



# OOP with Java

## 30. Building with Maven

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- ➊ Introduction
- ➋ Maven Basics
- ➌ Dependencies, Javadoc, Executable, More Infos
- ➍ Maven Build with JUnit Tests
- ➎ Summary



website

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- Maven does not just define the project dependencies, but also the complete build process
- Everything is versionized, so all builds are 100% reproducible (which sorts out the infamous “But it works on my machine. . .”)

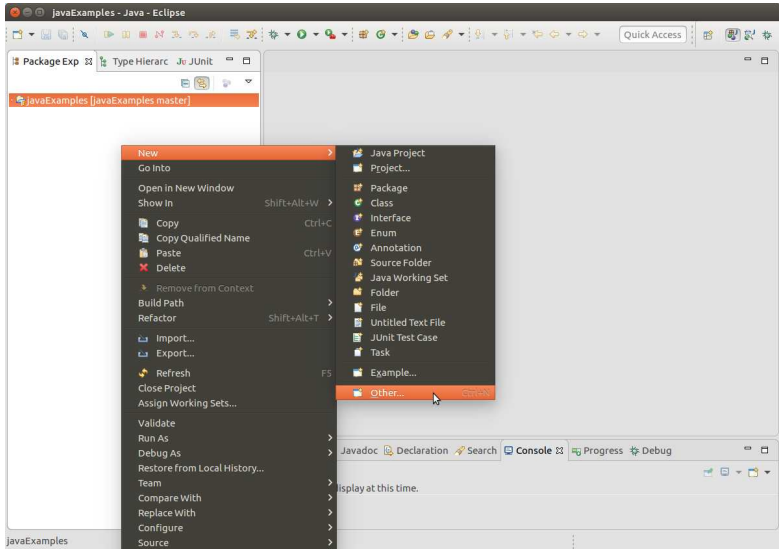


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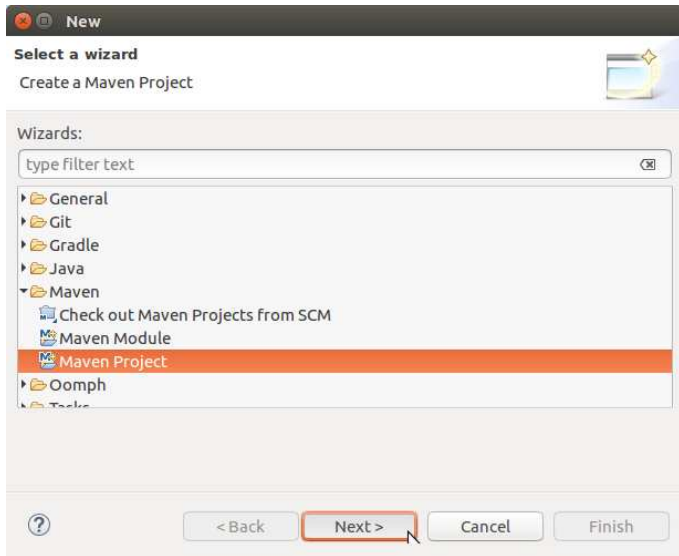
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**New Maven Project**

**New Maven project**  
Select project name and location

☒ Create a simple project (skip archetype selection)

☐ Use default workspace location

Location:

☐ Add project(s) to working set

Working set:

▶ Advanced



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  - In the following form, we make the selections shown here (which I will explain later) and click **Finish**:
    - Group Id: **cn.edu.hfu.iao**
    - Artifact Id: **simple-maven-project**
    - Version: **0.0.1**
    - Packaging: **jar**
    - Project name: **Simple Maven Project**

# Creating and Building a Basic Maven Project



**New Maven Project**

**New Maven project**  
Configure project

Artifact

Group Id:

Artifact Id:

Version:

Packaging:

Name:

Description:

Parent Project

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  - In the following form, we make the selections shown here (which I will explain later) and click **Finish**
  - A new Maven project has appeared, which basically is a special Eclipse Java project with a special folder structure and a file called **pom.xml** containing the project (and build) information

# Creating and Building a Basic Maven Project

A screenshot of the Eclipse IDE interface. The top window title is 'javaExamples - Java - simple-maven-project/pom.xml - Eclipse'. The left sidebar shows the 'Package Explorer' with a tree view of the project structure. The 'pom.xml' file is selected and highlighted. The main editor window displays the content of 'pom.xml', which is an empty Maven project configuration. The bottom status bar shows 'pom.xml - simple-maven-project'.

Package Explorer

- javaExamples [javaExamples master]
- simple-maven-project [javaExamples master]
  - src/main/java
  - src/main/resources
  - src/test/java
  - src/test/resources
- JRE System Library [J2SE-1.5]
- settings
- src
- target
- .classpath
- .gitignore
- .project
- pom.xml**

simple-maven-project/pom.xml

```
1<?xml version="1.0" encoding="UTF-8"?>
2<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
3  <modelVersion>4.0.0</modelVersion>
4  <groupId>cn.edu.hfuu.iao</groupId>
5  <artifactId>simple-maven-project</artifactId>
6  <version>0.0.1</version>
7  <name>Simple Maven Project</name>
8  <description>A simple maven project without any advanced features.</description>
9</project>
```

Overview | Dependencies | Dependency Hierarchy | Effective POM | **pom.xml**

Problems | Javadoc | Declaration | Search | Console | Progress | Debug

No consoles to display at this time.

