Using Maven2 to Get Control over Your Development Process

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What is Maven?

- It's a kind of Project Management Tool.
- Focus on standards and best practices.
  - Convention over configuration.
  - Shared language for build management.
  - Repeatable and robust builds.
  - Central point is the Project Object Model (POM).
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History

- Maven is a result of trying to make several Apache Software Foundation (ASF) projects work in the same predictable way.
- Started out in 2002.
- Came as an offspring of the ASF Turbine project.
- Initiated by Jason Van Zyl.
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Objectives

 Create a common and understandable build infrastructure
  • If you know Maven, moving from one project to the next means you can focus on the problem at hand and not spend time trying to understand how it is built.
  • Being able to build the same artifact version over and over again, regardless of changes to it over time.
Common problems in a project

- Traditionally, the larger the project, the more complex and less understandable the build process or build infrastructure gets.
- Bringing in a new team member often meant spending hours, even days of introduction to and trying to understand how various parts of the project is build.
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- Very often the build system is copied from a previous project that the senior developers participated in.
- Setting up an initial project through copy and paste means that hard to find errors often are introduced – “It worked the last time, why not now?”
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- Versioning of the project often becomes a nightmare if not a strict regime of code management is introduced.

- Dependencies on other libraries are hard to track, and often leads to problems when trying to rebuild a given version.
  - Ex: myexternallibrary.jar
    - No clue as to which version it is
    - No mention of version in manifest file
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- Documentation process is often "put off till later".
- Testing infrastructure is at best mediocre.
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- So how can Maven help us?
  - Common build logic
    - Separation of concerns
  - Standard naming convention
    - Directories
    - Project output
    - All build output is automatically identified with version number.
      - Ex: myjar-1.0.jar
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- Single output from a single Maven project
  - *i.e.* the resulting output from a build is a single artifact
  - A Maven project may consist of several subprojects each producing a single output.
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- Maven standard Build Lifecycle
  - Validate: validate the project is correct and all necessary information is available.
  - Generate-sources: generate any source code for inclusion in compilation.
  - Process-sources: process the source code, for example to filter any values.
  - Generate-resources: generate resources for inclusion in the package.
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- **Process-resources:** copy and process the resources into the destination directory, ready for packaging.
- **Compile:** compile the source code of the project.
- **Process-classes:** post-process the generated files from compilation, for example to do bytecode enhancement on Java classes.
- **Generate-test-sources:** generate any test source code for inclusion in compilation.
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- **Process-test-sources**: process the test source code, for example to filter any values.
- **Generate-test-resources**: create resources for testing.
- **Process-test-resources**: copy and process the resources into the test destination directory.
- **Test-compile**: compile the test source code into the test destination directory
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- **Test:** run tests using a suitable unit testing framework. These tests should not require the code be packaged or deployed.

- **Package:** take the compiled code and package it in its distributable format, such as a JAR.

- **Pre-integration-test:** perform actions required before integration tests are executed. This may involve things such as setting up the required environment.
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- **Integration-test:** process and deploy the package if necessary into an environment where integration tests can be run.
- **Post-integration-test:** perform actions required after integration tests have been executed. This may including cleaning up the environment.
- **Verify:** run any checks to verify the package is valid and meets quality criteria.
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- **Install:** install the package into the local repository, for use as a dependency in other projects locally.
- **Deploy:** done in an integration or release environment, copies the final package to the remote repository for sharing with other developers and projects.
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- Standard directory structure:
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- Installing Maven
  - Download from [http://maven.apache.org](http://maven.apache.org)
  - Unzip maven-xxx-bin.zip to the directory you wish to install Maven.
  - Add the bin directory to your path.
  - Run `mvn -version` to verify installation:
    - Should reply with: Maven version: x.x.x
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- Create a file: settings.xml in your home directory.

  Windows: \Documents and Settings\<user>\.m2

  ```xml
  <settings>
  <profiles>
  <profile>
    <id>Snapshots</id>
    <repositories>
      <repository>
        <id>Maven Snapshots</id>
        <url>http://snapshots.maven.codehaus.org/maven2/</url>
        <snapshots>
          <enabled>true</enabled>
        </snapshots>
        <releases>
          <enabled>false</enabled>
        </releases>
      </repository>
    </repositories>
  </profile>
  </profiles>
  </settings>
  ```
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```xml
<pluginRepositories>
  <pluginRepository>
    <id>Maven Snapshots</id>
    <url>http://snapshots.maven.codehaus.org/maven2/</url>
    <snapshots>
      <enabled>true</enabled>
    </snapshots>
    <releases>
      <enabled>false</enabled>
    </releases>
  </pluginRepository>
</pluginRepositories>

