Software Engineering and Architecture
Build Automation with Maven

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Agenda

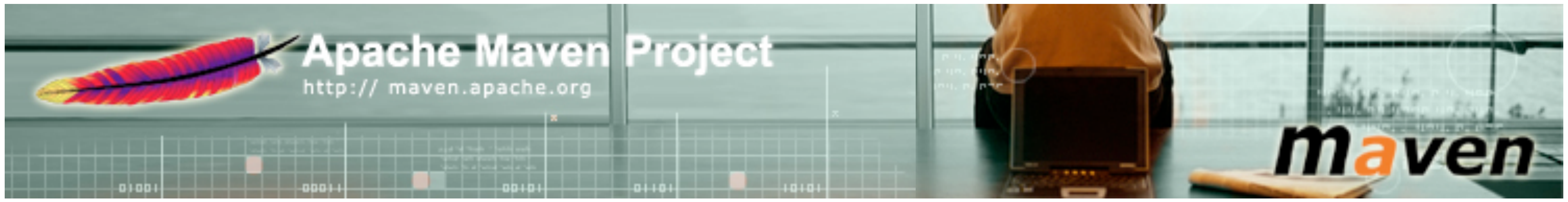
- Maven
- Core concepts
- Lifecycles, phases, plugins and goals (mojos)
- Project relationships
- Maven and Java EE

What is the difference between
a **library** and a **framework**?

HOLLYWOOD

What is the difference between
a **ant** and a **maven**?

Maven, a Yiddish word meaning **accumulator of knowledge**, was originally started as an attempt to **simplify the build processes** in the Jakarta Turbine project. There were several projects each with their own Ant build files that were all slightly different and JARs were checked into CVS. We wanted **a standard way to build the projects**, a clear **definition of what the project consisted of**, an easy way to **publish project information** and a way to **share JARs** across several projects.



References

http://www.sonatype.com/products/maven/documentation/book-defguide

February 2010
Edition 0.4
Maven
Maven: The Complete Reference
Sonatype

November 2009
Edition 0.1
Maven
Maven: By Example
An Introduction to Apache Maven
Sonatype

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Getting started...

- Install maven 2
    - http://maven.apache.org/download.html
- Create and build a project
- Look at these directories and files
    - ~/.m2/repository
    - ~/.m2/settings.xml
    - $INSTALLATION/conf/settings.xml

```
mvn archetype:generate \
   -DarchetypeGroupId=org.apache.maven.archetypes \
   -DarchetypeArtifactId=maven-archetype-quickstart \
   -DgroupId=ch.heigvd.osf.cool \
   -DartifactId=coolProject
cd coolProject
mvn install
```

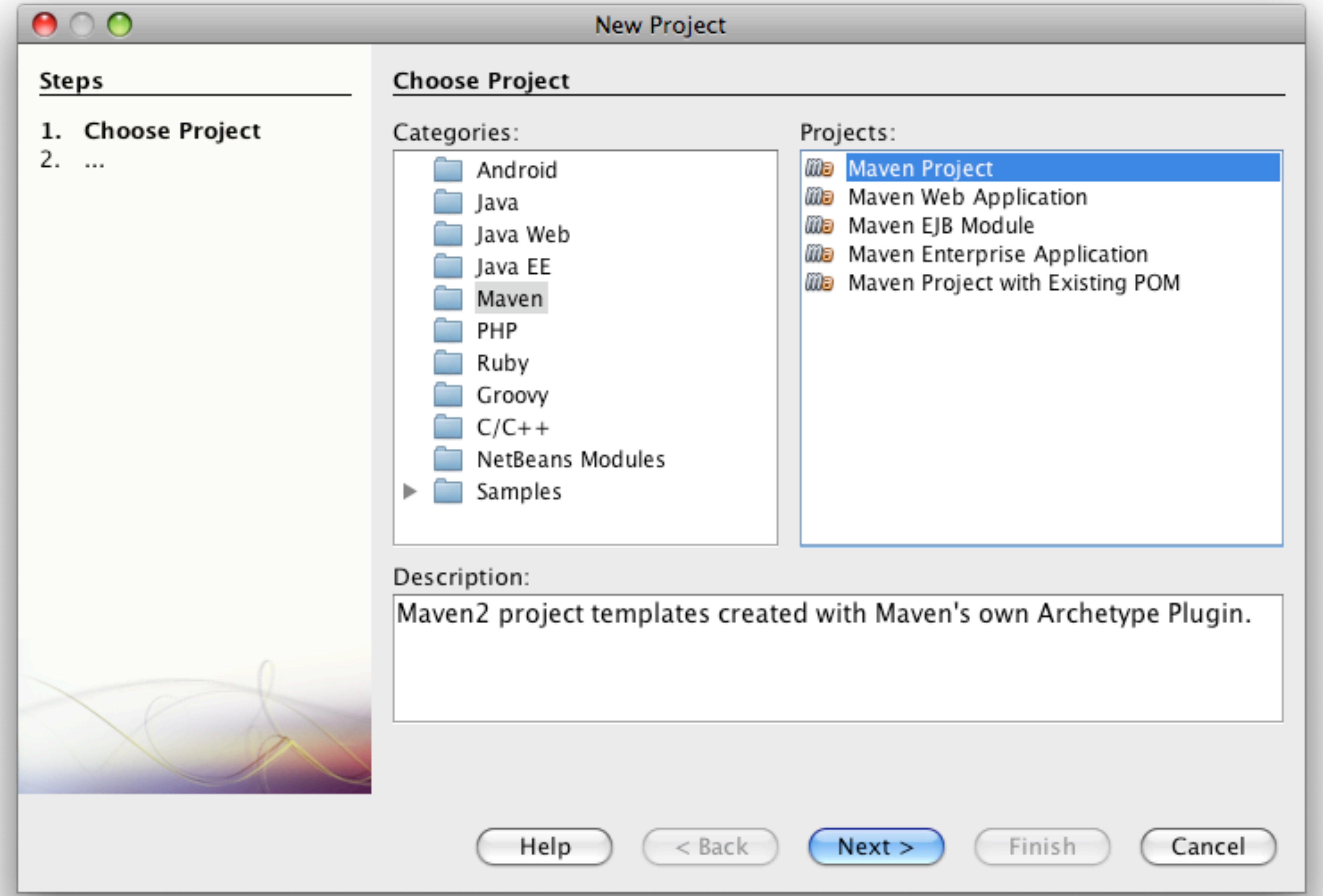
Project Object Model (POM)

- The POM is an XML document that describes the project:
    - What kind of artifacts are we building (jar, war, ear, etc.)?
    - What libraries do we depend on to build the artifact?
    - What are the special actions that need to be done during the build?
    - Where can plug-ins and dependencies be found?
    - Are there relationships with other maven-driven projects?
- In other words, with maven:
    - You declare “properties” about your project.
    - You let maven build the artifact, based on conventions and best practices.