pom.xml - simple-maven-project

## Listing: The contents of the Maven project file pom.xml

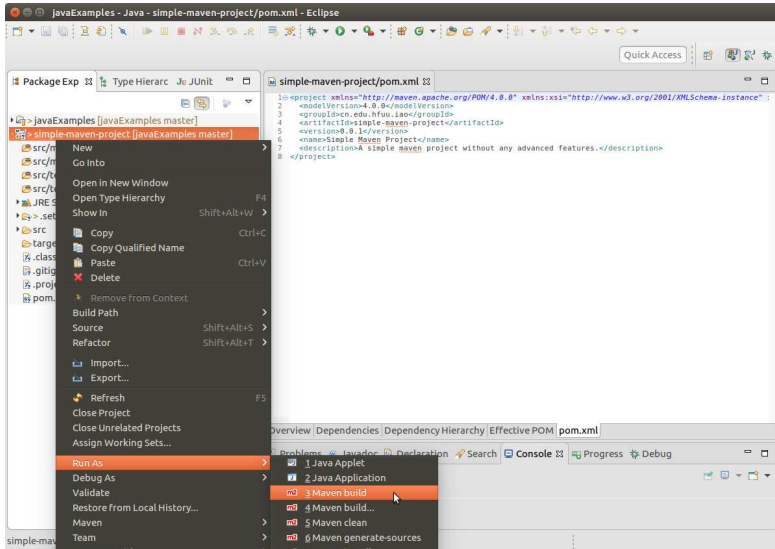
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<project xmlns="http://maven.apache.org/POM/4.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
    http://maven.apache.org/xsd/maven-4.0.0.xsd">
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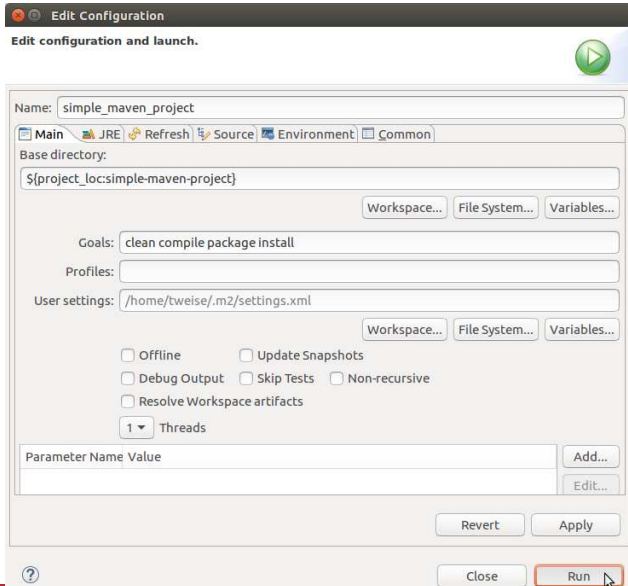


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javaExamples - Java - simple-maven-project/pom.xml - Eclipse

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Overview | Dependencies | Dependency Hierarchy | Effective POM | pom.xml

Problems | Javadoc | Declaration | Search | Console | Progress | Debug

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<terminated> simple_maven_project [Maven Build] /usr/lib/jvm/java-8-openjdk-amd64/bin/java (Feb 13, 2017, 6:04:3
WARNING] Using platform encoding (UTF-8 actually) to copy filtered resources, i.e. build is platform dependent!
[INFO] Copying 0 resource
[INFO]
[INFO] --- maven-compiler-plugin:3.1:compile (default-compile) @ simple-maven-project ---
[INFO] Nothing to compile - all classes are up to date
[INFO]
[INFO] --- maven-resources-plugin:2.6:testResources (default-testResources) @ simple-maven-project ---
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[INFO] --- maven-compiler-plugin:3.1:testCompile (default-testCompile) @ simple-maven-project ---
[INFO] Nothing to compile - all classes are up to date
[INFO]
[INFO] --- maven-surefire-plugin:2.12.4:test (default-test) @ simple-maven-project ---
[INFO] Skipping execution of surefire because it has already been run for this configuration
[INFO]
[INFO] --- maven-jar-plugin:2.4:jar (default-jar) @ simple-maven-project ---
[INFO]
[INFO] --- maven-install-plugin:2.4:install (default-install) @ simple-maven-project ---
[INFO] Downloading: https://repo.maven.apache.org/maven2/org/codehaus/plexus/plexus-digest/1.0/plexus-digest-1.0
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[INFO] Installing /home/tweise/local/programming/java/javaExamples/lessons/30/building with maven/simple_maven.p
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[INFO]
[INFO]
[INFO]
[INFO] Total time: 21.034 s
[INFO] Finished at: 2017-02-13T06:04:57+08:00
[INFO] Final Memory: 15M/296M
[INFO]
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simple-maven-project-0.0.1.jar - simple-maven-project/target

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- Let us take a closer look on the stuff we just did

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- For instance, I could have used `cn.edu.hfuu.iao.teaching` as a group for all of our teaching projects

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  - compile exactly the same with library version `a1.b1.c2`

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- Exception: If your project is still very experimental, you can use version `0.x.y`: For such versions, the rules for minor and patch level versions can be violated (but you should still try to not to)

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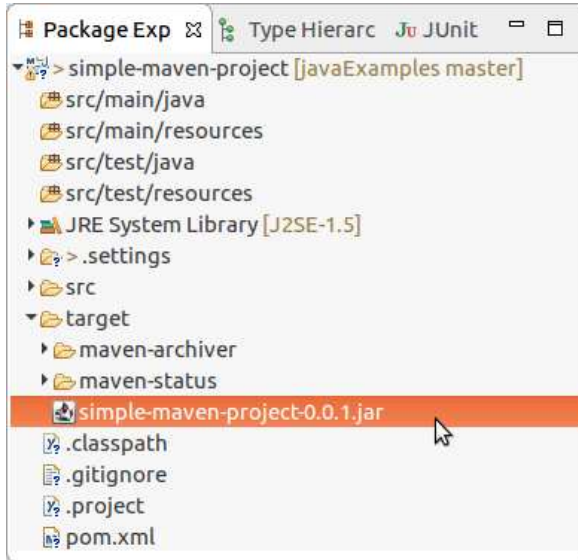
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## Listing: The contents of the Maven project file pom.xml

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  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>cn.edu.hfu.iao</groupId>
  <artifactId>simple-maven-project</artifactId>
  <version>0.0.1</version>
  <name>Simple Maven Project</name>
  <description>A simple maven project without any advanced
    features.</description>
</project>
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- In Eclipse (or when using the Maven command line tool **mvn**), you only need to specify **clean** together the *last* phase to be executed and all phases leading up to it are executed

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- Our simple project generated artifact `simple-maven-project-0.0.1.jar`



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- For this purpose, we generate a simple Maven project in exactly the same way as before, but name the artifact `project-with-dependencies`

