

Collaborative efforts



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://nexus.mi.hdm-stuttgart.de/nexus/repository/mi-naven/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

```
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)

App > main()

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

```
5
6 ▶ public class ShowReachedPoints {
7
8     /**
9      * Execution reveals the number of reached p
10     *
11     * @param args Unused
12     */
13     public static void main(String[] arg) {
14         RunTests.exec(
15             exerciseTitle: "Aufgabe 1" , Test_Helpe
16         }
17     }
18 }
19
20
```

Cannot resolve symbol 'args' [more...](#) (Ctrl+F1)

(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	5%
SCM usage	5%
Software functionality	40%

Sample forecast session

Sample forecast invocation

goi k@goi ki target> java -jar weather-1.0.jar Stuttgart ❶

1 = Stadtkreis Stuttgart ❷

2 = Regierungsbezirk Stuttgart

3 = Stuttgart

4 = Stuttgart Feuerbach

5 = Stuttgart Muehlhausen

Bitte gültige Auswahl 1 bis 5 treffen: 2 ❸

Vorhersage für Regierungsbezirk Stuttgart ❹

Di enstag, 15. 05

23: 00: 11° C, Lei cht er Regen

M ttwoch, 16. 05

02: 00: 10° C, Lei cht er Regen

05: 00: 10° C, Lei cht er Regen

08: 00: 11° C, Lei cht er Regen

...

Underlying data provider

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

```
{ "cod": "200", "message": 0.0042, "cnt": 40, "list": [
  { "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 Favour metric over imperial units.
- id=3214105 «3214105» identifies «*Regierungsbezirk Stuttgart*», see line 262703 in `cities.json`:

```
"id": 3214105,
"name": "Regierungsbezirk Stuttgart",
```

Underlying data provider

```
"country": "DE",  
"coord": {  
  "lon": 9.66667,  
  "lat": 49.083328  
}
```

② <https://openweathermap.org/api>'s reply providing JSON based weather data.

cities.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.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  
'/na/goi k/Forecast/6930414.json' from 196 seconds ago
```

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")) {
    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'

Running the currency converter terminal application.

Exam training by Guacamole



mistudent

●●●●●●●●

Login

1.1.0

Exam training by Guacamole

guacamole.mi.hdm-stuttgart.de/#/

Select a Location

Make sure your browser window has the preferred size now. The resolution of the remote client will be set accordingly.

R135_Remote	2 available (15 offline)
R133_Remote	1 available (19 offline)
R136_Remote	0 available (7 offline)

Log out **Continue**

Exam training by Guacamole

The screenshot shows the Guacamole web interface for a user named 'guacamole.mi.hdm-stuttgart.de'. The main content area is titled 'vmChooser' and displays a list of virtual machines under the heading 'Kursumgebungen speziell für diesen Raum'. The list includes various courses such as 'Mensch-Compute-Interaktion (HCI) 119203a Probeklausur', 'COPT Oxford Online Placement Test', and 'Web Development'. A red arrow points to the entry 'E-Exam 113105 Softwareentwicklung 1 Test / Teamviewer', which is highlighted in blue. To the right of the list, a 'Details' panel shows information for the selected VM: Name: E-Exam 113105 Softwareentwicklung 1 Test / Network blocked, Zustandig, Betriebssystem: Ubuntu (64 Bit), Plattform: VMware, and Beschreibung: Kann außerhalb von Prüfungszeiten gestartet werden. Zugriff auf externe Seiten durch lokale Firewall eingeschränkt. At the bottom of the interface, there are buttons for 'Abbrechen' and 'Start'.

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.

Preparing an examination

MI E-Exams - ILIAS Login P x

klausur.mi.hdm-stuttgart.de/ilias/login.php?target=&client_id=iliasclient1&auth_stat=

MI Klausuren Language

 HOCHSCHULE DER MEDIEN

LOGIN TO ILIAS

Username *

Password *

* Required **Login using your hdm account**

[New Account Registration](#) [Forgot your password?](#) [Forgot your username?](#)

[Terms of Service](#)

Preparing an examination

The screenshot shows a web browser window with the following elements:

- Browser tab: MI E-Exams - Current exam
- Address bar: klausur.mi.hdm-stuttgart.de/ilias/goto.php?target=cat_97&client_id=iliasclient1
- Page title: MI Examinations
- Navigation: PERSONAL DESKTOP, REPOSITORY
- Breadcrumbs: Repository » Current examinations
- Section: Current examinations (with an Actions dropdown)
- Sub-sections: Content, Info
- Section: TESTS
- Item: Exam 2019-07-17 (highlighted in yellow)
- Annotation: Choose your exam from the current list (written in red)

Preparing an examination

The screenshot shows a web browser window with the following elements:

- Browser tabs: MI E-Exams - Exam 20, Software developme..., Rheinwerk Computin..., LEO.org - Ihr Sprach...
- Address bar: klausur.mi.hdm-stuttgart.de/ilias/ilias.php?baseClass=ilObjTestGUI&cmd=infoScreen&ref_id=709
- Page title: MI Examinations
- Logo: HOCHSCHULE DER MEDIEN
- Navigation: PERSONAL DESKTOP, REPOSITORY
- Section: Pre-exam preparations
- Instructions:
 1. Start your web-browser of choice (*Firefox* or *Chromium*).
 2. Open related links:

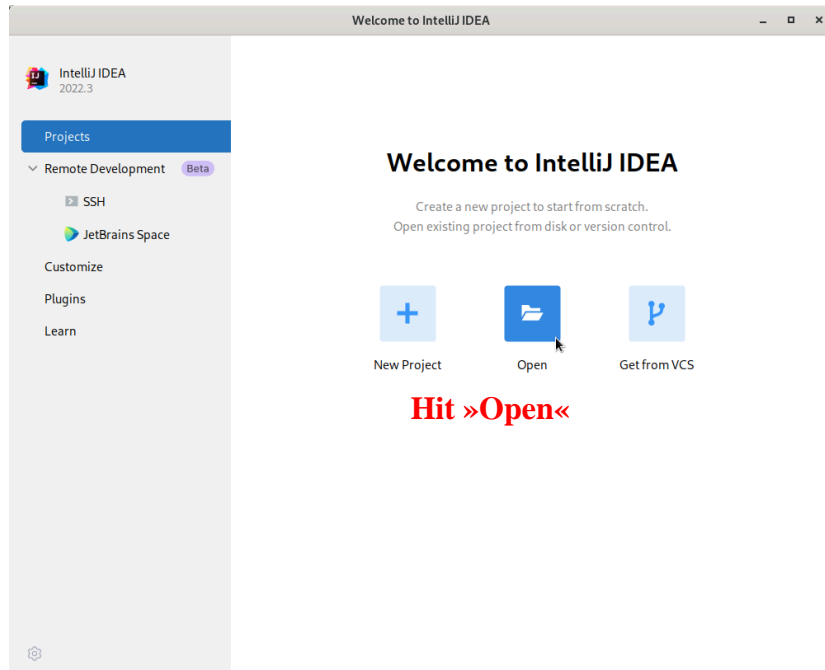
<ul style="list-style-type: none">◦ »Freedocs Software development 1« (some links may be blocked)◦ Java™ 11 API◦ On your Desktop: «Java: A Beginner's Tutorial»	<ul style="list-style-type: none">◦ Your personal «cheat sheet».◦ Textbook «Java ist auch eine Insel»◦ «Leo» online dictionary.◦ «dict.cc» online dictionary
---	---
 3. Important hints:
 - Intermediate uploads minimize the risk of ending up with nothing when exceeding this exam's timeout.

Address bar at bottom left: https://www.leo.org

**Open related links
you favour reading
during examination.**

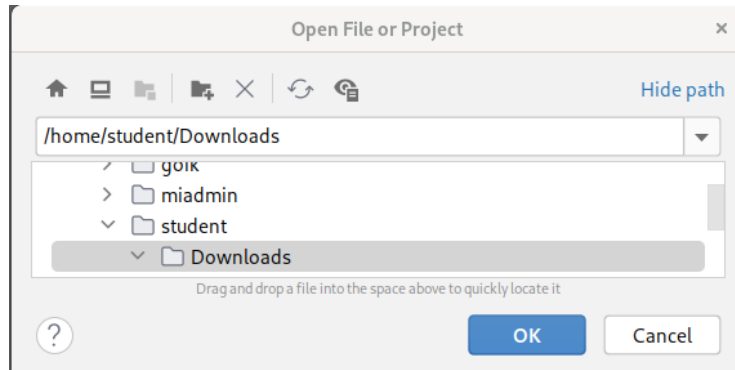
Preparing an examination

**Start IntelliJ beforehand
(may autostart)**



Preparing an examination

**Prepare for later project import
from »Downloads« folder**



Preparing an examination

The screenshot shows a web browser window with several tabs open: 'MI E-Exams - Exam 20...', 'Software developme...', 'Rheinwerk Computin...', and 'LEO.org - Ihr Sprach...'. The address bar shows the URL 'klausur.mi.hdm-stuttgart.de/ilias/ilias.php?baseClass=iObjTestGUI&cmd=infoScreen&ref_id=709'. The page title is 'MI Examinations' and the user is logged in as 'mi'. The page header includes the logo of Hochschule der Medien and navigation links for 'PERSONAL DESKTOP' and 'REPOSITORY'. The main content area features a green puzzle icon and the text 'Exam 2019-07-17' with an 'Actions' dropdown menu. Below this, there are tabs for 'Info' and 'Results'. A prominent green button labeled 'Start the Test' is highlighted with a mouse cursor, and the text 'Start the exam' is displayed in red next to it. Underneath, an 'INTRODUCTORY MESSAGE' section contains the heading 'Pre-exam preparations' and a numbered list of instructions: '1. Start your web-browser of choice (Firefox or Chromium).', '2. Open related links:'.

MI Examinations

HOCHSCHULE DER MEDIEN PERSONAL DESKTOP REPOSITORY

Exam 2019-07-17 Actions

Info Results

Start the Test **Start the exam**

INTRODUCTORY MESSAGE

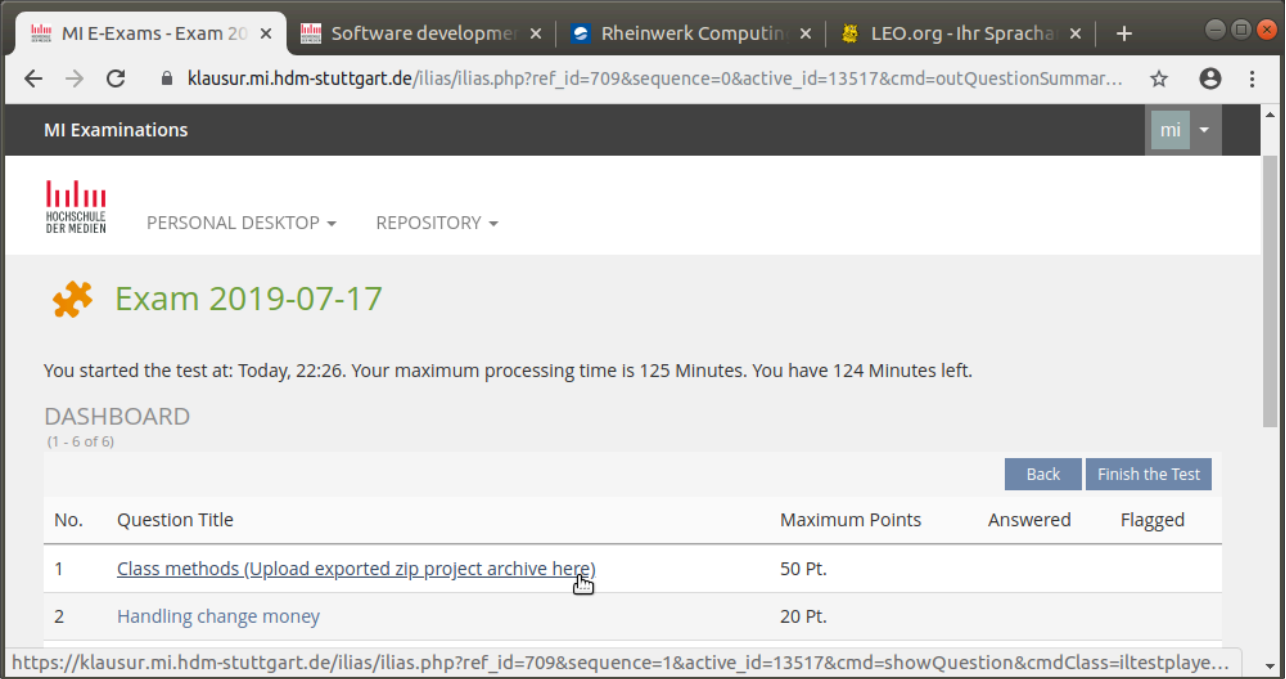
Pre-exam preparations

1. Start your web-browser of choice (*Firefox* or *Chromium*).
2. Open related links:

Preparing an examination

The screenshot shows a web browser window with several tabs open: 'MI E-Exams - Exam 20...', 'Software developme...', 'Rheinwerk Computin...', and 'LEO.org - Ihr Sprach...'. The address bar shows the URL 'klausur.mi.hdm-stuttgart.de/iliass/iliass.php?ref_id=709&sequence=0&lock=6ce4a43bd2a4e790518dfbd593c3...'. The page title is 'MI Examinations' and the logo for 'HOCHSCHULE DER MEDIEN' is visible. The breadcrumb trail is 'Repository » Current examinations » Exam 2019-07-17'. The main heading is 'Exam 2019-07-17' with a puzzle piece icon. Below this is the instruction 'ENTER TEST PASSWORD' and a note: 'This test can only be accessed with a test password. Please enter the test password to start the test.' A text input field contains a red warning message: 'The required access password will be provided by your exam supervisor'. To the left of the input field, the label reads 'Test Password (NOT your HdM password!!) *'. Below the input field, there are 'Submit' and 'Cancel' buttons. A red asterisk and the word 'Required' are positioned at the bottom left of the form area.

Preparing an examination



MI Examinations

HOCHSCHULE DER MEDIEN PERSONAL DESKTOP REPOSITORY

Exam 2019-07-17

You started the test at: Today, 22:26. Your maximum processing time is 125 Minutes. You have 124 Minutes left.

DASHBOARD (1 - 6 of 6)

Back Finish the Test

No.	Question Title	Maximum Points	Answered	Flagged
1	Class methods (Upload exported zip project archive here)	50 Pt.		
2	Handling change money	20 Pt.		

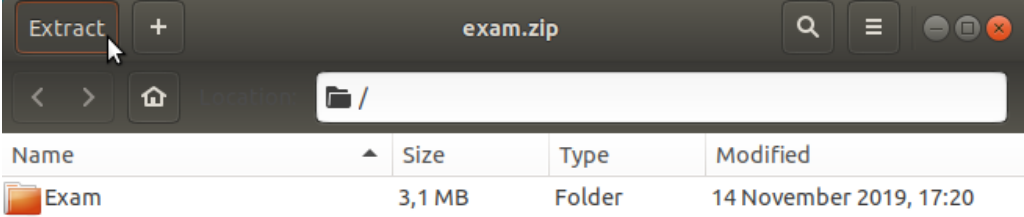
https://klausur.mi.hdm-stuttgart.de/ilias/ilias.php?ref_id=709&sequence=1&active_id=13517&cmd=showQuestion&cmdClass=iltestplaye...

Preparing an examination

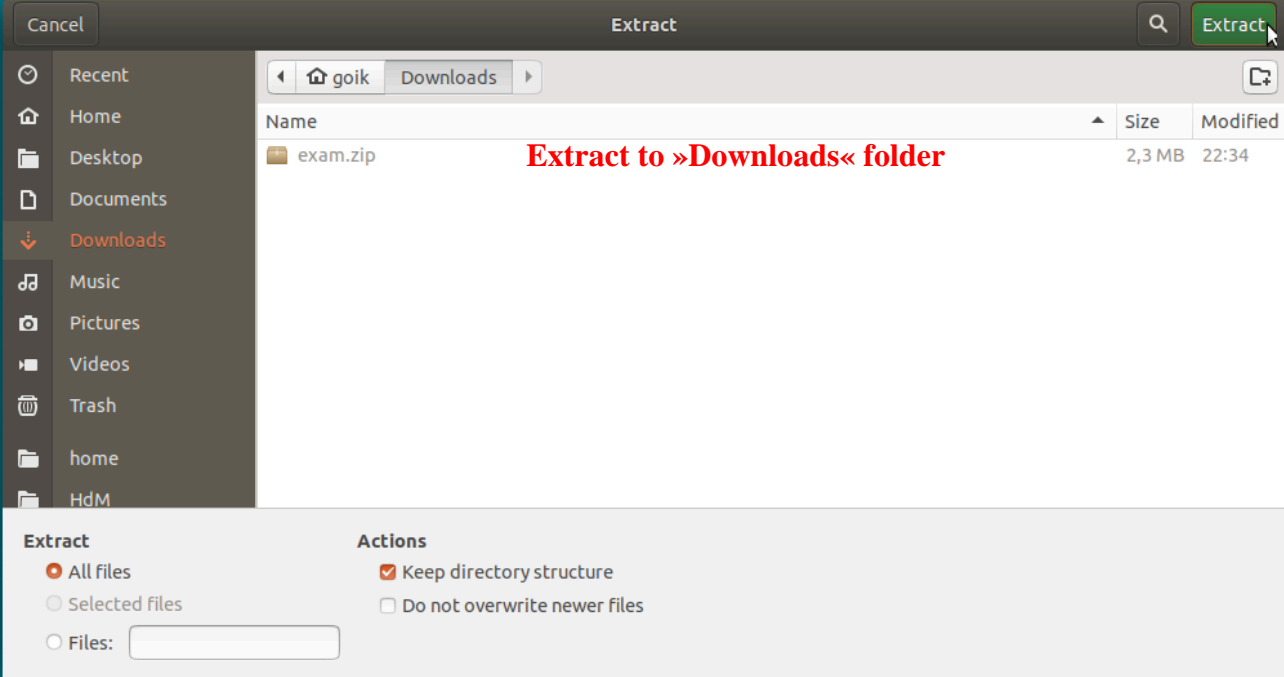
The screenshot shows a web browser window with several tabs open. The active tab is titled "MI E-Exams - Exam 20". The address bar shows the URL: `klausur.mi.hdm-stuttgart.de/ilias/ilias.php?ref_id=709&sequence=1&active_id=13517&cmd=showQuestion&cmdC...`. The page content includes the logo of Hochschule der Medien (HDM) and navigation links for "PERSONAL DESKTOP" and "REPOSITORY". A question titled "Question 1 of 6 (30 Points)" is shown as "Not answered". A prominent blue button with a download icon and the text "Maven Projekt Skelett" is visible. Below it, a file named "exam.zip (2.30 MB)" is listed with a red annotation "Download project skeleton" pointing to the file name. The page also features a "Preparations" section with the instruction: "Download and unzip the above file exam.zip. This will create a subfolder". At the bottom, a file manager interface shows the downloaded file "exam.zip" and a "Show all" button.

Preparing an examination

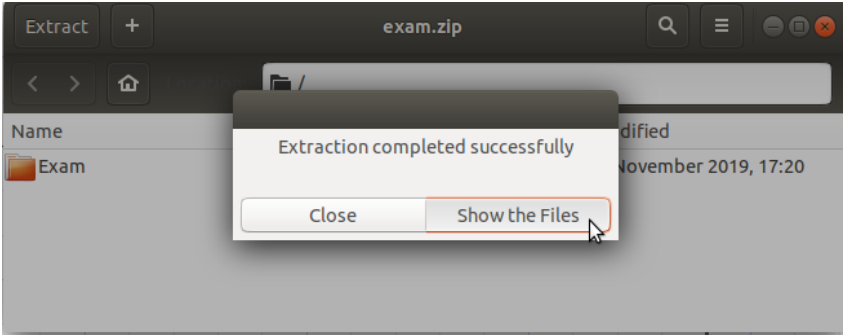
Openin file manager and hit »Extract«



Preparing an examination

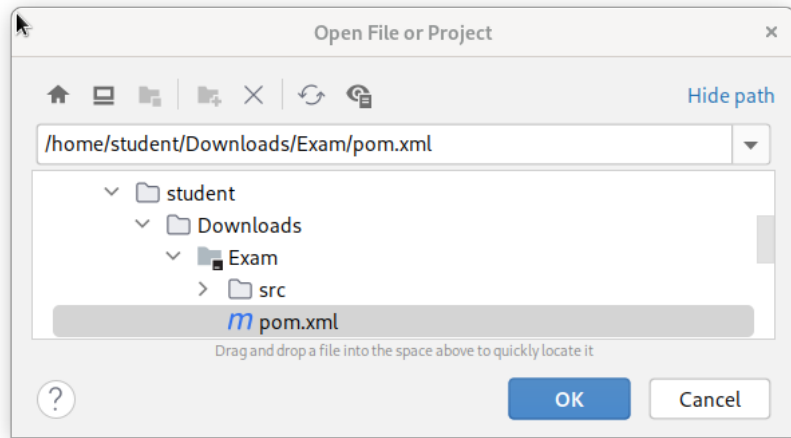


Preparing an examination



Preparing an examination

Import project into your Idea IDE by choosing the skeleton's pom.xml file



Generating Javadoc™.

- HTML is difficult to read:

