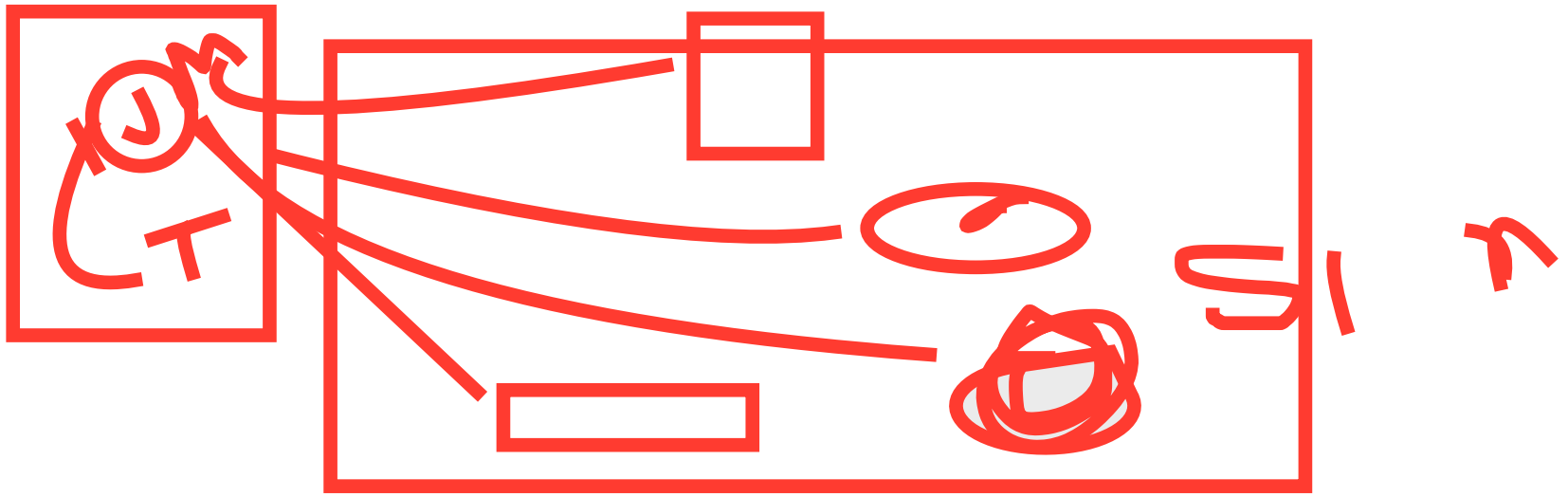
# Software project management

and

# Maven



# Problem area

- Large software projects usually contain tens or even hundreds of projects/modules
- Will become messy and incomprehensible if the projects don’t adhere to some common principles
- Will be time-consuming to build all projects manually

# The preferred solution

- Use a project management tool (like Maven)
- Maven helps you with various aspects:

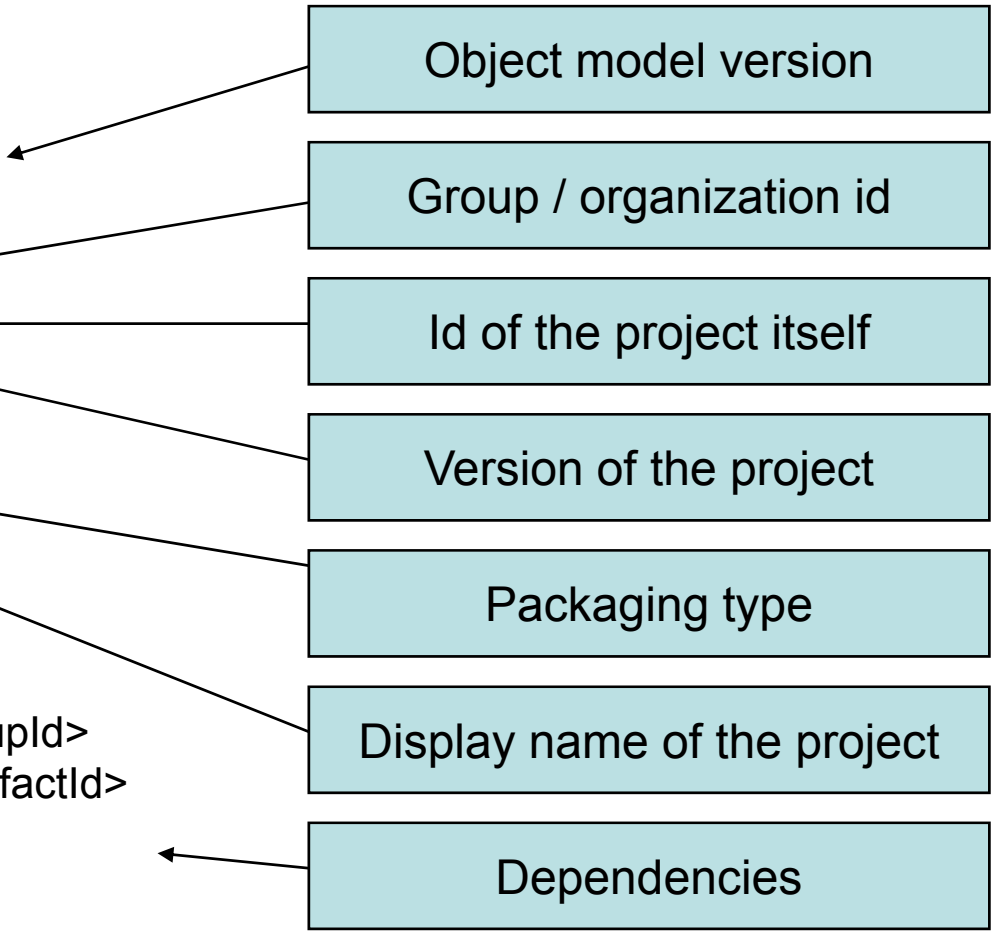
1. Build process
2. Project structure
3. Dependency management
4. Access to information and documentation

# 1. Build process

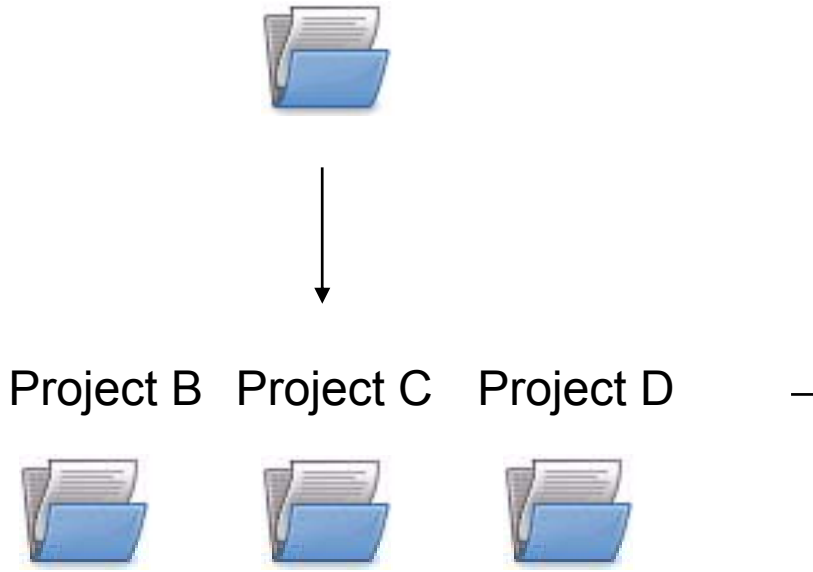
- The Project Object Model (POM) – an XML file – is the heart of a Maven 2 project
- Contains project information and configuration details used to build the project
  - Project dependencies
  - Commands (goals) that can be executed
  - Plugins
  - Metadata
- The POM extends the Super POM
  - Only 4 lines are required

# 1. POM - Simple example

```
<project>
   <modelVersion>4.0.0</modelVersion>

   <groupId>no.uio.inf5750</groupId>
   <artifactId>assignment-2</artifactId>
   <version>1.0-SNAPSHOT</version>

   <packaging>jar</packaging>
   <name>Assignment 2</name>

   <dependencies>
      <dependency>
         <groupId>commons-logging</groupId>
         <artifactId>commons-logging</artifactId>
         <version>1.4</version>
         <scope>compile</scope>
      </dependency>
   </dependencies>

</project>
```



# 1. POM – Project inheritance




```
<project>
   <modelVersion>4.0.0</modelVersion>
   <groupId>no.uio.inf5750</groupId>
   <artifactId>projectA</artifactId>
   <version>1</version>
   <packaging>war</packaging>
</project>
```

```
<project>
   <parent>
      <groupId>no.uio.inf5750</groupId>
      <artifactId>projectA</artifactId>
      <version>1</version>
   </parent>
   <modelVersion>4.0.0</modelVersion>
   <groupId>no.uio.inf5750</groupId>
   <artifactId>projectB</artifactId>
   <version>1</version>
</project>
```