- We then edit the generated `pom.xml` file to look as follows

## Listing: The contents of the pom.xml after we edit it

```

<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>cn.edu.hfuu.iao</groupId>
  <artifactId>project-with-dependencies</artifactId>
  <version>0.0.1</version>
  <name>Project with Dependencies</name>
  <description>A Maven project with dependencies and
    more information.
    also generating an executable JAR and
    Javadoc.</description>

  <url>http://iao.hfuu.edu.cn/</url>
  <organization>
    <url>http://iao.hfuu.edu.cn/</url>
    <name>Institute of Applied Optimization (IAO)</name>
  </organization>

  <developers>
    <developer>
      <id>thomasweise</id>
      <name>Thomas Weise</name>
      <email>weise@hfuu.edu.cn</email>
      <url>http://iao.hfuu.edu.cn/index.php/team/director/</url>
      <organization>Institute of Applied Optimization
        (IAO)</organization>
      <organizationUrl>http://iao.hfuu.edu.cn/</organizationUrl>
      <roles>
        <role>architect</role>
        <role>developer</role>
        <role>
          <timeZone>China Time Zone</timeZone>
        </role>
      </roles>
    </developer>
  </developers>

  <properties>
    <encoding>UTF-8</encoding>
    <project.build.sourceEncoding>${encoding}</project.build.sourceEncoding>
    <project.reporting.outputEncoding>${encoding}</project.reporting.outputEncoding>
    <jdk.version>1.8</jdk.version>
  </properties>

  <licenses>
    <license>
      <name>GNU GENERAL PUBLIC LICENSE Version 3, 29
        June 2007</name>
      <url>http://www.gnu.org/licenses/gpl-3.0-standalone.html</url>
      <distribution>repo</distribution>
    </license>
  </licenses>

  <issueManagement>
    <url>https://github.com/thomasweise/javaExamples/issues</url>
    <system>GitHub</system>
  </issueManagement>

  <scm>
    <connection>scm:git:git@github.com:thomasweise/javaExamples.git</connection>
    <developerConnection>
      scm:git:git@github.com:thomasweise/javaExamples.git</developerConnection>
    <url>git@github.com:thomasweise/javaExamples.git</url>
  </scm>

  <inceptionYear>2017</inceptionYear>

  <dependencies>
    <dependency>
      <groupId>org.apache.commons</groupId>
      <artifactId>commons-math3</artifactId>
      <version>3.6.1</version>
    </dependency>
  </dependencies>

  <build>
    <plugins>
      <plugin>
        <groupId>org.apache.maven.plugins</groupId>
        <artifactId>maven-compiler-plugin</artifactId>
        <version>3.1</version>
        <configuration>
          <source>${jdk.version}</source>
          <target>${jdk.version}</target>
          <encoding>${encoding}</encoding>
          <showWarnings>true</showWarnings>
          <showDeprecation>true</showDeprecation>
        </configuration>
      </plugin>

      <plugin>
        <groupId>org.apache.maven.plugins</groupId>
        <artifactId>maven-javadoc-plugin</artifactId>
        <version>2.9.1</version>
        <configuration>
          <show>private</show>
          <detectLinks>true</detectLinks>
          <detectJavaApiLink>true</detectJavaApiLink>
          <quiet>true</quiet>
        </configuration>
      </plugin>

      <plugin>
        <groupId>org.apache.maven.plugins</groupId>
        <artifactId>maven-jar-plugin</artifactId>
        <version>2.6</version>
        <configuration>
          <archive>
            <manifest>
              <addDefaultImplementationEntries />
              <addDefaultSpecificationEntries />
            </manifest>
            <archive>
              <configuration>
                <descriptorRef>
                  <descriptorRef>jar-with-dependencies</descriptorRef>
                </descriptorRef>
              </configuration>
            </archive>
          </archive>
        </configuration>
      </plugin>

      <plugin>
        <groupId>org.apache.maven.plugins</groupId>
        <artifactId>maven-assembly-plugin</artifactId>
        <version>3.0</version>
        <configuration>
          <goals>
            <goal>attached</goal>
          </goals>
          <phase>package</phase>
        </configuration>
      </plugin>

      <plugin>
        <groupId>org.apache.maven.plugins</groupId>
        <artifactId>maven-source-plugin</artifactId>
        <version>2.3</version>
        <configuration>
          <includePom>true</includePom>
        </configuration>
      </plugin>
    </plugins>
  </build>

  <includePom>true</includePom>
  <useDefaultExcludes>true</useDefaultExcludes>
  <useDefaultManifestFile>false</useDefaultManifestFile>
  </configuration>
  <execution>
    <id>attach-sources</id>
    <goals>
      <goal>jar</goal>
    </goals>
    </execution>
  </executions>
  </plugin>

  <plugin>
    <groupId>org.apache.maven.plugins</groupId>
    <artifactId>maven-jar-plugin</artifactId>
    <version>2.6</version>
    <configuration>
      <archive>
        <manifest>
          <addDefaultImplementationEntries />
          <addDefaultSpecificationEntries />
        </manifest>
        <archive>
          <configuration>
            <descriptorRef>
              <descriptorRef>jar-with-dependencies</descriptorRef>
            </descriptorRef>
          </configuration>
        </archive>
      </archive>
    </configuration>
  </plugin>

  <plugin>
    <groupId>org.apache.maven.plugins</groupId>
    <artifactId>maven-assembly-plugin</artifactId>
    <version>3.0</version>
    <configuration>
      <goals>
        <goal>attached</goal>
      </goals>
      <phase>package</phase>
    </configuration>
  </plugin>

  <plugin>
    <groupId>org.apache.maven.plugins</groupId>
    <artifactId>maven-source-plugin</artifactId>
    <version>2.3</version>
    <configuration>
      <includePom>true</includePom>
    </configuration>
  </plugin>
</project>

```



- We then edit the generated `pom.xml` file to look as follows
- OK, thank you, now the details

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)

## Listing: pom.xml Lines 6–12: Basic Info

```
<modelVersion>4.0.0</modelVersion>
<groupId>cn.edu.hfuu.iao</groupId>
<artifactId>project-with-dependencies</artifactId>
<version>0.0.1</version>
<name>Project with Dependencies</name>
<description>A Maven project with dependencies and
    more information,
also generating an executable JAR and
    Javadoc.</description>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project

## Listing: pom.xml Lines 15–19: Organization Info

```
<url>http://iao.hfuu.edu.cn/</url>
<organization>
  <url>http://iao.hfuu.edu.cn/</url>
  <name>Institute of Applied Optimization (IAO)</name>
</organization>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project

## Listing: pom.xml Lines 21–35: Developer Info

```
<developers>
  <developer>
    <id>thomasWeise</id>
    <name>Thomas Weise</name>
    <email>tweise@hfuu.edu.cn</email>
    <url>http://iao.hfuu.edu.cn/index.php/team/director/</url>
    <organization>Institute of Applied Optimization
      (IAO)</organization>
    <organizationUrl>http://iao.hfuu.edu.cn/</organizationUrl>
    <roles>
      <role>architect</role>
      <role>developer</role>
    </roles>
    <timezone>China Time Zone</timezone>
  </developer>
</developers>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties: contents of element `<n>contents</n>` become available as `${n}`



## Listing: pom.xml Lines 37–42: Properties

