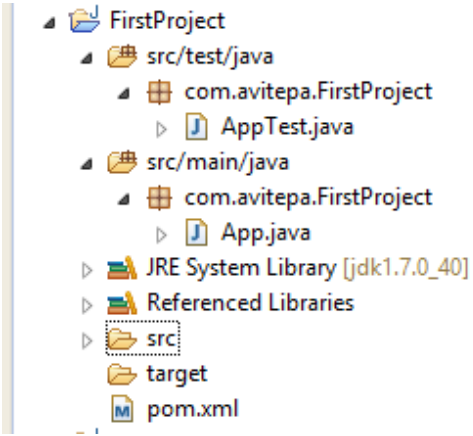
Maven Project Creation & Execution contd..

- Compile your sources
  - mvn compile
- Create a JAR file
  - mvn package
- Run the program
  - ..\FirstProject\target\classes>java com.avitepa.FirstProject.App

  Hello World!
- Clean the project by removing all build
  - mvn clean
  - Note: Invokes just clean
- Rebuild
  - mvn package
  - Mvn clean package
- Running the test
  - mvn test
- Create a report
  - Mvn site



pom.xml



Review generated POM

```
<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/maven-v4_0_0.xsd">
    <modelVersion>4.0.0</modelVersion>
    <groupId>com.avitepa.FirstProject</groupId>
    <artifactId>FirstProject</artifactId>
    <packaging>jar</packaging>
    <version>1.0-SNAPSHOT</version>
    <name>FirstProject</name>
    <url>http://maven.apache.org</url>
    <dependencies>
        <dependency>
            <groupId>junit</groupId>
            <artifactId>junit</artifactId>
            <version>3.8.1</version>
            <scope>test</scope>
        </dependency>
    </dependencies>
</project>
```

groupId: Id of Project group

artifactId: Id of project

version: version of project

Note: **Project Notation in repository -** groupId:artifactId:version

Update POM

- Generated pom.xml, may have mappings to JDK 1.4 & Junit test for version 3.8.x
- Let us update the versions of JDK and Junit.


```
<build>
    <plugins>
        <plugin>
            <groupId>org.apache.maven.plugins</groupId>
            <artifactId>maven-compiler-plugin</artifactId>
            <version>2.3.2</version>
            <configuration>
                <source>1.7</source>
                <target>1.7</target>
            </configuration>
        </plugin>
    </plugins>
</build>
```

JDK configured to 1.7

Update POM (contd..)

```
<dependencies>
    <dependency>
        <groupId>junit</groupId>
        <artifactId>junit</artifactId>
        <version>4.11</version>
        <scope>test</scope>
    </dependency>
</dependencies>
```

Version changed to 4.11

Compile, Run & Test

- Compile your sources
  - mvn compile
- Create a JAR file
  - mvn package
- Run the program
  - ..\FirstProject\target\classes>java com.avitepa.FirstProject.App

  Hello World!
- Clean the project (Remove entire build results)
  - mvn clean
  - Note: Invokes just clean
- Rebuild
  - mvn package
  - Mvn clean package
- Running the test
  - mvn test
- Create a report
  - Mvn site