Maven Coordinates

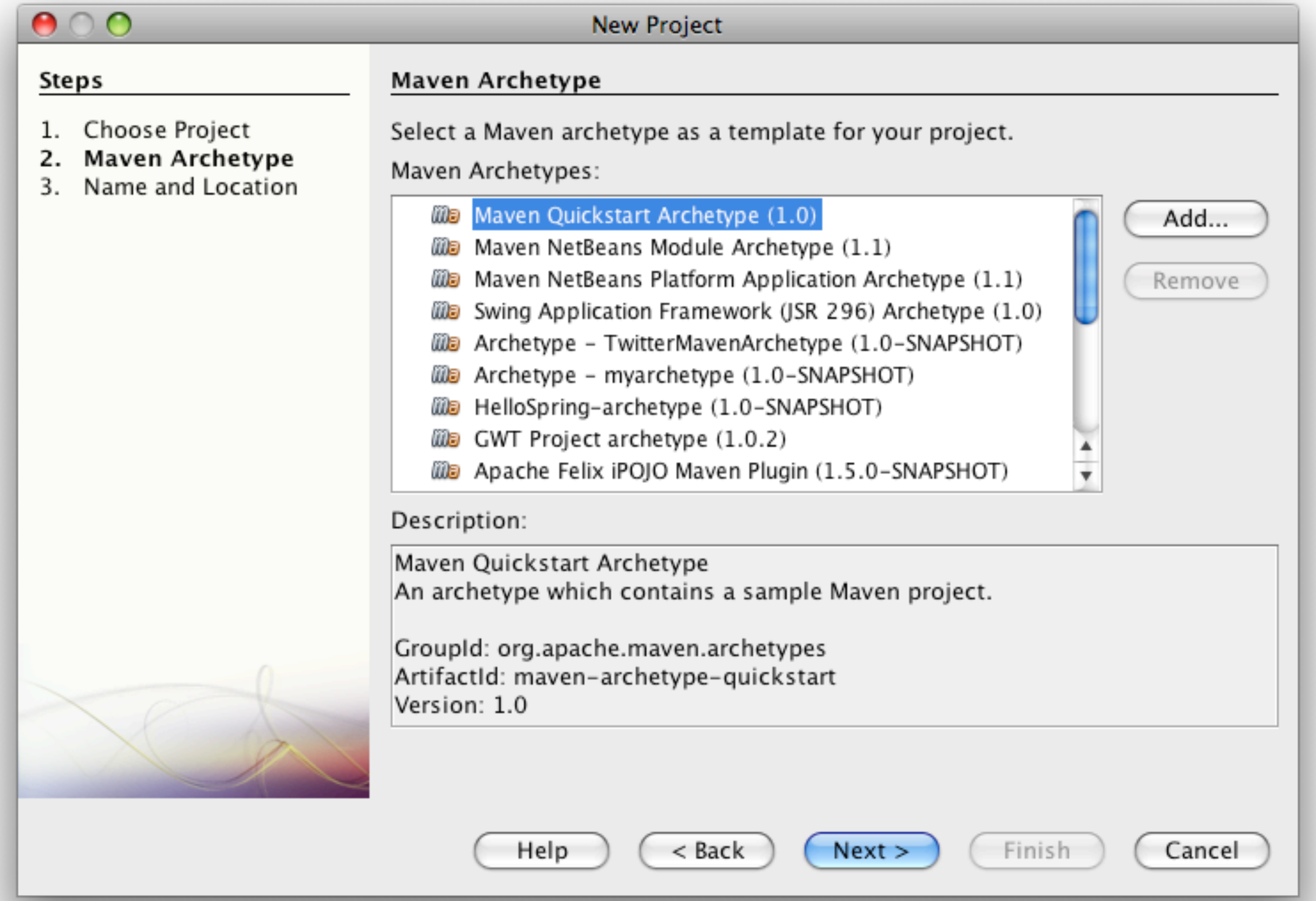
- Every maven project produces one **artifact**, whether it is a jar file, a war file or anything else.
- When a project has a **dependency** on an artifact produced by another project, it needs a way to **reference this artifact**.
- Maven **coordinates** address this need: every project is identified by three values:
  - A group id (used to group related artifacts)
  - An artifact id
  - A version number
- Maven coordinates are the things you will find in every **POM**.
- Maven coordinates are also used to capture **inheritance relationships** between projects (more on this later).

Creating a maven project with NetBeans



Maven2 project templates created with Maven's own Archetype Plugin.

Creating a maven project with NetBeans



Steps

1. Choose Project
2. **Maven Archetype**
3. Name and Location

Maven Archetype

Select a Maven archetype as a template for your project.

Maven Archetypes:

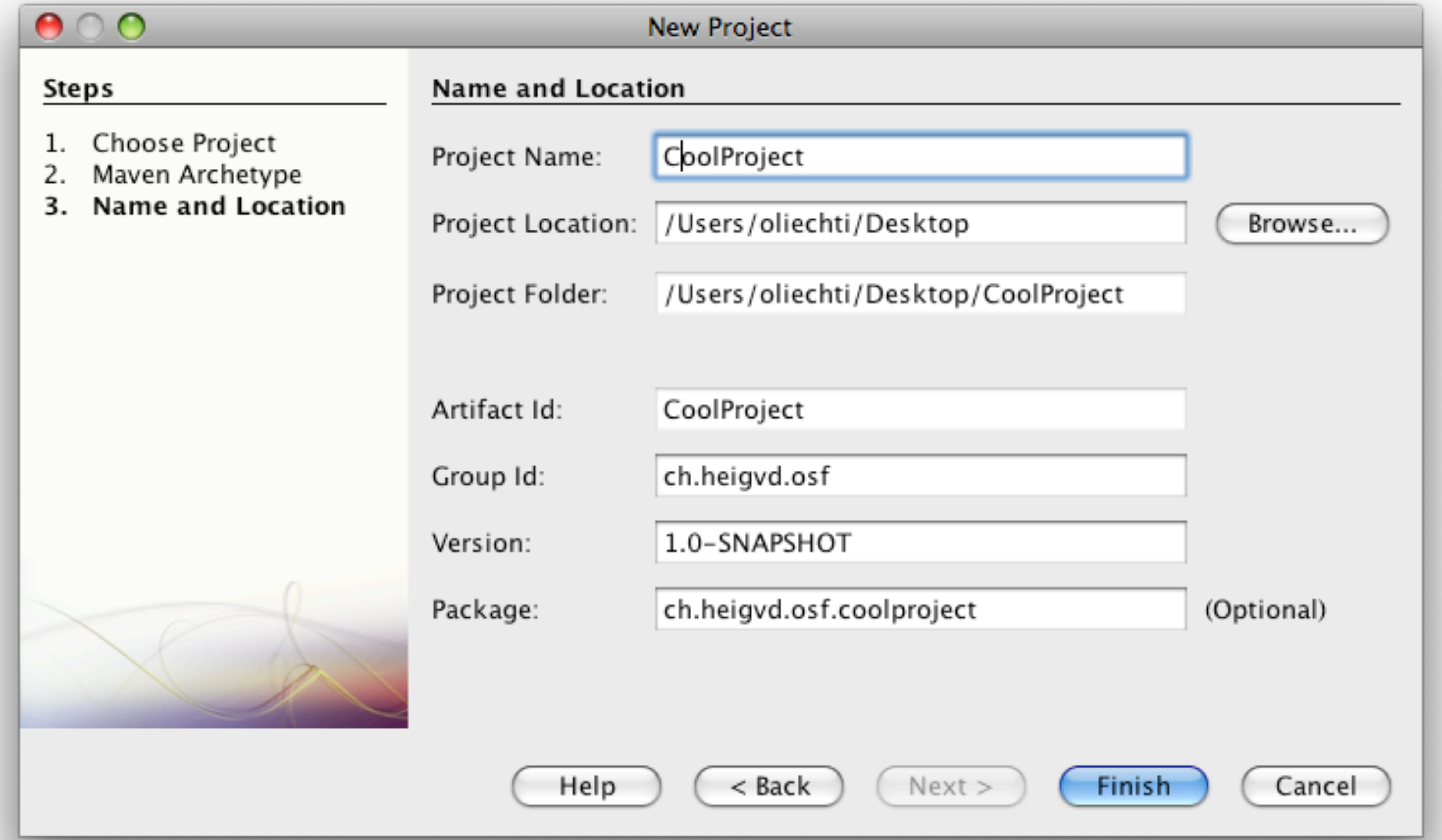
- Maven Quickstart Archetype (1.0)
- Maven NetBeans Module Archetype (1.1)
- Maven NetBeans Platform Application Archetype (1.1)
- Swing Application Framework (JSR 296) Archetype (1.0)
- Archetype - TwitterMavenArchetype (1.0-SNAPSHOT)
- Archetype - myarchetype (1.0-SNAPSHOT)
- HelloSpring-archetype (1.0-SNAPSHOT)
- GWT Project archetype (1.0.2)
- Apache Felix iPOJO Maven Plugin (1.5.0-SNAPSHOT)