```
<properties>
  <encoding>UTF-8</encoding>
  <project.build.sourceEncoding>${encoding}</project.build.sourceEncoding>
  <project.reporting.outputEncoding>${encoding}</project.reporting.outputEncoding>
  <jdk.version>1.8</jdk.version>
</properties>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties: contents of element `<n>contents</n>` become available as `${n}`
  - Licensing Information: here GPL version 3

## Listing: pom.xml Lines 44–50: License

```
<licenses>
  <license>
    <name>GNU GENERAL PUBLIC LICENSE Version 3, 29 June 2007</name>
    <url>http://www.gnu.org/licenses/gpl-3.0-standalone.html</url>
    <distribution>repo</distribution>
  </license>
</licenses>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties: contents of element `<n>contents</n>` become available as `${n}`
  - Licensing Information: here GPL version 3
  - Issue management: where to report errors

## Listing: pom.xml Lines 52–55: Issue Management

```
<issueManagement>  
  <url>https://github.com/thomasWeise/javaExamples/issues</url>  
  <system>GitHub</system>  
</issueManagement>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties: contents of element `<n>contents</n>` become available as `${n}`
  - Licensing Information: here GPL version 3
  - Issue management: where to report errors
  - Software configuration management: here our `git` repository

## Listing: pom.xml Lines 57–62: Software Configuration Management

```
<scm>  
  <connection>scm:git:git@github.com:thomasWeise/javaExamples.git</connection>  
  <developerConnection>  
    scm:git:git@github.com:thomasWeise/javaExamples.git</developerConnection>  
  <url>git@github.com:thomasWeise/javaExamples.git</url>  
</scm>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties
  - Licensing Information: here GPL version 3
  - Issue management: where to report errors
  - Software configuration management: here our `git` repository
  - Inception year: when did the project start



Listing: pom.xml Lines 64: Inception Year

```
<inceptionYear>2017</inceptionYear>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties
  - Licensing Information: here GPL version 3
  - Issue management: where to report errors
  - Software configuration management: here our `git` repository
  - Inception year: when did the project start
  - Dependencies: Which other libraries does our project need?

## Listing: pom.xml Lines 67–73: Dependencies

```
<dependencies>
  <dependency>
    <groupId>org.apache.commons</groupId>
    <artifactId>commons-math3</artifactId>
    <version>3.6.1</version>
  </dependency>
</dependencies>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties
  - Licensing Information: here GPL version 3
  - Issue management: where to report errors
  - Software configuration management: here our `git` repository
  - Inception year: when did the project start
  - Dependencies: Which other libraries does our project need?
  - Compilation process: here using Java `${jdk.version}` which was set to 1.8

## Listing: pom.xml Lines 75–89: Build (1): Compilation

```
<build>

  <plugins>
    <plugin>
      <groupId>org.apache.maven.plugins</groupId>
      <artifactId>maven-compiler-plugin</artifactId>
      <version>3.1</version>
      <configuration>
        <source>${jdk.version}</source>
        <target>${jdk.version}</target>
        <encoding>${encoding}</encoding>
        <showWarnings>true</showWarnings>
        <showDeprecation>true</showDeprecation>
      </configuration>
    </plugin>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties
  - Licensing Information: here GPL version 3
  - Issue management: where to report errors
  - Software configuration management: here our `git` repository
  - Inception year: when did the project start
  - Dependencies: Which other libraries does our project need?
  - Compilation process: here using Java `${jdk.version}` which was set to 1.8
- We also want a `jar` containing the generated Javadoc

## Listing: pom.xml Lines 91–109: Build (2): Javadoc jar

```
<plugin>
  <groupId>org.apache.maven.plugins</groupId>
  <artifactId>maven-javadoc-plugin</artifactId>
  <version>2.9.1</version>
  <configuration>
    <show>private</show>
    <detectLinks>true</detectLinks>
    <detectJavaApiLink>true</detectJavaApiLink>
    <quiet>true</quiet>
  </configuration>
  <executions>
    <execution>
      <id>attach-javadoc</id>
      <goals>
        <goal>jar</goal>
      </goals>
    </execution>
  </executions>
</plugin>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties
  - Licensing Information: here GPL version 3
  - Issue management: where to report errors
  - Software configuration management: here our `git` repository
  - Inception year: when did the project start
  - Dependencies: Which other libraries does our project need?
  - Compilation process: here using Java `${jdk.version}` which was set to 1.8
  - We also want a `jar` containing the generated Javadoc
  - We also want a `jar` containing all the source code



## Listing: pom.xml Lines 111–128: Build (3): Sources jar

```
<plugin>
  <groupId>org.apache.maven.plugins</groupId>
  <artifactId>maven-source-plugin</artifactId>
  <version>2.3</version>
  <configuration>
    <includePom>true</includePom>
    <useDefaultExcludes>true</useDefaultExcludes>
    <useDefaultManifestFile>false</useDefaultManifestFile>
  </configuration>
  <executions>
    <execution>
      <id>attach-sources</id>
      <goals>
        <goal>jar</goal>
      </goals>
    </execution>
  </executions>
</plugin>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties
  - Licensing Information: here GPL version 3
  - Issue management: where to report errors
  - Software configuration management: here our `git` repository
  - Inception year: when did the project start
  - Dependencies: Which other libraries does our project need?
  - Compilation process: here using Java `${jdk.version}` which was set to 1.8
  - We also want a `jar` containing the generated Javadoc
  - We also want a `jar` containing all the source code
  - Generate the “main” artifact: an executable `jar` with main class `cn.edu.hfu.iao.Main`