Quiz

1) .m2 repository which is local repository can be found inside

a) Maven home directory

b) Maven bin folder

c) users home directory

d) None of the above

2) A unit of work/ task in Maven is called as

a) Task

b) goal

Quiz

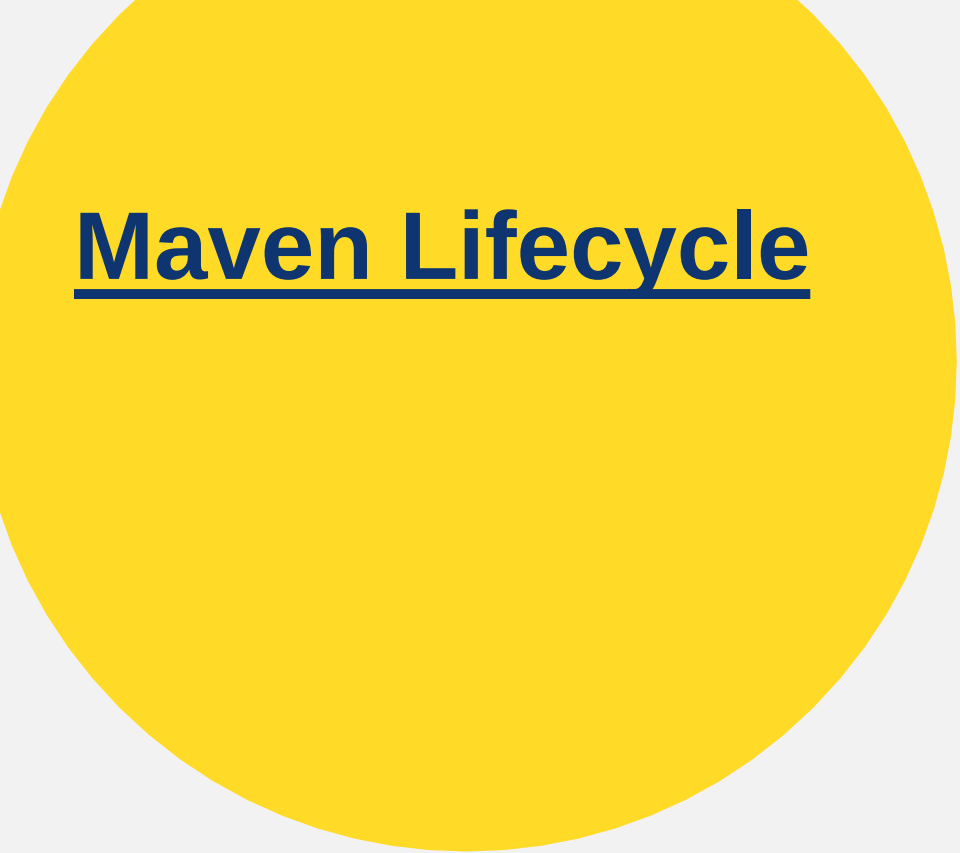
