Overview

Appendix

➟ Examination bonus point projects

Collaborative efforts

Is this your **TEAM**?

Toll

Ein

Anderer

Machts

Project rules

1. You are expected to work as a **team of three partners**.
2. Using the MI Gitlab SCM is a plus with respect to project evaluation. See table below.
3. Your team is expected to supply a Maven project based on the MI “Maven archetype quickstart” available from `https://maven.mi.hdm-stuttgart.de/nexus/repository/mi-maven/archetype-catalog.xml`.
4. You are expected to provide good internal code documentation with respect both to method signatures (Javadoc™) and method implementation.

Internal code documentation

You are expected to provide good internal code documentation with respect both to method signatures (Javadoc™) and method implementation. Possible problems involve:

```
24          value ++;
25
26
27          System.out.println("Value:" + value);
28
29
30          value++;
31
32          int result = (int) value / 2;
33
34      }
35  }
36
```

Casting 'value' to 'int' is redundant more... (Ctrl+F1)

Internal code documentation hints

Compile time warnings

Activate most compiler warnings at Editor --> Inspections. This will show potential compile time problems like dead / unnecessary / unreachable code, unused variable values, shadowing conflicts and so on.

Javadoc™ mismatches

Your method's formal parameters, their type and a method's return type must match your documentation.

```
5
6   public class ShowReachedPoints {
7
8       /**
9        * Execution reveals the number of reached p
10       *
11       * @param args Unused
12       */
13      Cannot resolve symbol 'args' more... (Ctrl+F1)
14      public static void main(String[] arg) {
15          RunTests.exec(
16                  exerciseTitle: "Aufgabe 1" , Test_Helpe
17
```

(Automated) tests

You are expected to provide meaningful unit tests:

- Try to cover all your implementation code and not just isolated modules / methods.
- If methods allow for null values write suitable tests.
- Test special cases: If a method expects i.e. an array of strings it may be allowed having zero length.

Deployment and execution

Your resulting project should be easily installable and runnable.

- Maven is a good starting point with respect both to testing and cross platform (Unix / Windows / Apple) portability.
- Avoid dependencies to local file system resources like `c:\users\xyz\testdata.txt`.

Tip

Test your application's deployability by installing it on an untouched target platform (possibly of a different hard/software architecture) and execute **mvn** `test` (provided you do have written meaningful unit tests).

Marking criteria

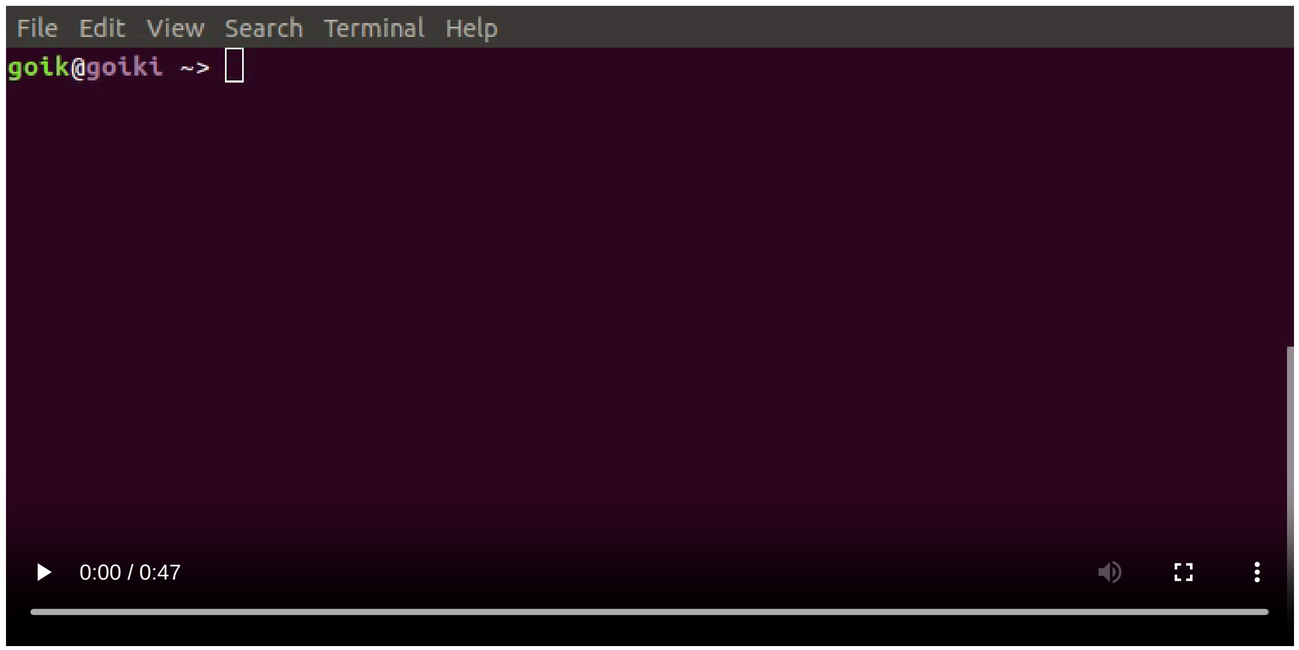
Criterion	Percentage
Overall code quality	20%
Code documentation	20%
Unit tests	10%
Deployment	10%
SCM usage	10%
Software functionality	30%

Overview

Appendix

- Examination bonus point projects
- Weather forecast

Sample forecast session



Sample forecast invocation

```
goik@goiki target> java -jar weather-1.0.jar Stuttgart (1)
1 = Stadtkreis Stuttgart          (2)
2 = Regierungsbezirk Stuttgart
3 = Stuttgart
4 = Stuttgart Feuerbach
5 = Stuttgart Muehlhausen

Bitte gültige Auswahl 1 bis 5 treffen:2 (3)
Vorhersage für Regierungsbezirk Stuttgart (4)
Dienstag, 15.05
    23:00:  11°C, Leichter Regen
Mittwoch, 16.05
    02:00:  10°C, Leichter Regen
    05:00:  10°C, Leichter Regen
    08:00:  11°C, Leichter Regen
 ...
```

Underlying data provider

```
https://api.openweathermap.org/data/2.5/forecast?lang=de& (1)
APPID=7cufdhdcgdhsgdhgfcgsdss67b3&units=metric&id=3214105


{"cod":"200","message":0.0042,"cnt":40,"list":[            (2)
 {"dt":1526428800,"main":{"temp":10.29,"temp_min":10.29,
"temp_max":12.45,"pressure":985.75,"sea_level":1027.48,
"grnd_level":985.75,"humidity":80,"temp_kf":-2.16},
"weather":[{"id":500,"main":"Rain",
"description":"Leichter Regen","icon":"10n"}],"clouds":
{"all":88},"wind":{"speed":1.59,"deg":313.503},"rain":
{"3h":0.315},"sys":{"pod":"n"},"dt_txt":"2018-05-16 00:00:00"},
{"dt":1526439600,"main": ...
```

(1) An URL containing an id value corresponding to a uniquely defined town or region. We identify the following components:

`lang=de`

Provide German localization e.g. «*Leichter Regen*» in favour of «light rain».

APPID=7cufdhdcgdhsgdhgfcgsdss67b3

This parameter allows for accessing the service: «7cufdhdcgdhsgdhgfcgsdss67b3» is actually a fake value. Your project requires obtaining an APPID token.

units=metric

`cities.list.json.gz` providing cities

```
[
  {
    "id": 2886241,
    "name": "Regierungsbezirk Köln",
    "country": "DE",
    "coord": {
      "lon": 7.16667,
      "lat": 50.833328
    }
  },
  {
    "id": 3247452,
    "name": "Kreis Euskirchen",
...
]
```

ma/Copy URL result to file

```
FileUtils.copyURLToFile(
  "https://api.openweathermap.org/data/2.5/forecast...",
  new File("weatherData.json"));
```

```
<dependency>
  <groupId>commons-io</groupId>
  <artifactId>commons-io</artifactId>
  <version>2.6</version>
</dependency>
```

Parse city data

```
public class Cities {
  static public final City[] cities;
   ...
}
```

```
@Test public void testParsedCityCount() {
  Assert.assertEquals(209579, Cities.cities.length);
}
```

Parse weather data

```
public class WeatherDataParser {

  static public final Weather parse(final String jsonWeatherDataFilename)
     throws IOException {
    return ...;
  }
}
```

```
@Test public void testParseWeatherData() {
...
  Weather weather = WeatherDataParser.parse(
    "src/main/resources/stuttgart.weather.json");
...
```

Requirements

1. The application shall accept a command line parameter like e.g. «Stuttgart» to filter matching cities from `cities.list.json`.
2. If a given filter matches multiple locations the user shall have an option for choosing the desired one.
3. The most recent city id value shall be cached in a file. Subsequent invocations without command line parameter shall provide a current forecast corresponding to this value.
4. Weather data belonging to a given id value shall be cached locally for 10 minutes. Subsequent weather queries within this period shall be read from cache rather than by accessing `https://api.openweathermap.org/...`.

