Maven

What is Maven?

- A **project management tool**, which encompasses
  - a project object model,
  - a set of standards,
  - a project lifecycle,
  - a dependency management system and
  - logic for executing plugin goals at defined phases in a lifecycle.
- Convention over Configuration
  - (standardised project layout)
- Example of use

```
$ mvn archetype:generate -DgroupId=com.mycompany.app -DartifactId=my-app -DarchetypeArtifactId=maven-archetype-quickstart -DarchetypeVersion=1.4 -DinteractiveMode=false
```

Standardised folder layout

```
PROJECTDIR/
    POM.XML
    SRC/
        MAIN/
            JAVA/
                ...
            RESOURCES/
                META-INF/
                    SPRING/
                        *.XML
                OSGI-INF/
                    BLUEPRINT/
                        *.XML
        TEST/
            JAVA/
            RESOURCES/
    TARGET/
        ...
```

- **POM** contains a complete description of how to build the project
- **src** directory contains all of the source material for building the project, its site and so on.
- **target** directory contains the results of the build (typically a JAR), as well as all the intermediate files.

The POM

- Maven is based on the concept of
  - **Project Object Model (POM)**
- XML file, always residing in the base directory of the project as **pom.xml**.
  - Users defined POMs extend the Super POM.
- The POM contains information about the project and various configuration detail used by Maven to build the project.
- The Maven POM is declarative
  - No procedural details are needed.

POM Structure

- The POM contains four categories of description and configuration:

1. General project information
   - human-readable information
2. Build Settings
   - add plugins, attach plugin goal to lifecycle
3. Build Environment
   - describe the "family" environment in which Maven lives

- POM Relationships
  - coordinates, inheritance, aggregations, dependencies

An Example of POM

```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/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>

    <groupId>pt.ua.deti.ies</groupId>
    <artifactId>WeatherRadar</artifactId>
    <version>0.0.1-SNAPSHOT</version>
    <packaging>jar</packaging>

    <name>WeatherRadar</name>
    <url>http://maven.apache.org</url>

    <licenses>
        <license>
            <name>Apache 2</name>
            <url>http://www.apache.org/licenses/LICENSE-2.0.txt</url>
            <distribution>repo</distribution>
            <comments>A business-friendly OSS license</comments>
        </license>
    </licenses>

    <organization>
        <name>UA_IES</name>
        <url>http://www.ua.pt</url>
    </organization>
```

Run:

$ mvn compile
$ mvn package

An Example of POM

```
43      <properties>
44          <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
45          <maven.compiler.source>14</maven.compiler.source>
46          <maven.compiler.target>14</maven.compiler.target>
47      </properties>
48
49      <dependencies>
50          <dependency>
51              <groupId>junit</groupId>
52              <artifactId>junit</artifactId>
53              <version>3.8.1</version>
54              <scope>test</scope>
55          </dependency>
56          <dependency>
57              <groupId>com.squareup.retrofit2</groupId>
58              <artifactId>retrofit</artifactId>
59              <version>2.6.1</version>
60          </dependency>
61          <dependency>
62              <groupId>com.squareup.retrofit2</groupId>
63              <artifactId>converter-gson</artifactId>
64              <version>2.6.1</version>
65          </dependency>
66          <dependency>
67              <groupId>log4j</groupId>
68              <artifactId>log4j</artifactId>
69              <version>1.2.12</version>
70              <scope>compile</scope>
71          </dependency>
72      </dependencies>
```

An Example of POM

```
74      <build>
75          <plugins>
76
77              <plugin>
78                  <groupId>org.apache.maven.plugins</groupId>
79                  <artifactId>maven-site-plugin</artifactId>
80                  <version>3.8.2</version>
81              </plugin>
82
83              <plugin>
84                  <groupId>org.apache.maven.plugins</groupId>
85                  <artifactId>maven-project-info-reports-plugin</artifactId>
```

Maven Coordinates

- Coordinates define the unique place of the project in the Maven universe.
- They are made up of **<groupID>**, **<artifactID>** and **<version>** (The Maven trinity!)
- Project versions are used to group and order releases:
  - <major version>.<minor version>.<incremental version>-<qualifier>
  - E.g.: 1.2.3-alpha-2
- If the qualifier contains the keyword –SNAPSHOT
  - Maven will expand this token to a date and time value converted to UTC.