3) Give the proper sequence of attributes of POM file which identifies an Object properly

a) Version

b) groupId

c) artifactId

Maven Lifecycle



Objectives

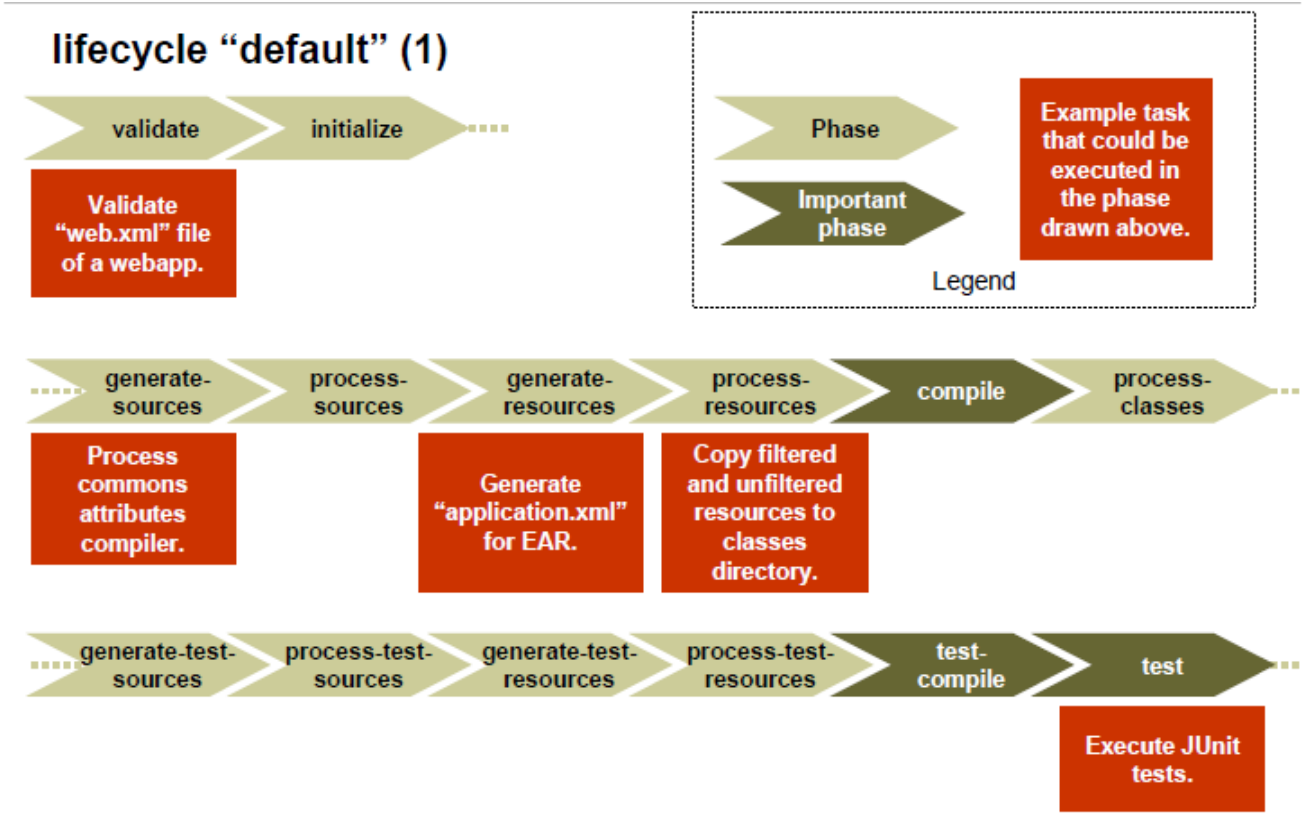
At the end of this section you would be able to