Project B inherits war packaging

# 1. POM – Project aggregation

Project A (Parent)



Project B Project C Project D

A command against Project A will be run against Project B as well

```
<project>
   <modelVersion>4.0.0</modelVersion>
   <groupId>no.uio.inf5750</groupId>
   <artifactId>projectA</artifactId>
   <version>1</version>
   <packaging>pom</packaging>

   <modules>
      <module>projectB</module>
   </modules>
</project>
```

```
<project>
   <modelVersion>4.0.0</modelVersion>
   <groupId>no.uio.inf5750</groupId>
   <artifactId>projectB</artifactId>
   <version>1</version>
</project>
```

# 1. Build Lifecycle and Phases

- The *build lifecycle* is the process of building and distributing an artifact
- A *phase* is a step in the build lifecycle
- Most important default phases:
  - Validate
  - Compile
  - Test
  - Package
  - Install
  - Deploy
- Some common phases *not* default:
  - Clean
  - Site
- For each step, all previous steps are executed

# 2. Standard directory layout

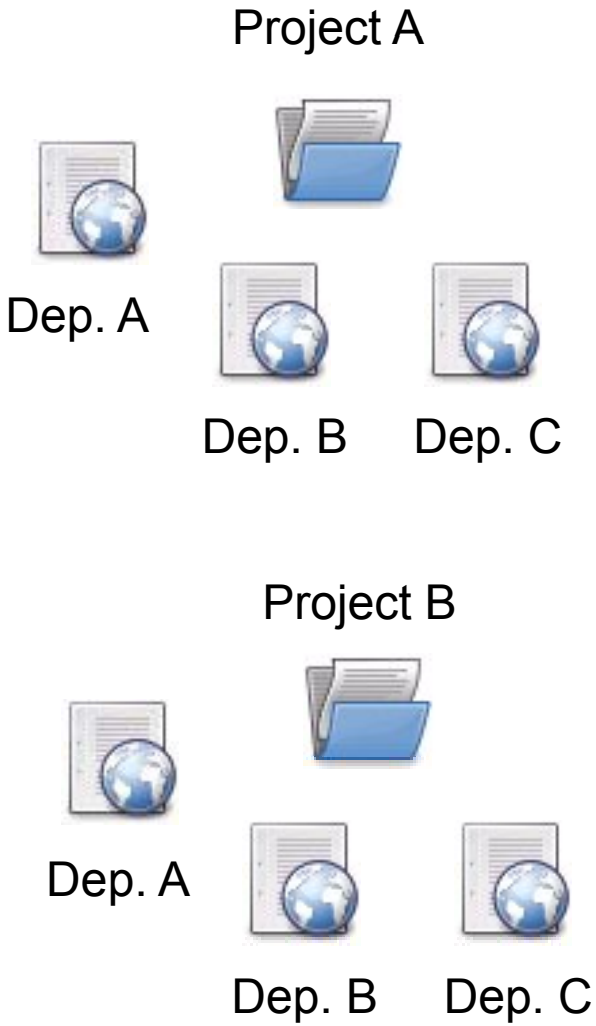
- Advantages:
  - A developer familar with Maven will quickly get familiar with a new project
  - No time wasted on re-inventing directory structures and conventions

| | |
|---|---|
| src/main/java | Java source files goes here |
| src/main/resources | Other resources your application needs |
| src/main/filters | Resource filters (properties files) |
| src/main/config | Configuration files |
| src/main/webapp | Web application directory for a WAR project |
| src/test/java | Test sources like unit tests (not deployed) |
| src/test/resources | Test resources (not deployed) |
| src/test/filters | Test resource filter files (not deployed) |
| src/site | Files used to generate the Maven project website |