Maven Coordinates

- **groupId**
  - Name of the company, organization, team etc., usually using the reverse URL naming convention
- **artifactId**
  - A unique name for the project under groupId
- **version**
- **packaging**, default: jar
- **classifier**

Maven coordinates uniquely identifies a project.

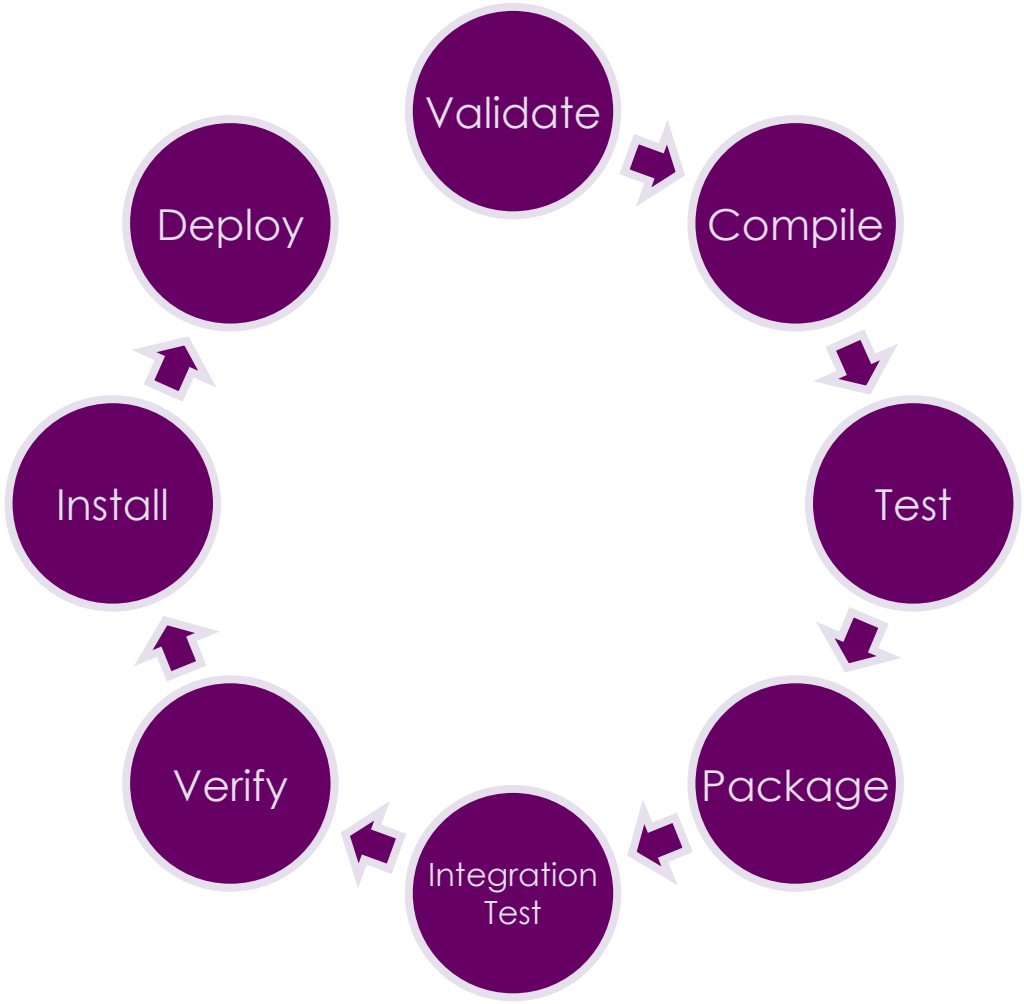
Maven Lifecycle

- A lifecycle is an organised sequence of phases that give order to a sequence of goals.
- Goals are packaged in plugins that are tied to phases.
- Calling a specific phase in a build cycle will trigger every prior build phase.