- Comprehend different phases of Maven build life cycle
- Have an understanding of the commands associated with the build
- Explain command hierarchy.

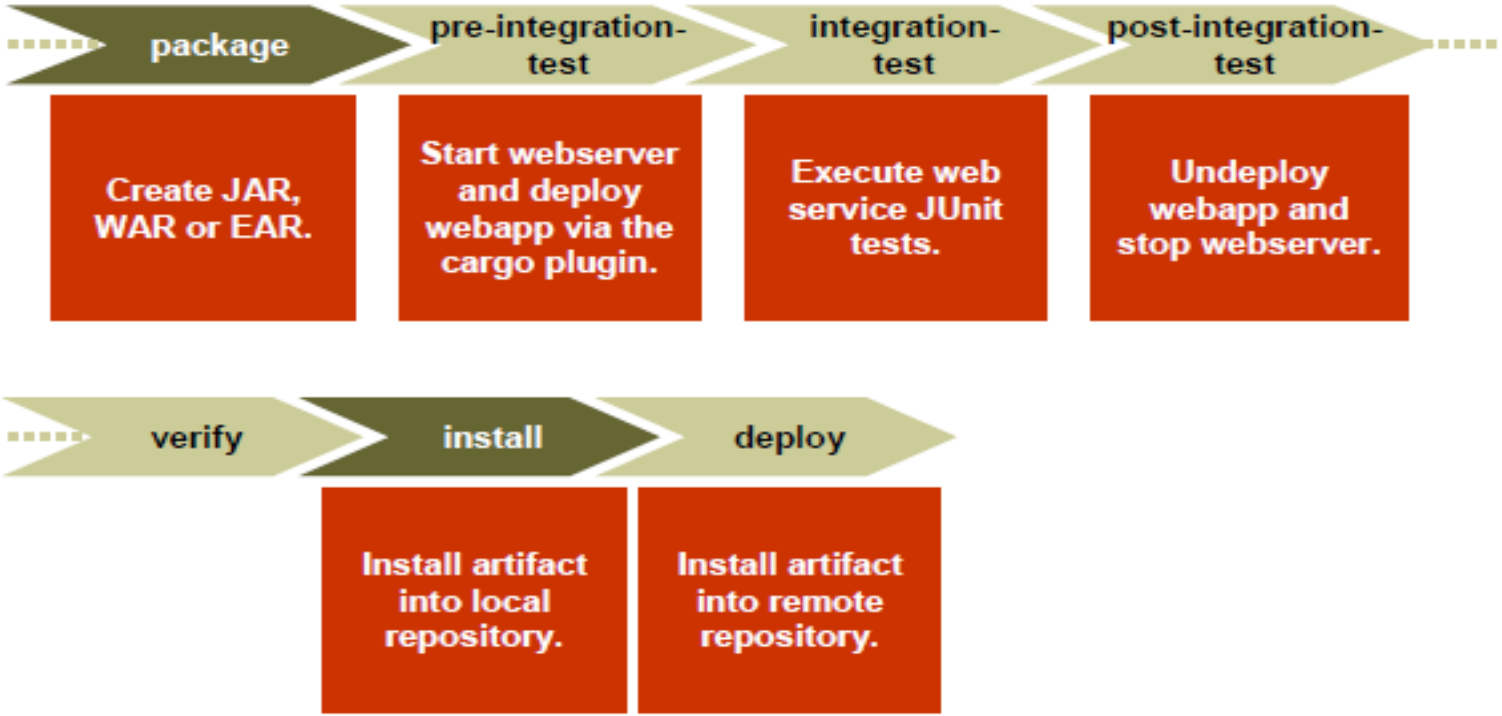
Maven plug-ins & goals

- A plugin is a set of goal or goals.
  - A goal is a “task” in Maven.
  - Goals can be executed independently
  - Goals can be executed as a part of a chain of goals.
  - Goals can have parameters with default values
  - Goal(s) can be attached to a Maven Life cycle Phase
- Goals are executed based on input found in pom.xml of that project
  - e.g., compiler:testCompile goal checks the input found in POM.xml for relevant parameters.

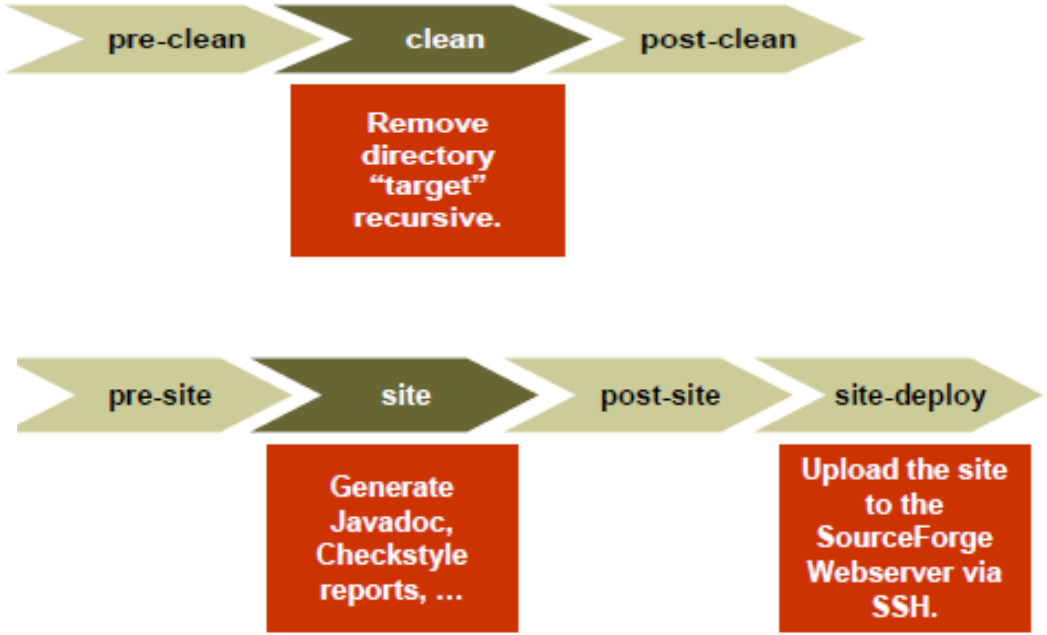
Life Cycle – “Default”



Life Cycle “default” (2)