   Provide logging to a file rather than to the console to avoid cluttering the user interface. Log cache handling.

Logging

- Provide logging to a file rather than to the console to avoid cluttering the user interface.
- Log cache handling.

```
main INFO  weather.Forecast - Re-using cache file
 '/ma/goik/Forecast/6930414.json' from 196 seconds ago
```

Overview

Appendix

- Examination bonus point projects
  - Reverse Polish notation (RPN) calculator
    - Implementation hints

Minimalist token scanner

```
final String[] patterns = new String[] {
  "sqrt",
  "[-]?([0-9]+[.]?[0-9]*|[.][0-9]+)(E[-]?[0-9]+)?",// Matches e.g. -1.5E-33
  "\\+"};// Escape required avoiding regular expression syntax clash.
final String expression = "2.1 -3.4 sqrt";
try (final Scanner scanner = new Scanner(expression)) {
  while (scanner.hasNext()) {
    for (final String p: patterns) {
      if (scanner.hasNext(p)) {
        System.out.println("Token '" + scanner.next(p) +
            "' matched by '" + p + "'");
        break;
      }
    }
  }
}
```

Scanner output `-1.34 0.34 + sqrt`

```
Token '2.1' matched by '[-]?([0-9]+[.]?[0-9]*|[.][0-9]+)(E[-]?[0-9]+)?'
Token '-3.4' matched by '[-]?([0-9]+[.]?[0-9]*|[.][0-9]+)(E[-]?[0-9]+)?'
Token 'sqrt' matched by 'sqrt'
```

Adding error detection

```
...
final String[] patterns = new String[] {
  "sqrt",
  "[-]?([0-9]+[.]?[0-9]*|[.][0-9]+)(E[-]?[0-9]+)?",// Matches e.g. -1.5E-33
  "\\+"};// Escape required avoiding regular expression syntax clash.
try (final Scanner scanner = new Scanner("2.1 -3.4 pbck") ❶ ) {
  while (scanner.hasNext()) {
    boolean foundToken = false;
    for (final String p: patterns) {
      if (scanner.hasNext(p)) {
        foundToken = true;
        System.out.println("Token '" + scanner.next(p) +
          "' matched by '" + p + "'");
        break;
      }
    }
    if (!foundToken) {
      System.out.println("Parsing error at '" + scanner.nextLine() + "'");
      System.exit(1);
    } ...
```

Error message

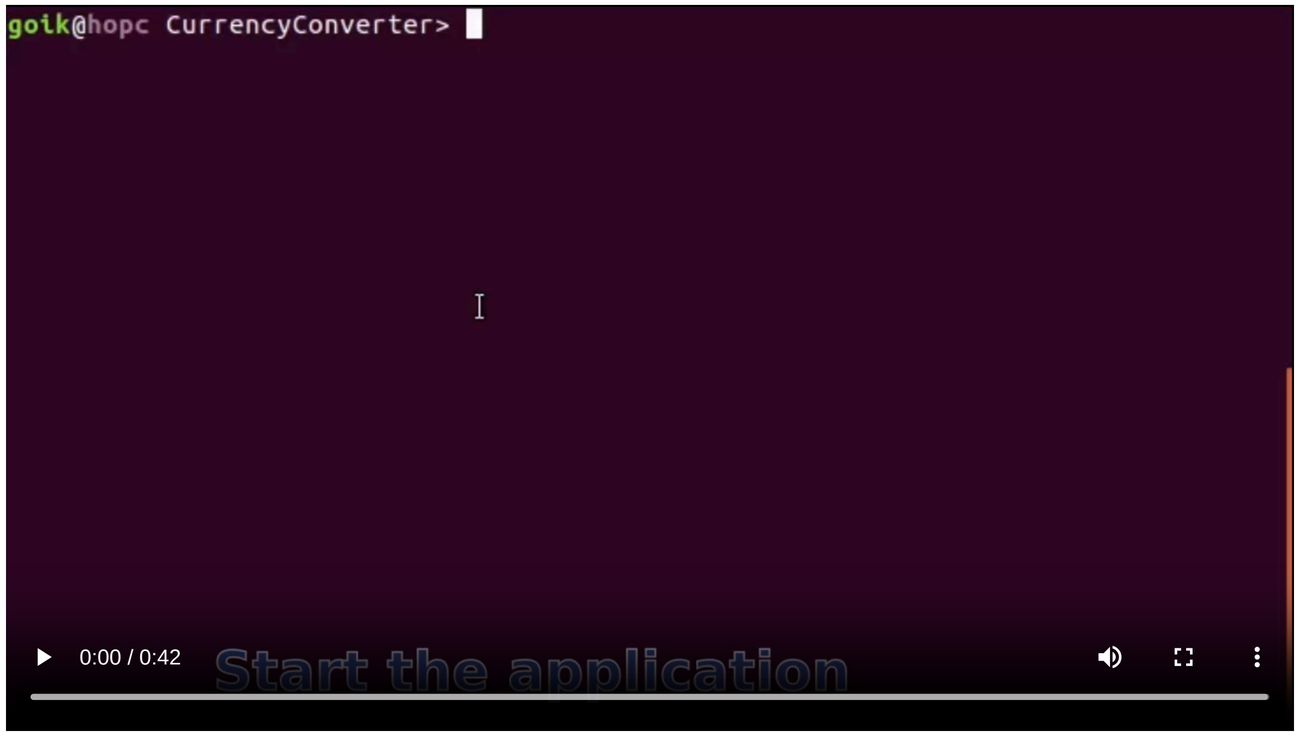
```
Token '2.1' matched by '[-]?([0-9]+[.]?[0-9]*|[.][0-9]+)(E[-]?[0-9]+)?'
Token '-3.4' matched by '[-]?([0-9]+[.]?[0-9]*|[.][0-9]+)(E[-]?[0-9]+)?'
Parsing error at 'pbck'
```

Overview

Appendix

- Examination bonus point projects
  - Currency converter, Summer 2017

Running the currency converter terminal application.