# 3. Dependency management

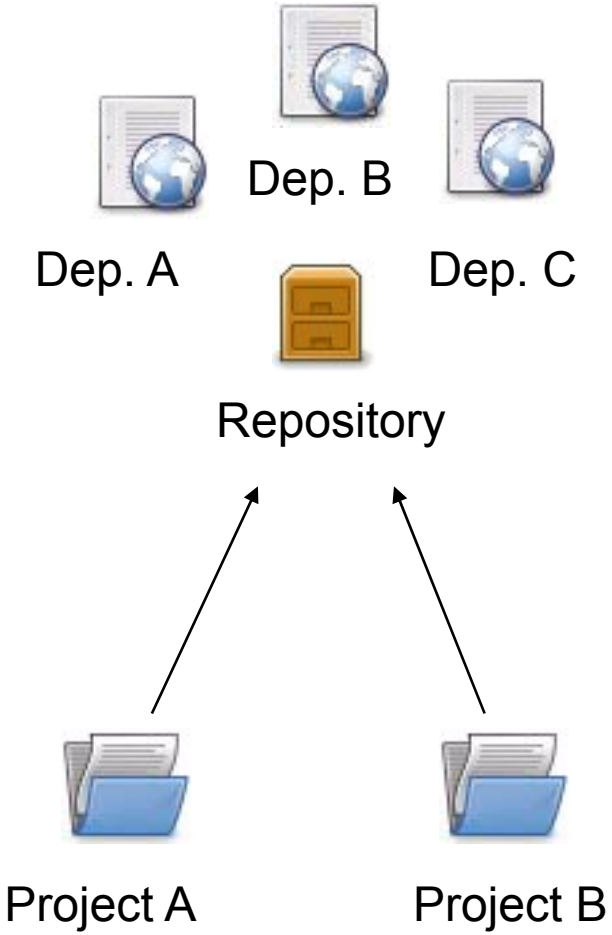
- Dependency: a third-party or project-local software library (JAR or WAR file)
- Dependency management is a challenge in multi-module projects

# 3. Dependency management




- The poor approach: Replicate all dependencies for every project (put in /lib folder within the project)
  - Dependencies are replicated and use more storage
  - Checking out a project will be slow
  - Difficult to keep track of versions

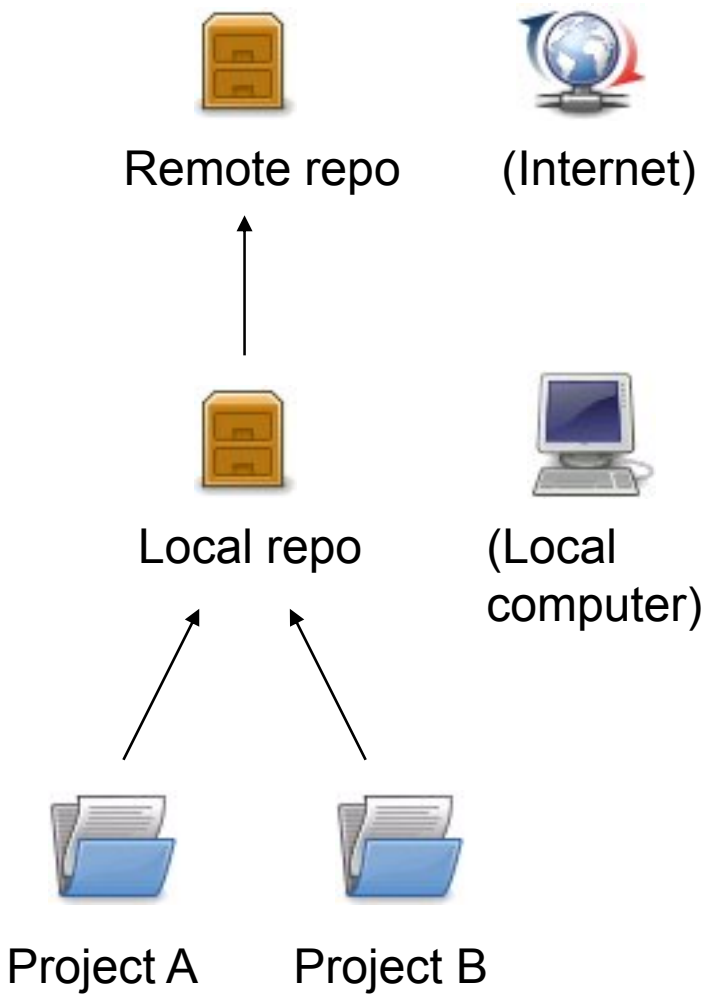
# 3. Dependency management




- The preferred solution: Use a *repository*
- Repository: A shared location for dependencies which all projects can access
  - Only one copy exists
  - Stored outside the project
- Dependencies are defined in the POM

```
<dependencies>
   <dependency>
      <groupId>commons-logging</groupId>
      <artifactId>commons-logging</groupId>
      <version>1.3</version>
   </dependency>
</dependencies>
```