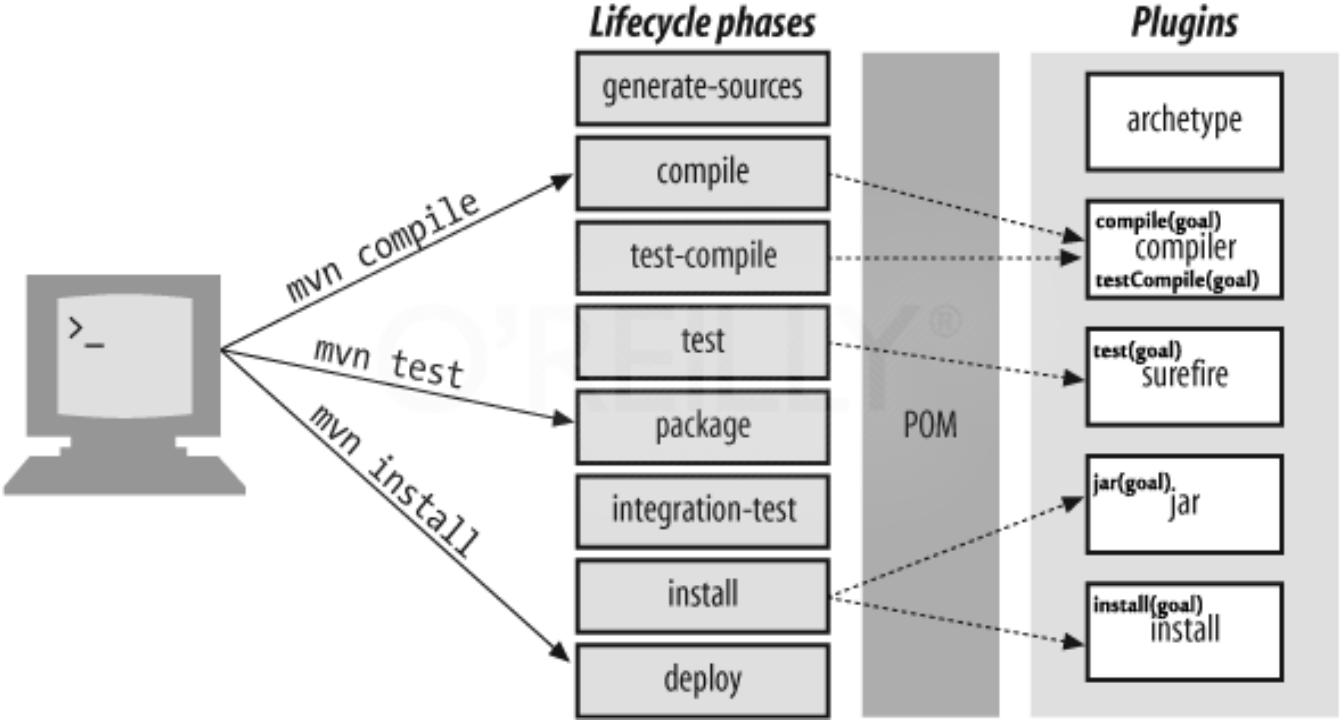
Lifecycle “clean” & “site”