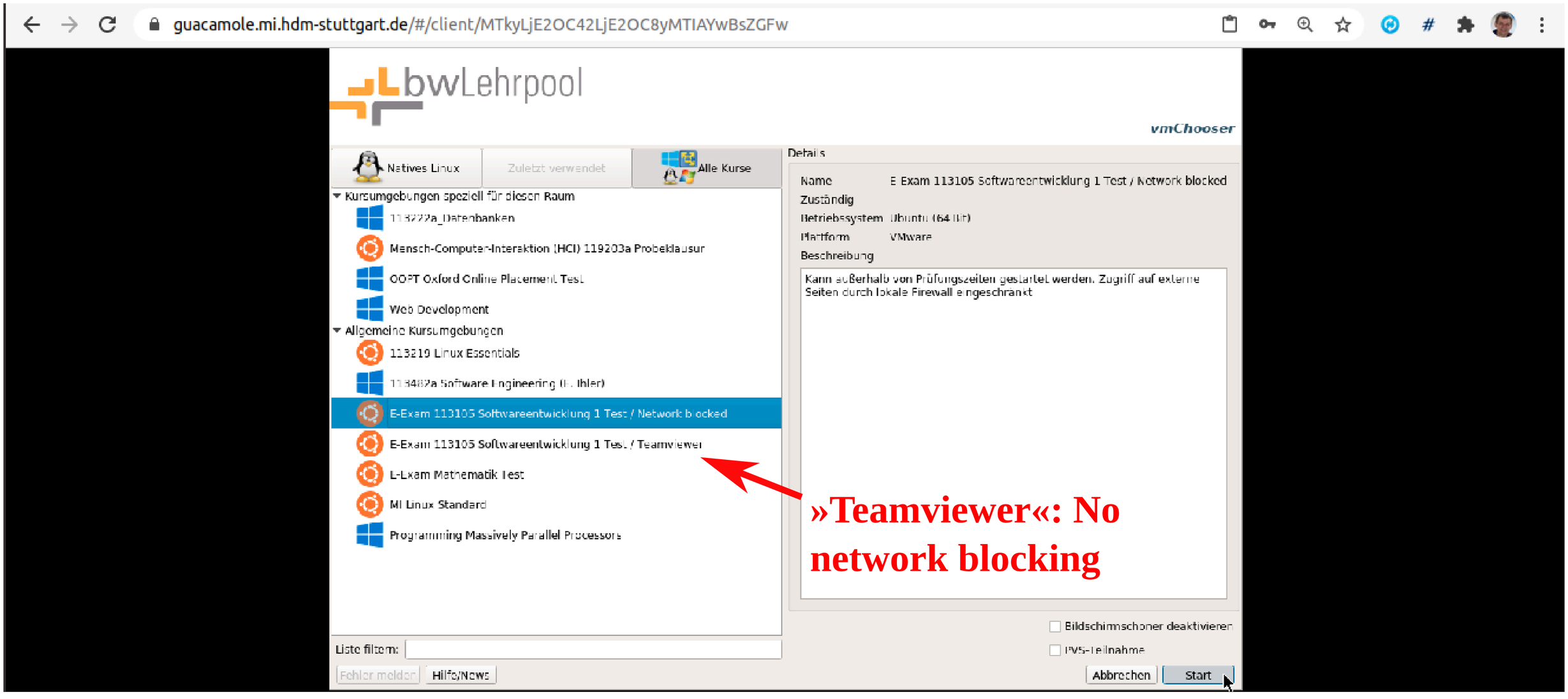


Overview

Appendix

- Exercising past examinations

Exam training by Guacamole



Environment hints:

The following installations allow for exercises with respect to the final examination:

- E-Exam 113105 *Softwareentwicklung* 1 Test / Network blocked:

  The examination environment with firewall rules restricting Internet access to a small number of allowed sites.

- E-Exam 113105 *Softwareentwicklung* 1 Test / Teamviewer:

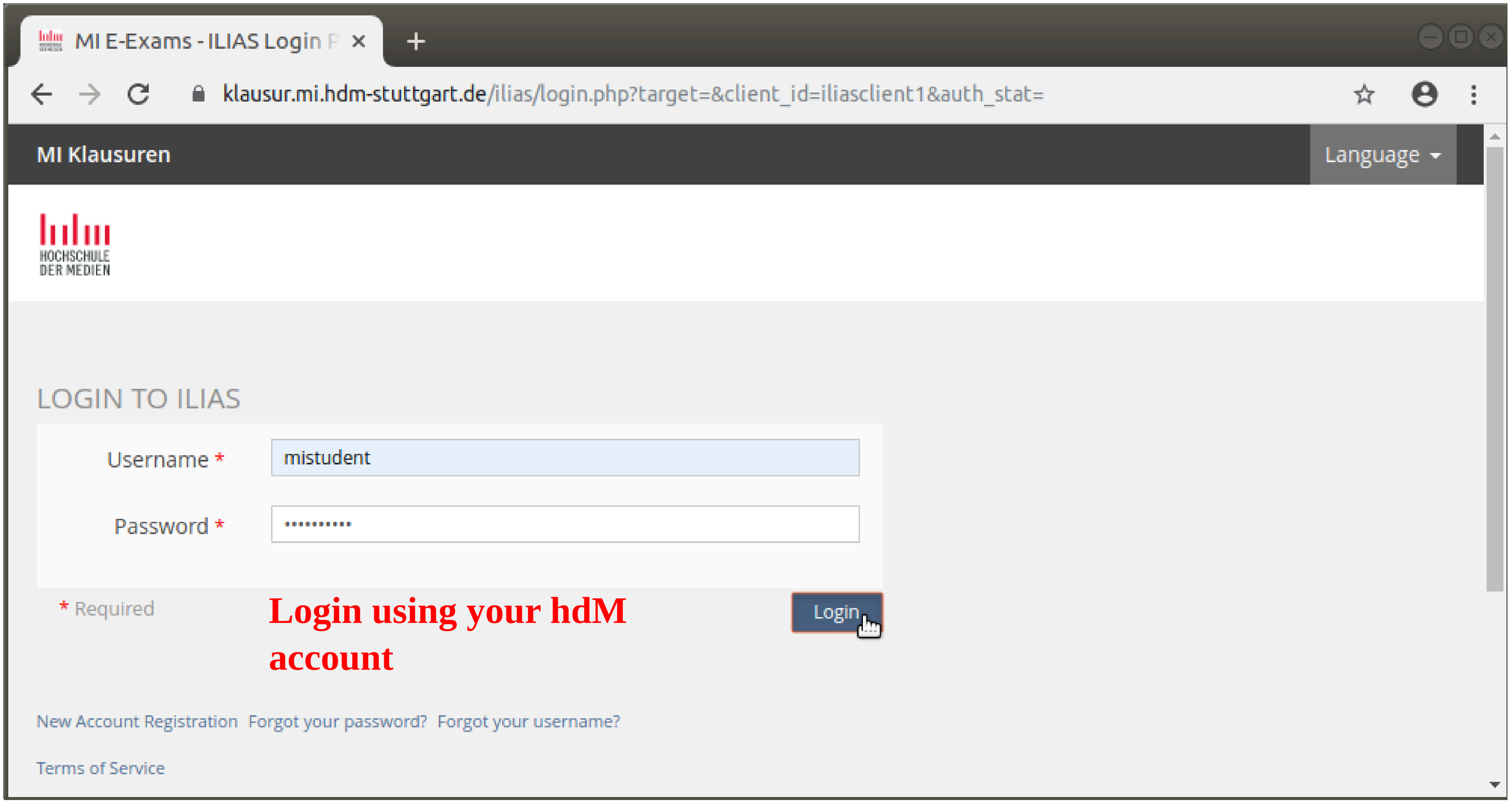
  No Internet blocking. Teamviewer allows for getting external help.

Overview

Appendix

- Exercising past examinations
- Starting an exam

Preparing an examination



Overview

Appendix

- Exercising past examinations
  - Implementing the project skeleton

Generating Javadoc™.

- HTML is difficult to read:

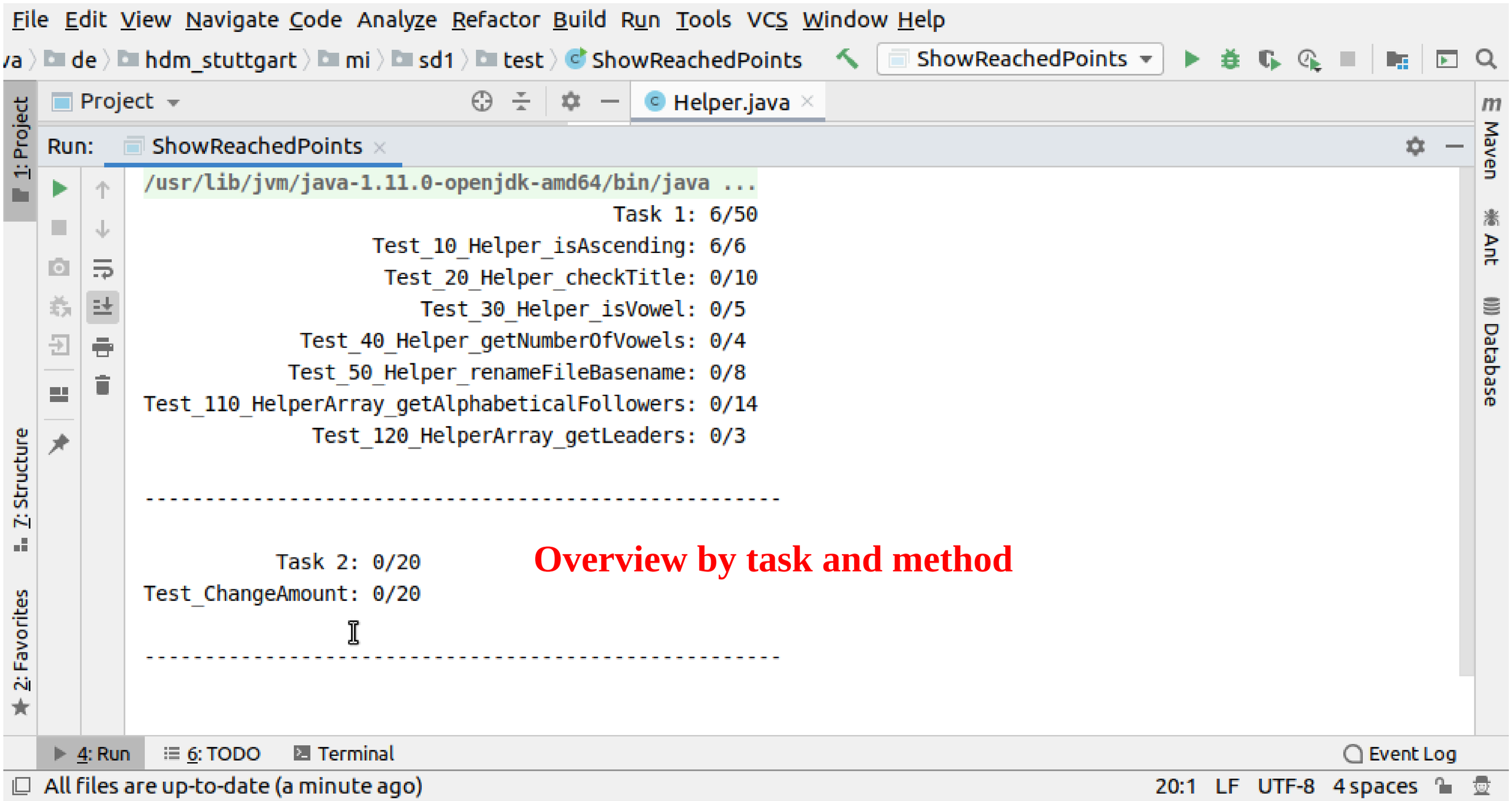
```
     *     <td><code>a = -3</code>, <code>b = 4</code>, <code>c = 3</code>
     *     <td>4 - (-3) = 7</td>
     *   </tr>
     * </table>
     ...
     */
    static public int getMaxAbsoluteDiff(int a, int b, int c) {
      return 42;  // TODO: Implement me correctly
```

- ⇒ Generate Javadoc™ by CLI or Idea.

Programming hints

- The debugger is your friend ...
- ... but only if acquiring prior proficiency.
- Train prime or related example.

The implement - test - implement cycle

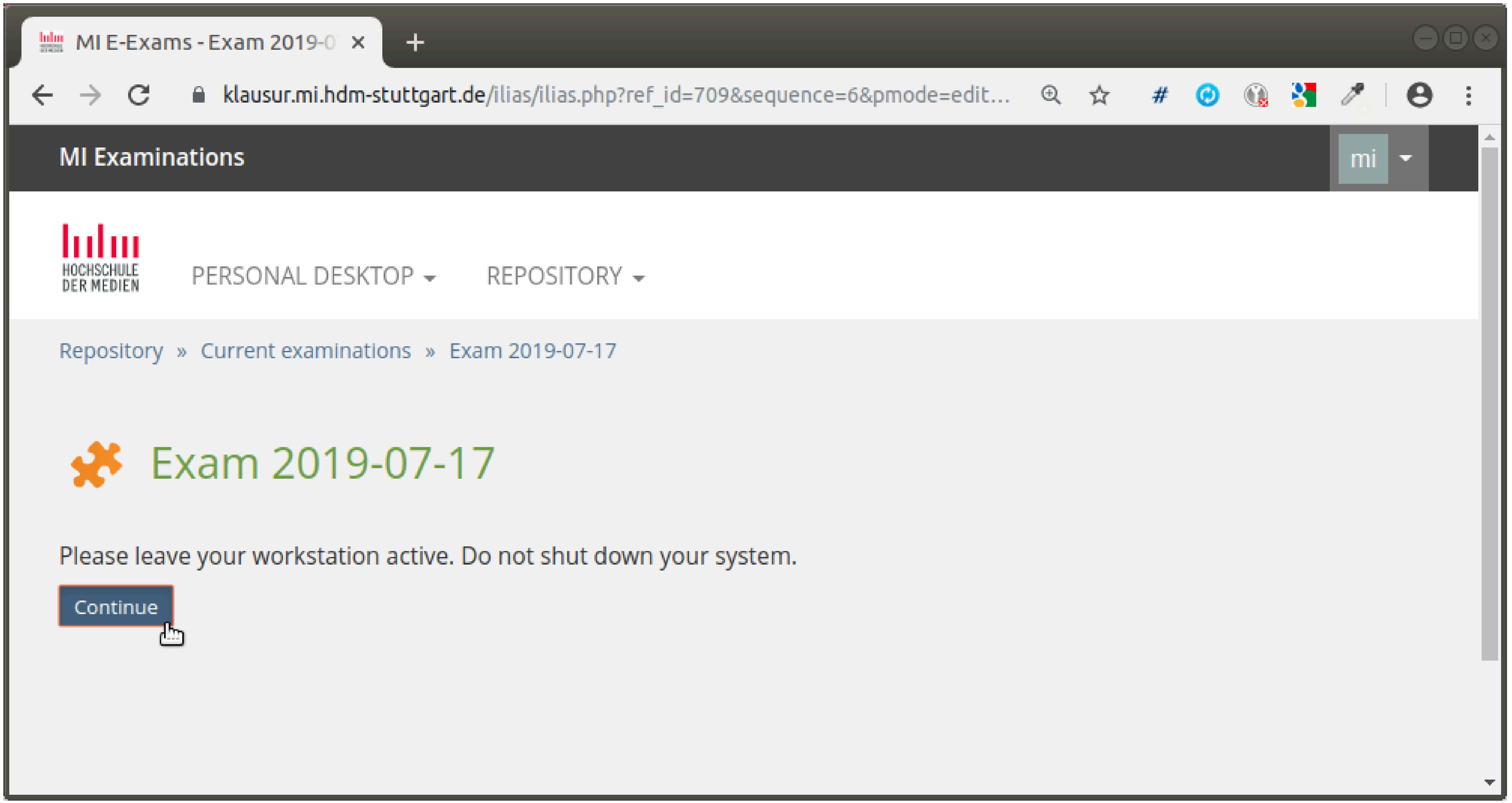


Overview

Appendix

- Exercising past examinations
- Finish the exam

Finishing the exam



Overview

Appendix

➟ Examination hints

Personal examination cheat sheets

- Zip archive of **10 MB max**.

  Caution: Use standard formats e.g. png, gif, pdf. Stuff like .doc, .docx, .rtf may be unsupported
- Upload your cheat sheet here

  Caution: **Unavailable during active e-examinations!**
- Verify your uploaded cheat sheet at here.

  Caution: **Limited to HdM network / VPN**

Unit tests in examinations

- Task definitions by Javadoc™.
- Corresponding Unit tests.
- Automated evaluation scoring your achievements.
- Individual weights reflecting a test's significance.

Example interface definition

```java
/**
* Finde das n-te ungerade Element einer Wertefolge.
*
* <p>Beispiel: Im Array {3, 2, 0, 1, 4} ist der Wert «1» an der Index-
*   position «3» das zweite ungerade Element.</p>
*
* @param werte Die zu durchsuchenden Werte.
* @param n Die gewünschte Position, Start bei 1.
*
* @return Den Index des n-ten ungeraden Wertes falls es mindestens n
* ungerade Werte gibt, ...
*/
static public int getNtesUngeradesElement(final int[] werte, final int n){
    return 12345; // TODO: Implementiere mich korrekt!
}
```

Corresponding test

```
@Test
@Marking(points=1) /* 1 point if test passes */
public void test_400() {
  Assert.assertEquals(
    2, /* Expected result */
    Helper.getNtesUngeradesElement(new int[]{-4,  6,  1, -2,   8}, 1));
}
```

Don’t cheat!