## Listing: pom.xml Lines 131–144: Build (4): (executable) jar

```
<plugin>
  <groupId>org.apache.maven.plugins</groupId>
  <artifactId>maven-jar-plugin</artifactId>
  <version>2.6</version>
  <configuration>
    <archive>
      <manifest>
        <addDefaultImplementationEntries />
        <addDefaultSpecificationEntries />
        <mainClass>cn.edu.hfu.iao.Main</mainClass>
      </manifest>
    </archive>
  </configuration>
</plugin>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties
  - Licensing Information: here GPL version 3
  - Issue management: where to report errors
  - Software configuration management: here our `git` repository
  - Inception year: when did the project start
  - Dependencies: Which other libraries does our project need?
  - Compilation process: here using Java `${jdk.version}` which was set to 1.8
  - We also want a `jar` containing the generated Javadoc
  - We also want a `jar` containing all the source code
  - Generate the “main” artifact
  - Generate an executable `jar` *including* all dependencies (here `commons-math3` ) with main class `cn.edu.hfu.iao.Main`

## Listing: pom.xml Lines 146–172: Build (5): (executable) jar with dependencies

```
<plugin>
  <groupId>org.apache.maven.plugins</groupId>
  <artifactId>maven-assembly-plugin</artifactId>
  <executions>
    <execution>
      <goals>
        <goal>attached</goal>
      </goals>
      <phase>package</phase>
      <configuration>
        <descriptorRefs>
          <descriptorRef>jar-with-dependencies</descriptorRef>
        </descriptorRefs>
        <archive>
          <manifest>
            <mainClass>cn.edu.hfu.iao.Main</mainClass>
          </manifest>
        </archive>
      </configuration>
    </execution>
  </executions>
</plugin>

</plugins>
</build>

</project>
```

- We then edit the generated `pom.xml` file to look as follows
  - Basic Project Information (almost the same as before)
  - Project URL and info about the organization behind project
  - The developers working on the project
  - Properties
  - Licensing Information: here GPL version 3
  - Issue management: where to report errors
  - Software configuration management: here our `git` repository
  - Inception year: when did the project start
  - Dependencies: Which other libraries does our project need?
  - Compilation process: here using Java `${jdk.version}` which was set to 1.8
  - We also want a `jar` containing the generated Javadoc
  - We also want a `jar` containing all the source code
  - Generate the “main” artifact
  - Generate an executable `jar` *including* all dependencies
- The `pom.xml` specifies quite a complex build process!

## Listing: Our Main class using Dependency

```

package cn.edu.hfuu.iao;

import java.util.Scanner;

import org.apache.commons.math3.stat.regression.SimpleRegression; // import class from dependency library

/** The main class of our project: it reads data from stdin and returns a linear function fitting to it */
public class Main {

    /** read data from a Scanner, return a SimpleRegression instance with the fitting result */
    static final SimpleRegression fitLine(final Scanner scanner) {
        SimpleRegression regression = new SimpleRegression(); // using commons-math3's simple regression class
        for (;;) {
            if (!scanner.hasNextDouble()) { break; } // if there is no double number, stop reading
            double x = scanner.nextDouble(); // ok, there is one, read it as x coordinate
            if (!scanner.hasNextDouble()) { break; } // if there is no double number, stop reading
            double y = scanner.nextDouble(); // ok, there is one, read it as y coordinate
            regression.addData(x, y); // add the new x and y coordinate to the dataset
        }
        return regression;
    }

    /** The main routine
     * @param args
     * we ignore this parameter for now */
    public static final void main(final String[] args) {
        System.err.println("Welcome to the linear curve fitting program."); // $NON-NLS-1$
        System.err.println("Enter point pairs one pair a line, x and y coordinates separated by space or tab."); // $NON-NLS-1$
        System.err.println("Linear curve is fitted when stdin ends or Ctrl-D is pressed."); // $NON-NLS-1$

        SimpleRegression regression; // using commons-math3's simple regression class
        try (final Scanner scanner = new Scanner(System.in)) { // using a Scanner in try-with-resource on System.in
            regression = fitLine(scanner); // fit the data from the scanner
        }

        System.out.print("y\u2248"); // $NON-NLS-1$ // print "y is approximately "
        System.out.print(regression.getIntercept()); // print the y coordinate at x=0
        System.out.print(", x\u2248"); // $NON-NLS-1$ // " + x + "
        System.out.print(regression.getSlope()); // print the slope
        System.out.print("(root mean square error: "); // print RMSE: is 0 if data is linear // $NON-NLS-1$
        System.out.print(Math.sqrt(regression.getMeanSquareError()));
        System.out.println(')');
    }
}

```

- We now can build our project using goals `clean install`



JavaExamples - Java - project-with-dependencies/pom.xml - Eclipse

Package Explorer | Type Hierarchy | JUnit

project-with-dependencies [JavaExamples master]

- src/main/java
  - cn.edu.hfu.iao
    - Main.java
    - package-info.java
- src/main/resources
- src/test/java
- src/test/resources
- JRE System Library [JavaSE-1.8]
- Maven Dependencies
- .settings
- src
- target
  - apidocs
  - archive-tmp
  - generated-sources
  - javadoc-bundle-options
  - maven-archiver
  - maven-status
  - project-with-dependencies-0.0.1-jar-with-dependencies.jar
  - project-with-dependencies-0.0.1-javadoc.jar
  - project-with-dependencies-0.0.1-sources.jar
  - project-with-dependencies-0.0.1.jar
  - .classpath
  - .gitignore
  - .project
  - pom.xml

4 items selected

project-with-dependencies/pom.xml | package-info.java | Main.java

```

138 <addDefaultImplementationEntries />
139 <addDefaultSpecificationEntries />
140 <mainClass>cn.edu.hfu.iao.Main</mainClass>
141 </manifest>
142 </archive>
    </configuration>
    
```

Overview | Dependencies | Dependency Hierarchy | Effective POM | pom.xml

Problems | Javadoc | Declaration | Search | Console | Progress | Debug

<terminated> project\_with\_dependencies (2) [Maven Build] /usr/lib/jvm/java-8-openjdk-amd64/bin/java