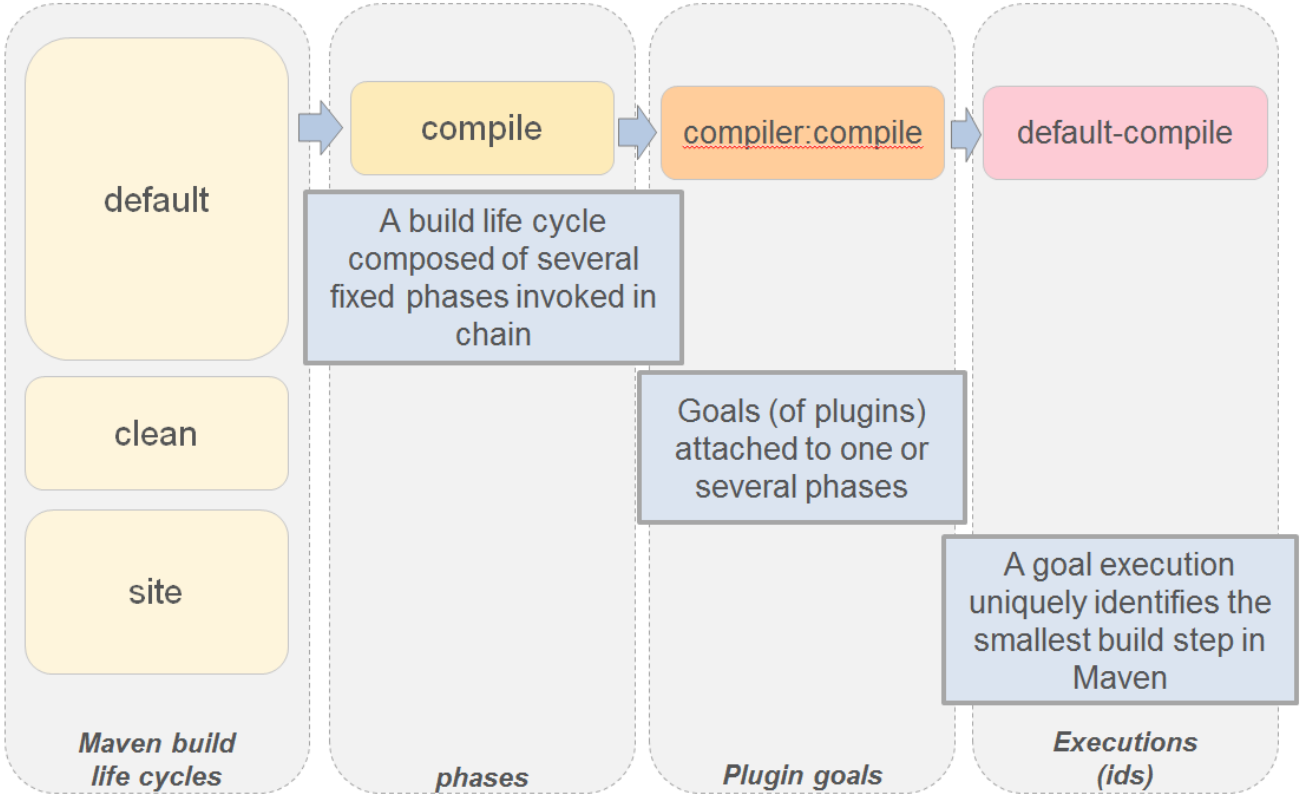
Maven life cycle

- Maven's default life cycle include the most common build phases like testing.
- The important Maven life cycle phases include the following list:
  - validate – It checks whether the project is correct & all information is available
  - compile – It compiles source code into binary artifacts
  - test – It executes the tests
  - package – It takes the compiled code & package it into jar/war/ear files
  - integration-test – It takes packaged result & executes additional tests, that requires the packaging
  - verify – It performs checks whether the package is valid
  - install – It installs the result of package phase into local Maven repository
  - deploy – It deploys the package to a local or remote repository

Lifecycle Phases & Plugins



Lifecycle Phases & Plugins contd..



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Invoke Maven build by setting a lifecycle “goal”

- mvn install: triggers generate*, compile, test, package, integration-test, install
- mvn clean: Clean old builds from project folder
- mvn clean compile: Cleans old builds & then executes generate*, compile
- mvn compile install: triggers generate*, compile, test, integration-test, package, install in that sequence
- mvn test clean: triggers generate*, compile, test and then cleans

For a complete list of the Maven phases see
http://maven.apache.org/guides/introduction/introduction-to-the-lifecycle.html