# 3. Repositories



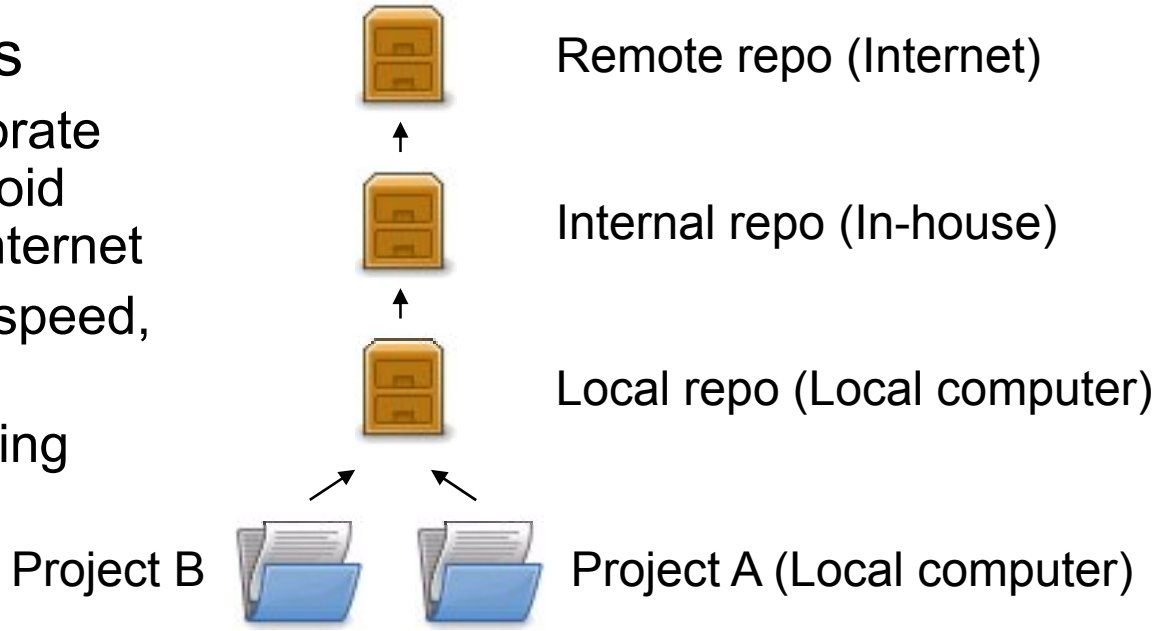

- Remote repository:
  - Provides software artifacts (dependencies) for download
  - E.g. repo1.maven.org houses Maven's central repository
- Local repository:
  - Copy on local computer which is a cache of the remote downloads
  - May contain project-local build artifacts as well
  - Located in USER_HOME/.m2/repository
  - Same structure as remote repos

# 3. Repositories

- Downloading from a remote repository
  - Central repo is default
  - Can be overridden