Description:

Maven Quickstart Archetype
An archetype which contains a sample Maven project.

GroupId: org.apache.maven.archetypes
ArtifactId: maven-archetype-quickstart
Version: 1.0

Creating a maven project with NetBeans

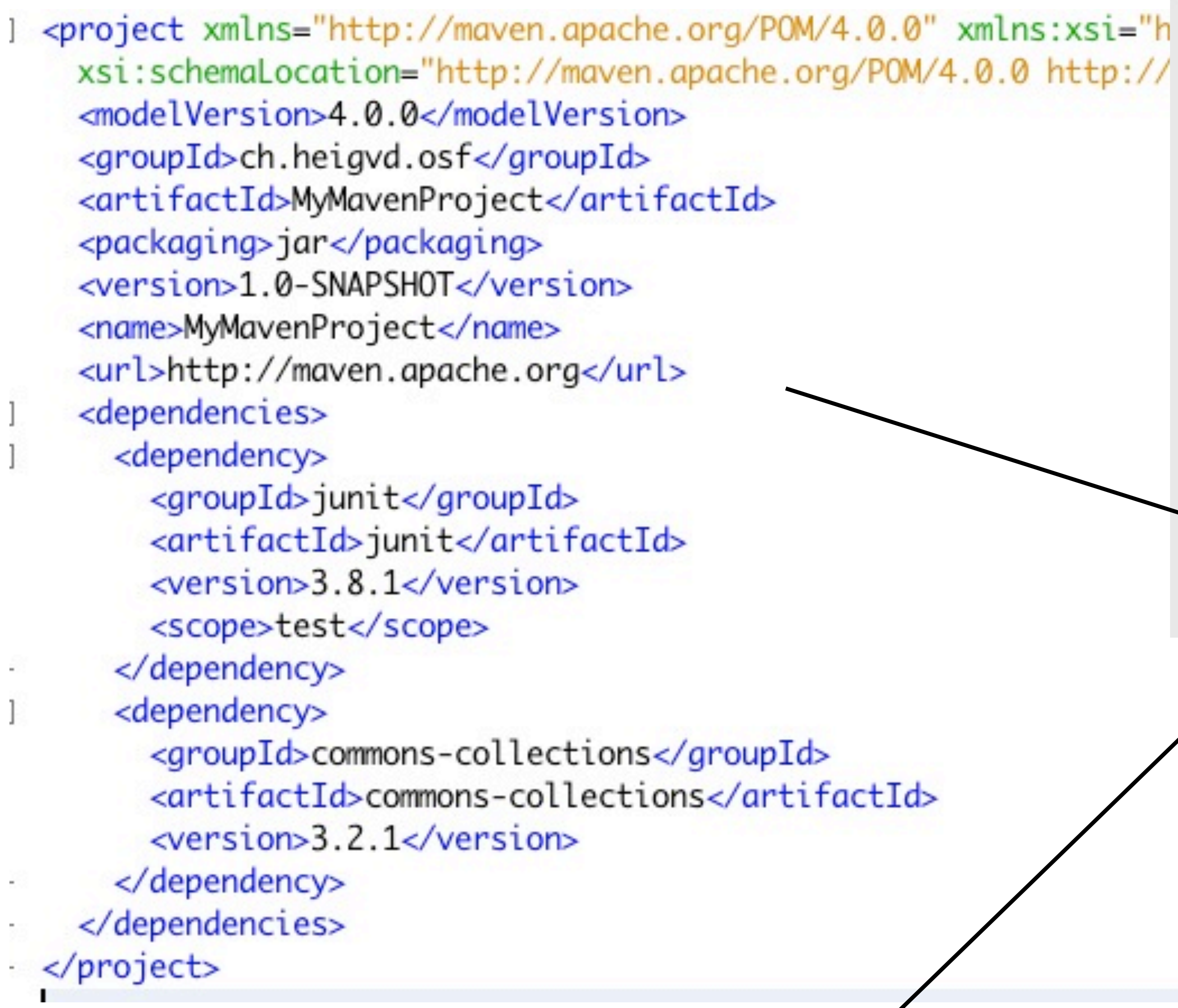


Steps

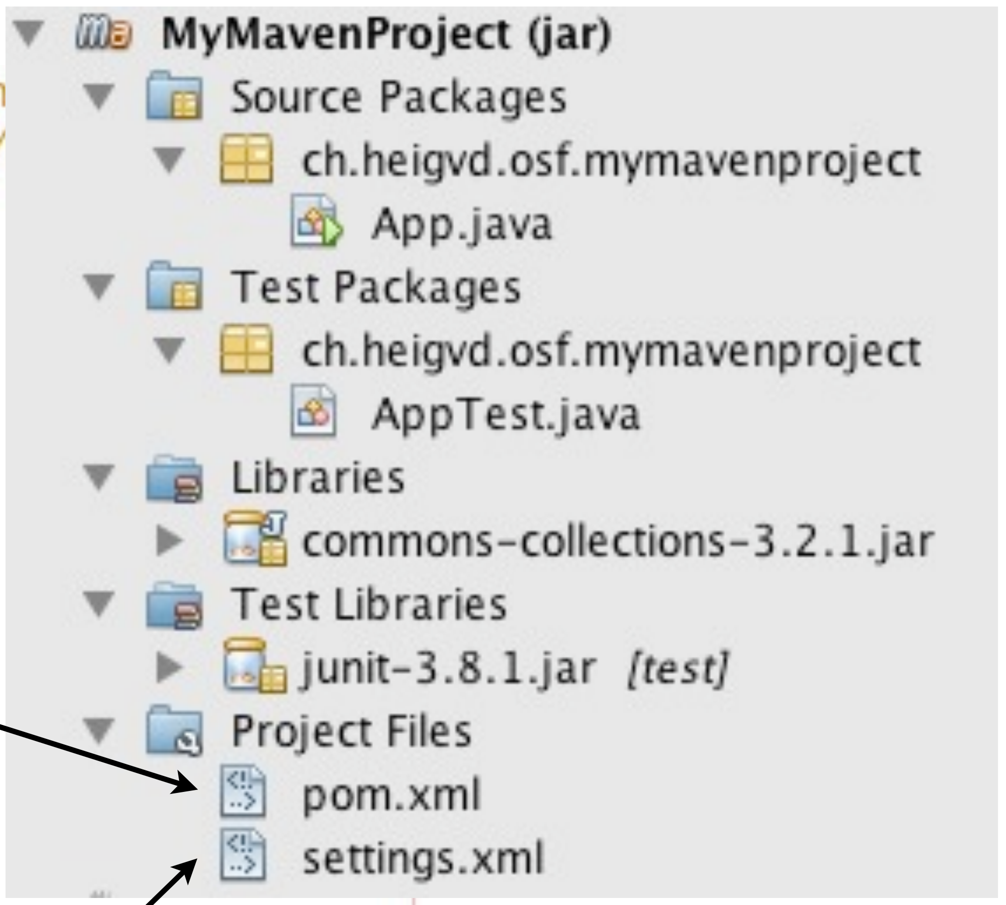
1. Choose Project
2. Maven Archetype
3. **Name and Location**

Name and Location

Project Name:	CoolProject
Project Location:	/Users/oliechti/Desktop
Project Folder:	/Users/oliechti/Desktop/CoolProject
Artifact Id:	CoolProject
Group Id:	ch.heigvd.osf
Version:	1.0-SNAPSHOT
Package:	ch.heigvd.osf.coolproject (Optional)



```xml
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="h
  xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://
  <modelVersion>4.0.0</modelVersion>
  <groupId>ch.heigvd.osf</groupId>
  <artifactId>MyMavenProject</artifactId>
  <packaging>jar</packaging>
  <version>1.0-SNAPSHOT</version>
  <name>MyMavenProject</name>
  <url>http://maven.apache.org</url>
  <dependencies>
    <dependency>
      <groupId>junit</groupId>
      <artifactId>junit</artifactId>
      <version>3.8.1</version>
      <scope>test</scope>
    </dependency>
    <dependency>
      <groupId>commons-collections</groupId>
      <artifactId>commons-collections</artifactId>
      <version>3.2.1</version>
    </dependency>
  </dependencies>
</project>
```



```
▼ MyMavenProject (jar)
  ▼ Source Packages
    ▼ ch.heigvd.osf.mymavenproject
        App.java
  ▼ Test Packages
    ▼ ch.heigvd.osf.mymavenproject
        AppTest.java
  ▼ Libraries
    ▶ commons-collections-3.2.1.jar
  ▼ Test Libraries
    ▶ junit-3.8.1.jar  [test]
  ▼ Project Files
      pom.xml
      settings.xml
```

Shortcut on your maven preferences

Dependencies

- Scopes
  - **compile**: you need to compile and it will be packaged with the artifact.
  - **provided**: you need it to compile, but it will not be packaged - it will be provided by the runtime environment.
  - **runtime**: you need it to execute the system, but not to compile it.
  - **test**: you only need it during for running tests.
  - **system**: similar to provided, but path has to be provided.

```xml
<project>
  ...
  <dependencies>
    <dependency>
      <groupId>org.codehaus.xfire</groupId>
