Software project management

and

Maven

Problem area

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

The preferred* solution

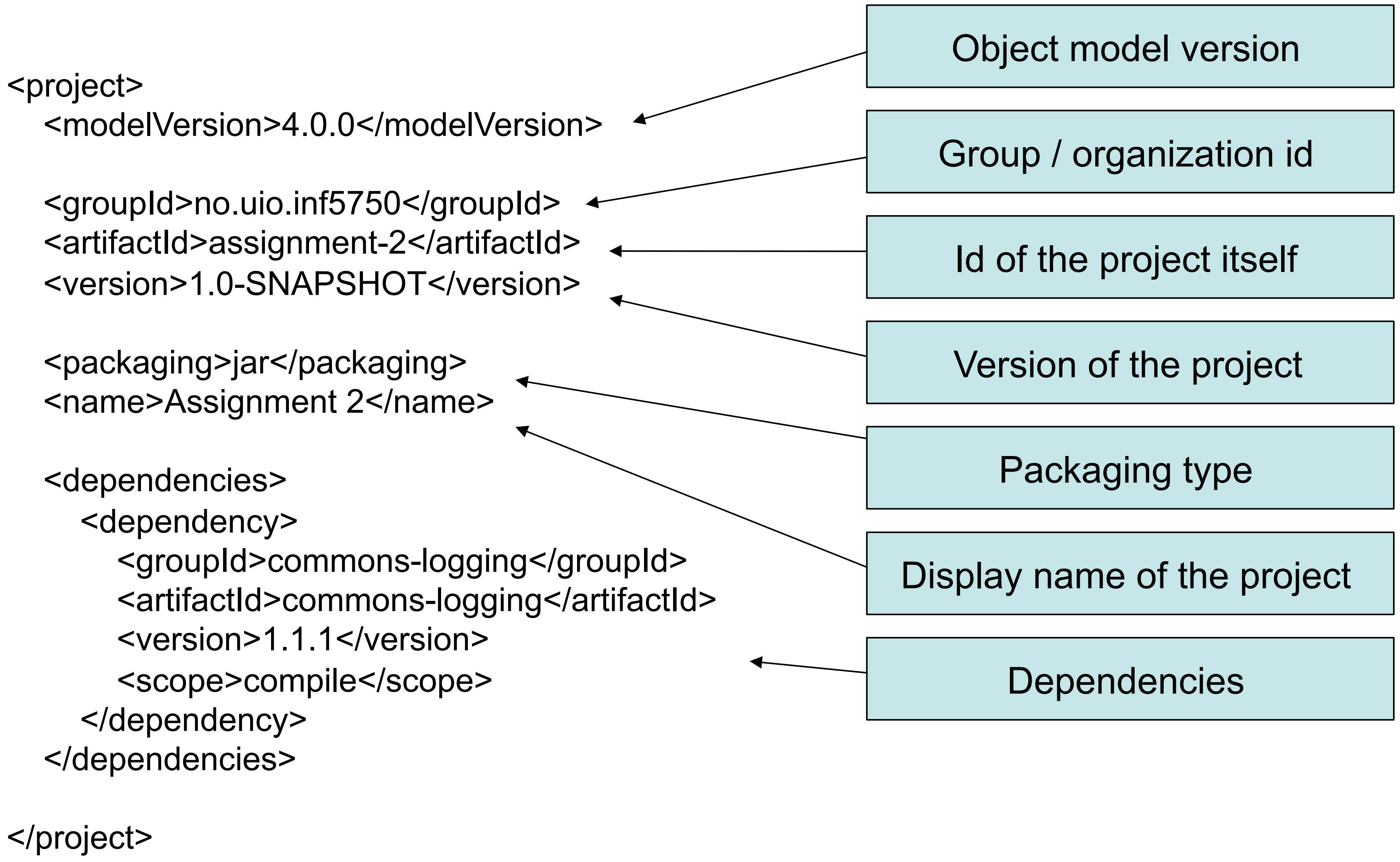
- Use a project management tool (like Maven)
- Maven helps you with various aspects:

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

1. Build process

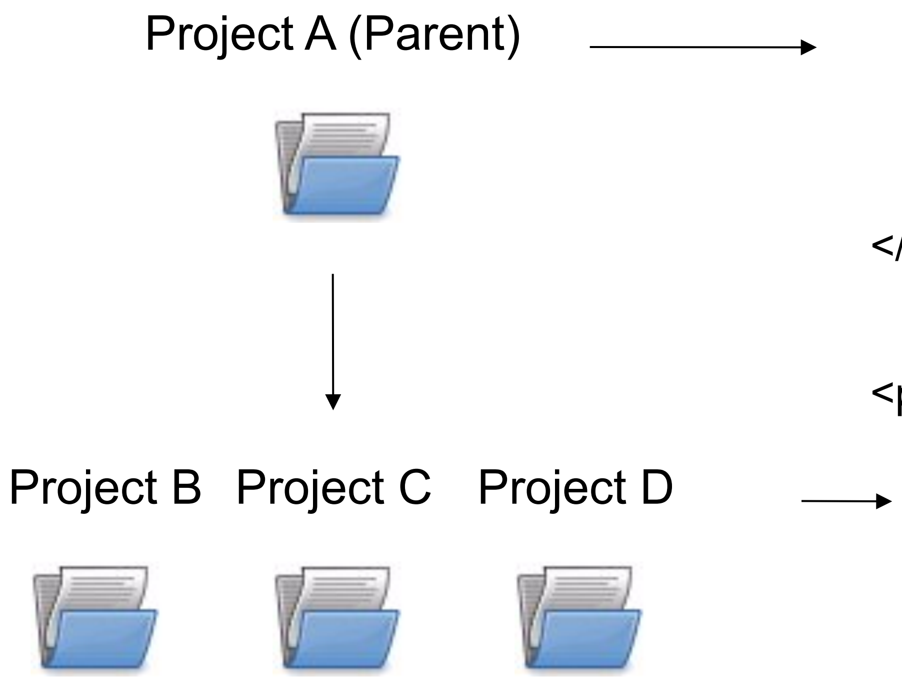
- The Project Object Model (POM) – an XML file – is the heart of a Maven 2 project
- Contains project information and configuration details used to build the project
  - Project dependencies
  - Commands (goals) that can be executed
  - Plugins
  - Metadata
- The POM extends the Super POM
  - Only 4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

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>1.1.1</version>
         <scope>compile</scope>
      </dependency>
   </dependencies>

</project>
```

1. POM – Project inheritance

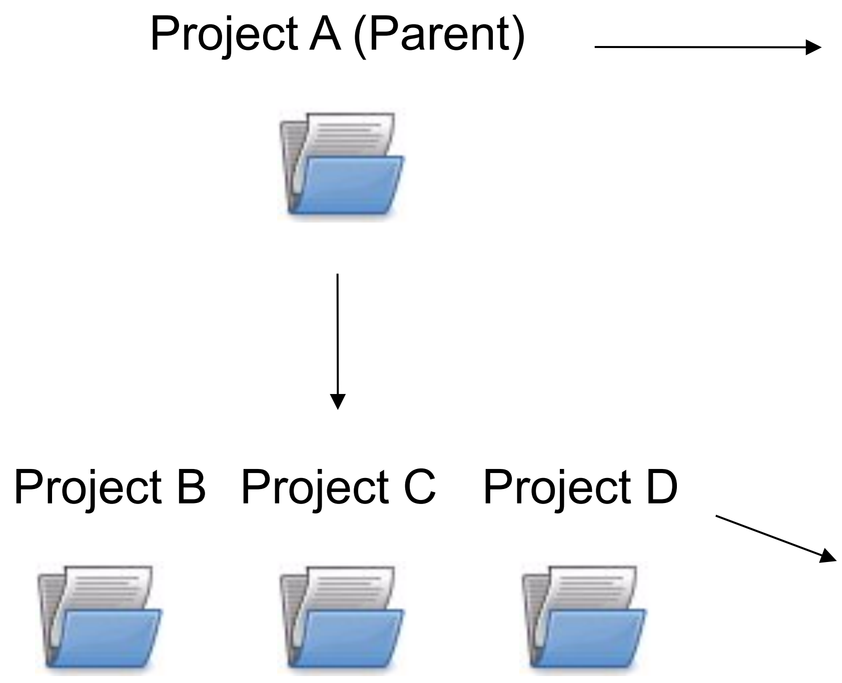


```
<project>
    <modelVersion>4.0.0</modelVersion>
    <groupId>no.uio.inf5750</groupId>
    <artifactId>projectA</artifactId>
    <version>1</version>
    <packaging>war</packaging>
</project>
```