Unit Tests	Your solution

`assertFalse(isPrime(1));`
`assertTrue (isPrime(2));`
`assertTrue (isPrime(3));`
`assertFalse(isPrime(4));`
`assertTrue (isPrime(5));`
`assertFalse(isPrime(6));`
`assertTrue (isPrime(7));`
`assertFalse(isPrime(8));`
`assertFalse(isPrime(9));`
`assertFalse(isPrime(10));`
	`... boolean isPrime(final int p) {`
	`  switch (p) {`
	`  case 2:`
	`  case 3:`
	`  case 5:`
	`  case 7:`
	`  return true;`
	`  default:`
	`  return false;  }`

Will be treated as an **attempt at deception** / ***Täuschungsversuch***.

Unit tests strategy in examinations

- Unit testing is relentless: You are no longer at high school where a result having “just” a wrong sign used to matter next to nothing.
- Focus on completing units of work rather than “nearly” finishing a large number of tasks.
- Watching a test fail just happens. Learn to *systematically* fix bugs:
    1. Use your IDE's debugger. Practise debugging Junit tests individually addressing failures one by one.
    2. Insert log statements using log4j.

Followup exercises

209. Task
210. Swapping two variables
211. 0 and null
212. Task
213. Executing main(...)
214. Strange arithmetics
215. Task
216. Beginner's nightmare
217. Strange endless loop result
218. Task
219. switch versus if ... else if ... else
220. Exception handling
221. Task
222. Extraterrestrial integer value representation
223. An initialization issue
224. Tasks
225. `equals()` and `hashCode()`
226. The average of three byte values

Overview

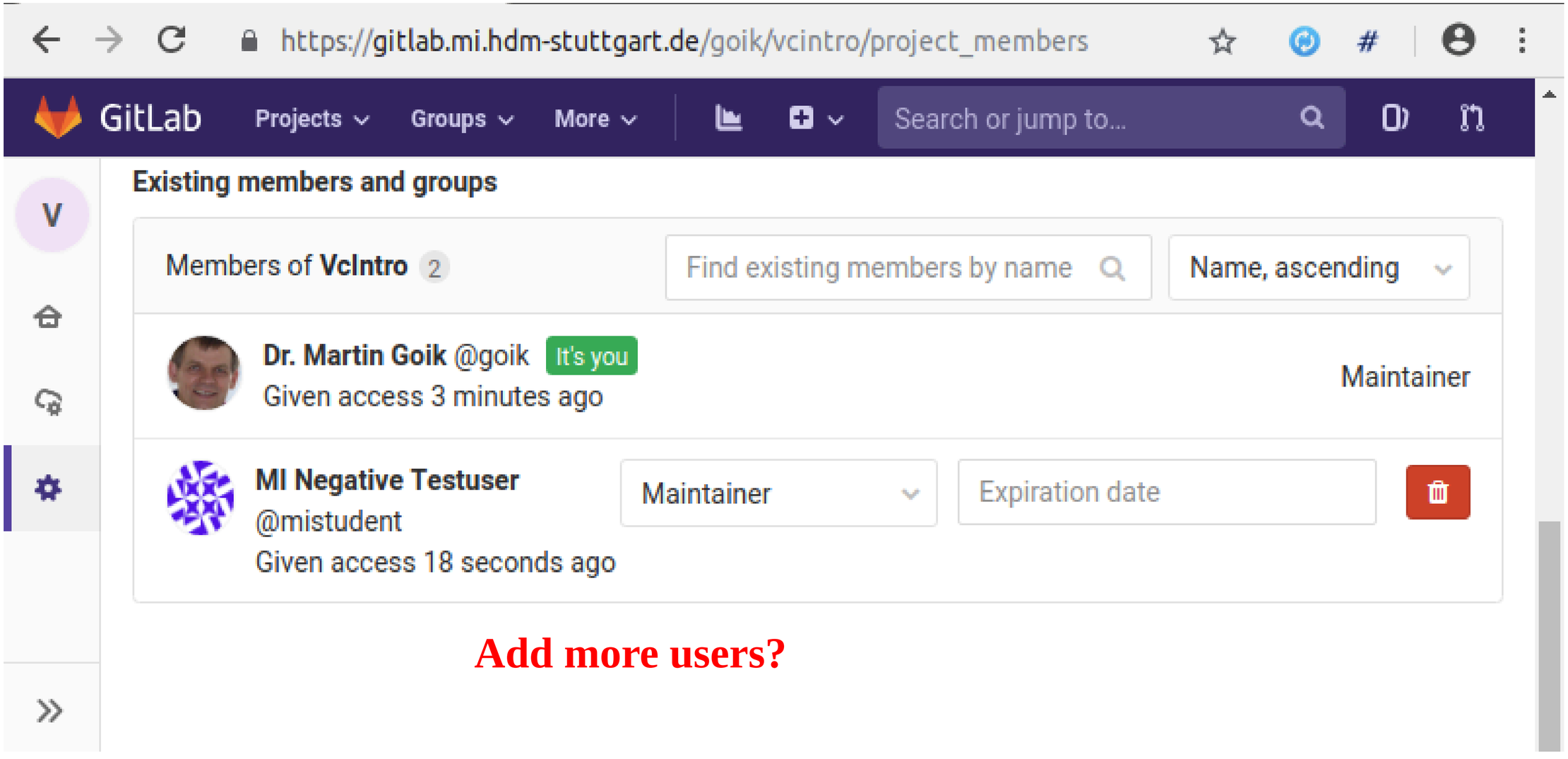
Appendix

➠ Working with git

Steps creating a new project

1. Creating an empty new project itself.
2. Adding fellow project users for participation.

Creating a project at MI gitlab



Cloning a git project

```
>git clone git@gitlab.mi.hdm-stuttgart.de:goik/vcintro.git
Cloning into 'vcintro'...
warning: You appear to have cloned an empty repository.
```

Enter project folder, add `Readme.md`

```
>cd vcintro/
>vim Readme.md
>git add Readme.md
```

```
# Initial project description.

Will be extended when adding more assets.
```

Committing change set

```
EDITOR=vim git commit Readme.md
```

```
Adding Readme file in Markdown format
# Please enter the commit message for your changes. Lines starting
# with '#' will be ignored, and an empty message aborts the commit.
#
# On branch master
#
# Initial commit
#
# Changes to be committed:
#       new file:   Readme.md
```

Push to upstream repository

```
>git push
Counting objects: 3, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (2/2), done.
Writing objects: 100% (3/3), 306 bytes | 306.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0)
To gitlab.mi.hdm-stuttgart.de:goik/vcintro.git
 * [new branch]      master -> master
```

Inserting a Maven project

```
>mvn --batch-mode -e archetype:generate -Dversion=0.9 \
> -DgroupId=de.hdm_stuttgart.mi.sd1 \
> -DartifactId=first -DarchetypeGroupId=de.hdm_stuttgart.mi \
> -DarchetypeArtifactId=mi-maven-archetype-quickstart -DarchetypeVersion=1.2.1
```

```
>find first/ -type f
first/.gitignore
first/src/test/java/de/hdm_stuttgart/mi/sd1/AppTest.java
first/src/main/java/de/hdm_stuttgart/mi/sd1/App.java
first/src/main/resources/log4j2.xml
first/pom.xml
```

git status 1

```
> git status
On branch master
Your branch is up to date with 'origin/master'.

Untracked files:
  (use "git add <file>..." to include in what will be committed)

        first/

nothing added to commit but untracked files present (use "git add" to track)
```

Adding Maven files to repository

```
>git add `find first/ -type f`
>git status
On branch master
Your branch is up to date with 'origin/master'.

Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

        new file:   first/.gitignore
        new file:   first/pom.xml
        new file:   first/src/main/java/de/hdm_stuttgart/mi/sd1/App.java
        new file:   first/src/main/resources/log4j2.xml
        new file:   first/src/test/java/de/hdm_stuttgart/mi/sd1/AppTest.java
```

git status 2

```
>git status
On branch master
Your branch is up to date with 'origin/master'.

Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

      new file:   first/.gitignore
      new file:   first/pom.xml
      new file:   first/src/main/java/de/hdm_stuttgart/mi/sd1/App.java
      new file:   first/src/main/resources/log4j2.xml
      new file:   first/src/test/java/de/hdm_stuttgart/mi/sd1/AppTest.java
```