```
*      <td><code>a = - 3</code>, <code>b = 4</code>, <code>c = 3</code></td>
*      <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

The screenshot shows an IDE window with the following components:

- Project Structure:** A tree view on the left showing the project hierarchy. The path is `Exam [sd1_2019summer_exam] > src > main > java > de.hdm_stuttgart.mi.sd1 > task1 > Helper`. The `Helper` class is highlighted in blue.
- Code Editor:** The main window displays the source code of `Helper.java`. The `isAscending` method is highlighted in blue. The code is as follows:

```
28 * <tr>
29 * <td>{1, 2, 2}</td>
30 * <td>Not strictly ascending since <code>2 &lt;
31 * </tr>
32 *
33 * </table>
34 *
35 * @param a The first integer value.
36 * @param b The second integer value.
37 * @param c The third integer value.
38 * @return <code>true</code> if all three values are in
39 */
40 static public boolean isAscending(final int a, final int b, final int c) {
41     return true; // TODO:Implement me correctly
42 }
43
44 /**
45 * <p>A valid title text shall obey the following cond
```
- Annotations:** A red text annotation `Start implementing class` is placed over the `Helper` class in the project structure.
- IDE Interface:** The top menu bar includes File, Edit, View, Navigate, Code, Analyze, Refactor, Build, Run, Tools, VCS, Window, Help. The status bar at the bottom shows "132 chars, 2 line breaks 42:6 LF UTF-8 4 spaces".

The implement - test - implement cycle

The screenshot shows an IDE window for a file named `Helper.java`. The code contains several lines of HTML-like test cases and a Java method signature. A red text annotation is overlaid on the code.

```
25 * <td>Not strictly ascending since <code>5 &lt; 4</code> is false.</td>
26 * </tr>
27 *
28 * <tr>
29 * <td>{1, 2, 2}</td>
30 * <td>Not strictly ascending since <code>2 &lt; 2</code> is false.</td>
31 * </tr>
32 *
33 * </table>
34 *
35 * @param a The first integer value.
36 * @param b The second integer value.
37 * @param c The third integer value.
38 * @return <code>true</code> if all three values are in strictly ascending order, <code>>false</code> otherwise.
39 */
40 static public boolean isAscending(final int a, final int b, final int c) {
41     return true; // TODO:Implement me correctly
42 }
```

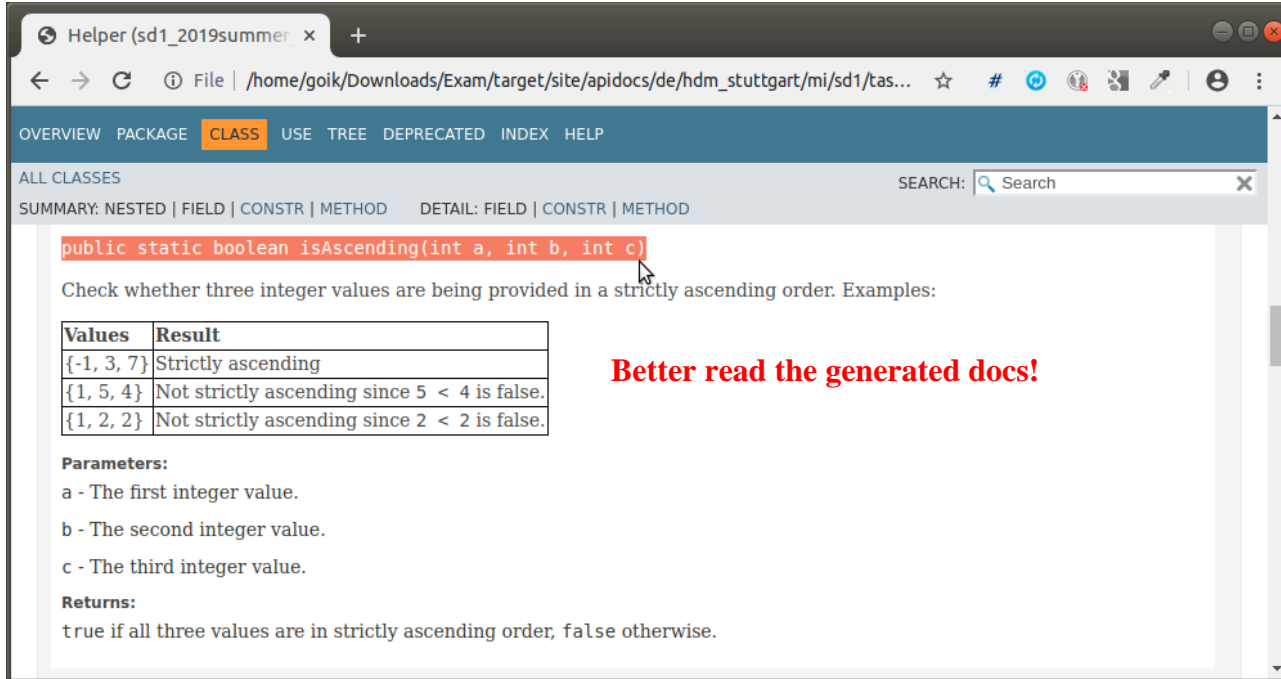
Fancy acting as HTML renderer?

Helper > isAscending()

6: TODO Terminal Event Log

261 chars, 7 line breaks 32:1 LF UTF-8 4 spaces

The implement - test - implement cycle



The screenshot shows a web browser window with the URL `/home/goik/Downloads/Exam/target/site/apidocs/de/hdm_stuttgart/mi/sd1/tas...`. The browser displays the Java documentation for the `isAscending` method. The method signature `public static boolean isAscending(int a, int b, int c)` is highlighted in red. Below the signature, there is a description: "Check whether three integer values are being provided in a strictly ascending order. Examples:". This is followed by a table with two columns: "Values" and "Result". The table contains three rows of examples. Below the table, there are sections for "Parameters:" and "Returns:". The "Parameters:" section lists three parameters: "a - The first integer value.", "b - The second integer value.", and "c - The third integer value.". The "Returns:" section states: "true if all three values are in strictly ascending order, false otherwise." A red text overlay "Better read the generated docs!" is positioned to the right of the table.

```
public static boolean isAscending(int a, int b, int c)
```

Check whether three integer values are being provided in a strictly ascending order. Examples:

Values	Result
{-1, 3, 7}	Strictly ascending
{1, 5, 4}	Not strictly ascending since $5 < 4$ is false.
{1, 2, 2}	Not strictly ascending since $2 < 2$ is false.

Parameters:

- a - The first integer value.
- b - The second integer value.
- c - The third integer value.

Returns:

true if all three values are in strictly ascending order, false otherwise.

Better read the generated docs!

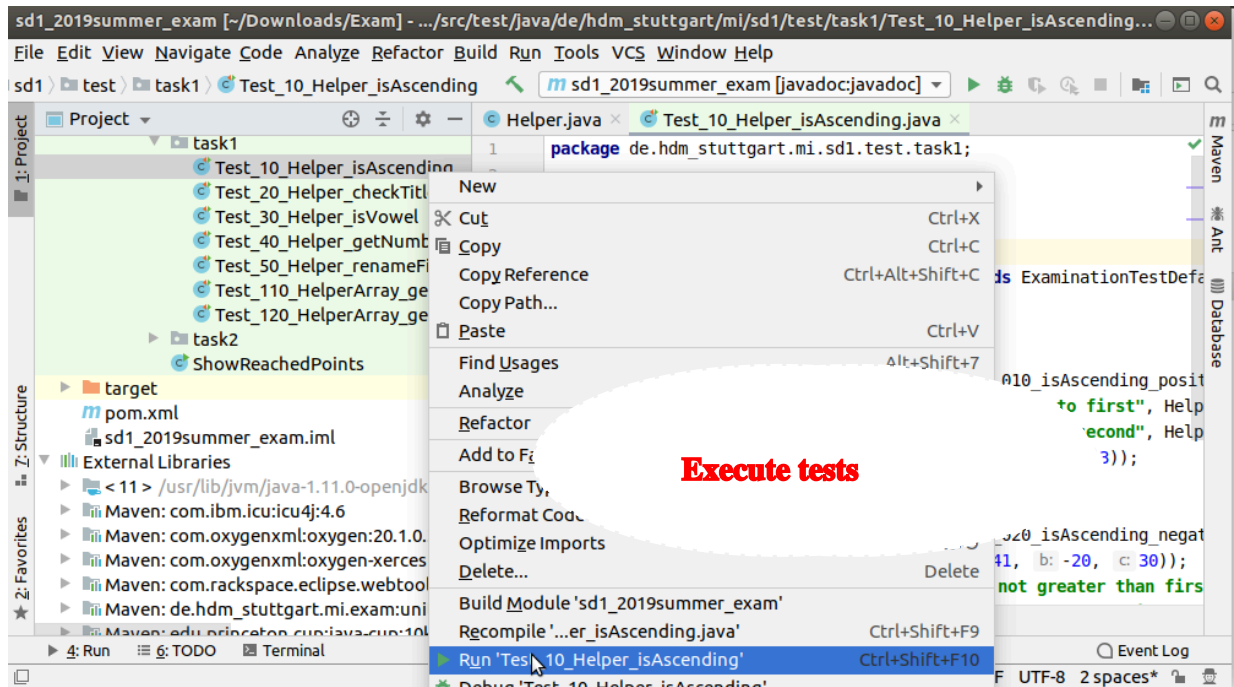
The implement - test - implement cycle

The screenshot shows an IDE window with the following components:

- Project Explorer (Left):** Shows a project structure with a package `de.hdm_stuttgart.mi.sd1.test.task1`. The file `Test_10_Helper_isAscending.java` is highlighted in green.
- Code Editor (Center):** Displays the source code of `Test_10_Helper_isAscending.java`. The class is annotated with `@FixMethodOrder(MethodSorters.NAME_ASCENDING)` and extends `ExaminationTestDefault`. It contains two test methods: `test_010_isAscending_positive` and `test_020_isAscending_negative`. The text **Find corresponding test class** is overlaid in red on the project explorer.
- Run/Debug Console (Bottom):** Shows the output of the test run, including the text `Test_10_Helper_isAscending`.

```
1 package de.hdm_stuttgart.mi.sd1.test.task1;
2
3 import ...
10
11 @FixMethodOrder(MethodSorters.NAME_ASCENDING)
12 public class Test_10_Helper_isAscending extends ExaminationTestDefault {
13     /* Section: isAscending */
14
15     @Marking(points = 3) public void test_010_isAscending_positive() {
16         t.assertFalse( message: "Second value equal to first", Help
17         .rt.assertFalse( message: "Third value equal to second", Help
18         Assert.assertTrue(Helper.isAscending( a: 1, b: 2, c: 3));
19     }
20
21
22 @Test @Marking(points = 3) public void test_020_isAscending_negative() {
23     Assert.assertTrue(Helper.isAscending( a: -41, b: -20, c: 30));
24     Assert.assertFalse( message: "Second value not greater than first");
25 }
```

The implement - test - implement cycle



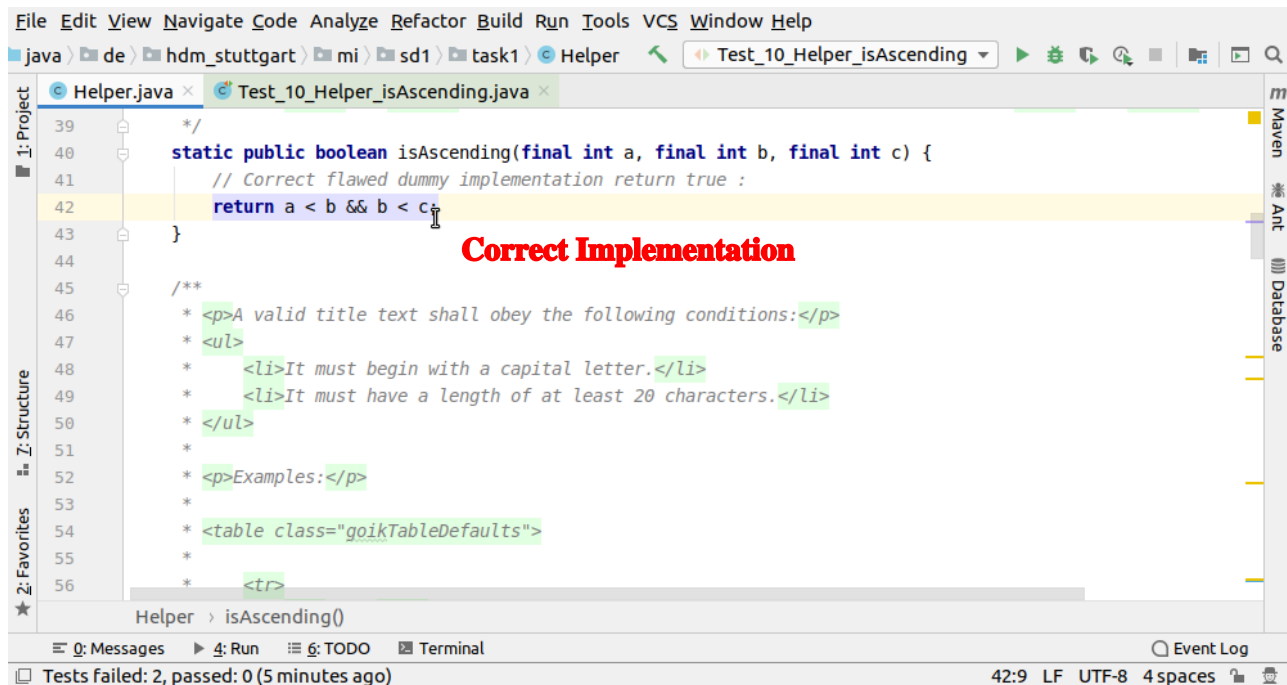
The implement - test - implement cycle

The screenshot shows an IDE with the following components:

- Editor:** Displays the code for `Test_10_Helper_isAscending.java`. Lines 17-19 are highlighted in yellow. Line 17 contains `Assert.assertFalse(message: "Second value equal to first", Helper.isAscending(a: 1, b: 1, c: 3));`. Line 18 contains `Assert.assertFalse(message: "Third value equal to second", Helper.isAscending(a: 1, b: 2, c: 2));`. Line 19 contains `Assert.assertTrue(Helper.isAscending(a: 1, b: 2, c: 3));`.
- Run Console:** Shows the execution results. The summary is "Tests failed: 2 of 2 tests - 43 ms". The test results are:
 - `test_010_isA`: 38 ms, failed with `java.lang.AssertionError: Second value equal to first`
 - `test_020_isA`: 5 ms, failed with `<3 internal calls>`
- Stack Trace:** Shows the call stack for the failed test:
 - `at de.hdm_stuttgart.mi.sd1.test.task1.Test_10_Helper_isAscending.test_010_isAscending() [Test_10_Helper_isAscending.java:17]`
 - `at java.base/java.util.concurrent.FutureTask.run(FutureTask.java:264)`
 - `at java.base/java.lang.Thread.run(Thread.java:834)`

A red text overlay in the center of the screenshot reads: **Some tests fail**

The implement - test - implement cycle



The screenshot shows an IDE window with the following content:

```
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
java > de > hdm_stuttgart > mi > sd1 > task1 > Helper Test_10_Helper_isAscending
Helper.java x Test_10_Helper_isAscending.java x
39  */
40  static public boolean isAscending(final int a, final int b, final int c) {
41      // Correct flawed dummy implementation return true :
42      return a < b && b < c;
43  }
44
45  /**
46   * <p>A valid title text shall obey the following conditions:</p>
47   * <ul>
48   * <li>It must begin with a capital letter.</li>
49   * <li>It must have a length of at least 20 characters.</li>
50   * </ul>
51   *
52   * <p>Examples:</p>
53   *
54   * <table class="goikTableDefaults">
55   *
56   * <tr>
```

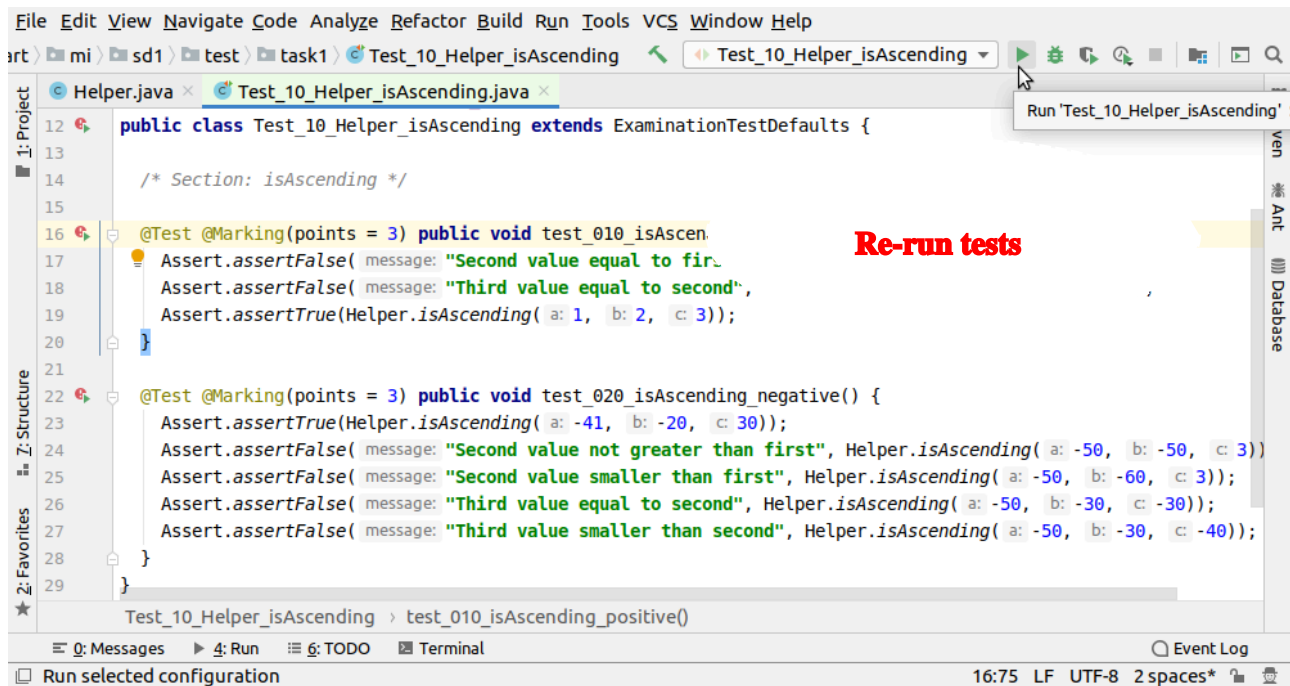
Correct Implementation

Helper > isAscending()

0: Messages 4: Run 6: TODO Terminal Event Log

Tests failed: 2, passed: 0 (5 minutes ago) 42:9 LF UTF-8 4 spaces

The implement - test - implement cycle

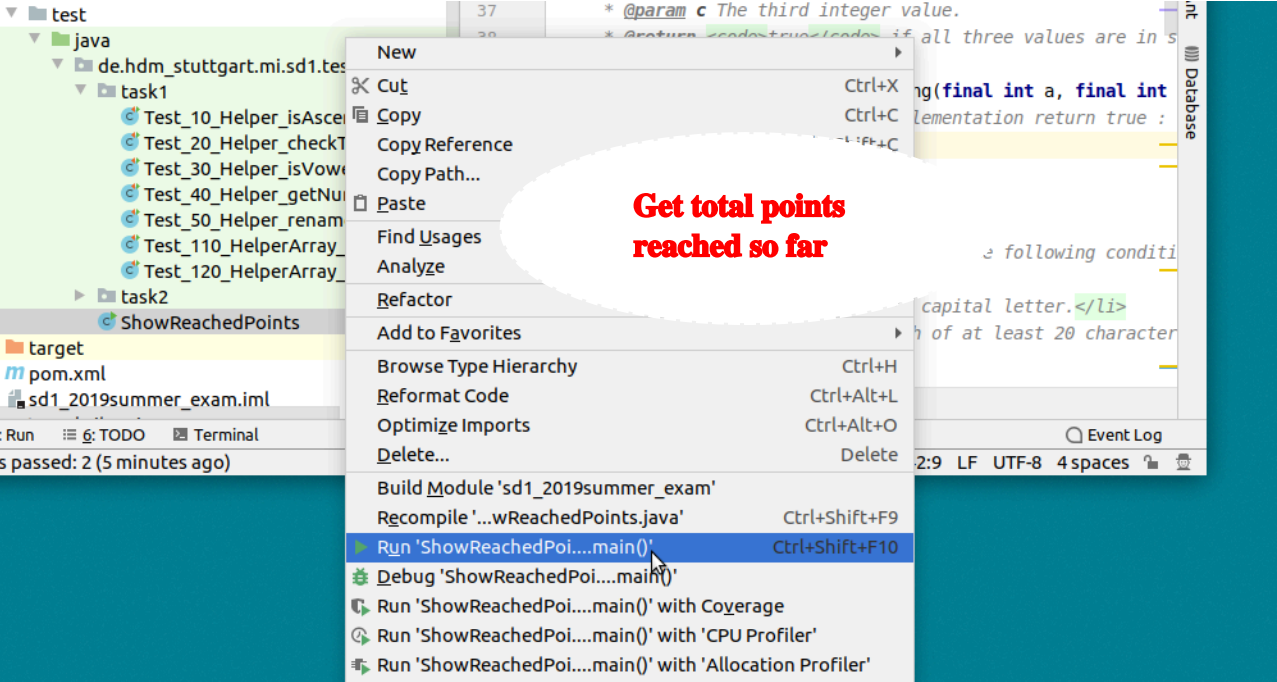


The implement - test - implement cycle

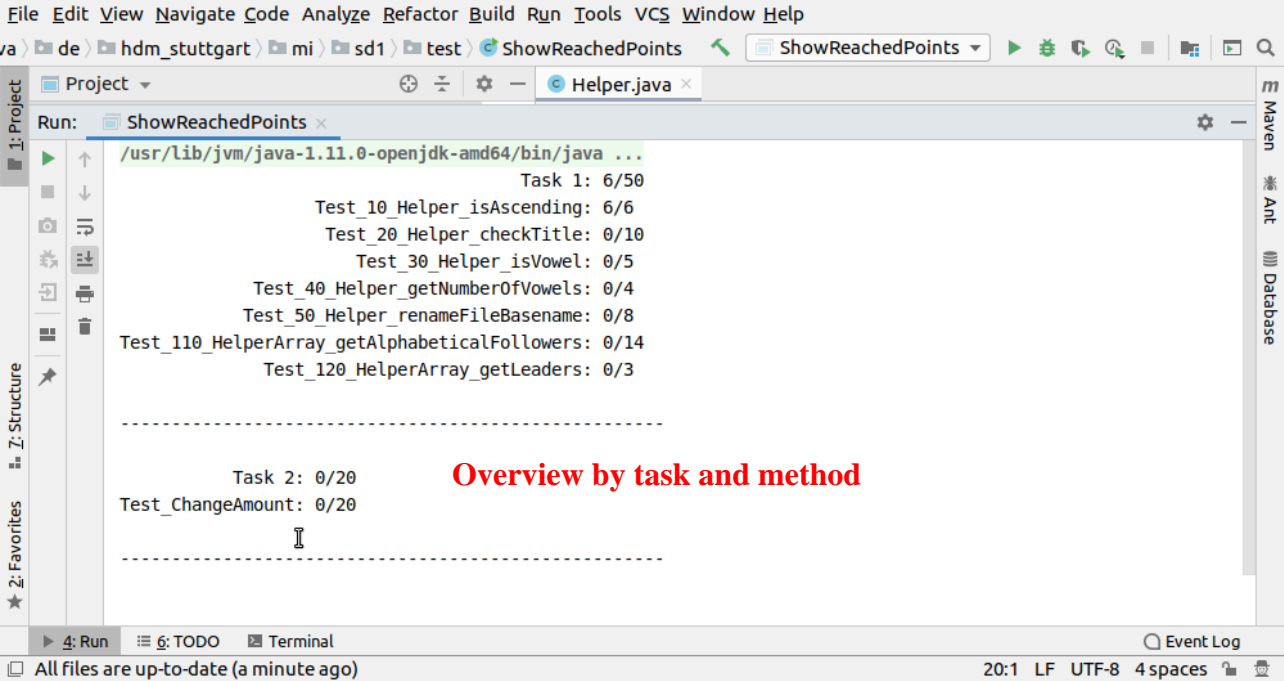
The screenshot displays an IDE interface with the following components:

- Code Editor:** Shows the source code for `Test_10_Helper_isAscending.java`. The class extends `ExaminationTestDefaults` and contains a test method `test_010_isAscending_positive()` that uses `Assert.assertFalse` to verify that `Helper.isAscending(a: 1, b: 1, c: 3)` returns `false`. The test method is annotated with `@Test @Marking(points = 3)`.
- Run Console:** Shows the execution results for the test. It indicates that 2 tests passed in 10 ms. The specific test results are:
 - ✓ Test_10_Helper 10 ms
 - ✓ test_010_isA: 3 ms
 - ✓ test_020_isA: 7 msThe process finished with exit code 0.
- Annotations:** A large red text overlay **Positive!** is placed over the test results in the Run console.
- IDE Elements:** The interface includes a menu bar (File, Edit, View, etc.), a toolbar, a Project Explorer on the left, and a Maven/Ant/Database sidebar on the right.