```
<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>
   <modelVersion>4.0.0</modelVersion>
   <groupId>no.uio.inf5750</groupId>
   <artifactId>projectA</artifactId>
   <version>1</version>
   <packaging>pom</packaging>
   <modules>
      <module>projectB</module>
      <module>projectC</module>
      <module>projectD</module>
   </modules>
</project>
```

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

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

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

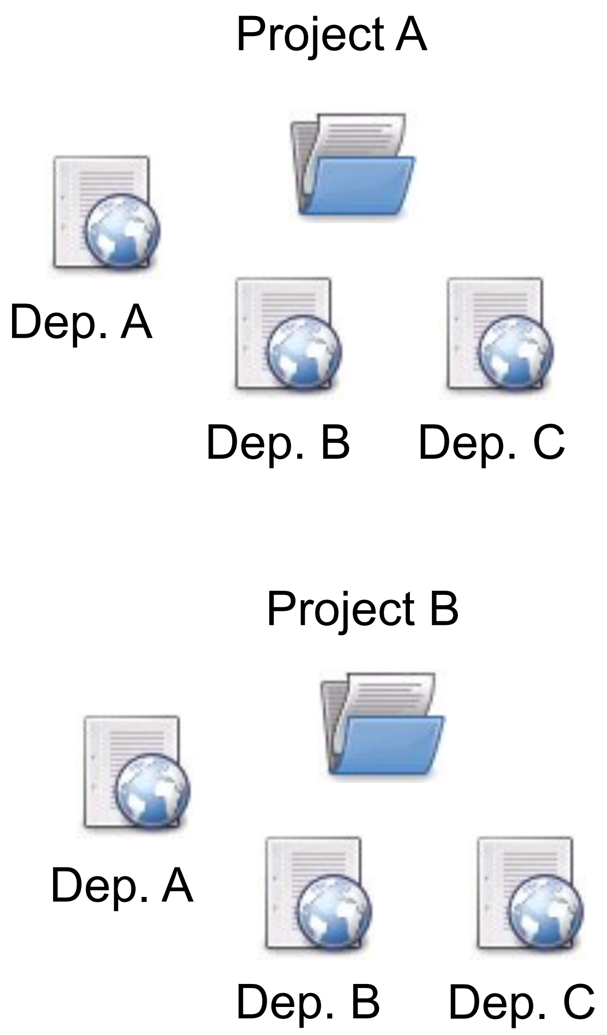
- Advantages:
  - A developer familar with Maven will quickly get familiar with a new project
  - No time wasted on re-inventing directory structures and conventions

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

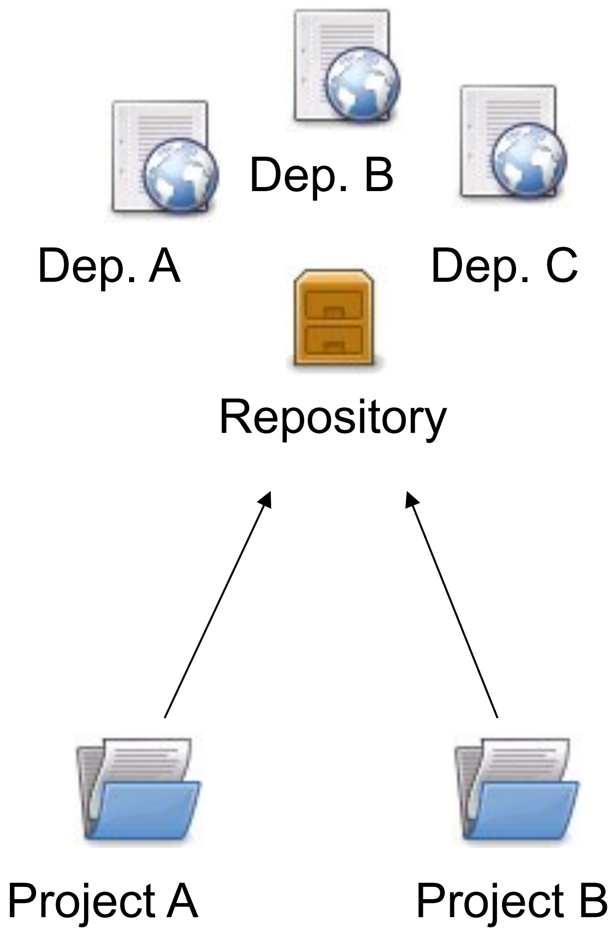
- Dependency: a third-party or project-local software library (JAR or WAR file)
- Dependency management is a challenge in multi-module projects

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

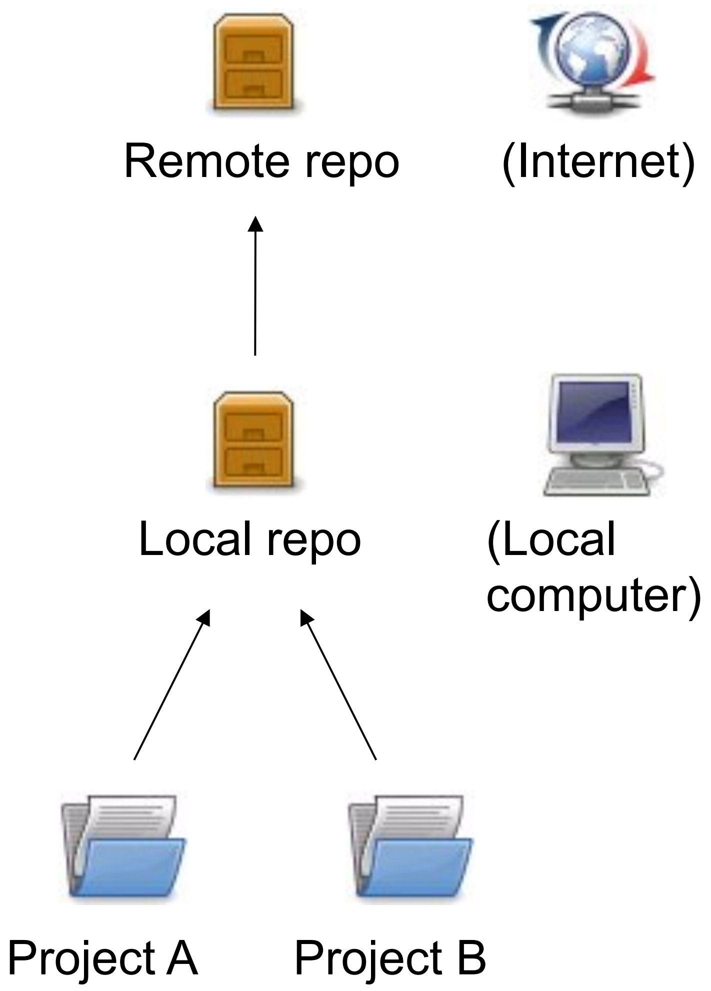
3. Dependency management



- 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>1.1.1</version>
   </dependency>
</dependencies>
```