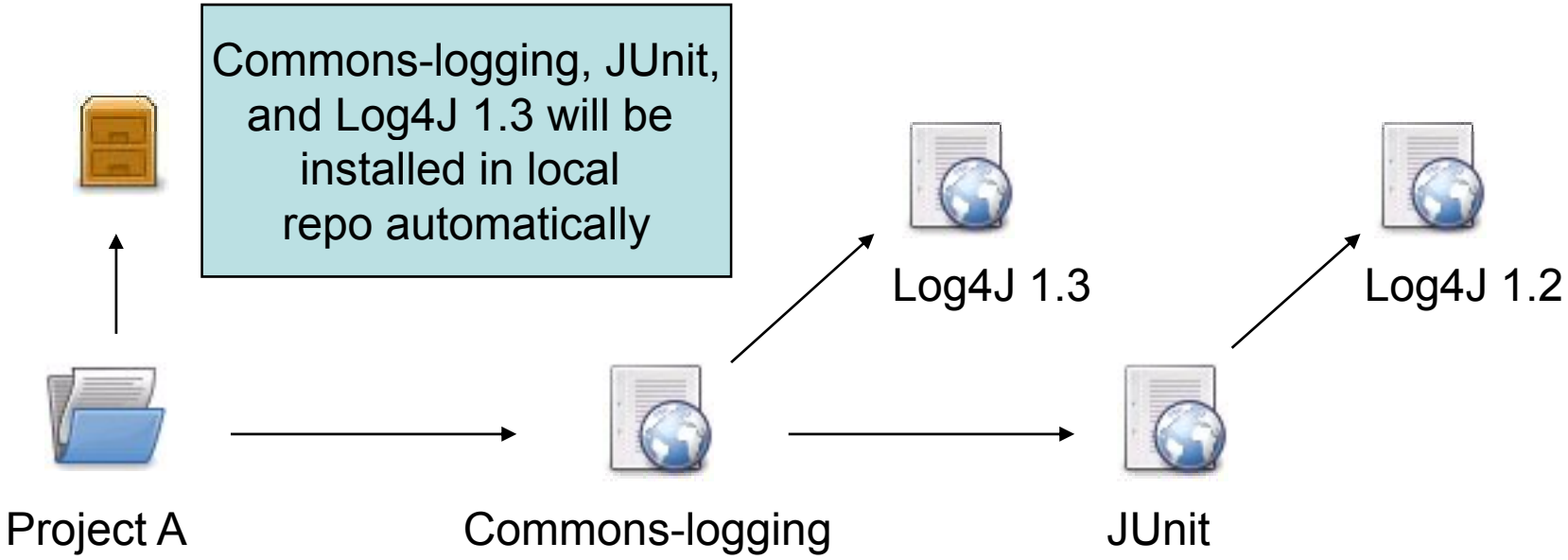
```
<repositories>
   <repository>
      <id>my-repo-</id>
      <url>http://my-server/repo</url>
   </repository>
</repositories>
```

- Internal repositories
  - Often used in corporate environments to avoid connection to the internet
  - Improves security, speed, and bandwidth
  - Suitable for publishing private artifacts



# 3. Transitive dependencies

- Maven reads the POM files of your dependencies and automatically includes their required libraries
- No limit on the number of levels
- *Dependency mediation* – nearest definition



# 3. Dependency scope

- Affects the classpath used for various build tasks
- Can be defined for all dependencies, *compile* default
- 5 dependency scopes available:
  - Compile: Available in all classpaths (default)
  - Provided: The JDK or the container provides it
  - Runtime: Only required for execution, not for compilation
  - Test: Only required for testing, not for normal use (not deployed)
  - System: You provide it locally, not looked up in a repo

```
<dependency>
   <groupId>commons-logging</groupId>
   <artifactId>commons-logging</artifactId>
   <version>1.4</version>
   <scope>compile</scope>
</dependency>
```

# 3. Dependency management

- Mechanism for centralizing dependency information
- Favourable for projects that inherits a common parent
- Useful for controlling versions of transitive dependencies

Parent POM

```
<dependencyManagement>
   <dependencies>
      <dependency>
         <groupId>junit</groupId>
         <artifactId>junit</groupId>
         <version>4.0</version>
         <scope>test</scope>
         <type>jar</type>
      </dependency>
   </dependencies>
</dependencyManagement>
```

Child POMs

```
...
   <dependency>
      <groupId>junit</groupId>
      <artifactId>junit</groupId>
   </dependency>
...
```

Child POM dependency inherits information from parent POM

Transitive occurences of JUnit guaranteed to be of version 4.0

# 4. Project information

- Powerful feature in Maven: Create a project site automatically
- Info retrieved from the POM, source code
- Provides information regarding
  - Dependencies
  - Issue tracking
  - Licensing
  - Development team
- Provides various reports
  - Test coverage
  - Internationalisation
  - JavaDocs
  - Potential code problems

# Useful commands

- $ mvn package — Compile and create JARs/WARs
- $ mvn install — Package + copy to local repo
- $ mvn clean — Delete target directory
- $ mvn test — Run unit tests

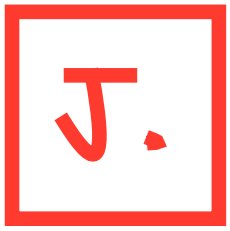
- $ mvn eclipse:eclipse — Create Eclipse project files
- $ mvn idea:idea — Create IDEA project files

- $ mvn jetty:run-war — Run a WAR file in Jetty
- $ mvn site — Generates project site

# Summary

- We've learned that Maven facilitates:
  - Uniform building of projects through the POM
  - Consistent project structure
  - Management of dependencies through repositories to avoid replication and ease re-use and versioning
  - Standardized and professional-quality project information

# Resources

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