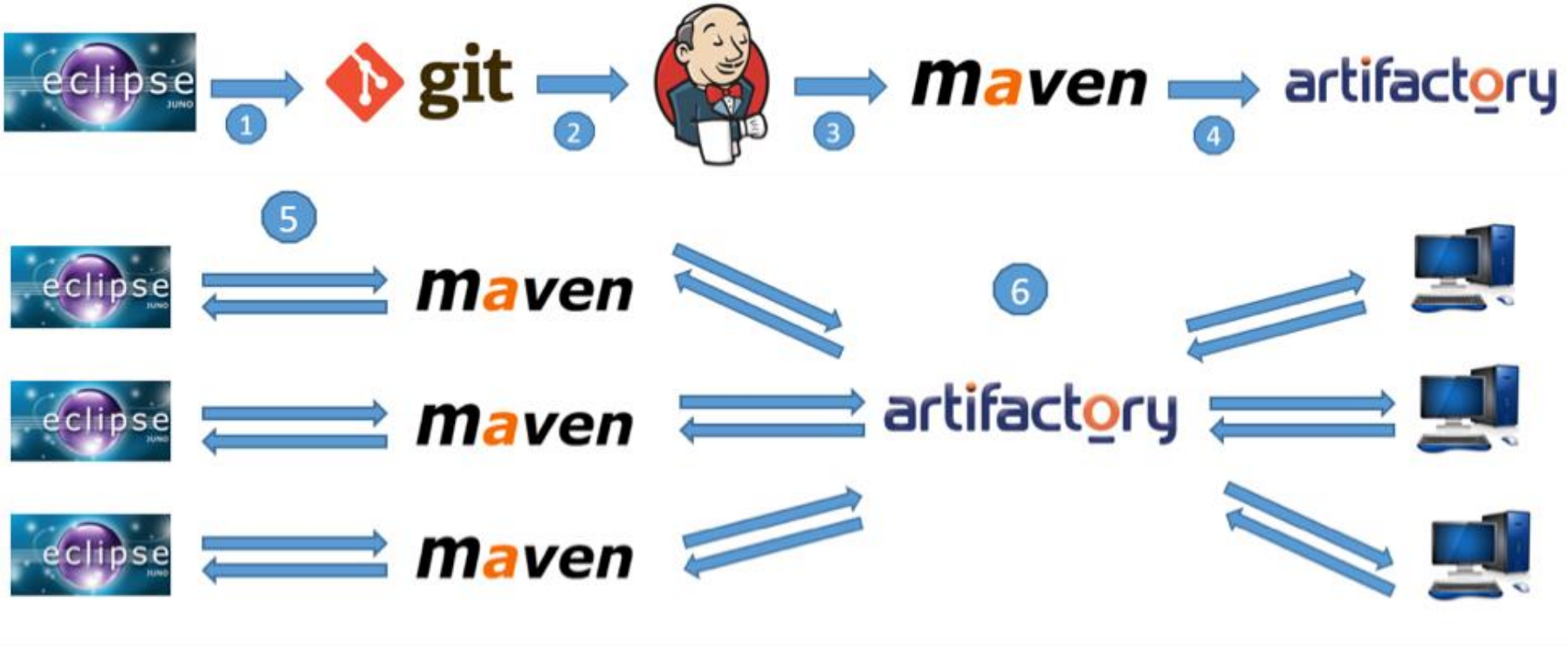
If you instruct Maven to execute a phase, it executes all previous phases in the pre-defined sequence until it has executed the defined phase. All relevant goals are executed during this process. A goal is relevant for a phase if the Maven plug-in or the pom binds this goal to the corresponding life cycle phase.

Maven lifecycle is a combination of phases (one or more)

- By default, Maven knows, the following 3 lifecycles:
  - Default: It Is used for most activities on artifacts like performing a build.
  - Clean: It Is used to delete generated parts
  - Site: It Is used to generate a website for the current artifact

- A maven lifecycle has one or more phases & the goal(s) can be mapped to a phase. When the phases of the lifecycle start, few pre-defined plugin-goals automatically gets executed

Here is an example of multiple unit test splits in a big build pipeline:



Lab 4 : Exercise/Web Project

Quiz

1) List of the proper hierarchy of Build lifecycle

a) Verify
b) Validate
c) Compile
d) Package
e) Integration test
f) Test
g) Deploy
h) Install

Quiz

2) Command which generates jar file is

a) Deploy
b) Install
c) Validate
d) Package

3) Command which helps to release the build is

a) Install
b) Deploy
c) Package
d) Integration-test

Site plugin

```
<plugin>
<groupId>org.apache.maven.plugins</groupId>
<artifactId>maven-site-plugin</artifactId>
<version>3.7.1</version>
</plugin>
```

```
<plugin>
<groupId>org.apache.maven.plugins</groupId>
<artifactId>maven-project-info-reports-plugin</artifactId>
<version>3.0.0</version>
</plugin>
```

artifactory

1. Start & Login with admin credentials
2. Select => libs-release>set me up => generate settings>generate settings > Download snippet
   - Downloaded Settings.xml (Decrypted credentials) place it within .m2 folder
   - Copy DistribuionManagement > update within POM
   - Update JDK compiler mapping (optional)
3. Define Artifactory server with credentials within maven settings.xml

```
<server>
  <username>devops</username>
  <password>devops</password>
  <id>central</id>
</server>
```