3. Repositories



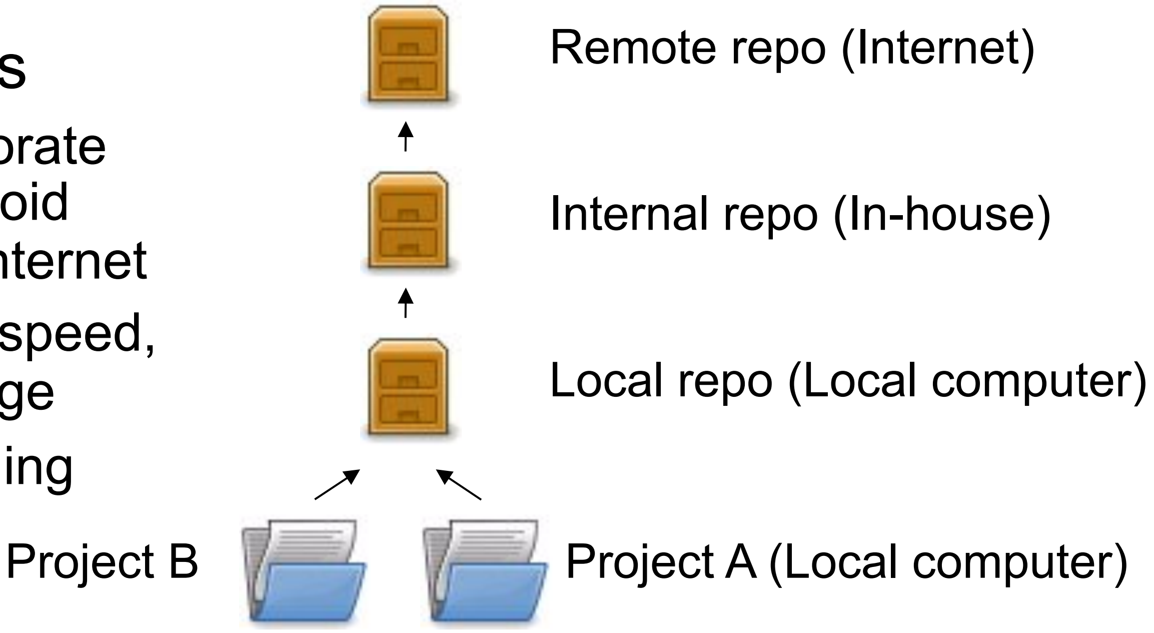
- Remote repository:
  - Provides software artifacts (dependencies) for download
  - E.g. repo1.maven.org houses Maven's central repository
- Local repository:
  - Copy on local computer which is a cache of the remote downloads
  - May contain project-local build artifacts as well
  - Located in USER_HOME/.m2/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