The implement - test - implement cycle

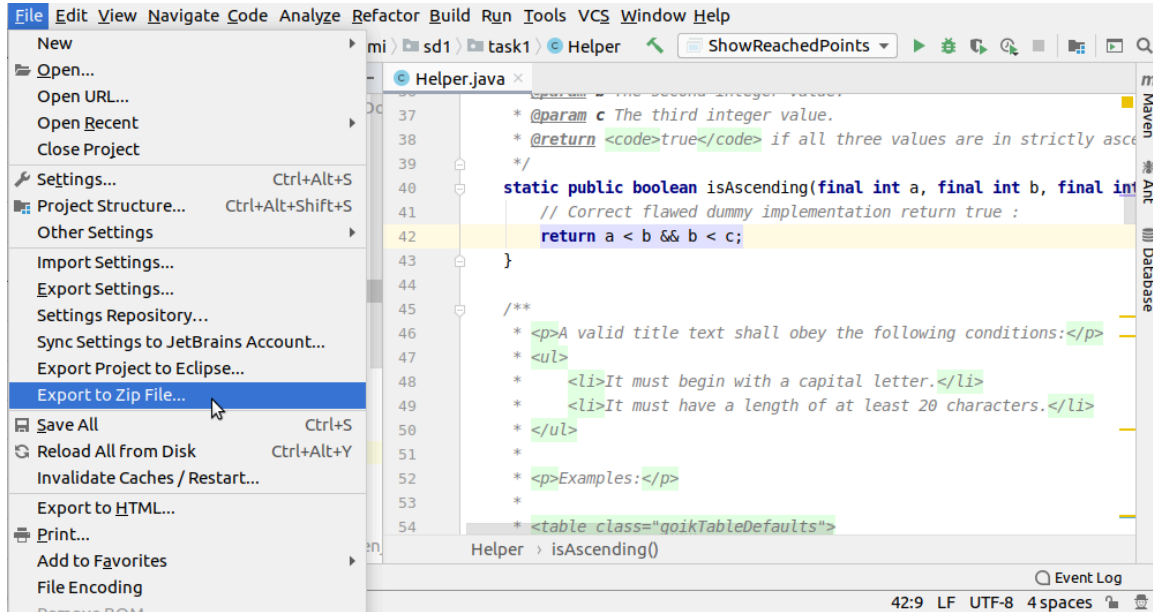


The implement - test - implement cycle

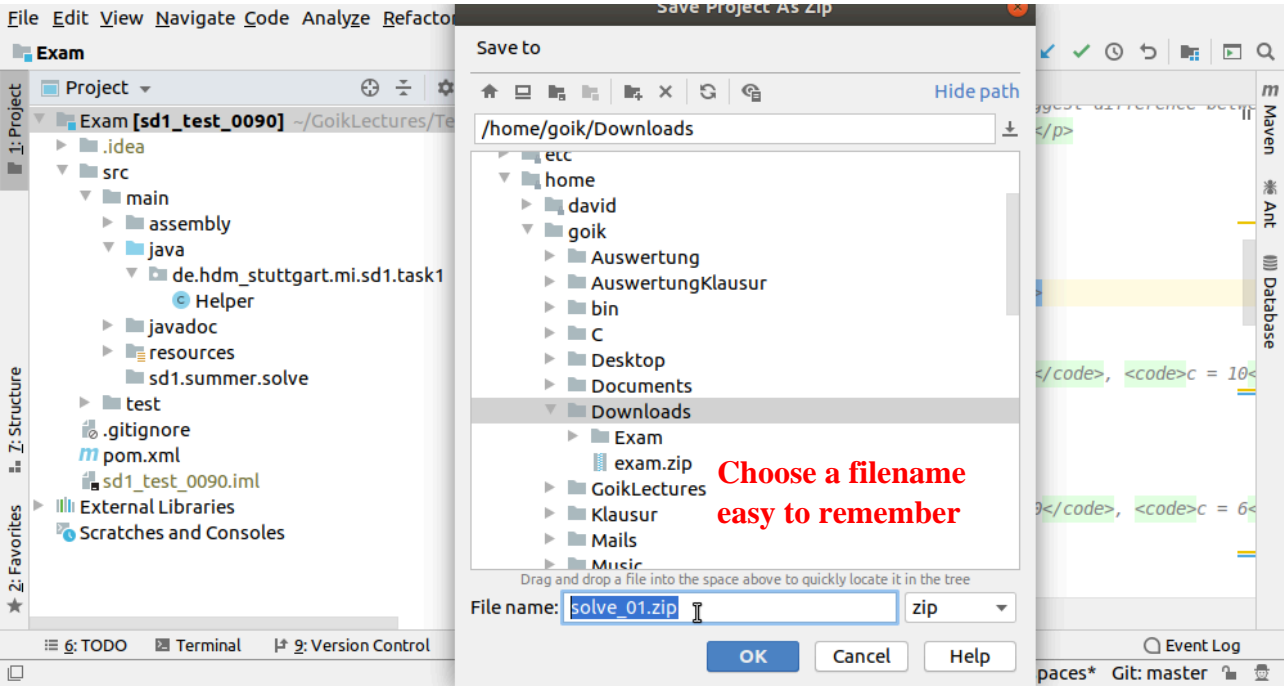


Finishing the exam

Export your current Maven project to .zip file



Finishing the exam



Finishing the exam

MI E-Exams - Exam 2019-0 x

klausur.mi.hdm-stuttgart.de/ilias/ilias.php?ref_id=709&sequence=1&active_id=13...

MI Examinations mi

HOCHSCHULE DER MEDIEN PERSONAL DESKTOP REPOSITORY

You have 114 Minutes left.

LIST OF QUESTIONS

- Class methods (Upload exported zip project archive here)
- Handling change money
- Logical expression
- Device states

Hide List of Questions Dashboard Finish the Test

Go to your programming task and scroll down ... Next →

Class methods (Upload exported zip project archive here)

Question 1 of 6 (50 Points)
Not answered

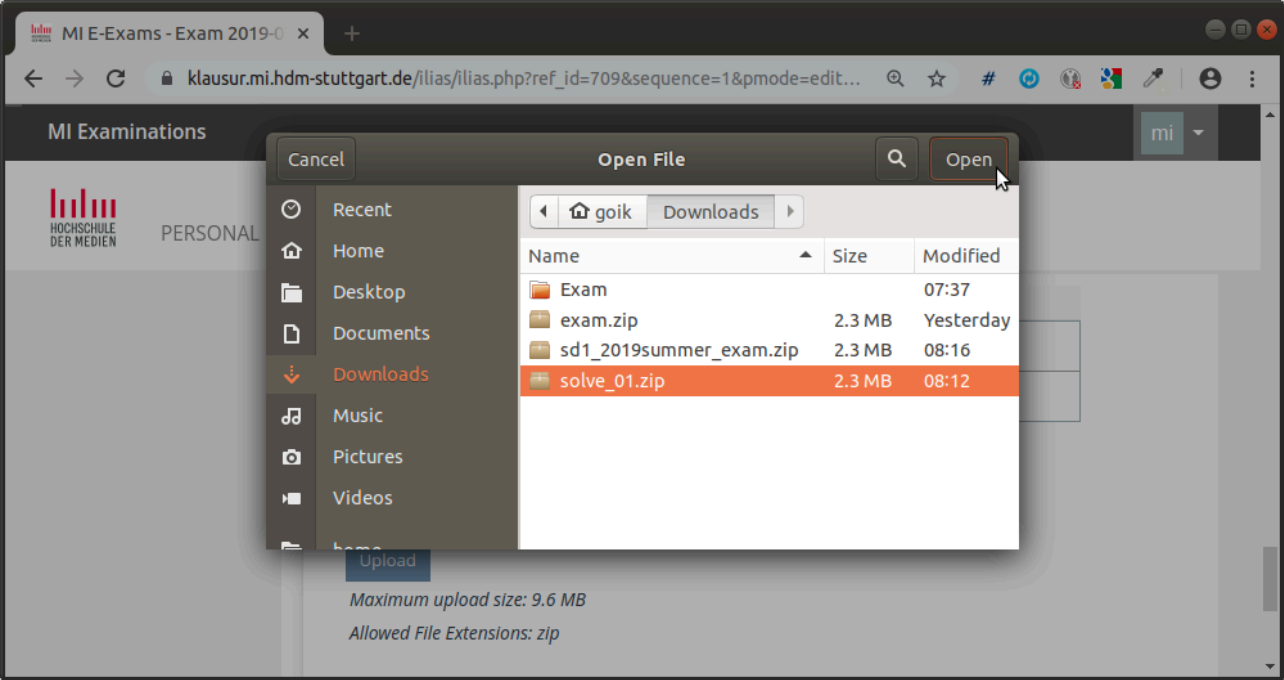
↓ Maven Projekt Skelett

Finishing the exam

The screenshot shows a web browser window with the address bar containing the URL `klausur.mi.hdm-stuttgart.de/ilias/ilias.php?ref_id=709&sequence=1&active_id=13...`. The page title is "MI Examinations". The header includes the logo of Hochschule der Medien and navigation links for "PERSONAL DESKTOP" and "REPOSITORY". A timer shows "08:20". Below the timer, there is a "Select All" checkbox and a "Delete" button. The text "(1 - 1 of 1)" is displayed. The "Upload File" section contains a "Choose File" button, the text "No file chosen", and an "Upload" button. At the bottom, it states "Maximum upload size: 9.6 MB".

**... to the »Upload« section
selecting your exported project
archive solution_01.zip file**

Finishing the exam



Finishing the exam

MI E-Exams - Exam 2019-0 x

klausur.mi.hdm-stuttgart.de/ilias/ilias.php?ref_id=709&sequence=1&pmode=edit...

MI Examinations mi

HOCHSCHULE DER MEDIEN PERSONAL DESKTOP REPOSITORY

SUBMITTED FILES

File Name	Date
This object is empty and contains no items.	

Upload File

Choose File solve_01.zip

Upload

Maximum upload size: 9.6 MB

Allowed File Extensions: zip

Hit »Upload«

Finishing the exam

MI Examinations

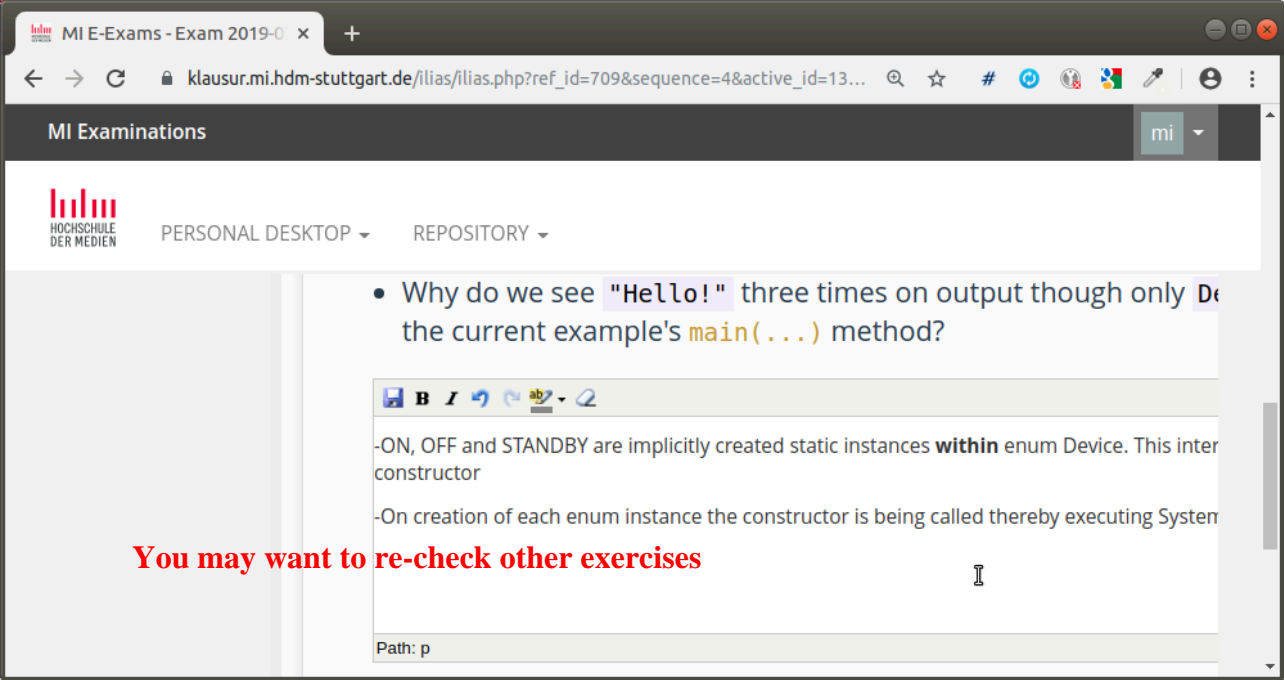
PERSONAL DESKTOP REPOSITORY

SUBMITTED FILES
(1 - 1 of 1)

File Name	Date
<input type="checkbox"/> solve_01.zip	14. Dec 2019, 08:20
<input type="checkbox"/> Select All	

You may upload multiple files for safety reasons (>>sudden<< exam time out!)