      <artifactId>xfire-java5</artifactId>
      <version>1.2.5</version>
    </dependency>
    <dependency>
      <groupId>junit</groupId>
      <artifactId>junit</artifactId>
      <version>3.8.1</version>
      <scope>test</scope>
    </dependency>
    <dependency>
      <groupId>javax.servlet</groupId>
      <artifactId>servlet-api</artifactId>
      <version>2.4</version>
      <scope>provided</scope>
    </dependency>
  </dependencies>
  ...
</project>
```

Local and Remote Repositories

- **Local repository**
  - On **every machine**, there is a local repository. It is located in ~/.m2/repository.
  - This repository acts as a **cache** (when you fetch libraries during a build, they are kept there for later usage).
  - When you build your artifacts, they are "**installed**" here.
- **Remote repositories**
  - Remote repositories are used to **share artifacts** between several developers & organizations.
  - A remote repository can be **public** (e.g. http://repo1.maven.org/maven2/, maven repositories of open source projects, etc.)
  - A remote repository can be **private** (i.e. a company manages a repository so that internal developers can share artifacts).

Want to manage your repository?

- http://archiva.apache.org/
- http://nexus.sonatype.org/

http://www.flickr.com/photos/garryknight/2818736770/sizes/m/#cc_license

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Plugins

“The core of Maven is pretty dumb, it doesn't know how to do much beyond parsing a few XML documents and keeping track of a lifecycle and a few plugins.

Maven has been designed to delegate most responsibility to a set of Maven Plugins which can affect the Maven Lifecycle and offer access to goals.”

http://www.sonatype.com/books/mvnref-book/reference/installation-sect-universal-reuse.html

Plugins

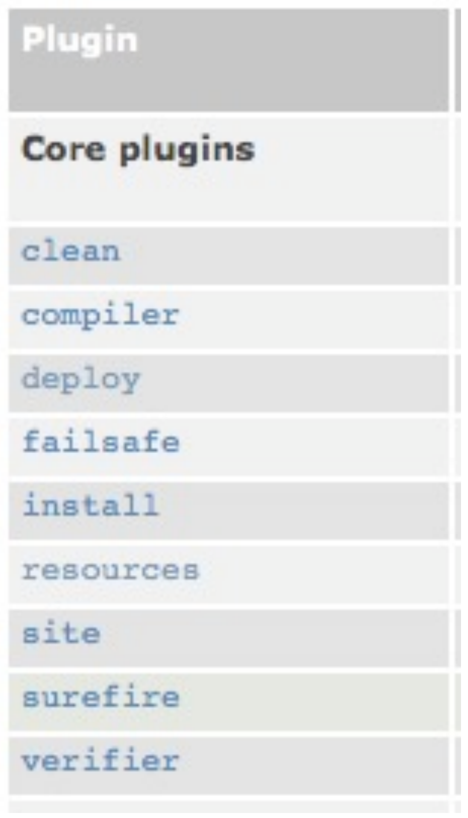
- A **plugin** implements a number of actions, called “**goals**” (aka “**mojos**”)
  - The `clean` plugin has one goal: `clean:clean`
  - The `jar` plugin has too goals: `jar:jar` and `jar:test-jar`
- Plugin goals often accept **parameters** (some optional, some required)
- Plugins are contributed by the **community** - you can write your own plugins.
- You can **invoke** a goal directly:

```
mvn clean:clean
```