Clean Lifecyle
pre-clean
clean
post-clean

Default Lifecyle	
validate	test-compile
initialize	process-test-classes
generate-sources	test
process-sources	prepare-package
generate-resources	**package**
process-resources	pre-integration-test
compile	integration-test
process-classes	post-integration-test
generate-test-sources	verify
process-test-sources	**install**
generate-test-resources	**deploy**
processs-test-resources	

Maven Lifecycle



Maven Lifecycle

1. Validate
   - Validates the project structure is correct.
     - For example – It checks if all the dependencies have been downloaded and are available in the local repository.
2. Compile
   - It compiles the source code, converts the .java files to .class, and stores the classes in the target/classes folder.
3. Test
   - It runs unit tests for the project.
4. Package
   - It packages the compiled code in a distributable format like JAR or WAR.

Maven Lifecycle

5. Integration test
   - It runs the integration tests for the project.
6. Verify
   - It runs checks to verify that the project is valid and meets the quality standards.
7. Install
   - It installs the packaged code to the local Maven repository.
8. Deploy
   - It copies the packaged code to the remote repository for sharing it with other developers.

Build Lifecycle

- The process for building and distributing a project
- A build lifecycle consists of several steps called phases
- Some Default Lifecycle Phases
  - validate
  - compile
  - test
  - package
  - deploy

Goals and Plugins

- Goals are operations provided by Maven plugins
- Each phase is a sequence of goals
  - Each goal is responsible for a specific task
- When we run a phase, all goals bound to this phase are executed in order
- Some Maven Plugins
  - resources
  - compiler
  - surefire
  - jar, war

Archetype

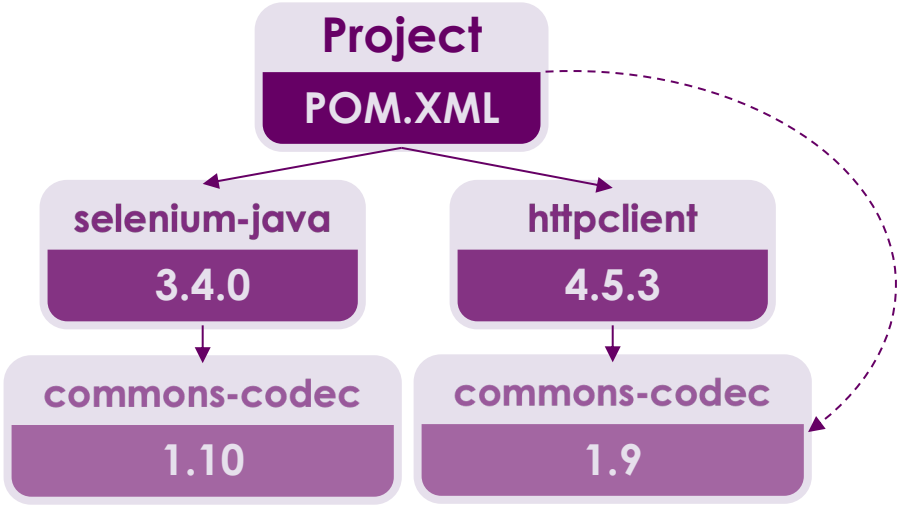
- An archetype is a *template* for a Maven project which can be used to create new projects quickly
- Example: creating a project from archetype
  - `maven-archetype-quickstart`
  - `maven-archetype-webapp`
- Users can create new archetypes and publish them through catalogs
  - Main Maven archetype catalog: http://repo1.maven.org/maven2/archetype-catalog.xml

Dependency Management

- A dependency of a project is a library that the project depends on
- Adding a dependency to a project is as simple as adding the coordinates of the library to `pom.xml`
- Maven *automatically downloads the library from an online repository* and store it locally for future use

Dependencies and Repositories

- Search for dependency coordinates
  - http://mvnrepository.com/
  - https://search.maven.org
- Maven Central Repository
  - https://repo.maven.apache.org/maven2/



Git and GitHub

Why version control?