Finishing the exam



The screenshot shows a web browser window with the following elements:

- Browser tab: MI E-Exams - Exam 2019-0
- Address bar: klausur.mi.hdm-stuttgart.de/filias/filias.php?ref_id=709&sequence=4&active_id=13...
- Page title: MI Examinations
- Logo: HOCHSCHULE DER MEDIEN
- Navigation: PERSONAL DESKTOP, REPOSITORY
- Question: Why do we see "Hello!" three times on output though only De the current example's `main(...)` method?
- Code editor: Contains text about static instances `ON`, `OFF`, and `STANDBY` within an enum `Device`, and a note that the constructor is called on creation of each enum instance.
- Path: p

You may want to re-check other exercises

Finishing the exam

The screenshot shows a web browser window with the URL `klausur.mi.hdm-stuttgart.de/ilias/ilias.php?ref_id=709&sequence=6&active_id=13...`. The page header includes the logo for Hochschule der Medien and navigation links for 'PERSONAL DESKTOP' and 'REPOSITORY'. The main content area features a large timer: 'You have 100 Minutes left.' Below the timer are three buttons: 'Hide List of Questions', 'Dashboard', and 'Finish the Test', with a mouse cursor hovering over the last one. A red warning message reads 'Hit »Finish the test«'. The current question is 'Software project bonus points', 'Question 6 of 6 (10 Points)', and 'Not answered'. A 'Previous' button is on the left and an 'Actions' dropdown is on the right. The address bar at the bottom shows a URL with `pmode=edit&cmd=finishTest&cmdClass=ilt...`.

Finishing the exam

MI E-Exams - Exam 2019-0 x

klausur.mi.hdm-stuttgart.de/filias/filias.php?ref_id=709&sequence=6&pmode=edit...

MI Examinations mi

HOCHSCHULE DER MEDIEN PERSONAL DESKTOP REPOSITORY

- Project uploads containing compile time syntax errors receive a point deduction penalty of 20%.
- Results just residing on your local workstation and not being uploaded before examination termination time are invisible to marking and will thus be discarded.
- Allocate enough time for project export and upload. Do intermediate uploads for safety reasons.

SUBMITTED FILES

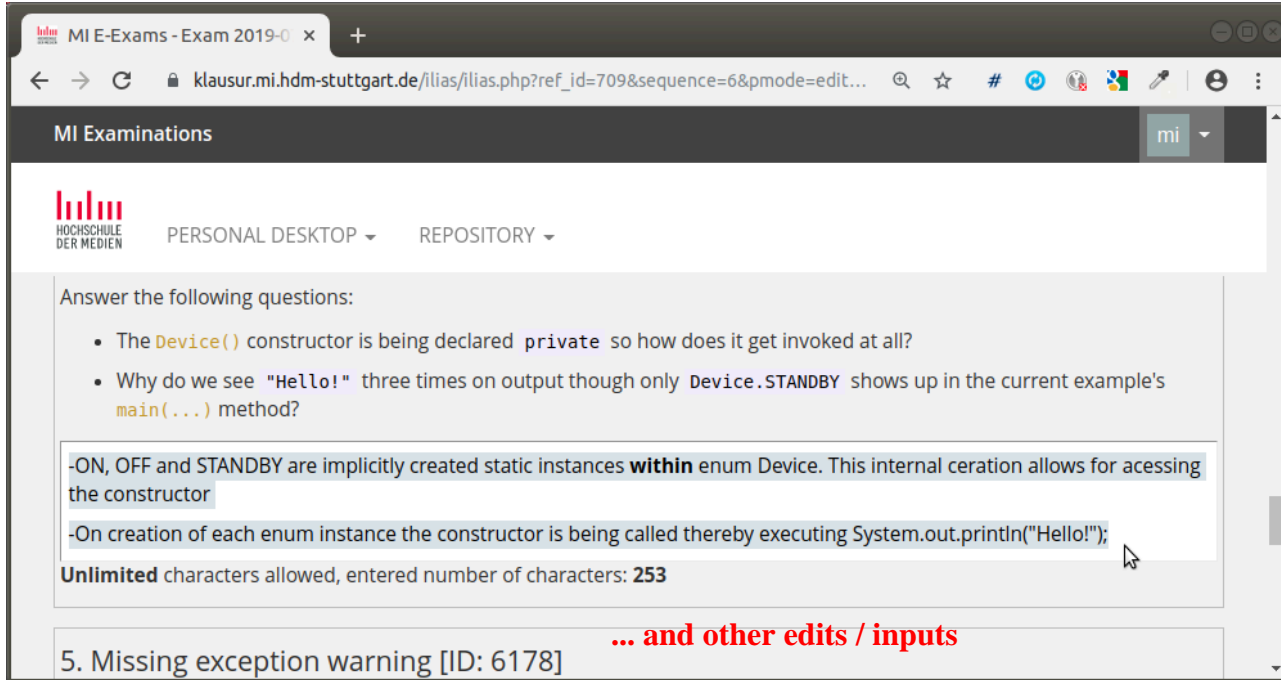
File Name	Date
solve_01.zip	14. Dec 2019, 08:20

Upload File

Choose File No file chosen

Re-check the presence of desired uploads ...

Finishing the exam



MI E-Exams - Exam 2019-0 x +

klausur.mi.hdm-stuttgart.de/filias/filias.php?ref_id=709&sequence=6&pmode=edit...

MI Examinations mi

HOCHSCHULE DER MEDIEN PERSONAL DESKTOP REPOSITORY

Answer the following questions:

- The `Device()` constructor is being declared `private` so how does it get invoked at all?
- Why do we see "Hello!" three times on output though only `Device.STANDBY` shows up in the current example's `main(...)` method?

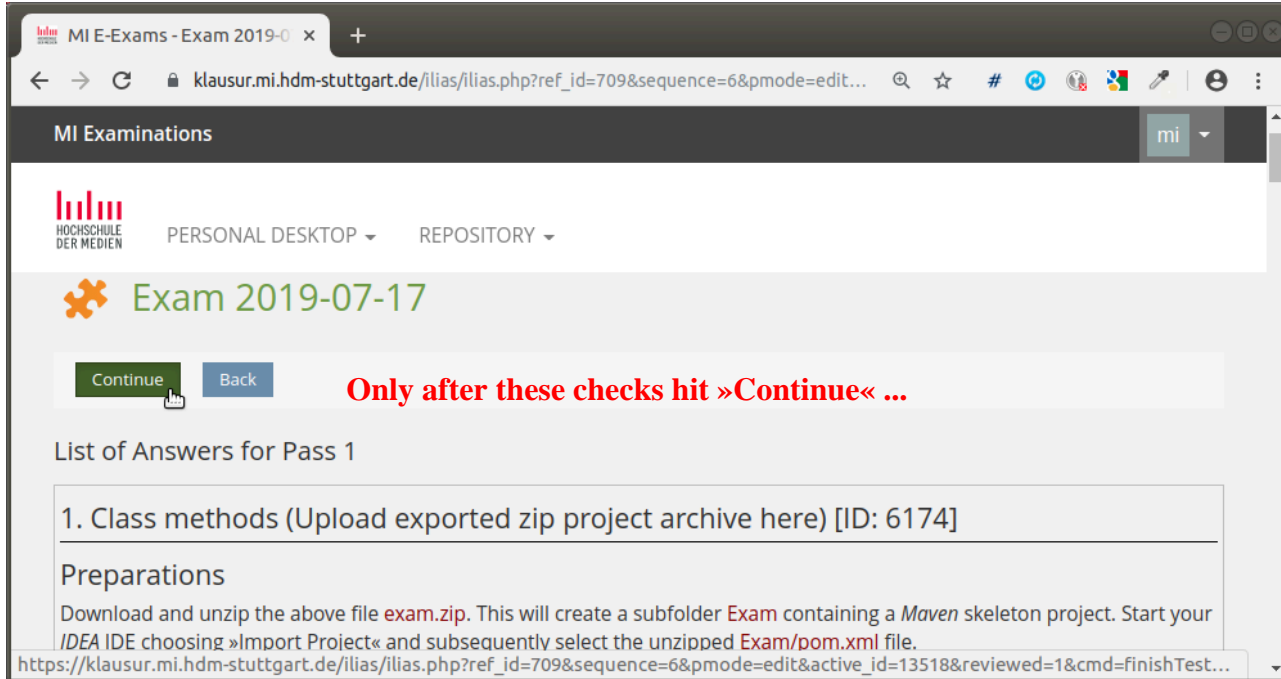
-ON, OFF and STANDBY are implicitly created static instances **within** enum Device. This internal ceration allows for accessing the constructor

-On creation of each enum instance the constructor is being called thereby executing `System.out.println("Hello!");`

Unlimited characters allowed, entered number of characters: 253

5. Missing exception warning [ID: 6178] **... and other edits / inputs**

Finishing the exam



MI E-Exams - Exam 2019-0 x +

klausur.mi.hdm-stuttgart.de/ilias/ilias.php?ref_id=709&sequence=6&pmode=edit...

MI Examinations mi

HOCHSCHULE DER MEDIEN PERSONAL DESKTOP REPOSITORY

Exam 2019-07-17

Continue Back **Only after these checks hit »Continue« ...**

List of Answers for Pass 1

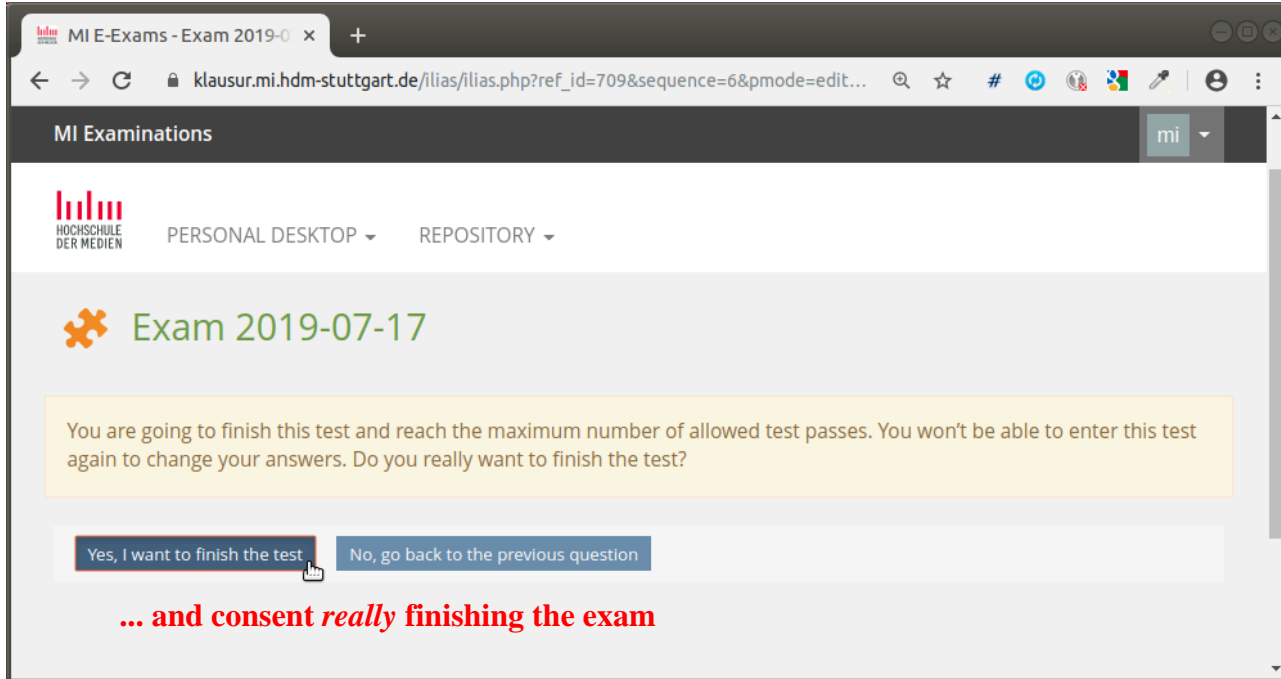
1. Class methods (Upload exported zip project archive here) [ID: 6174]

Preparations

Download and unzip the above file `exam.zip`. This will create a subfolder `Exam` containing a *Maven* skeleton project. Start your *IDEA* IDE choosing »Import Project« and subsequently select the unzipped `Exam/pom.xml` file.

https://klausur.mi.hdm-stuttgart.de/ilias/ilias.php?ref_id=709&sequence=6&pmode=edit&active_id=13518&reviewed=1&cmd=finishTest...

Finishing the exam

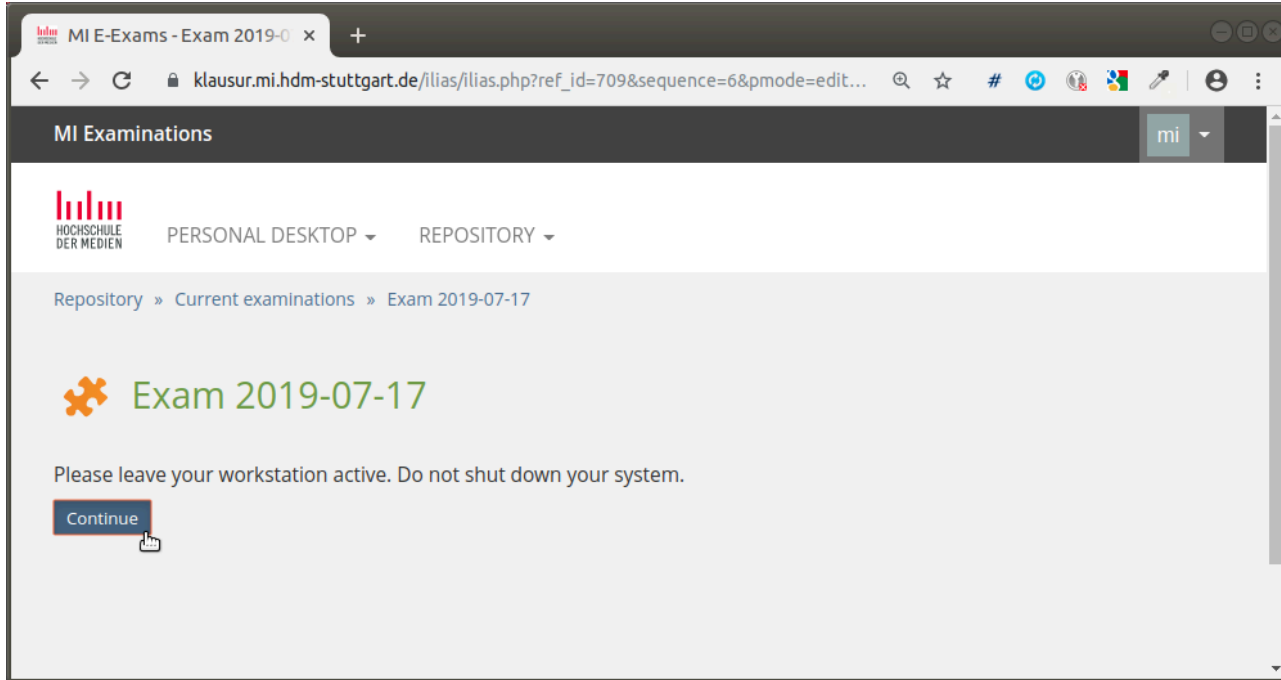


The screenshot shows a web browser window with the following elements:

- Browser tab: MI E-Exams - Exam 2019-0
- Address bar: klausur.mi.hdm-stuttgart.de/filias/filias.php?ref_id=709&sequence=6&pmode=edit...
- Page header: MI Examinations
- Navigation: PERSONAL DESKTOP, REPOSITORY
- Page title: Exam 2019-07-17
- Warning message: You are going to finish this test and reach the maximum number of allowed test passes. You won't be able to enter this test again to change your answers. Do you really want to finish the test?
- Buttons: Yes, I want to finish the test (highlighted with a red box), No, go back to the previous question

... and consent *really* finishing the exam

Finishing the exam




MI E-Exams - Exam 2019-0 x

klausur.mi.hdm-stuttgart.de/filias/filias.php?ref_id=709&sequence=6&pmode=edit...