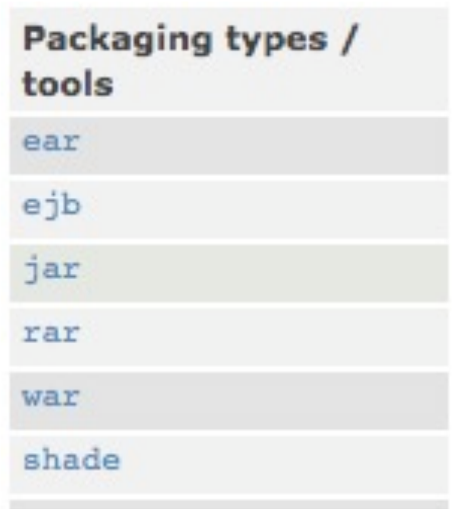
- You can let maven invoke the right goals at the right time (**hollywood** principle)

```
mvn install
```

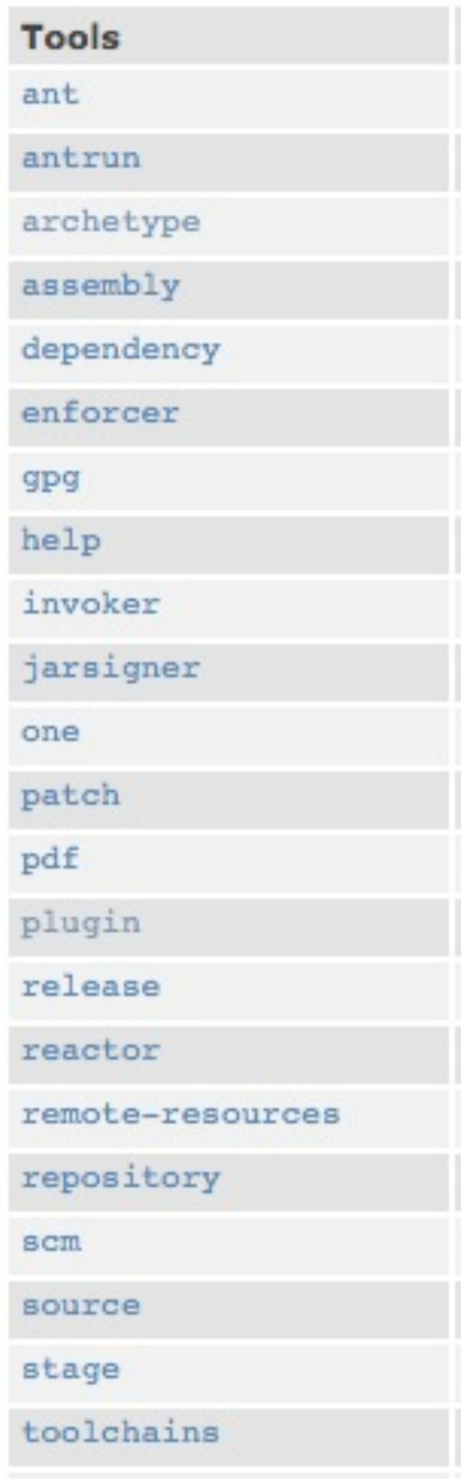
Maven Plugins



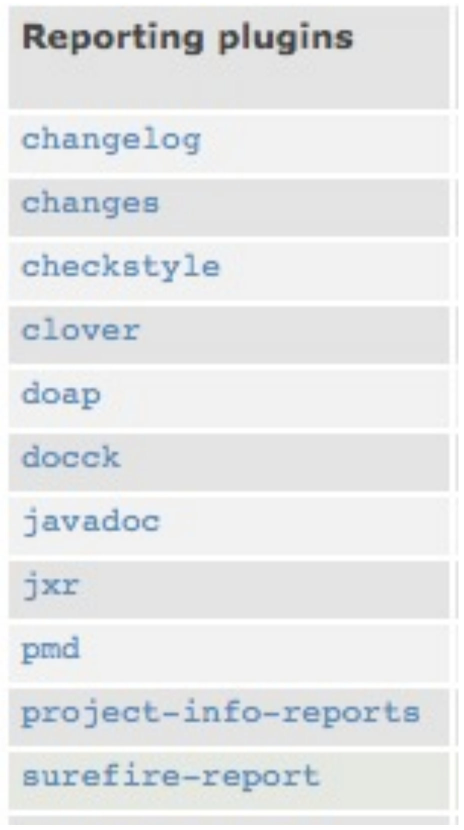
Plugin
Core plugins
clean
compiler
deploy
failsafe
install
resources
site
surefire
verifier



Packaging types / tools
ear
ejb
jar
rar
war
shade



Tools
ant
antrun
archetype
assembly
dependency
enforcer
gpg
help
invoker
jarsigner
one
patch
pdf
plugin
release
reactor
remote-resources
repository
scm
source
stage
toolchains



Reporting plugins
changelog
changes
checkstyle
clover
doap
docck
javadoc
jxr
pmd
project-info-reports
surefire-report

Lifecycle

- A **lifecycle** is a sequence of phases (e.g. compile, test, package, etc.)
- A **phase** is where some actions can be attached (e.g. invoke a compiler during the compile phase)
- Maven provides **standard lifecycles**:
  - clean lifecycle
  - default lifecycle
  - site lifecycle
- Lifecycles can be customized depending on the **type of artifact** being built (building .jar does not involve the same steps as building a .war).
- **Convention over configuration**: if you don't specify otherwise, you let maven proceed "as usual" and do not care about the setup of lifecycles and plugins.