- Scenario 1
  - Your program is working
  - You change "just one thing"
  - Your program breaks
  - You change it back
  - Your program is still broken--why?
- Scenario 2
  - Your program worked well enough yesterday
  - You made a lot of improvements last night...
    - ...but you haven't gotten them to work yet
  - You need to turn in your program now

Version control for teams

- Scenario 1
  - You change one part of a program--it works
  - Your co-worker changes another part--it works
  - You put them together--it doesn't work
  - Some change in one part must have broken something in the other part
  - What were all the changes?

- Scenario 2
  - You make a number of improvements to a class
  - Your co-worker makes a number of different improvements to the same class
  - How can you merge these changes?

Version control systems

- A version control system (often called a source code control system) does these things:
  - Keeps multiple (older and newer) versions of everything (not just source code)
  - Requests comments regarding every change
  - Allows “check in” and “check out” of files so you know which files someone else is working on
  - Displays differences between versions

Benefits of version control

- For working by yourself:
  - Gives you a "time machine" for going back to earlier versions
  - Gives you great support for different versions (standalone, web app, etc.) of the same basic project
- For working with others:
  - Greatly simplifies concurrent work, merging changes

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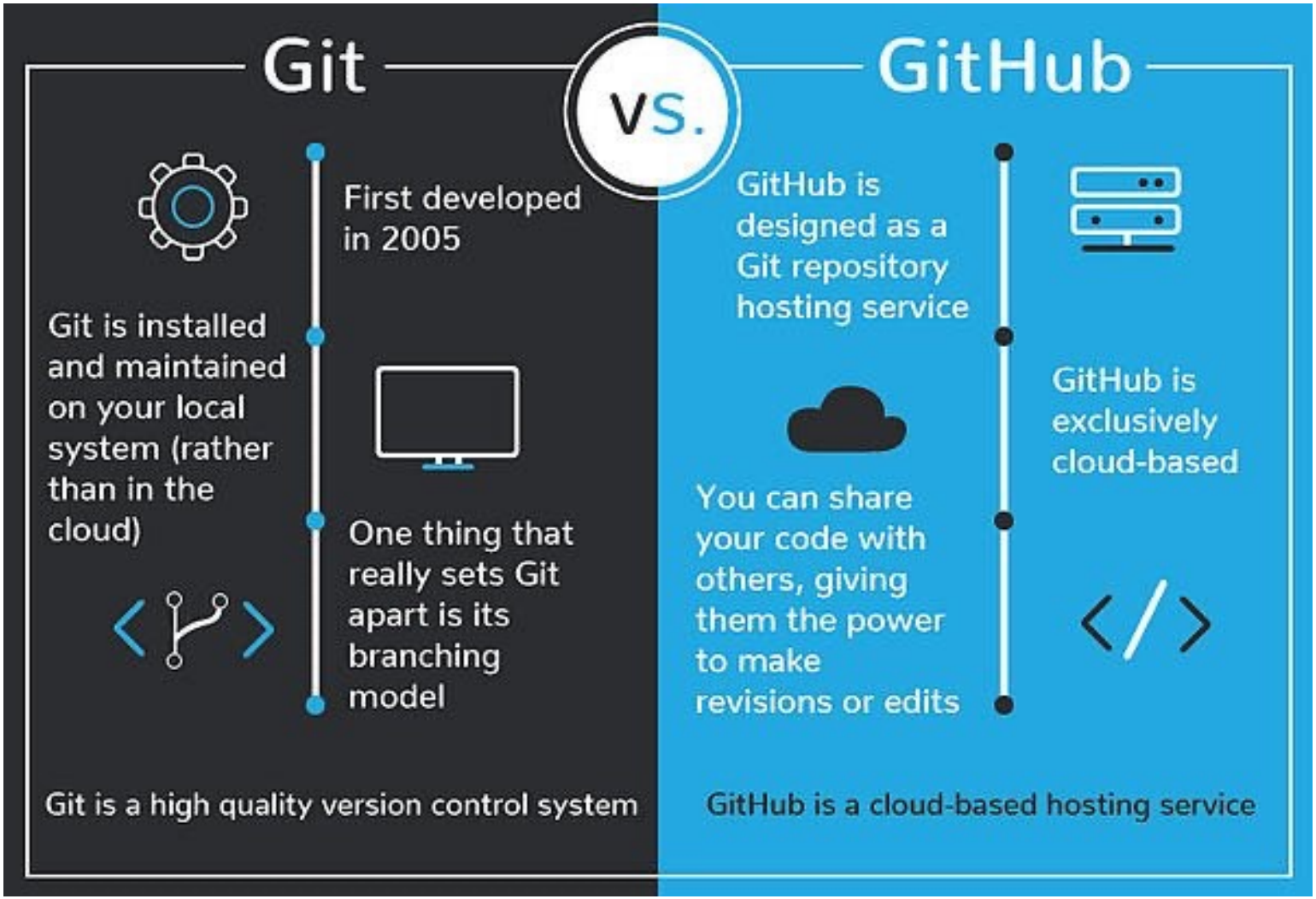
What are Git and GitHub