```

[INFO] Using 'UTF-8' encoding to copy filtered resources.
[INFO] Copying 0 resource
[INFO]
[INFO] --- maven-compiler-plugin:3.1:testCompile (default-testCompile) @ project-with-dependencies ---
[INFO] Nothing to compile - all classes are up to date
[INFO]
[INFO] --- maven-surefire-plugin:2.12.4:test (default-test) @ project-with-dependencies ---
[INFO]
[INFO] --- maven-jar-plugin:2.6:jar (default-jar) @ project-with-dependencies ---
[INFO] Building jar: /home/tweise/local/programming/java/javaExamples/lessons/30_building_with_maven/
[INFO]
[INFO] --- maven-javadoc-plugin:2.9.1:jar (attach-javadoc) @ project-with-dependencies ---
[INFO] Building jar: /home/tweise/local/programming/java/javaExamples/lessons/30_building_with_maven/
[INFO]
[INFO] >>> maven-source-plugin:2.3:jar (attach-sources) > generate-sources @ project-with-dependencies
[INFO]
[INFO] <<< maven-source-plugin:2.3:jar (attach-sources) < generate-sources @ project-with-dependencies
[INFO]
[INFO] --- maven-source-plugin:2.3:jar (attach-sources) @ project-with-dependencies ---
[INFO] Building jar: /home/tweise/local/programming/java/javaExamples/lessons/30_building_with_maven/
[INFO]
[INFO] --- maven-assembly-plugin:2.2-beta-5:attached (default) @ project-with-dependencies ---
[INFO] Building jar: /home/tweise/local/programming/java/javaExamples/lessons/30_building_with_maven/
[INFO]
[INFO] --- maven-install-plugin:2.4:install (default-install) @ project-with-dependencies ---
[INFO] Installing /home/tweise/local/programming/java/javaExamples/lessons/30_building_with_maven/prc
[INFO] Installing /home/tweise/local/programming/java/javaExamples/lessons/30_building_with_maven/prc
[INFO] Installing /home/tweise/local/programming/java/javaExamples/lessons/30_building_with_maven/prc
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[INFO] Installing /home/tweise/local/programming/java/javaExamples/lessons/30_building_with_maven/prc
    
```

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- We find that the `target` folder now contains several artifacts

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  - `project-with-dependencies-0.0.1.jar` – the main, executable `jar` of our project; requires `commons-math3` in the classpath to run

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  - `project-with-dependencies-0.0.1-jar-with-dependencies.jar` – an executable `jar` of our project; contains `commons-math3`, can run directly
  - `project-with-dependencies-0.0.1-javadoc.jar` : the generated Javadoc documentation of our project (remember, a `jar` is basically a `zip` archive...)

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  - `project-with-dependencies-0.0.1-javadoc.jar` : the generated Javadoc documentation of our project (remember, a `jar` is basically a `zip` archive...)
  - `project-with-dependencies-0.0.1-sources.jar` : a `jar` archive containing the source code of our project (easy for distribution)

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- But we never downloaded that library



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  - Whenever you need one of these public libraries (via your dependencies), Maven can find it and download it automatically

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  - There is one central repository in the internet, where organizations can register themselves and upload their open source artifacts
  - Whenever you need one of these public libraries (via your dependencies), Maven can find it and download it automatically
  - There also is a “local” repository on your machine, where dependencies are cached (and your compiled artifacts are `install` ed into)



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  - We adapt the basic project information to fit to the new project name

## Listing: pom.xml Lines 5–11: Basic Info

```
<modelVersion>4.0.0</modelVersion>
<groupId>cn.edu.hfuu.iao</groupId>
<artifactId>project-with-tests</artifactId>
<version>0.0.1</version>
<name>Project with Tests</name>
<description>A project similar to "Project with
    Dependencies",
but now also performing JUnit tests.</description>
```

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  - We add a dependency on `JUnit`

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## Listing: pom.xml Lines 66–78: Added Test-time Dependency on JUnit

```
<dependencies>
  <dependency>
    <groupId>junit</groupId>
    <artifactId>junit</artifactId>
    <version>4.11</version>
    <scope>test</scope>
  </dependency>
  <dependency>
    <groupId>org.apache.commons</groupId>
    <artifactId>commons-math3</artifactId>
    <version>3.6.1</version>
  </dependency>
</dependencies>
```

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- We make the following changes to the Maven `pom.xml` file:
  - We adapt the basic project information to fit to the new project name
  - We add a dependency on `JUnit`
  - We use the `surefire` plugin in the build process while will execute the JUnit tests for us

Listing: pom.xml Lines 173–177: Using surefire Plugin (runs tests)

```
<plugin>
  <groupId>org.apache.maven.plugins</groupId>
  <artifactId>maven-surefire-plugin</artifactId>
  <version>2.18</version>
</plugin>
```

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## Listing: pom.xml Lines 182–195: Using surefire Plugin Report HTML

```
<reporting>
  <plugins>
    <plugin>
      <groupId>org.apache.maven.plugins</groupId>
      <artifactId>maven-project-info-reports-plugin</artifactId>
      <version>2.7</version>
    </plugin>
    <plugin>
      <groupId>org.apache.maven.plugins</groupId>
      <artifactId>maven-surefire-report-plugin</artifactId>
      <version>2.18</version>
    </plugin>
  </plugins>
</reporting>
```



- We now want to investigate the JUnit integration in Maven
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  - We can also generate a nice HTML report about the whole project and the test results, for this purpose we invoke the `site` goal when building and add a set of reporting plugins the the `pom.xml`
- In the next step, we can add a JUnit test and place it into the same package as the real code, just in the `src/test/java` hierarchy

## Listing: The JUnit test of our Main class

```
package cn.edu.hfuu.iao;

import java.io.StringReader;
import java.util.Scanner;

import org.apache.commons.math3.stat.regression.SimpleRegression;
import org.junit.Assert;
import org.junit.Test;

/** The unit test for our line-fitting main routine */
public class MainTest {

    /** test whether (0,0) and (1,1) will fit to  $y=0+x*1$  */
    @Test
    public void testFitting0011ResultsIn01() {
        SimpleRegression regression;

        try (final StringReader sr = new StringReader("0_0\n1_1")) { //$NON-NLS-1$
            try (final Scanner scanner = new Scanner(sr)) {
                regression = Main.fitLine(scanner);
            }
        }

        Assert.assertEquals(0d, regression.getIntercept(), 1e-10d);
        Assert.assertEquals(1d, regression.getSlope(), 1e-10d);
    }
}
```

- We can now build the new project by invoking Maven with the goals  
`clean test install site`

- We can now build the new project by invoking Maven with the goals  
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- The build will compile our code

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`clean test install site`
- The build will compile our code, run our tests, complete successful

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- We can now build the new project by invoking Maven with the goals `clean test install site`
- The build will compile our code, run our tests, complete successful, and the same artifacts as last time are generated
- There will also be one interesting new artifact, a folder called `site`



# Building the New Project



javaExamples - Java - project\_with\_tests/pom.xml - Eclipse

Package Explore | Type Hierarchy | JUnit

project\_with\_tests [javaExamples master]

- src/main/java
  - cn.edu.hfu.iao
  - Main.java
  - package-info.java
  - src/main/resources
- src/test/java
  - cn.edu.hfu.iao
  - MainTest.java
  - src/test/resources
- JRE System Library [JavaSE-1.8]
- Maven Dependencies
- settings
- src
- target
  - apidocs
  - archive-tmp
  - generated-sources
  - generated-test-sources
  - javadoc-bundle-options
  - maven-archiver
  - maven-status
  - site
    - project-with-tests-0.0.1-jar-with-dependencies.jar
    - project-with-tests-0.0.1-javadoc.jar
    - project-with-tests-0.0.1-sources.jar
    - project-with-tests-0.0.1.jar
    - classpath
    - gitignore
    - project
    - pom.xml

project\_with\_tests/pom.xml