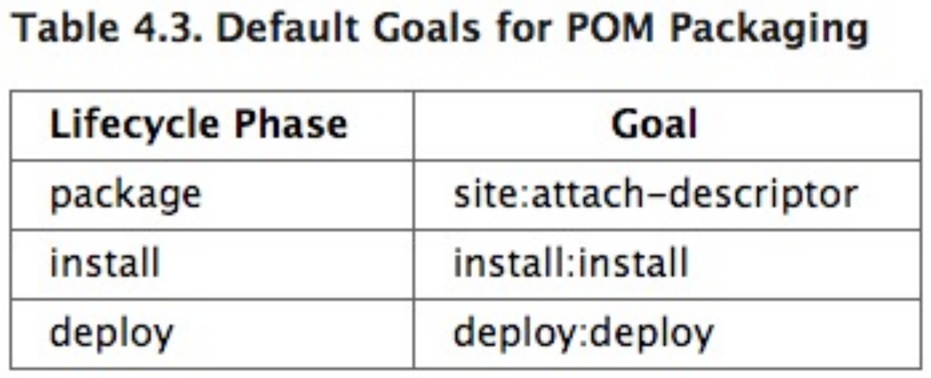


Table 4.3. Default Goals for POM Packaging

Lifecycle Phase	Goal
package	site:attach-descriptor
install	install:install
deploy	deploy:deploy

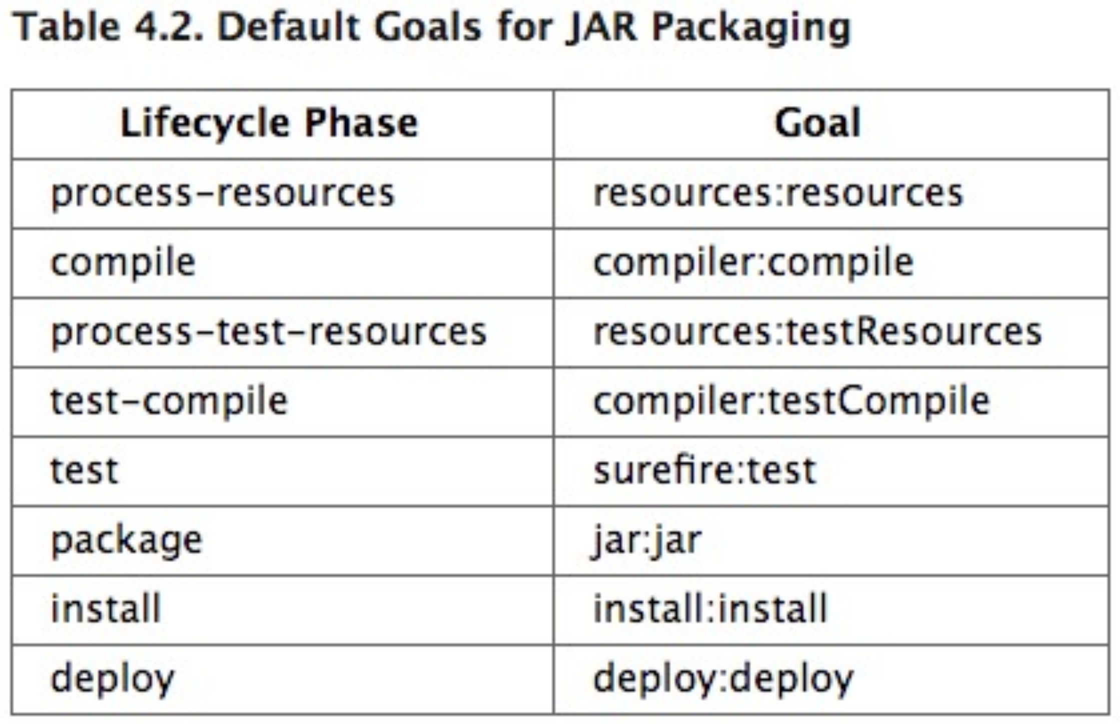


Table 4.2. Default Goals for JAR Packaging

Lifecycle Phase	Goal
process-resources	resources:resources
compile	compiler:compile
process-test-resources	resources:testResources
test-compile	compiler:testCompile
test	surefire:test
package	jar:jar
install	install:install
deploy	deploy:deploy

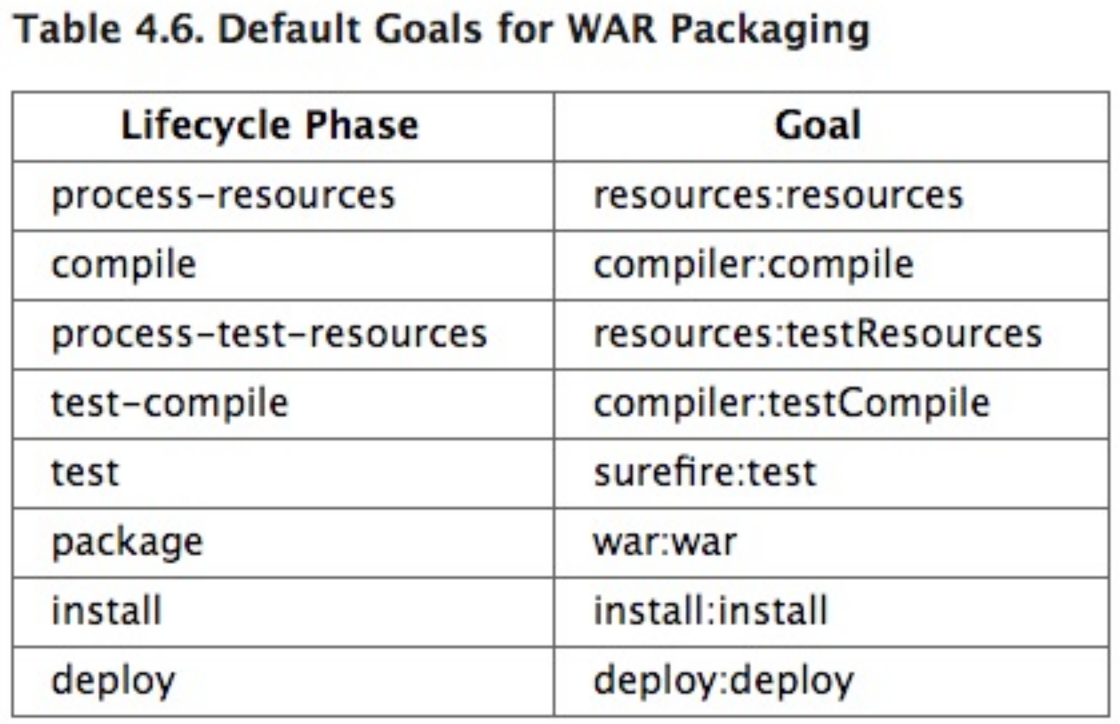


Table 4.6. Default Goals for WAR Packaging

Lifecycle Phase	Goal
process-resources	resources:resources
compile	compiler:compile
process-test-resources	resources:testResources
test-compile	compiler:testCompile
test	surefire:test
package	war:war
install	install:install
deploy	deploy:deploy