Commit Maven project files

```
EDITOR=vim git commit -a
```

```
Adding a Maven project.
# Please enter the commit message for your changes. Lines starting
# with '#' will be ignored, and an empty message aborts the commit.
#
# On branch master
# Your branch is up to date with 'origin/master'.
#
# Changes to be committed:
#       new file:   first/.gitignore
#       new file:   first/pom.xml
#       new file:   first/src/main/java/de/hdm_stuttgart/mi/sd1/App.java
#       new file:   first/src/main/resources/log4j2.xml
#       new file:   first/src/test/java/de/hdm_stuttgart/mi/sd1/AppTest.java
```

git status 3

```
>git status
On branch master
Your branch is ahead of 'origin/master' by 1 commit.
  (use "git push" to publish your local commits)

nothing to commit, working tree clean
```

Push to upstream again

```
>git push
Counting objects: 22, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (10/10), done.
Writing objects: 100% (22/22), 3.31 KiB | 1.10 MiB/s, done.
Total 22 (delta 0), reused 0 (delta 0)
To gitlab.mi.hdm-stuttgart.de:goik/vcintro.git
   32da2ff..4e19142  master -> master
```

Reverting changes

```
>git status
...
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working directory)

        modified:   Readme.md
```

```
git checkout -- Readme.md
```

```
>git status
Your branch is up to date with 'origin/master'.
nothing to commit, working tree clean
```

Pull changes from upstream

```
>git pull
remote: Enumerating objects: 10, done.
remote: Counting objects: 100% (10/10), done.
remote: Compressing objects: 100% (6/6), done.
remote: Total 6 (delta 0), reused 0 (delta 0)
Unpacking objects: 100% (6/6), done.
From gitlab.mi.hdm-stuttgart.de:goik/vcintro
   3751344..83bd7b9  master     -> origin/master
Updating 3751344..83bd7b9
Fast-forward
 Readme.md | 3 +--
 1 file changed, 1 insertion(+), 2 deletions(-)
```

Overview

Appendix

➟ Apache Maven

Maven: Recommended reading

- [Maven2010]

What is Maven anyway?

- Build tool
- Project management tool
  - Create reports
  - Continuous integration support

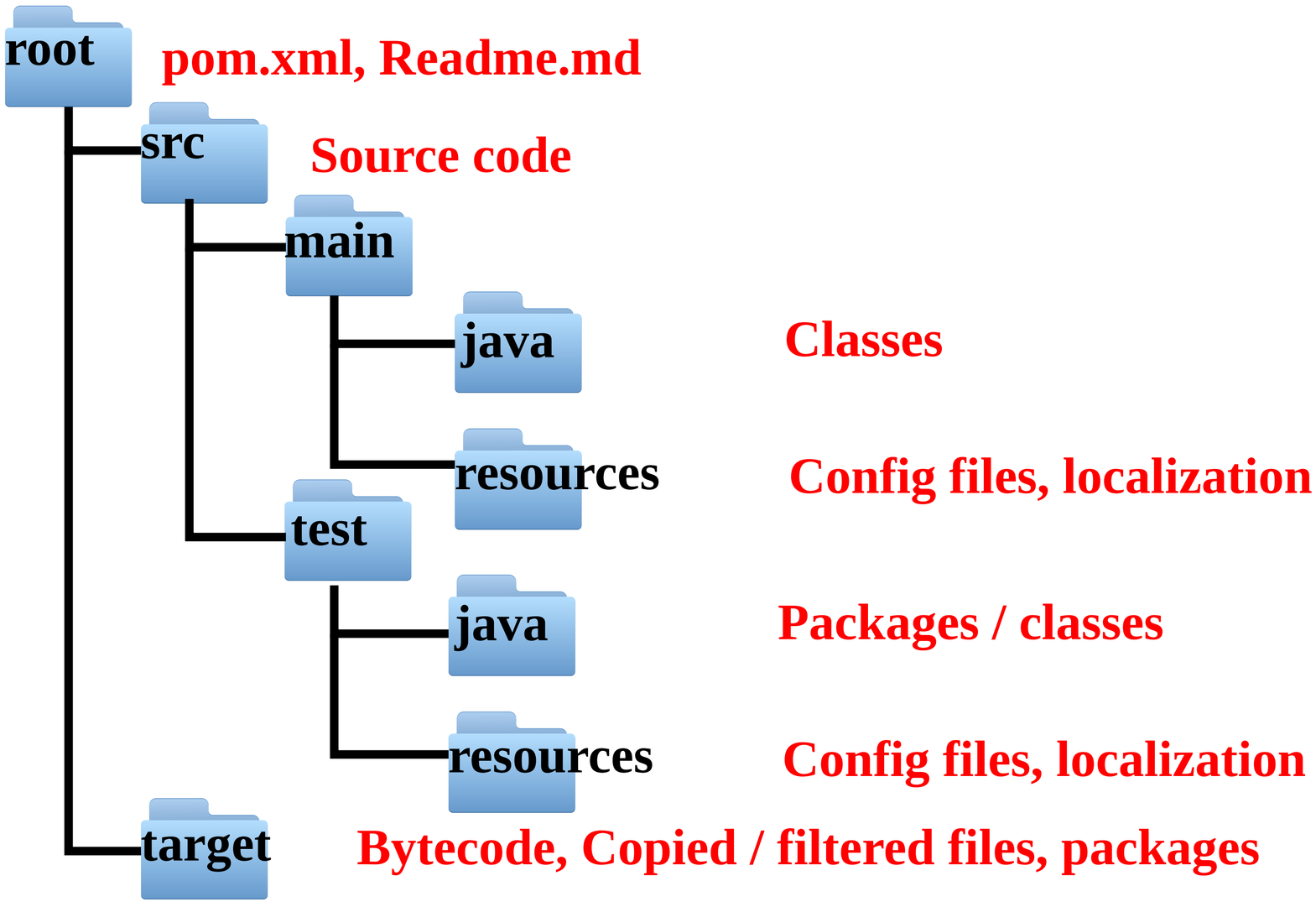
Maven: Facts and benefits

- Build tool
- Dependency management
- Repository system
- Plugin framework

Convention Over Configuration

- Sensible default values:
  - Source below `${basedir}/src/main/java`
  - Tests below `${basedir}/src/test`
  - Bytecode, jar/war archives below `${basedir}/target`
  - ...

Maven project layout



The project object model file

```
<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
  <a class="uri" href="http://maven.apache.org/xsd/maven-4.0.0.xsd" target="_blank">http://maven.apache.org/xsd/mav
"> <modelVersion>4.0.0</modelVersion> ... </project>
```

pom.xml characteristics

- Declarative project description
  - Dependencies
  - Builds
  - Artifacts
- No explicit instructions

pom.xml vs. Makefile

```
<plugin>
  <groupId>org.apache.maven.plugins</groupI
  <artifactId>maven-shade-plugin</artifactI
  <configuration>
    <Main-Class>org.devel.App</Main-Class>
...
      <execution>
        <phase>package</phase>
        <goals>
          <goal>shade</goal>
        </goals>
...
```

```
module.o: module.c
  gcc -c -g module.c
```

Overview

Appendix

- Apache Maven
  - The project object model `pom.xml`

“Hello, world” pom.xml

```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>de.hdm_stuttgart.mi</groupId>
  <artifactId>first</artifactId>
  <version>0.9</version>

</project>
```

Executing “compile” phase

```
mkdir -p src/main/java (1)

vim src/main/java/Hello.java (2)

first> mvn compile ...
[WARNING] File encoding has not been set, using platform encoding UTF-8, (3)
    i.e. build is platform dependent! ...
[ERROR] error: Source option 5 is no longer supported. (4) Use 6 or later.
[ERROR] error: Target option 1.5 is no longer supported. (5) Use 1.6 or later.
```

Examining the Java™ version culprit

```
>mvn help:effective-pom

<project ...>
   ...
  <plugin>
    <artifactId>maven-compiler-plugin</artifactId> ...

> find ~/.m2/repository/ -name maven-compiler-plugin\* ...

>jar -xf ~/.m2/repository/org/apache/maven/plugins/maven-compiler-plugin/3.7.0/maven-compiler-plugin-3.7.0.jar
>cat META-INF/maven/plugin.xml
```

```
<encoding implementation="java.lang.String" default-value="${project.build.sourceEncoding}">${encoding}</encoding>
<source implementation="java.lang.String" default-value="1.5">${maven.compiler.source}</source>
<target implementation="java.lang.String" default-value="1.5">${maven.compiler.target}</target>
```