<activeProfiles>
  <activeProfile>Snapshots</activeProfile>
</activeProfiles>
</settings>
```
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- Settings.xml controls your build environment
  - Proxies
  - Repository locations
  - Profiles (more on that later)
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- Archetypes

  ➢ What's an archetype?
  
  • Template of a project which is combined with some user input to produce a working Maven project that has been tailored to your requirements.
  
  • Used to initialize a new project of a particular kind.
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Several archetypes available:

- j2ee-simple
- marmalade-mojo
- mojo
- portlet
- profiles
- quickstart
- simple
- site-simple
- site
- Webapp
- \textit{etc.}
Running an archetype:

- `mvn archetype:create -DgroupId=css -DartifactId=myfirstproject`

- Creates a simple standard Maven project:
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- One directory containing source and one directory containing test source.
  - `src/main/java/<package>`
  - `src/test/java/<package>`
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POM file for the project:

```xml
<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>css</groupId>
  <artifactId>myfirstproject</artifactId>
  <packaging>jar</packaging>
  <version>1.0-SNAPSHOT</version>
  <name>Maven Quick Start Archetype</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>
```
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- Contains a sample source java file and a sample test java file
  - App.java
  - AppTest.java
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Running Maven to build the simple sample:

```
mvn clean install
```

- Clean ensures that any previously build artifacts are removed prior to the execution
- Install tells Maven to go through the lifecycles and build the single project artifact.
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- Produces a standard single artifact, and creates a standard output directory structure.
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- After execution the result is:
  - myfirstproject-1.0-SNAPSHOT.jar
Creating your own archetype:

- Create a directory to contain your archetype
- Then create a pom for the archetype in this directory:

```
<project>
  <modelVersion>4.0.0</modelVersion>
  <groupId>css2006.maven</groupId>
  <artifactId>my-archetype</artifactId>
  <version>1.0-SNAPSHOT</version>
  <packaging>maven-plugin</packaging>
  <dependencies>
    <dependency>
      <groupId>junit</groupId>
      <artifactId>junit</artifactId>
      <version>3.8.1</version>
      <scope>test</scope>
    </dependency>
  </dependencies>
</project>
```
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- Then create a new directory:
  - `src/main/resources/META-INF/`

- Create a archetype descriptor in it.
  - Archetype.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<archetype>
  <id>css2006-archetype</id>
  <resources>
    <resource>src/main/java/css2006/maven/archetype1/StdBean.java</resource>
    <resource>src/main/test/css2006/maven/test/archetype1/TestStdBean.java</resource>
  </resources>
</archetype>
```
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Create a directory a new directory that will contain the resources that should be standard
- `src/main/resources/archetype-resources`  

Then create a standard Maven project structure under that, which will contain all the resources that should be part of you standard setup:
- `src/main/resources/archetype-resources/src/main/java`
- `src/main/resources/archetype-resources/src/main/test`
- `src/main/resources/archetype-resources/src/main/resources`
- `etc.`
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- Under the java directory we create a package structure for our standard classes and the classes themselves:
  - src/main/resources/archetype-resources/src/main/java/css2006/maven/archetype1
    - StdBean.java

- Under the test directory we create a package structure for our standard classes and the test classes themselves:
  - src/main/resources/archetype-resources/src/main/test/css2006/maven/test/archetype1
    - TestStdBean.java
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So now we have a directory structure as such:

```
- MavenArchetypes
  - src
    - main
    - resources
    - archetype-resources
    - archetype-resources
      - src
        - main
        - java
        - css2006
        - maven
          - archetype1
        - test
          - css2006
          - maven
            - test
              - archetype1
- META-INF
```
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```java
package css2006.maven.archetype1;

public class StdBean {

    public StdBean() {
        super();
    }

    public String sayHello(String name) {
        if (name != null) {
            return "Hello" + name;
        }
        return "Who are you?";
    }

}
```
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TestStdBean.java

```java
package css2006.maven.test.archetype1;
import junit.framework.Test;
import junit.framework.TestCase;
import junit.framework.TestSuite;
import css2006.maven.archetype1.StdBean;
public class TestStdBean extends TestCase {
    public static Test suite() {
        return new TestSuite( TestStdBean.class );
    }
    public void testSayHello() {
        StdBean sb=new StdBean();
        String retval=sb.sayHello("CSS2006");
        assertEquals(retval,"Hello:CSS2006");
    }
}
```
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- Augmenting the archetype
  - Resources
    - Property files
    - *etc.*
  - Site resources for the generated site
    - Stylesheets
    - Images
    - *etc.*
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- A little more complex archetype: multiproject
- Now we will create a archetype that contains a main project and two subprojects
  - A web project
  - A utility jar project
- We repeat the process from the previous archetype, but make some differences to the master pom for the project to be created.
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The revised project master pom:

```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/maven-v4_0_0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <groupId>css2006.maven</groupId>
  <version>1.0</version>
  <artifactId>projectroot</artifactId>
  <packaging>pom</packaging>
  <name>CSS2006 Multimodule project</name>
  <modules>
    <module>util</module>
    <module>web</module>
  </modules>
</project>
```
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- We added the modules definition section for the two modules that we want to be created.
- Remember: What we put under archetype-resources is a mirror of the Maven project we want create.
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- Complex archetypes – *i.e.* execute something
  - Can not be done using the regular way
  - Archetypes are simple in nature – they do not execute code.
  - Lets say that you have a standard project structure in your organization. If you want to be able to introduce a new team member into a project as painless as possible, you can do the following:
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- Start out by creating an archetype for your standard structure.
- Then in the pom for the project, you add a scm section that will point to where your code is stored.
- Then first run the mvn archetype:create
- Change to the root of your newly created project and then do: *mvn install*
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- An alternative method is to create an Ant based mojo.
  - A mojo is a Maven plugin that executes some code at a given lifecycle.
  - It can run Java code, Ant scripts and more
- The reason for using an Ant based mojo is that to be able to run more than one task in a mojo we need to use what is known as the Embedder.
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- The Embedder can however not be run as a mojo – hence we introduce Ant to help us. With the Ant script we are able to fork a new Java process in a new environment, thereby circumventing the mojo/Embedder limitation.
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- We start by creating our mojo, using the mojo archetype available to us
- Then add a src/main/scripts directory
- In this directory we create our Ant script – css2006build.xml
- Then we add our execution script to this
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Script

```xml
<project default="MvnRun" xmlns:artifact="antlib:org.apache.maven.artifact.ant">
  <target name="MvnRun">
    <java jvm="${env.JAVA_HOME}/java/bin/java.exe" fork="true" classname="css2006.maven.embedder.MvnRun" newenvironment="true" dir="."/>
  </target>
</project>
```
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- Then we need to create a css2006build.mojos.xml file which is a description of our Ant mojo.

```xml
<pluginMetadata>
  <mojos>
    <mojo>
      <goal>MvnRun</goal>
      <call>MvnRun</call>
      <requiresDependencyResolution>runtime</requiresDependencyResolution>
      <description>Run maven goals</description>
    </mojo>
  </mojos>
</pluginMetadata>
```
Then we need to create the java file that we want to execute when the Ant script is run.
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```java
public class MvnRun extends AbstractMojo{
    public MvnRun()
    {
        super();
    }

    public void execute() throws MojoExecutionException, MojoFailureException {
        MavenEmbedder embedder = new MavenEmbedder();
        embedder.setClassLoader(Thread.currentThread().getContextClassLoader());
        embedder.setLogger(new MavenEmbedderConsoleLogger());
        try {
            embedder.start();
        } catch (MavenEmbedderException mee) {
            throw new MojoExecutionException("Embedder", mee);
        }
    }
```
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```java
Settings settings;
try {
    settings = embedder.buildSettings(embedder
    .getUserSettingsPath(null), embedder.getGlobalSettingsPath(),
    false, false, false, Boolean.FALSE);
} catch (SettingsConfigurationException sce) {
    throw new MojoExecutionException("Embedder", sce);
}
...

List goals = new ArrayList();
goals.add("archetype:create");
```
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MavenExecutionRequest request = new DefaultMavenExecutionRequest()
    .setBasedir(new File(".")) .setGoals(goals)
    .setLocalRepositoryPath(
    embedder.getLocalRepositoryPath(settings)) .setSettings(
    settings) .setProperties(main_props) .addEventMonitor(
    new DefaultEventMonitor(new ConsoleLogger(
    ConsoleLogger.LEVEL_DISABLED, "logger")));

try {
    embedder.execute(request);
} catch (MavenExecutionException mee) {
    throw new MojoExecutionException("Embedder", mee);
}
...

...
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goals.clear();
goals.add("scm:checkout");
request = new DefaultMavenExecutionRequest().setPomFile(pomFile)
          .setBasedir(new File(pomFile)).setGoals(goals)
          .setLocalRepositoryPath(embedder.getLocalRepositoryPath(settings)).setSettings(settings).setProperties(main_props).addEventMonitor(new DefaultEventMonitor(new ConsoleLogger(ConsoleLogger.LEVEL_DISABLED, "logger")))
try {
    embedder.execute(request);
} catch (MavenExecutionException mee) {
    throw new MojoExecutionException("Embedder", mee);
}
...
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- We create this Java file in a project of its own, and we declare a dependency on it in our Ant based mojo pom.
- We now install both projects into the repository and we are ready to go.
- Next we alter the project pom for our simple archetype.
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...<scm>

<connection>scm:svn:http://localhost/css2006/simple/</connection>
<developerConnection>
    scm:svn::http://localhost/css2006/simple/
</developerConnection>
<url:http://localhost/css2006/simple/></url>
</scm>
...

- Here we have said that our source for this particular project is stored in Subversion
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- Then we run the plugin:
  - `mvn css2006:mvnrun`

- We then get created our standard project, and then the project pom is run as a normal Maven run, with the goal `scm:checkout`.

- The result of this is that we now have a ready to go project for a new developer in the project with all the source/artifacts in place.
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- Time permitting, some more samples.
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- References:
  - http://maven.apache.org
  - http://www.mergere.com/m2book_download.jsp
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