MI Examinations mi

HOCHSCHULE DER MEDIEN PERSONAL DESKTOP REPOSITORY

Repository » Current examinations » Exam 2019-07-17

 Exam 2019-07-17

Please leave your workstation active. Do not shut down your system.

Continue

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

- Link for cheat sheet uploads outside exam periods
- **Check sheets after uploading** at <https://freedocs.mihdmstuttgart.de/cheat>.

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

```
/**
 * 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.getNesUngradesElement(new int[]{-4, 6, 1, -2, 8}, 1));
}
```

Don't cheat!

Unit Tests	Your solution
<pre>assert False(isPrime(1)); assert True (isPrime(2)); assert True (isPrime(3)); assert False(isPrime(4)); assert True (isPrime(5)); assert False(isPrime(6)); assert True (isPrime(7)); assert False(isPrime(8)); assert False(isPrime(9)); assert False(isPrime(10));</pre>	<pre>... boolean isPrime(final int p) { switch (p) { case 2: case 3: case 5: case 7: return true; default: return false; }</pre>

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.

Related exercises

Exercise 202: Task

Exercise 203: Executing main(...)

Exercise 204: Strange arithmetics

Exercise 205: Task

Exercise 206: Beginner's nightmare

Exercise 207: Strange endless loop result

Exercise 208: Task

Exercise 209: switch versus if ... else if ... else

Exercise 210: Exception handling

Exercise 211: Task

Exercise 212: Extraterrestrial integer value representation

Exercise 213: An initialization issue

Exercise 214: Tasks

Exercise 215: equals() and hashCode()

Exercise 216: The average of three byte values

Exercise 217: Tasks

Exercise 218: Spoiled execution

Exercise 219: Method overriding

Exercise 220: Tasks

Exercise 221: Type conflict

Exercise 222: Weird subtraction

Exercise 223: Tasks

Exercise 224: Surprising difference

Exercise 225: Type assignment problem

Exercise 226: Tasks

Exercise 227: Return type

Related exercises

Exercise 228: Weird behaviour

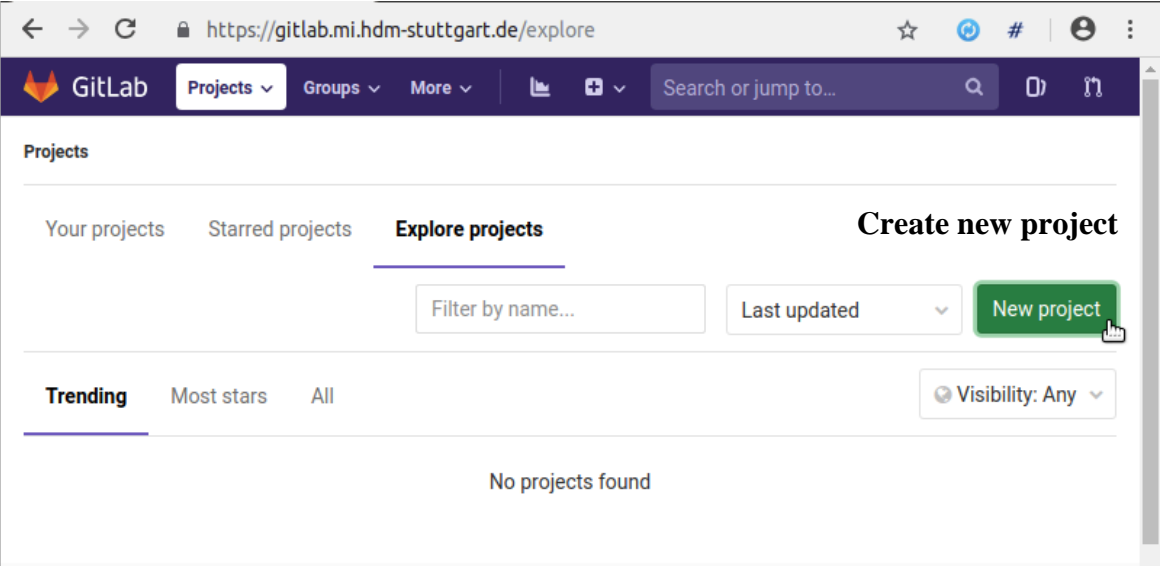
Exercise 229: Tasks

Exercise 230: Tasks

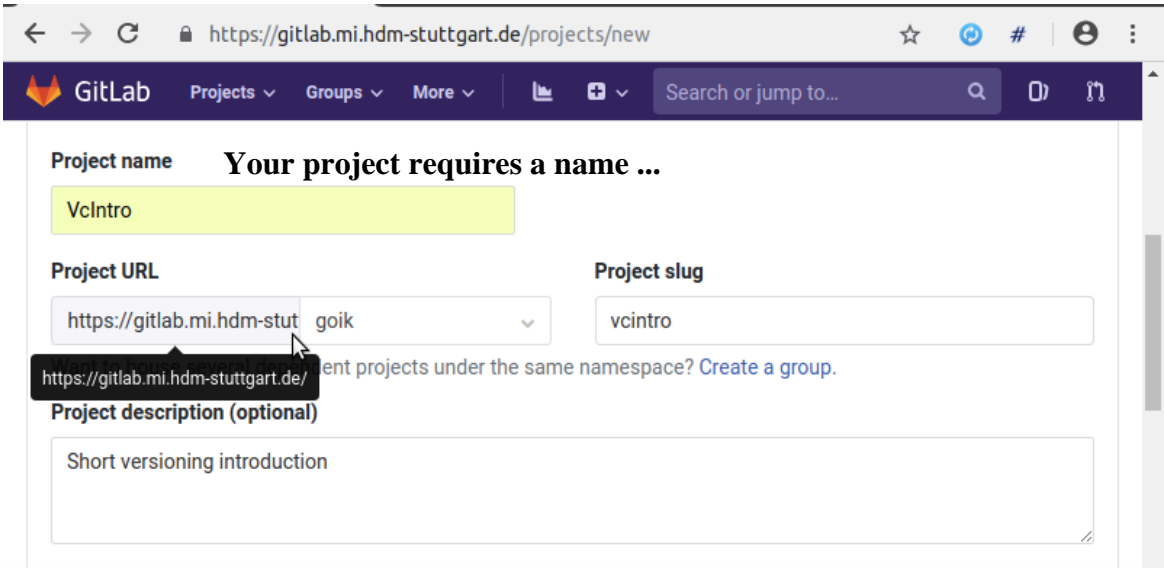
Steps creating a new project

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

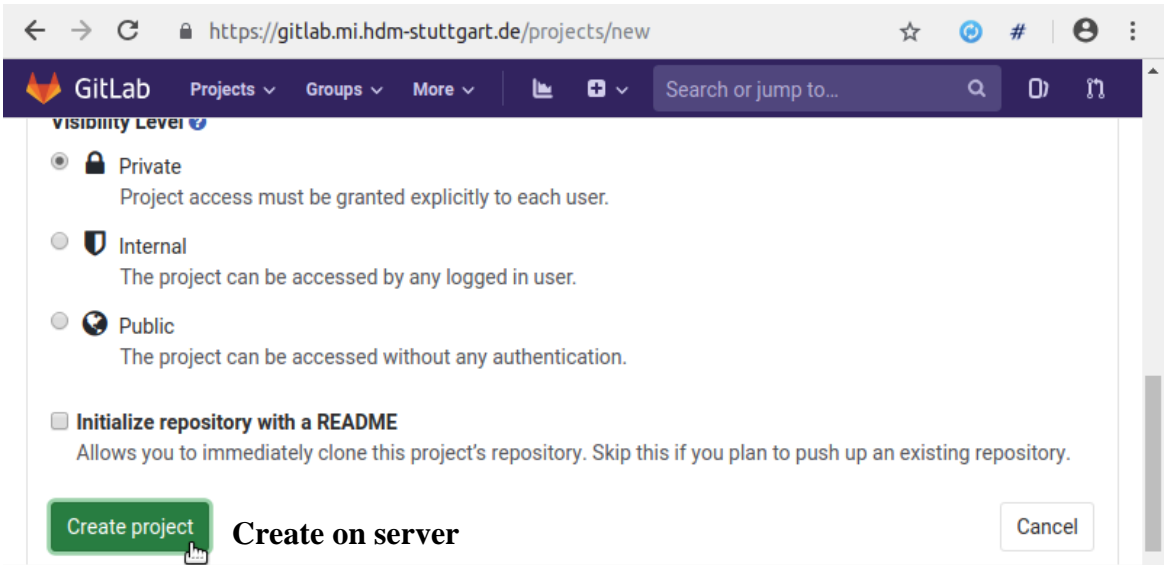
Creating a project at MI gitlab



Creating a project at MI gitlab



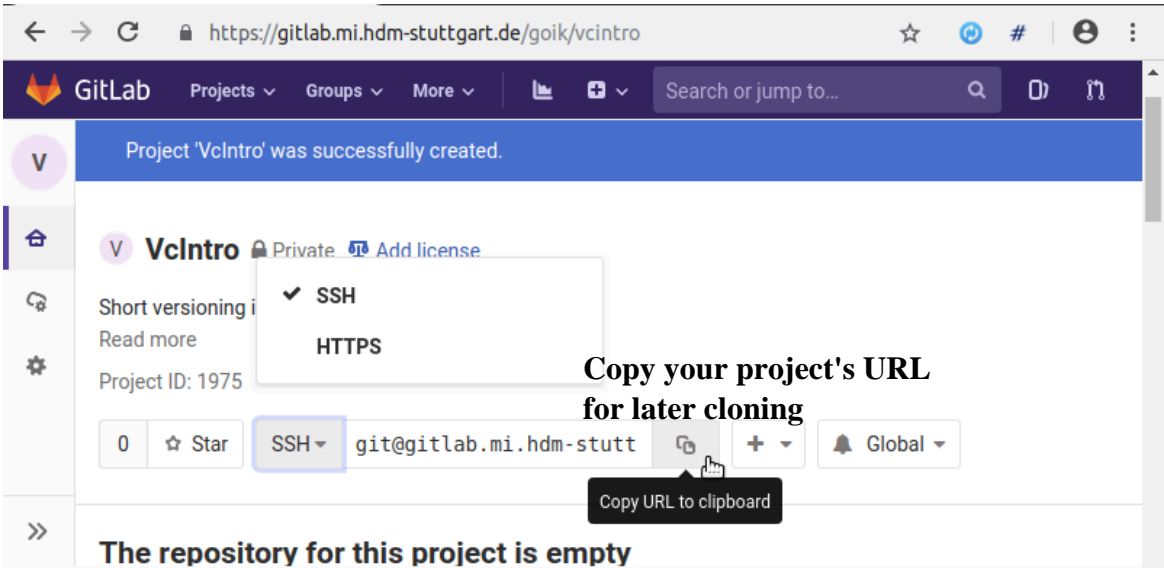
Creating a project at MI gitlab



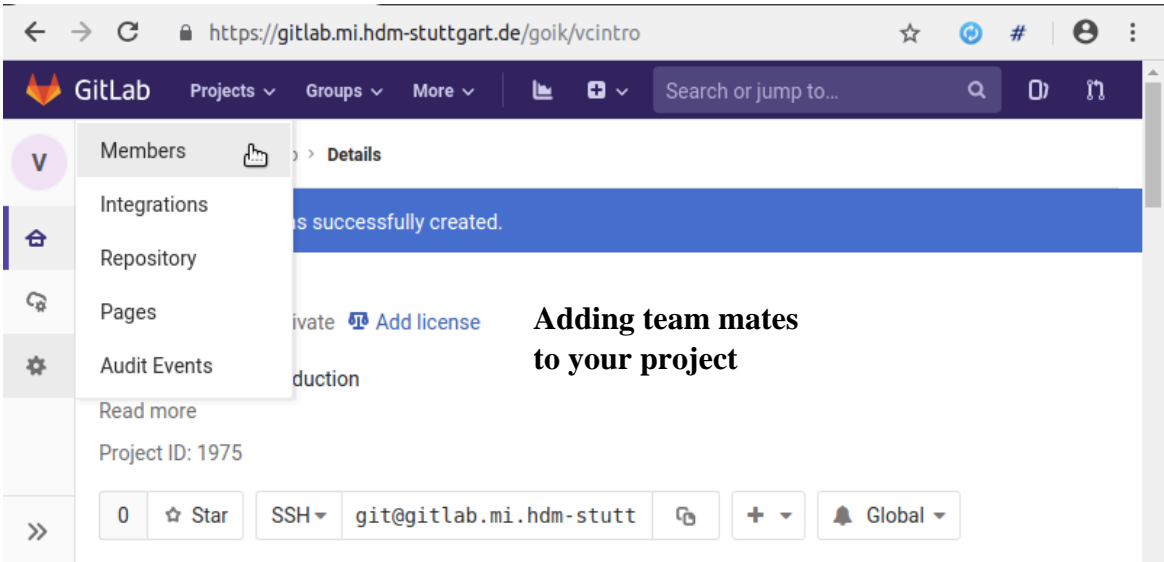
Creating a project at MI gitlab

The screenshot shows a web browser window displaying the GitLab interface. The URL is `https://gitlab.mi.hdm-stuttgart.de/goik/vcintro`. A blue notification banner at the top states "Project 'VcIntro' was successfully created." Below this, the project name "VcIntro" is shown as private. A tooltip is visible over the authentication dropdown menu, which currently has "SSH" selected. The tooltip text reads: "Choose »https« unless ssh authentication being configured". The dropdown menu also shows "HTTPS" as an option. Below the menu, the repository URL is `git@gitlab.mi.hdm-stutt`. At the bottom of the page, it says "The repository for this project is empty".

Creating a project at MI gitlab



Creating a project at MI gitlab



Creating a project at MI gitlab

The screenshot shows the GitLab web interface for the 'Project members' page. The browser address bar displays the URL: `https://gitlab.mi.hdm-stuttgart.de/goik/vcintro/project_members`. The navigation bar includes the GitLab logo, 'Projects', 'Groups', and 'More' dropdowns, along with a search bar containing the text 'Search or jump to...'. On the left sidebar, a user profile icon with the letter 'V' is visible, along with navigation icons for home, refresh, settings, and a double arrow icon.

Project members

You can invite a new member to **VcIntro** or invite another group.

Two tabs are present: 'Invite member' (active) and 'Invite group'.