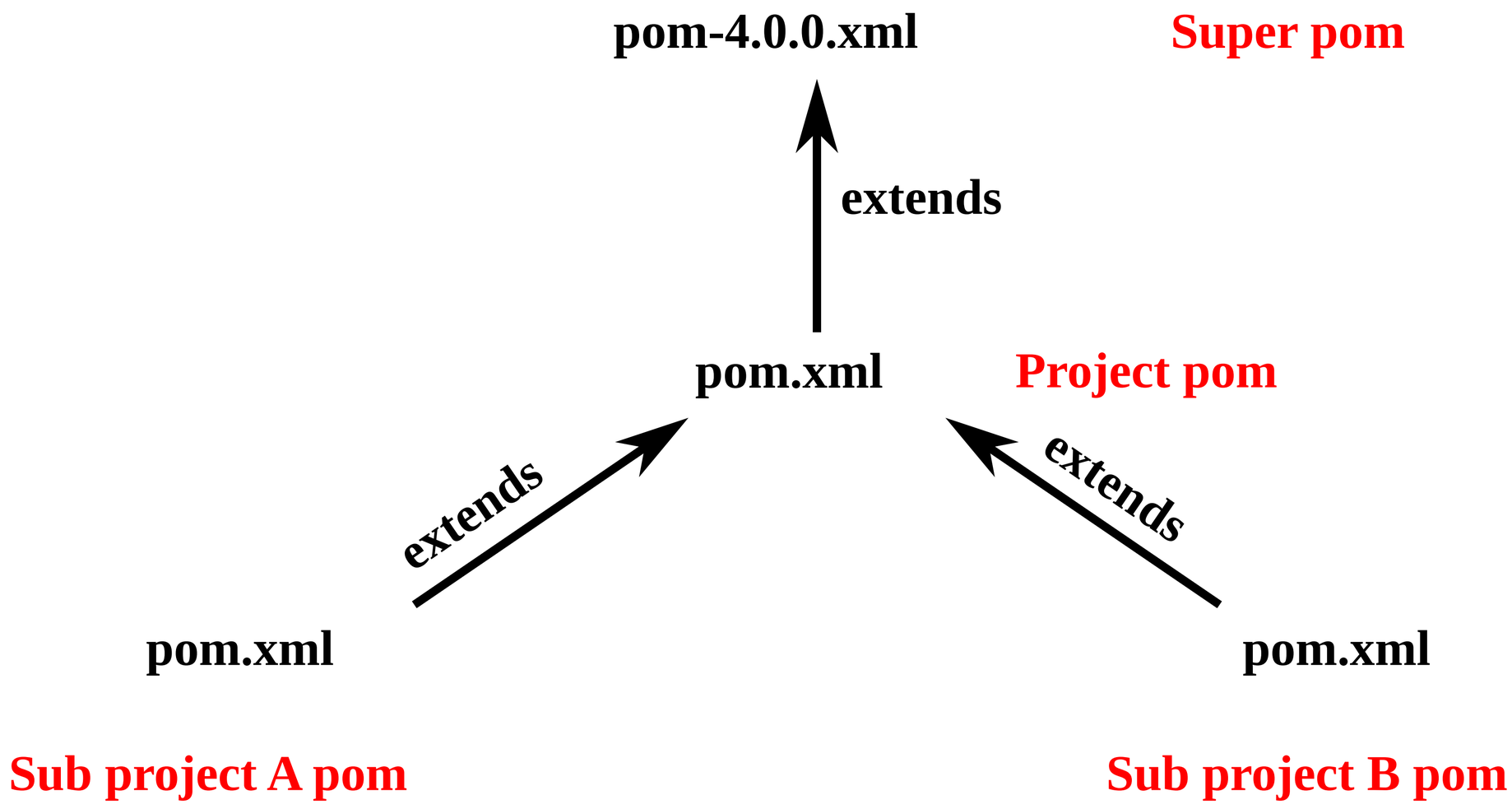
Resolving encoding / Java™ version issues

```
<project ... xsd/maven-4.0.0.xsd">
...
  <properties>
    <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>

    <maven.compiler.source>1.8</maven.compiler.source>
    <maven.compiler.target>1.8</maven.compiler.target>
  </properties> ...
```

```
rm -rf ~/.m2/repository/
mvn compile;     find ~/.m2/repository/ -type f|wc -l
220
```

POM inheritance



The Super POM

```
jar -tf /usr/share/apache-maven-3.0.5/lib/maven-model-builder-3.0.5.jar

...
org/apache/maven/model/plugin/ReportingConverter.class
org/apache/maven/model/pom-4.0.0.xml
org/apache/maven/model/profile/activation/FileProfileActivator$1.class
...
```

pom-4.0.0.xml content

```
...                          <!-- Does this ring a (security related?) bell? -->
<repositories>
  <repository>
    <id>central</id>
    <name>Central Repository</name>
    <url>http://repo.maven.apache.org/maven2</url>
...
  <pluginRepositories>
    <pluginRepository>
      <id>central</id>
      <name>Central Repository</name>
      <url>http://repo.maven.apache.org/maven2</url>
...
```

Favour https in `~/.m2/settings.xml`

```
<settings ... settings-1.0.0.xsd">

  <mirrors>
    <mirror>
      <id>central-secure</id>
      <mirrorOf>central</mirrorOf>
      <name>Maven Central: Favour https over http.</name>
      <url>https://repo.maven.apache.org/maven2</url>
    </mirror>
  </mirrors>
  ...
```

Resolving to effective pom.xml

```
first> mvn help:effective-pom
... Effective POMs, after inheritance, interpolation, and profiles are applied:

<project xmlns="http://maven.apache.org/POM/4.0.0" ...>
  <modelVersion>4.0.0</modelVersion>
...
      <plugin>
        <artifactId>maven-jar-plugin</artifactId>
        <version>2.3.2</version>
        <executions>
          <execution>
            <id>default-jar</id>
...
```

Overview

Appendix

- Apache Maven
- Plugins

Plugin architecture

- Tiny core
- Plugin extensible

Hint: **mvn** `help:effective-pom` lists included plugins.

Sample plugins

- Testing: `maven-surefire-plugin`
- Library dependencies: `maven-dependency-plugin`
- Packaging: `maven-jar-plugin`
- Documentation: `maven-javadoc-plugin`

Example: The `maven-javadoc-plugin`

```
first> jar -tf ~/.m2/repository/org/apache/maven/plugins/\
        maven-javadoc-plugin/3.0.0/maven-javadoc-plugin-3.0.0.jar
...
META-INF/LICENSE
META-INF/maven/org.apache.maven.plugins/maven-javadoc-plugin/plugin-help.xml
javadoc-report.properties
META-INF/maven/plugin.xml
log4j.properties
META-INF/NOTICE
org/apache/maven/plugins/javadoc/AbstractFixJavadocMojo$JavaEntityTags.class
org/apache/maven/plugins/javadoc/AggregatorTestJavadocReport.class
...
```

Overview

Appendix

- Apache Maven
  - Dependencies

Adding test capabilities

```
<project ... maven-4.0.0.xsd"> ...
  <dependencies>
    <dependency>
      <groupId>junit</groupId>
      <artifactId>junit</artifactId>
      <version>4.12</version>
      <scope>test</scope>
    </dependency>...
```

```
import org.junit.Test;
import org.junit.Assert;

public class AppTest {
  @Test
  public void doTest() {
    Assert.assertEquals(1, 1);
  }
```

```
first> mvn test
[INFO] Scanning for projects...
Running de.hdm_stuttgart.mi.sd1.AppTest
Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.053 sec
```

Dependency listing

```
first> mvn dependency:tree
        ...
[INFO] de.hdm_stuttgart.mi.sd1:first:jar:0.9
[INFO] \- junit:junit:jar:4.12:test
[INFO]    \- org.hamcrest:hamcrest-core:jar:1.3:test
```

- ~/.m2/repository/**junit/junit/4.12/junit-4.12.jar**
- ~/.m2/repository/**org/hamcrest/hamcrest-core/1.3/hamcrest-core-1.3.jar**