Introduce yourself to Git

- On your computer, open the Git Shell application.
- Enter these lines (with appropriate changes):

```
git config --global user.name "John Smith"
git config --global user.email jsmith@seas.upenn.edu
```

- You only need to do this once
- If you want to use a different name/email address for a particular project, you can change it for just that project
  - cd to the project directory
  - Use the above commands, but leave out the `--global`

init and the .git repository

- When you execute the command **git init** in your project directory, or when you clone an existing project, you create a repository
  - The repository is a subdirectory named .git containing various files
  - The dot indicates a "hidden" directory
  - You do not work directly with the contents of that directory; various git commands do that for you

- At any time, you can take a "snapshot" of everything (or selected things) in your project directory, and put it in your repository
  - This "snapshot" is called a **commit object**

Making commits

- You do your work in your project directory, as usual
- If you create new files and/or folders, they are not tracked by Git unless you ask it to do so

```
git add newFile1 newFolder1 newFolder2 newFile2
```

- Committing makes a "snapshot" of everything being tracked into your repository
  - A message telling what you have done is required

```
git commit –m "Uncrevulated the conundrum bar"
git commit
```

Commits and graphs

- A **commit** is when you tell git that a change (or addition) you have made is ready to be included in the project
- When you commit your change to git, it creates a **commit object**
  - a complete state of the project, including all the files in the project
  - The very first commit object has no "parents"
  - Usually, you take some commit object, make some changes, and create a new commit object; the original commit object is the parent of the new commit object
    - Hence, most commit objects have a single parent
  - You can also **merge** two commit objects to form a new one
    - The new commit object has two parents
- Hence, commit objects forms a directed graph
  - **Git is all about using and manipulating this graph**

Commit messages

- In git, "Commits are cheap." Do them often.
- When you commit, you must provide a one-line message stating what you have done
  - Terrible message: "Fixed a bunch of things"
  - Better message: "Corrected the calculation of median scores"
- Commit messages can be very helpful, to yourself as well as to your team members
- You can't say much in one line, so commit often