```
<execution>
<goals>
<goal>attached</goal>
</goals>
<phase>package</phase>
<configuration>
<descriptorRefs>
<descriptorRef>jar-with-dependencies</descriptorRef>
</descriptorRefs>
</execution>
```

Overview | Dependencies | Dependency Hierarchy | Effective POM | pom.xml

Problems | Javadoc | Declaration | Search | Console | Progress | Debug

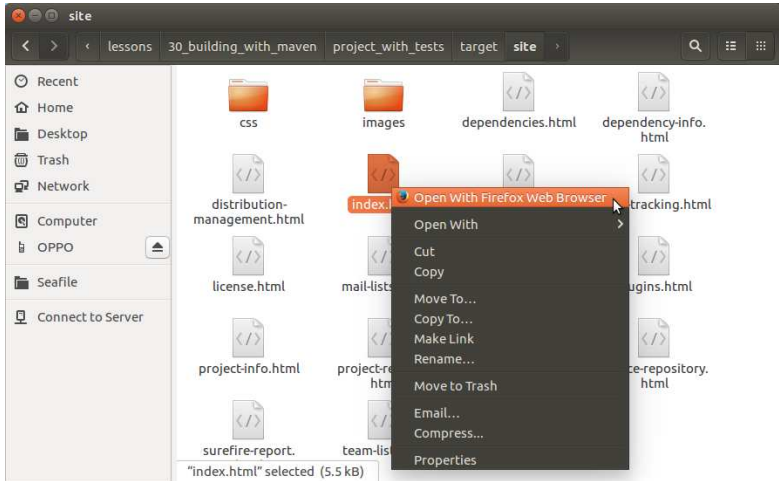
```
<terminated>project_with_tests (2) [Maven Build] /usr/lib/jvm/java-8-openjdk-amd64/bin/java (Feb 13, 2017, 2
[INFO] Skipped 'Surefire Report' report, file 'surefire-report.html' already exists for the English version
[INFO] Generating 'About' report ... maven-project-info-reports-plugin:2.7
[INFO] Generating 'Plugin Management' report ... maven-project-info-reports-plugin:2.7
[INFO] Downloading: https://repo.maven.apache.org/maven2/org/apache/maven/plugins/maven-antrun-plugin/1.3/m
[INFO] Downloaded: https://repo.maven.apache.org/maven2/org/apache/maven/plugins/maven-antrun-plugin/1.3/m
[INFO] Downloading: https://repo.maven.apache.org/maven2/org/apache/maven/plugins/maven-plugins/12/maven-pl
[INFO] Downloaded: https://repo.maven.apache.org/maven2/org/apache/maven/plugins/maven-plugins/12/maven-pl
[INFO] Downloading: https://repo.maven.apache.org/maven2/org/apache/maven/plugins/maven-dependency-plugin/2
[INFO] Downloaded: https://repo.maven.apache.org/maven2/org/apache/maven/plugins/maven-dependency-plugin/2
[INFO] Downloading: https://repo.maven.apache.org/maven2/org/apache/maven/plugins/maven-release-plugin/2.3
[INFO] Downloaded: https://repo.maven.apache.org/maven2/org/apache/maven/plugins/maven-release-plugin/2.3
[INFO] Downloading: https://repo.maven.apache.org/maven2/org/apache/maven/release/maven-release/2.3.2/maven
[INFO] Downloaded: https://repo.maven.apache.org/maven2/org/apache/maven/release/maven-release/2.3.2/maven
[INFO] Generating 'Distribution Management' report ... maven-project-info-reports-plugin:2.7
[INFO] Generating 'Dependency Information' report ... maven-project-info-reports-plugin:2.7
[INFO] Generating 'Source Repository' report ... maven-project-info-reports-plugin:2.7
[INFO] Generating 'Mailing Lists' report ... maven-project-info-reports-plugin:2.7
[INFO] Generating 'Issue Tracking' report ... maven-project-info-reports-plugin:2.7
[INFO] Generating 'Continuous Integration' report ... maven-project-info-reports-plugin:2.7
[INFO] Generating 'Project Plugins' report ... maven-project-info-reports-plugin:2.7
[INFO] Downloading: https://repo.maven.apache.org/maven2/org/apache/maven/plugins/maven-deploy-plugin/2.7/m
[INFO] Downloaded: https://repo.maven.apache.org/maven2/org/apache/maven/plugins/maven-deploy-plugin/2.7/m
[INFO] Generating 'Project License' report ... maven-project-info-reports-plugin:2.7
[INFO] Generating 'Project Team' report ... maven-project-info-reports-plugin:2.7
[WARNING] The time zone 'China Time Zone' for the developer 'Thomas Weise' is not a recognised time zone, u
[INFO] Generating 'Project Summary' report ... maven-project-info-reports-plugin:2.7
[INFO] Generating 'Dependencies' report ... maven-project-info-reports-plugin:2.7
[INFO] Generating 'Surefire Report' report ... maven-surefire-report-plugin:2.18
[WARNING] Unable to locate Test Source XRef to link to - DISABLED
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 02:19 min
[INFO] Finished at: 2017-02-13T14:56:29+08:00
[INFO] Final Memory: 47M/62MB
[INFO] -----
```

site-project\_with\_tests/target

- We can now build the new project by invoking Maven with the goals `clean test install site`
- The build will compile our code, run our tests, complete successful, and the same artifacts as last time are generated
- There will also be one interesting new artifact, a folder called `site`
- It contains a documentation of our project and the surefire test report

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- It contains a documentation of our project and the surefire test report
- We click on `index.html` inside this folder

# Building the New Project



A screenshot of a Mozilla Firefox browser window. The title bar reads "Project with Tests - About - Mozilla Firefox". The address bar shows the file path "file:///home/tweise/local/programming/ja...". The page content has a header "Project with Tests" and a sub-header "About Project with Tests". A sidebar on the left lists "Project Documentation" items, with "Project Reports" highlighted. A mouse cursor points to the "Project Reports" link. Below the sidebar, a banner says "Built by: maven Project Reports". The main content area contains a paragraph: "A project similar to 'Project with Dependencies', but now also performing JUnit tests." The footer of the page states "Copyright © 2017 Institute of Applied Optimization (IAO). All Rights Reserved."

file:///home/tweise/local/programming/javaE...ject\_with\_tests/target/site/project-reports.html