http://www.sonatype.com/books/mvnref-book/reference/lifecycle-sect-war.html#

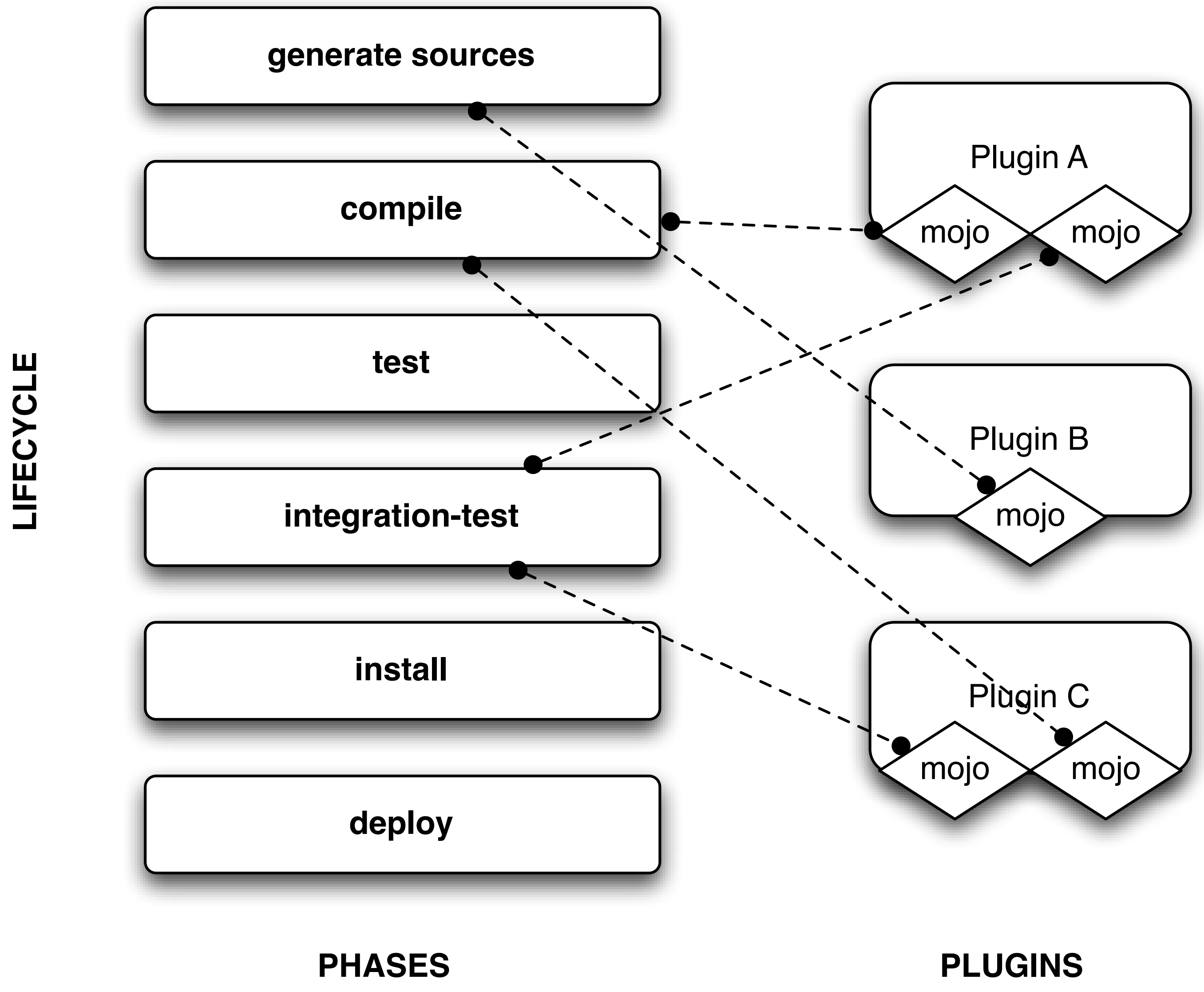
```
mvn install
```

This runs the lifecycle until the install phase; this results in the installation of the artifact in the local maven repository.

All mojos attached to the phases are executed.

```
mvn deploy
```

This runs the lifecycle until the deploy phase; this results in the deployment of the artifact in a remote maven repository.



Relationships between Projects (1)

- Multi-modules projects
  - A project can be organized in sub-projects.
  - When you built the project artifact, you also want to build the artifacts of the sub-projects.
  - If there are dependencies between some of the sub-projects, you need to build the artifacts in the right order.
  - Maven takes care of that, through the “Reactor”.

```
<modules>
  <module>moduleA</module>
  <module>moduleC</module>
  <module>moduleB</module>
</modules>
```

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Relationships between Projects (2)

- Inheritance relationships between project
  - A maven project can extend another maven project.
  - This is a way to inherit various properties, such as the versions of the libraries used all sub-projects (“everybody should use log4j version 1.3.2”).
  - The relationship is captured at the beginning of the POM, using maven coordinates.
- Lost in your inheritance tree?
  - Run this goal: mvn help:effective-pom

```
<parent>
  <groupId>your.group.id</groupId>
  <artifactId>toto</artifactId>
  <version>1.0-SNAPSHOT</version>
</parent>
```

Inheritance & dependency management

```
<project>
  <modelVersion>4.0.0</modelVersion>
  <groupId>org.sonatype.mavenbook</groupId>
  <artifactId>a-parent</artifactId>
  <version>1.0.0</version>
  ...
  <dependencyManagement>
    <dependencies>
      <dependency>
        <groupId>mysql</groupId>
        <artifactId>mysql-connector-java</artifactId>
        <version>5.1.2</version>
      </dependency>
      ...
    <dependencies>
  </dependencyManagement>
```

```
<project>
  <modelVersion>4.0.0</modelVersion>
  <parent>
    <groupId>org.sonatype.mavenbook</groupId>
    <artifactId>a-parent</artifactId>
    <version>1.0.0</version>
  </parent>
  <artifactId>project-a</artifactId>
  ...
  <dependencies>
    <dependency>
      <groupId>mysql</groupId>
      <artifactId>mysql-connector-java</artifactId>
    </dependency>
  </dependencies>
</project>
```

Profiles

- For the same project, you often want to be able to do **different types of builds**:
  - A developer builds the artifact on his local machine during development.
  - Continuous integration triggers daily builds on a QA server.
  - You want to build the artifact before putting into production.
- For every **different type of build**, you may want to:
  - Use different “components” in the environment (different glassfish domains, different DBs, etc.)
  - Skip some of the phases in the build process.
  - Attach some special plugins to some of the phases
- Profiles allow you to do just that. Within a **profile definition**, you declare the expected behavior. You then **activate** one or more profiles (either via a command line flag, or indirectly through maven properties).