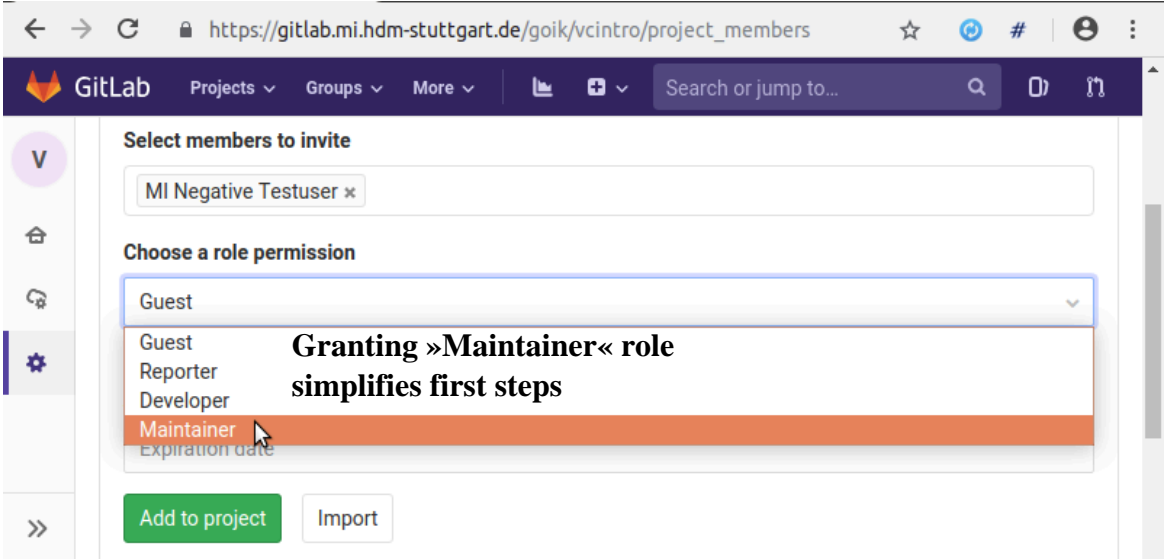
Select members to invite

The search input field contains the text 'mistudent'. A search result is displayed below the input field:

- Enter HdM login name**
- MI Negative Testuser@mistudent

The search result for 'MI Negative Testuser@mistudent' includes a purple snowflake icon and a hand cursor icon, indicating it is a selectable option.

Creating a project at MI gitlab



Creating a project at MI gitlab

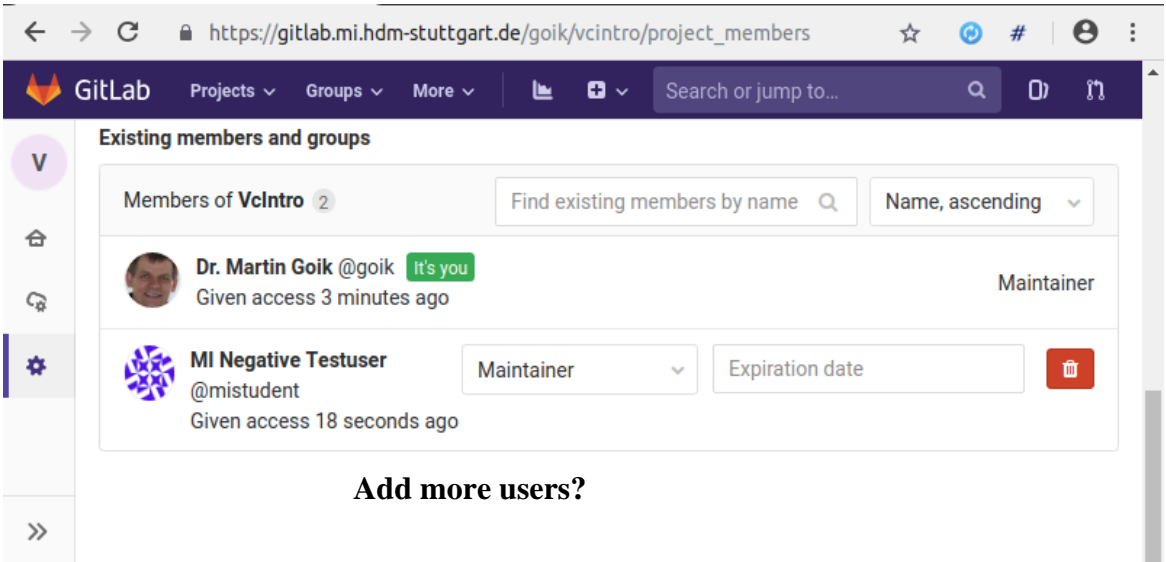
The screenshot shows the GitLab web interface for adding a user to a project. The browser address bar shows the URL: `https://gitlab.mi.hdm-stuttgart.de/goik/vcintro/project_members`. The page title is "Add user to your project".

The form contains the following fields and options:

- Select members to invite:** A search input field containing "MI Negative Testuser *".
- Choose a role permission:** A dropdown menu currently set to "Maintainer". Below it is a link: [Read more about role permissions](#).
- Access expiration date:** An input field labeled "Expiration date".

At the bottom of the form, there are two buttons: "Add to project" (highlighted with a mouse cursor) and "Import".

Creating a project at MI gitlab



The screenshot shows the GitLab interface for managing project members. The browser address bar displays the URL: `https://gitlab.mi.hdm-stuttgart.de/goik/vcintro/project_members`. The page title is "Existing members and groups".

At the top, there is a search bar with the text "Find existing members by name" and a dropdown menu set to "Name, ascending". Below this, two members are listed:

- Dr. Martin Goik** (@goik): Given access 3 minutes ago, role: Maintainer. A green badge indicates "It's you".
- MI Negative Testuser** (@mistudent): Given access 18 seconds ago, role: Maintainer. Includes an "Expiration date" field and a delete icon.

At the bottom of the list, the text "Add more users?" is displayed.

Cloning a git project

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

Enter project folder, add Readme.md

```
>cd vci ntro/  
>vi m Readme.md  
>git add Readme.md
```

```
# Initial project description.
```

```
Will be extended when adding more assets.
```


Committing change set

```
EDITOR=vi m 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.mhdmstuttgart.de:goik/vci nt ro.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=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

```
EDI TOR=vi m 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/hdmstuttgart/mi/sd1/App.java
```

```
#       new file:   first/src/main/resources/log4j2.xml
```

```
#       new file:   first/src/test/java/de/hdmstuttgart/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 MB/s, done.
Total 22 (delta 0), reused 0 (delta 0)
To gitlab.mi.hdm-stuttgart.de:goik/vci nt ro.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.mhdm.stuttgart.de: goik/vcintr
 3751344..83bd7b9 master -> origin/master
Updating 3751344..83bd7b9
Fast-forward
 3 files changed, 3 insertions(+), 2 deletions(-)
```

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

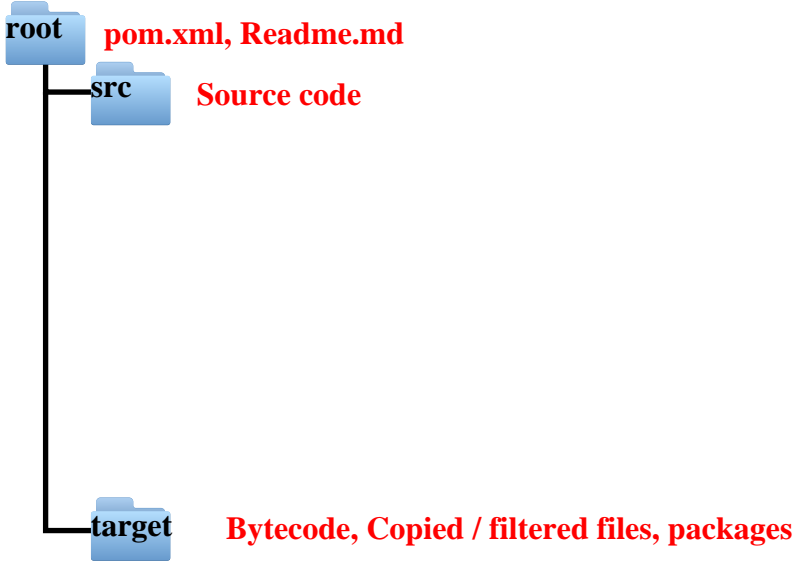


`pom.xml`, `Readme.md`

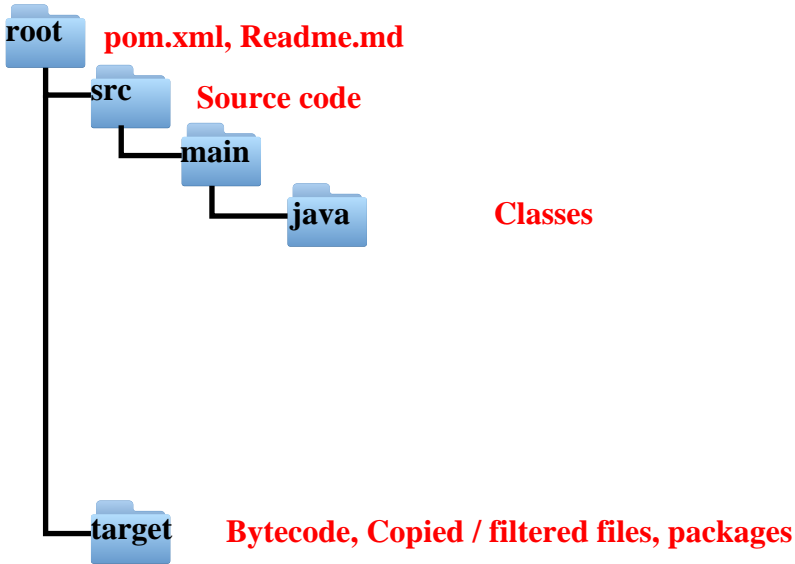
Maven project layout



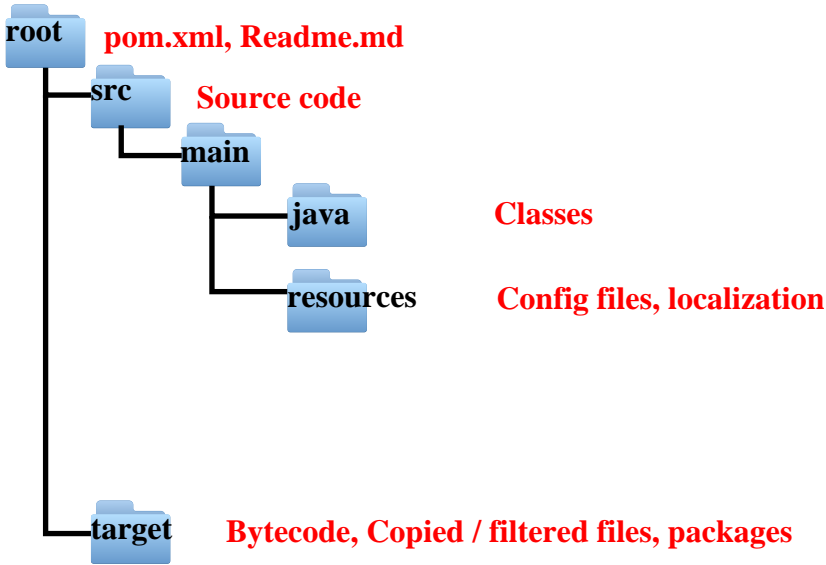
Maven project layout



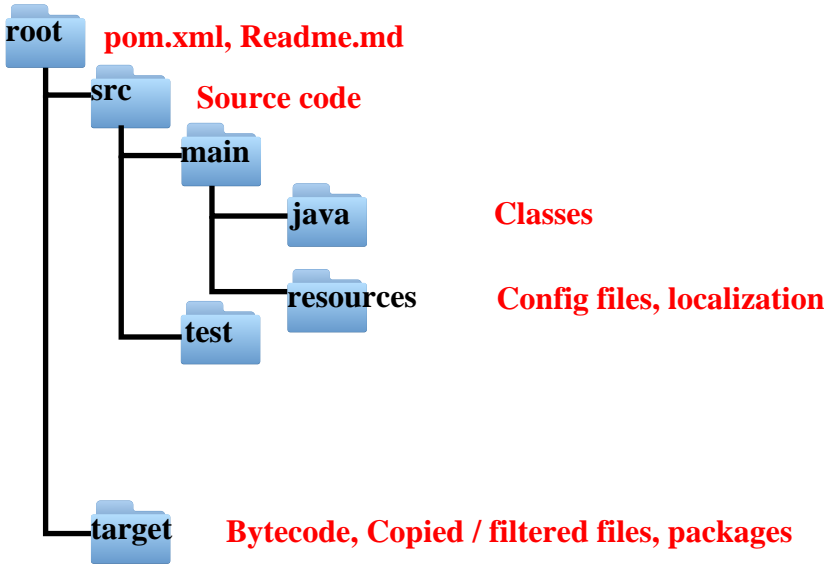
Maven project layout



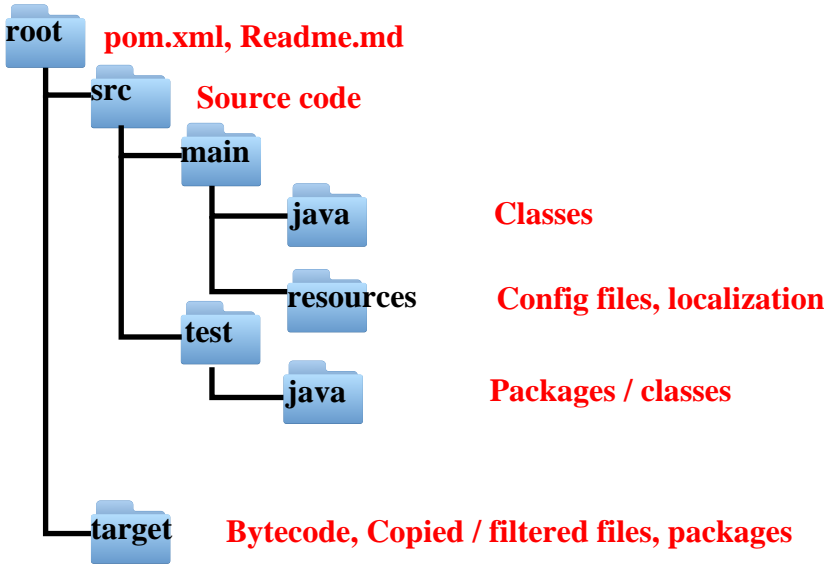
Maven project layout



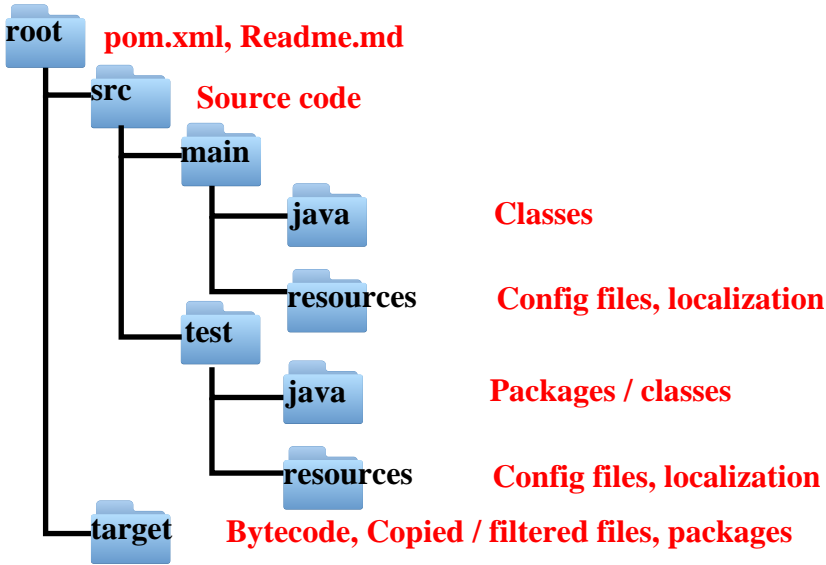
Maven project layout



Maven project layout



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
    http://maven.apache.org/xsd/maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  ...
</project>
```


pom.xml characteristics

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

pom.xml vs. Makefile

```
<pl ugi n>  
  <gr oupI d>org. apache. maven. pl ugi ns</gr oupI d>  
  <art i fact I d>maven- shade- pl ugi n</art i fact I d>  
  <conf i gur at i on>  
    <M ai n- Cl ass>org. devel . App</M ai n- Cl ass>  
  ...  
  <execut i on>  
    <phase>package</phase>  
    <goal s>  
      <goal >shade</goal >  
    </goal s>
```

```
mødul e. o: mødul e. c  
gcc -c -g mødul e. c
```