- Configure jenkins>Manage Jenkins> Configure System>Artifactory
- Test Connection (By pass proxy)

webserver

```
<plugin>
     <groupId>org.apache.tomcat.maven</groupId>
     <artifactId>tomcat7-maven-plugin</artifactId>
     <version>2.1</version>
     <configuration>
          <url>http://localhost:5050/manager/text</url>
          <server>myserver</server>
          <path>/ILP_Bookstore</path>
      <update>true</update>
      <username>admin</username>
      <password>admin</password>
     </configuration>
</plugin>
<plugin>
     <groupId>org.apache.maven.plugins</groupId>
     <artifactId>maven-deploy-plugin</artifactId>
     <version>2.7</version>
</plugin>
```

Integration Test

```xml
<plugin>
    <groupId>org.codehaus.mojo</groupId>
    <artifactId>build-helper-maven-plugin</artifactId>
    <version>1.9.1</version>
    <executions>
        <execution>
            <id>add-integration-test-sources</id>
            <phase>generate-test-sources</phase>
            <goals>
                <goal>add-test-source</goal>
            </goals>
            <configuration>
                <sources>
                    <source>src/integration-test/java</source>
                </sources>
            </configuration>
        </execution>
        <execution>
            <id>add-integration-test-resources</id>
            <phase>generate-test-resources</phase>
            <goals>
                <goal>add-test-resource</goal>
            </goals>
            <configuration>
                <resources>
                    <resource>
                        <filtering>true</filtering>
                        <directory>src/integration-test/resources</directory>
                    </resource>
                </resources>
            </configuration>
        </execution>
    </executions>
</plugin>
```

```xml
<plugin>
    <artifactId>maven-surefire-plugin</artifactId>
    <version>2.18.1</version>
    <configuration>
        <excludedGroups>devops.ilp1.IntegrationTest</excludedGroups>
    </configuration>
</plugin>
```

```xml
<plugin>
    <groupId>org.apache.maven.plugins</groupId>
    <artifactId>maven-failsafe-plugin</artifactId>
    <version>2.19.1</version>
    <configuration>
        <includes>
            <include>**/*.java</include>
        </includes>
        <groups>devops.ilp1.IntegrationTest</groups>
    </configuration>
    <executions>
        <execution>
            <goals>
                <goal>integration-test</goal>
                <goal>verify</goal>
            </goals>
        </execution>
    </executions>
</plugin>
```

Integration Test contd..

```
</plugin>
<plugin>
    <groupId>org.apache.tomcat.maven</groupId>
    <artifactId>tomcat7-maven-plugin</artifactId>
    <version>2.2</version>
    <configuration>
        <port>6080</port>
        <path>/ILP_Bookstore</path>
    </configuration>
    <executions>
        <execution>
            <id>start-tomcat</id>
            <phase>pre-integration-test</phase>
            <goals>
                <goal>run</goal>
            </goals>
            <configuration>
                <fork>true</fork>
            </configuration>
        </execution>
        <execution>
            <id>stop-tomcat</id>
            <phase>post-integration-test</phase>
            <goals>
                <goal>shutdown</goal>
            </goals>
        </execution>
    </executions>
</plugin>
```

SonarQube

- Maven settings.xml

```
<settings>
    <pluginGroups>
        <pluginGroup>org.sonarsource.scanner.maven</pluginGroup>
    </pluginGroups>
    <profiles>
        <profile>
            <id>sonar</id>
            <activation>
                <activeByDefault>true</activeByDefault>
            </activation>
            <properties>
                <!-- Optional URL to server. Default value is http://localhost:9000 -->
                <sonar.host.url>
                  http://myserver:9000
                </sonar.host.url>
            </properties>
        </profile>
    </profiles>
</settings>
```

Sonar scanner configuration

```
<plugin>
  <groupId>org.sonarsource.scanner.maven</groupId>
  <artifactId>sonar-maven-plugin</artifactId>
  <version>3.6.0.1398</version>
</plugin>
```

References

1. https://www.cs.colorado.edu/~kena/classes/5828/s12/presentation-materials/bowesjesse.pdf

Thank You

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