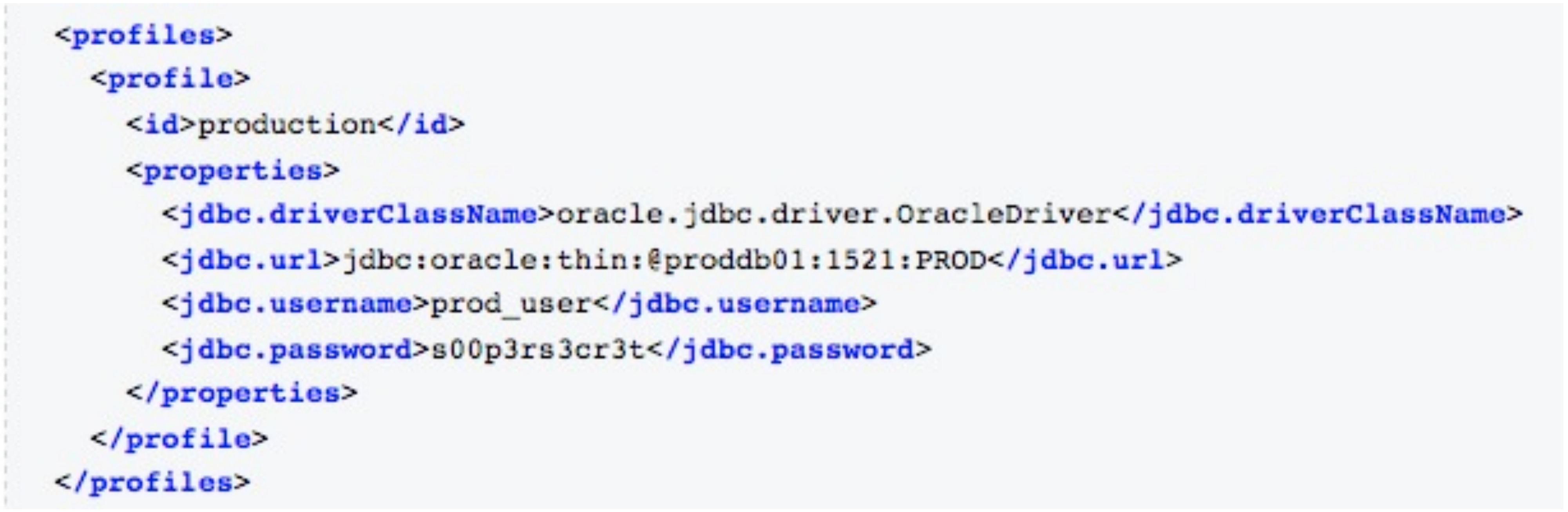
Profiles

```
<project>
  <profiles>
    <profile>
      <build>
        <defaultGoal>...</defaultGoal>
        <finalName>...</finalName>
        <resources>...</resources>
        <testResources>...</testResources>
        <plugins>...</plugins>
      </build>
      <reporting>...</reporting>
      <modules>...</modules>
      <dependencies>...</dependencies>
      <dependencyManagement>...</dependencyManagement>
      <distributionManagement>...</distributionManagement>
      <repositories>...</repositories>
      <pluginRepositories>...</pluginRepositories>
      <properties>...</properties>
    </profile>
  </profiles>
</project>
```

Resource Filtering

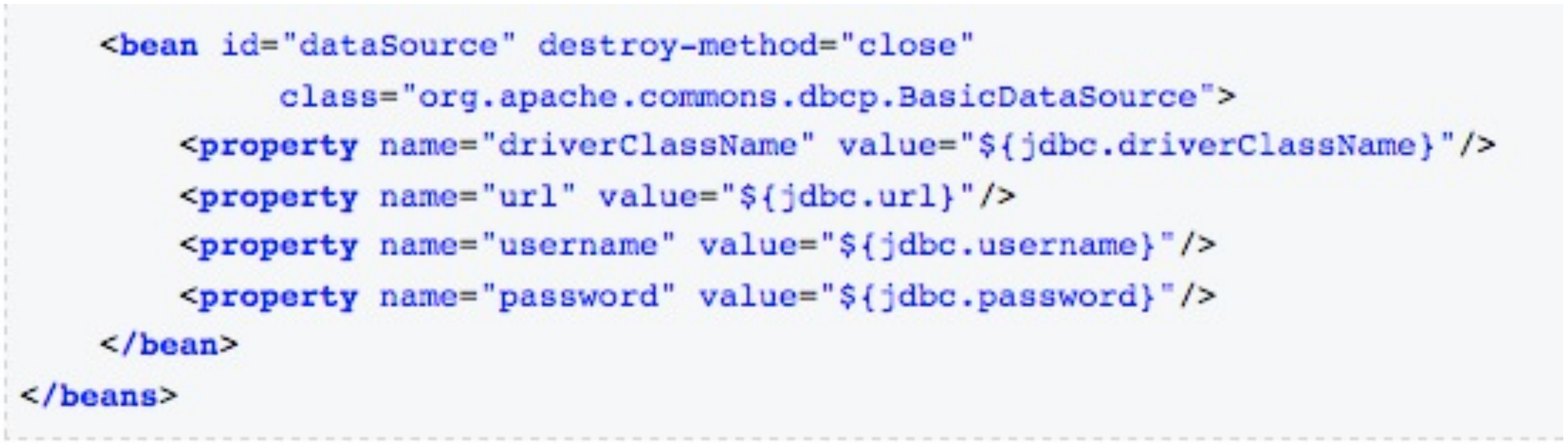
- Very often, you want some parts of your resource files, possibly of your source code, to depend on the execution environment:
  - If I deploy on the QA server, I want to talk to this DB server; if I deploy on the production server, I want to talk to this other DB server.
  - If I deploy on the test server, I want to invoke this web service endpoint; if I deploy on the production server, I want to use this other endpoint.
- Resource filtering is a mechanism, where you can ask maven to **expand properties** in your code base during the build process.

Resource Filtering



```
<profiles>
  <profile>
    <id>production</id>
    <properties>
      <jdbc.driverClassName>oracle.jdbc.driver.OracleDriver</jdbc.driverClassName>
      <jdbc.url>jdbc:oracle:thin:@proddb01:1521:PROD</jdbc.url>
      <jdbc.username>prod_user</jdbc.username>
      <jdbc.password>s00p3rs3cr3t</jdbc.password>
    </properties>
  </profile>
</profiles>
```

POM.xml - you give values to properties



```
    <bean id="dataSource" destroy-method="close"
             class="org.apache.commons.dbcp.BasicDataSource">
        <property name="driverClassName" value="${jdbc.driverClassName}"/>
        <property name="url" value="${jdbc.url}"/>
        <property name="username" value="${jdbc.username}"/>
        <property name="password" value="${jdbc.password}"/>
    </bean>
</beans>
```

Source - you reference maven properties with ${xxx}

Archetypes

- A maven archetype is a **skeleton** for a certain type of project.
- You have already used archetypes when creating your first maven project.
- Archetype definitions can be **shared** via repositories.
- **Creating you own archetype is a very efficient way to create a SDK.**
- **AppFuse** is an open source project that uses archetypes as a way to pre-integrate several open source frameworks (with a layer on top of them).
- The archetype facility is available through the **archetype plugin**:

  http://maven.apache.org/archetype/maven-archetype-plugin/

http://appfuse.org

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Maven and Java EE

- There are several archetypes for starting with Java EE projects. One of them is available here:
  - http://code.google.com/p/javaee5-maven-archetype/
- There is maven plugin that makes it possible to control Glassfish during the build process:
  - https://maven-glassfish-plugin.dev.java.net/
- Note: this particular archetype includes a reference to the glassfish plug-in