3. Repositories

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

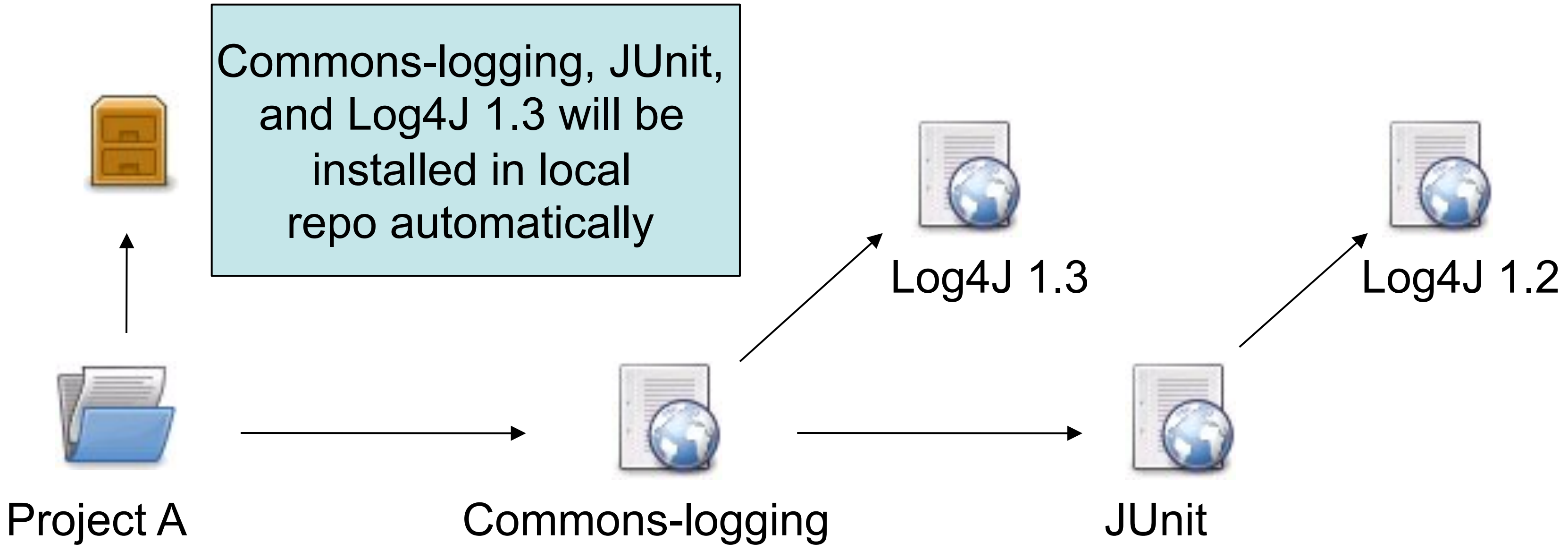
```
<repositories>
   <repository>
      <id>my-repo-</id>
      <url>http://my-server/repo</url>
   </repository>
</repositories>
```

- Internal repositories
  - Often used in corporate environments to avoid connection to the internet
  - Improves security, speed, and bandwidth usage
  - 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


Commons-logging, JUnit, and Log4J 1.3 will be installed in local repo automatically
Log4J 1.3
Log4J 1.2
Project A
Commons-logging
JUnit

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 project information

- Side topic: IDE support
  - Advantage of standardisation (but also the curse!)

Resources

- ”Better builds with Maven”
  - Free PDF book online
  - http://www.maestrodev.com/better-build-maven

- Maven homepage
  - Documentation and guides
  - http://maven.apache.org