A screenshot of a Mozilla Firefox browser window displaying a web page titled 'Project with Tests - Generated Reports'. The address bar shows a file path: 'file:///home/tweise/local/programming/java...'. The page has a dark header with the title and a light gray sidebar on the left. The sidebar contains a 'Project Documentation' section with links to 'Project Information' and 'Project Reports', and a 'Built by: maven' logo. The main content area has a 'Generated Reports' section with a paragraph explaining that the document provides an overview of reports generated by Maven. Below this is an 'Overview' section containing a table with two columns: 'Document' and 'Description'. The table has one row with 'Surefire Report' and 'Report on the test results of the project.' respectively. A mouse cursor is pointing at the 'Surefire Report' link. At the bottom of the page, there is a copyright notice: 'Copyright © 2017 Institute of Applied Optimization (IAO). All Rights Reserved.'

Project with Tests - Generated Reports - Mozilla Firefox

Project with Tests - Ge... x +

file:///home/tweise/local/programming/java... Search ☆ 📁 » ☰

## Project with Tests

Last Published: 2017-02-13 | Version: 0.0.1 [Project with Tests](#)

**Project Documentation**

- Project Information
- ▼ Project Reports
  - Surefire Report

Built by: 

### Generated Reports

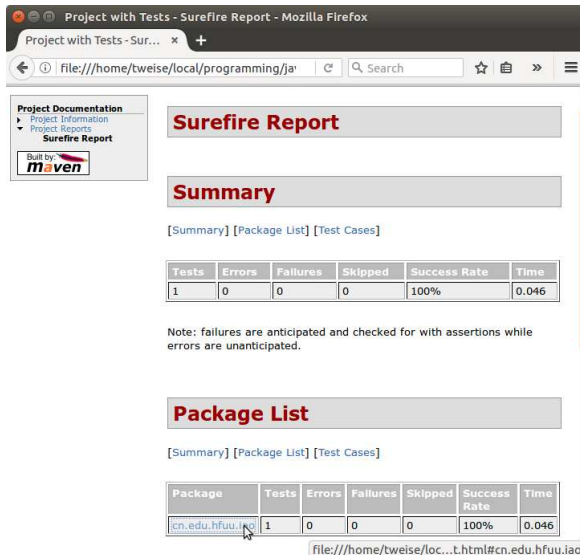
This document provides an overview of the various reports that are automatically generated by [Maven](#). Each report is briefly described below.

#### Overview

Document	Description
<a href="#">Surefire Report</a>	Report on the test results of the project.

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file:///home/tweise/local/programming/java/javaE...ject\_with\_tests/target/site/surefire-report.html

A screenshot of a web browser displaying a Surefire Report. The browser window has a title bar that says 'Project with Tests - Surefire Report - Mozilla Firefox'. The address bar shows the file path 'file:///home/tweise/local/programming/ja...'. The page content includes a sidebar with 'Project Documentation' links, a main heading 'Surefire Report', a 'Summary' section with a table of test results, a note about failures, a 'Package List' section with another table, and a URL bar at the bottom showing the current page location.


Project with Tests - Surefire Report - Mozilla Firefox

Project with Tests - Sur... x +

file:///home/tweise/local/programming/ja... Search ☆ 🗑️ » ☰

**Project Documentation**

- Project Information
- Project Reports
  - Surefire Report**

Built by: 

## Surefire Report

### Summary

[Summary] [Package List] [Test Cases]

Tests	Errors	Failures	Skipped	Success Rate	Time
1	0	0	0	100%	0.046

Note: failures are anticipated and checked for with assertions while errors are unanticipated.

### Package List

[Summary] [Package List] [Test Cases]

Package	Tests	Errors	Failures	Skipped	Success Rate	Time
cn.edu.hfuu.iao	1	0	0	0	100%	0.046

file:///home/tweise/loc...t.html#cn.edu.hfuu.iao

# Building the New Project



Project with Tests - Surefire Report - Mozilla Firefox

Project with Tests - Sur... x +

file:///home/tweise/local/programming/ja... Search ☆ 📁 » ☰

Package	Tests	Errors	Failures	Skipped	Success Rate	Time
cn.edu.hfuu.iao	1	0	0	0	100%	0.046

Note: package statistics are not computed recursively, they only sum up all of its testsuites numbers.

cn.edu.hfuu.iao

	Class	Tests	Errors	Failures	Skipped	Success Rate	Time
	MainTest	1	0	0	0	100%	0.046

**Test Cases**

[\[Summary\]](#) [\[Package List\]](#) [\[Test Cases\]](#)

MainTest

	testFitting0011ResultsIn01	0.046
--	----------------------------	-------

file:///home/tweise/local/programming/java...te/surefire-report.html#cn.edu.hfuu.iaoMainTest



- We have learned about creating and building projects with Maven
- Maven is the most widely used build tool in the Java world
- Maven allows us to specify the “coordinates”, i.e., a group ID, an artifact ID, and a version, which uniquely identify one exact version of our project
- It allows us to specify other projects we depend upon by using their coordinates
- It allows us to define a complete build process, where each plugin executed is again specified by its coordinate
- It can find and download many open source libraries from the internet automatically for us (based on the coordinates in the dependency information)
- Maven also automatically resolves the dependencies of our dependencies recursively for us
- Maven builds and project configurations are thus 100% reproducible
- It can generate all kinds of artifacts for us, including Javadoc, jars, source code jars, and a HTML page describing our project
- It allows us to specify meta-data about our project, such as an URL and developer information

# 谢谢

## Thank you

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Caspar David Friedrich, "Der Wanderer über dem Nebelmeer", 1818  
[http://en.wikipedia.org/wiki/Wanderer\\_above\\_the\\_Sea\\_of\\_Fog](http://en.wikipedia.org/wiki/Wanderer_above_the_Sea_of_Fog)