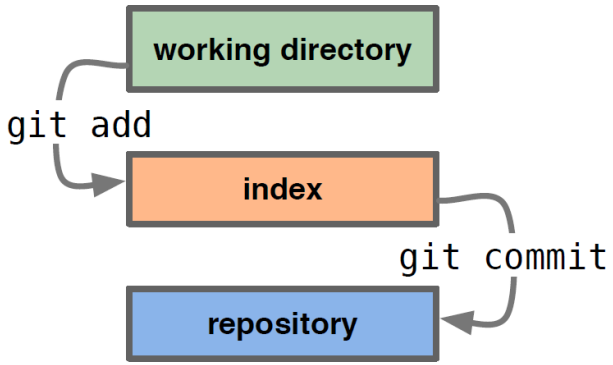
Typical workflow

`git status`

- See what Git thinks is going on
- Use this frequently!

- Work on your files

```
git add your editfiles
git commit –m “What I did”
```

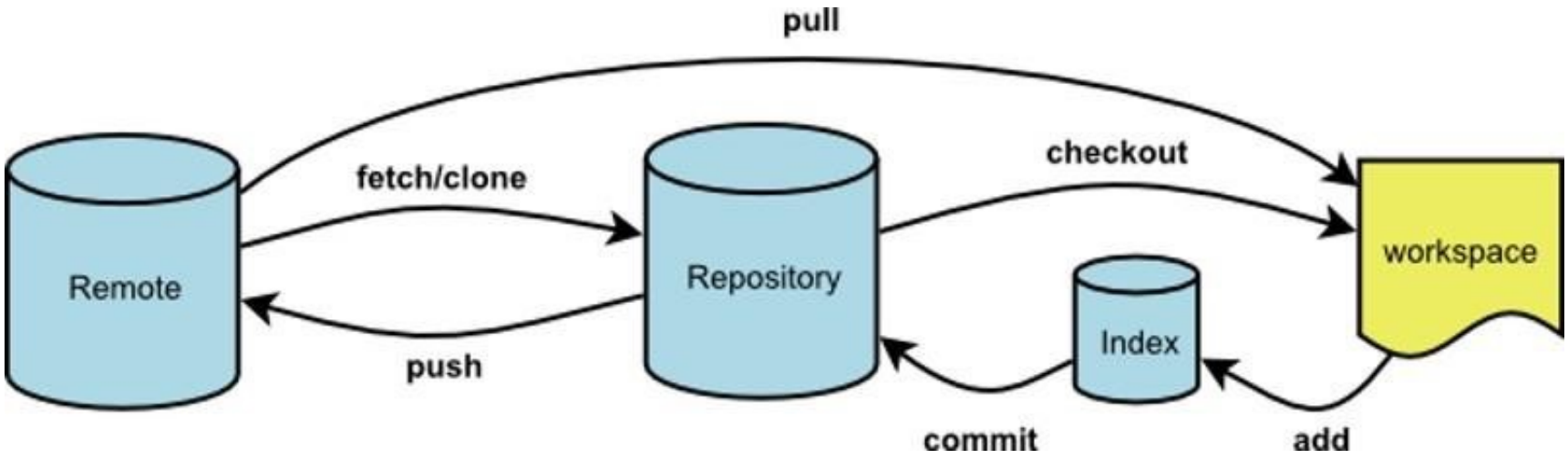


Keeping it simple

- If you:
  - Make sure you are current with the central repository
  - Make some improvements to your code
  - Update the central repository before anyone else does
- Then you don't have to worry about resolving conflicts or working with multiple branches
  - All the complexity in git comes from dealing with these
- Therefore:
  - Make sure you are up-to-date before starting to work
  - Commit and update the central repository frequently

- If you need help: https://help.github.com/

More Commands



Remote repositories

- GitHub
- GitLab
- Bitbucket
- Amazon AWS CodeCommit
- Codebase
- Microsoft Azure DevOps
- SourceForge

Introduce yourself to GitHub

- Register on GitHub
  - https://github.com/
- Authenticating to GitHub Desktop
- Create or add a repository to GitHub
- Commit your changes on GitHub
- Creating a branch for your work
- Synchronizing your branch