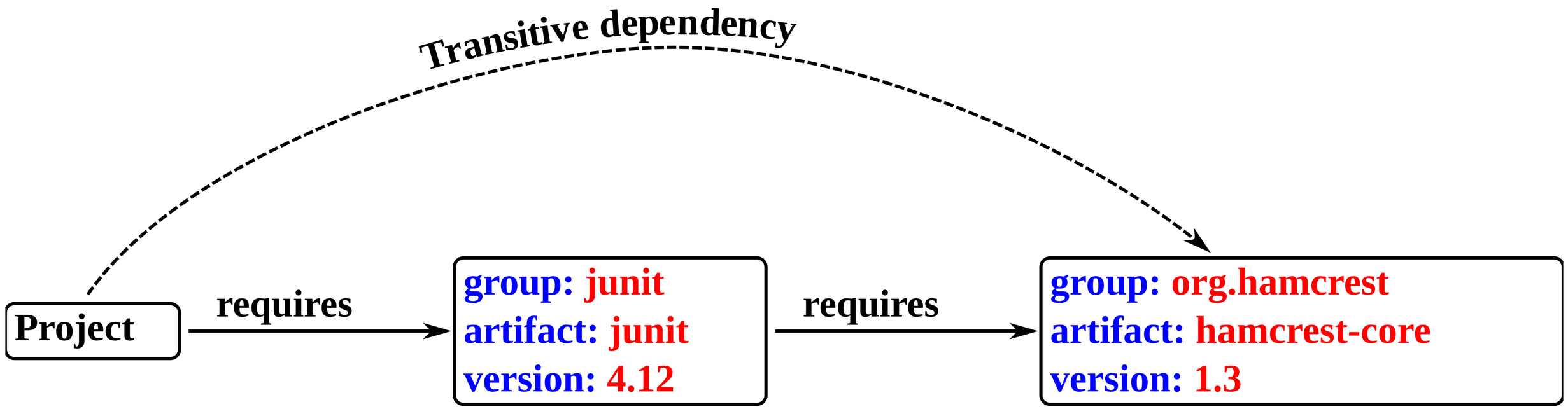
Absence of hamcrest in `pom.xml`

```
<project ... maven-4.0.0.xsd">
      ...
<!-- no such entry -->
  <dependency>
    <groupId>org.hamcrest</groupId>
    <artifactId>hamcrest-core</artifactId>
    <version>1.3</version>
    <scope>test</scope>
</dependency>
     ...
```

~/.m2/repository/junit/junit/4.12/junit-4.12.pom

```
<dependency>
  <groupId>org.hamcrest</groupId>
  <artifactId>hamcrest-core</artifactId>
  <version>1.3</version>
  </dependency>
</dependencies>
```

Transitive dependencies




```
<dependency>
  <groupId>junit<...
  <artifactId>junit<...
  <version>4.12<...
</dependency>
```

```
<dependency>
  <groupId>org.hamcrest<...
  <artifactId>hamcrest-core<...
  <version>1.3<...
</dependency>
```

Oblivious to test implementation: TestNG

```
<project ... maven-4.0.0.xsd"> ...
  <dependencies>
    <dependency>
      <groupId>org.testng</groupId>
      <artifactId>testng</artifactId>
      <version>6.14.3</version>
      <scope>test</scope>
    </dependency>...
```

```
import org.testng.annotations.Test;
import org.testng.Assert;

public class AppTest {
  @Test
  public void doTest() {
    Assert.assertEquals(1, 1);
  }
```

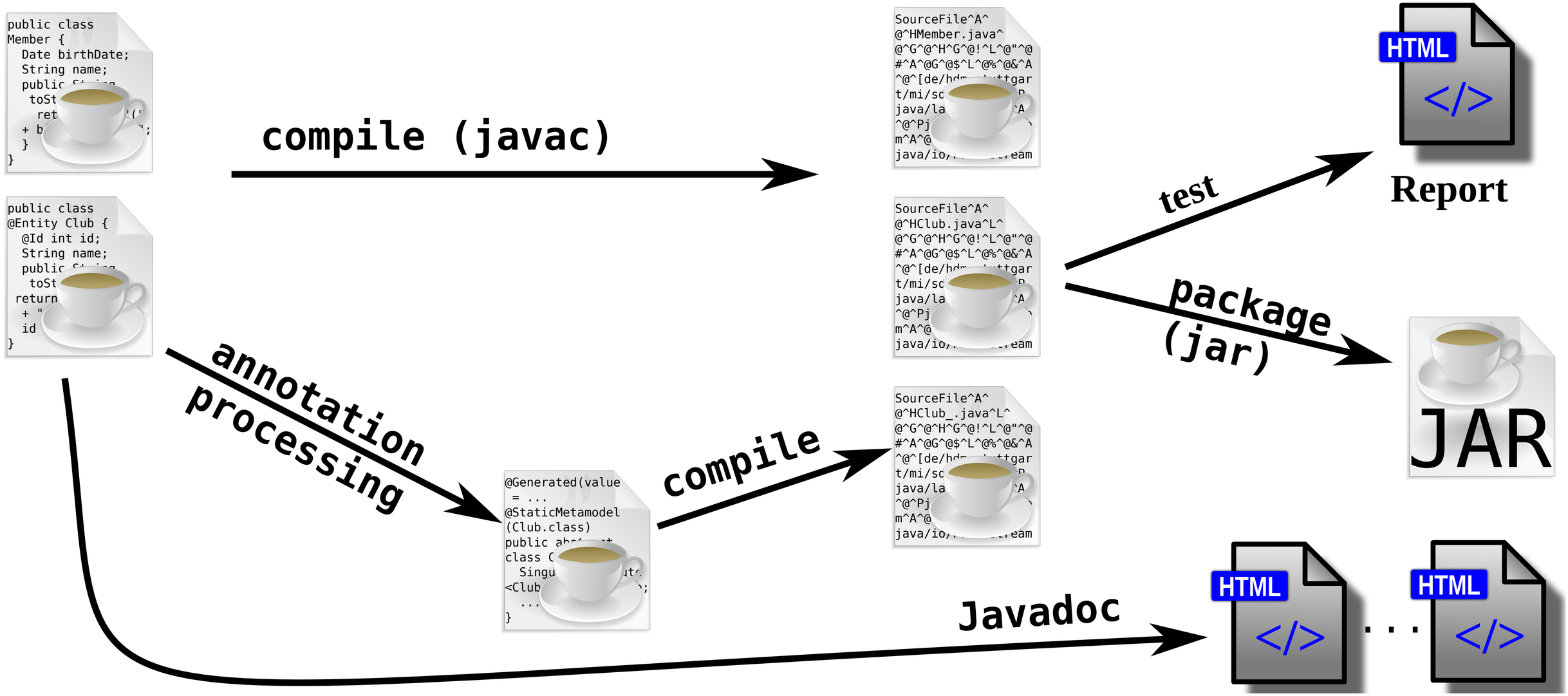
```
testng> mvn test
Running de.hdm_stuttgart.mi.sd1.AppTest
Configuring TestNG with: org.apache.maven.surefire...
Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.372 sec
```

Overview

Appendix

- Apache Maven
  - Lifecycle, phases and goals

Phases


public class
Member {
Date birthDate;
String name;
compile (javac)
SourceFile^A^
@^HMember.java^
HTML
</>
Report
test
public class
@Entity Club {
@Id int id;
String name;
SourceFile^A^
@^HClub.java^L^
package
(jar)
annotation
processing
@Generated(value
= ...
@StaticMetamodel
(Club.class)
compile
SourceFile^A^
@^HClub_.java^L^
JAR
Javadoc
HTML
</>
HTML
</>

Maven lifecyles and phases

Phases:

clean, compile, test, package, deploy, ...

Lifecycle

Sequence of named phases

Example: mvn `clean` (Lifecycle)

- `pre-clean`
- `clean` (Phase)
- `post-clean`

See Default Lifecycle.

hooking into phase

```
<plugin>
  <groupId>com.mysema.maven</groupId>
  <artifactId>apt-maven-plugin</artifactId>
  <version>1.1.3</version>
  <executions>
    <execution>
      <id>process</id>
      <goals>
        <goal>process</goal>
      </goals>
      <phase>generate-sources</phase>
      <configuration>
        <outputDirectory>${project.build.directory}/metamodel</outputDirectory>
        <processor>com.mysema.query.apt.jpa.JPAAnnotationProcessor</processor>
      </configuration>
      ...
```