«Hello, world» 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>de.hdm-stuttgart.mi</groupId>
  <artifactId>first</artifactId>
  <version>0.9</version>
```

```
</project>
```

Executing «compile» phase

```
mkdir -p src/main/java ❶
```

```
vim src/main/java/Hello.java ❷
```

```
first> mvn compile ...
```

```
[WARNING] File encoding has not been set, using platform encoding UTF-8, ❸
```

```
    i.e. build is platform dependent! ...
```

```
[ERROR] error: Source option 5 is no longer supported. ❹ Use 6 or later.
```

```
[ERROR] error: Target option 1.5 is no longer supported. ❺ 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.builtSourceEncoding>UTF-8</project.builtSourceEncoding>
```

```
<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
```

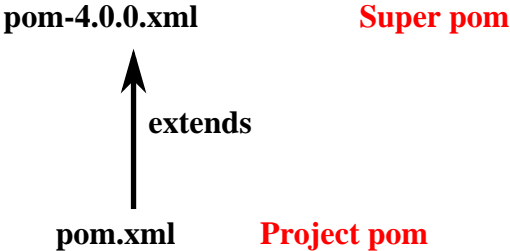
220

POM inheritance

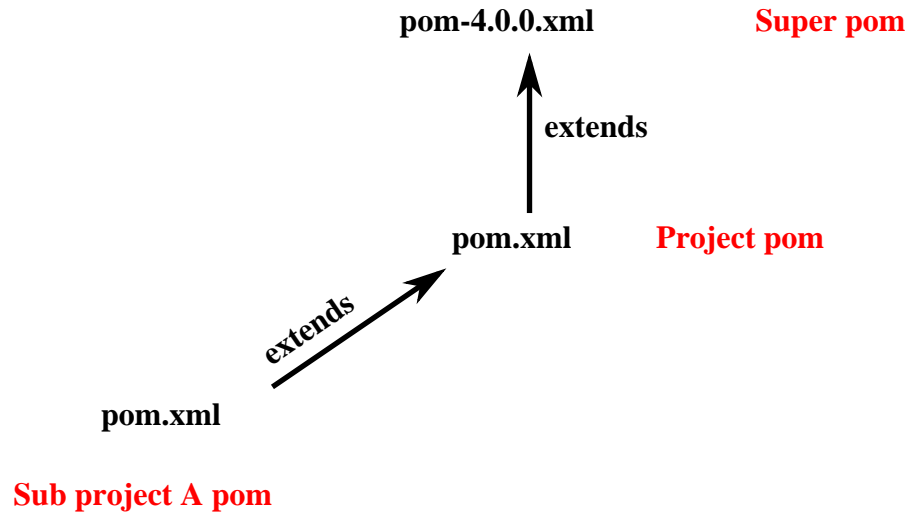
pom-4.0.0.xml

Super pom

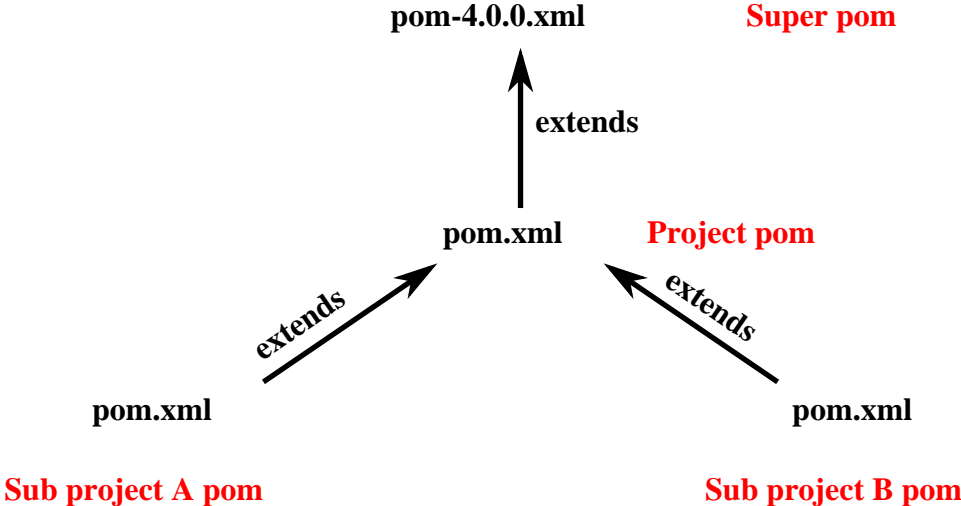
POM inheritance



POM inheritance



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 POM, 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>
```

...

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
...
```

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>...
```

```
first> mvn test
```

```
[INFO] Scanning for projects...
```

```
Running de.hdmstuttgart.ni.sd1.AppTest
```

```
Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.053 sec
```

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

Dependency listing

```
first> mvn dependency:tree
```

```
    ...  
[INFO] de.hdmi.stuttgart.misdi: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>
```

```
...
```

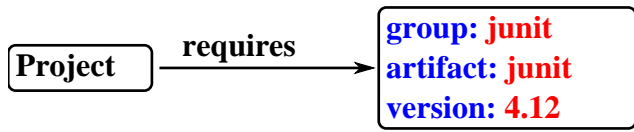
~/m2/repository/junit/junit/4.12/junit-4.12.pom

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

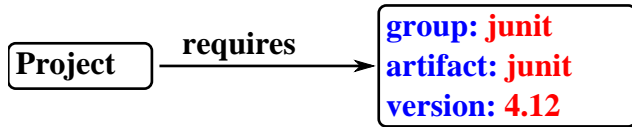
Transitive dependencies

Project

Transitive dependencies

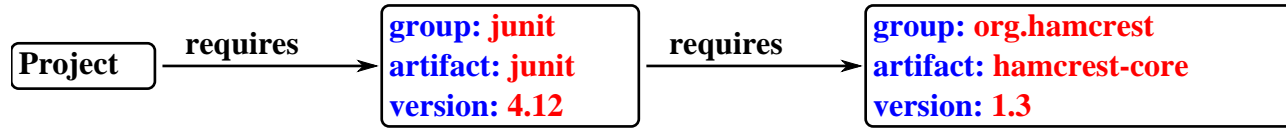


Transitive dependencies



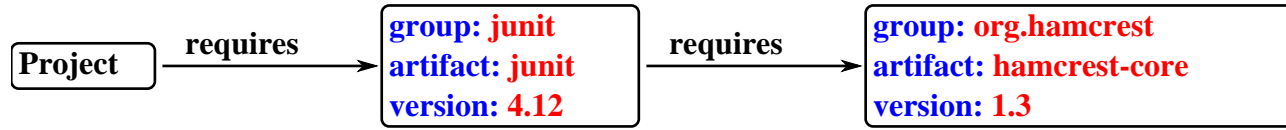
```
<dependency>  
  <groupId>junit<...  
  <artifactId>junit<...  
  <version>4.12<...  
</dependency>
```


Transitive dependencies



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

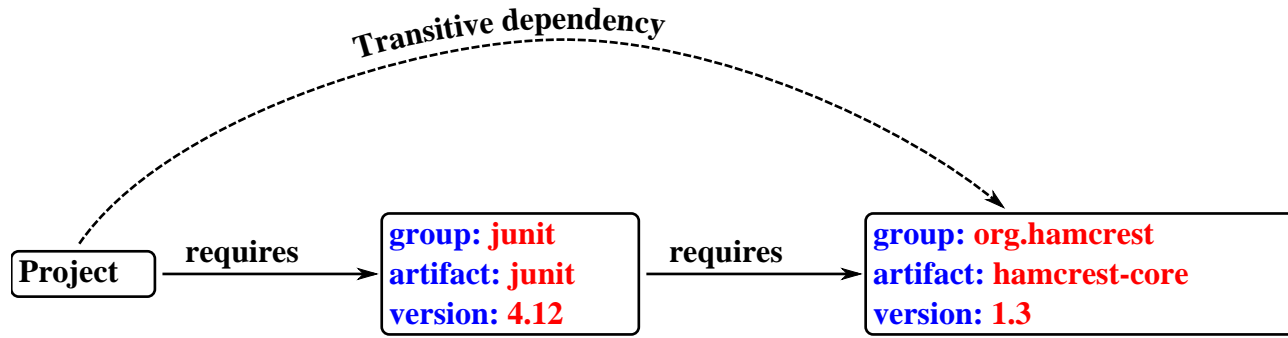
Transitive dependencies



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

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

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>...
```

```
testng> mvn test
```

```
Running de.hdmstuttgart.mi.sd1.AppTest
```

```
Configuring TestNG with: org.apache.maven.surefire...
```

```
Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.372 sec
```

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

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

Phases

```
public class Member {  
    Date birthDate;  
    String name;  
    public String  
    toString()  
    return n  
    + birth  
}  
}
```



```
public class @Entity Club {  
    @Id int id;  
    String name;  
    public String  
    toString()  
    return name  
    + " (id"  
    + id + ")  
}  
}
```



Phases

```
public class Member {  
    Date birthDate;  
    String name;  
    public String toString()  
    {  
        return name + " born " + birthDate;  
    }  
}
```

```
public class @Entity Club {  
    @Id int id;  
    String name;  
    public String toString()  
    {  
        return name + " with id " + id;  
    }  
}
```

compile (javac)



```
SourceFile: "Member.java"  
@G^@H^G^@!^A^@*^@  
#^A^@G^@S^!^@%~^@&^A^@  
^@%de hdm  
!mi$dl/A  
javaLangA  
^@%Pj  
m^A^@%  
java to P...
```

```
SourceFile: "Club.java"  
@G^@H^G^@!^A^@*^@  
#^A^@G^@S^!^@%~^@&^A^@  
^@%de hdm  
!mi$dl/A  
javaLangA  
^@%Pj  
m^A^@%  
java to P...
```

Phases

```
public class Member {  
    Date birthDate;  
    String name;  
    public String toString()  
    return n  
    + birth  
}
```

compile (javac)

```
SourceFile-A^  
@HMMember.java^  
@G^@H^G^@!^LA^@^@  
#^A^@G^@S^L^@%^^&^A^  
^@%de hdm  
!misi/!A  
javaLangA  
^@%Pj  
m^A^%  
java to P
```

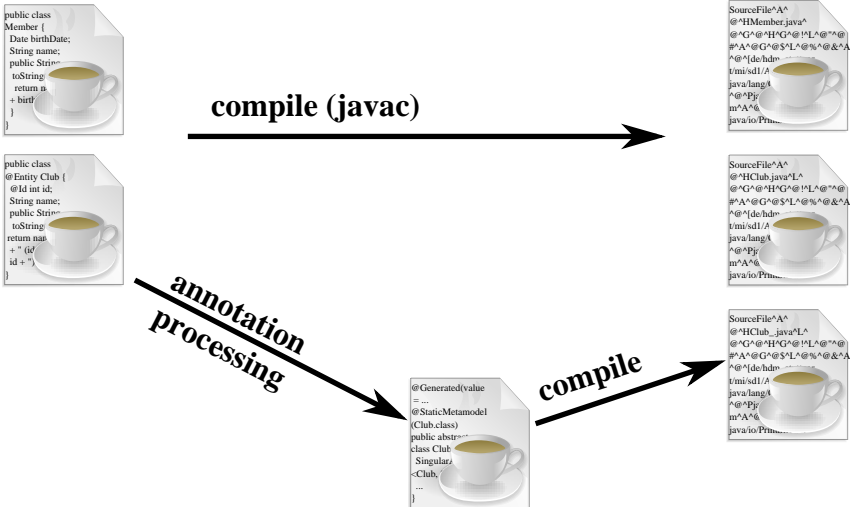
```
public class @Entity Club {  
    @Id int id;  
    String name;  
    public String toString()  
    return na  
    + " (id  
    id = ")  
}
```

```
SourceFile-A^  
@HClub.java!A  
@G^@H^G^@!^LA^@^@  
#^A^@G^@S^L^@%^^&^A^  
^@%de hdm  
!misi/!A  
javaLangA  
^@%Pj  
m^A^%  
java to P
```

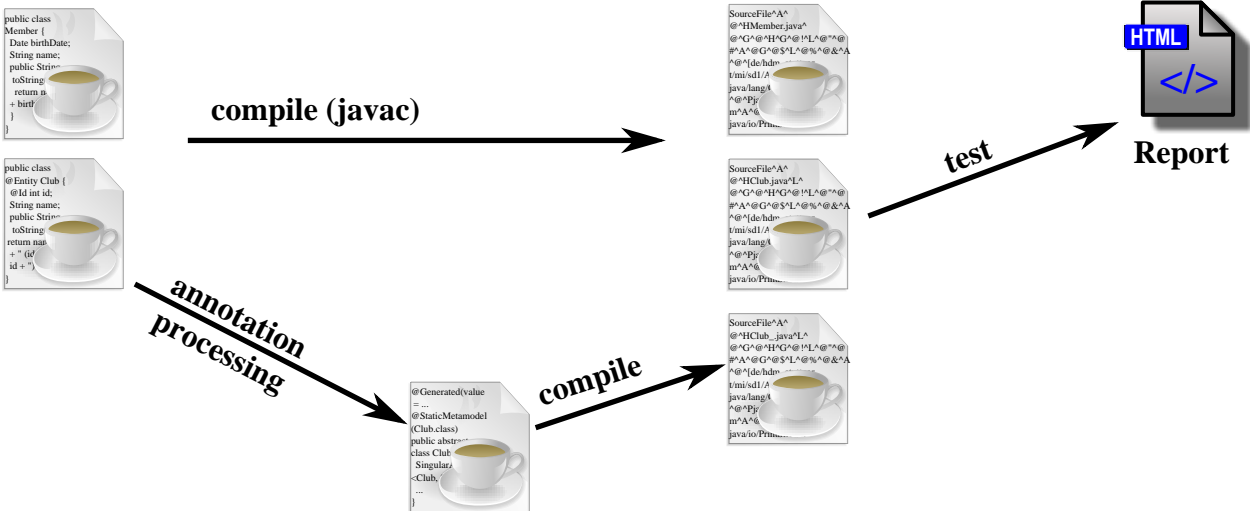
annotation processing

```
@Generated(value  
= ...  
@StaticMetamodel  
(Club.class)  
public abstract  
class Club  
Singular  
<-Club  
...  
}
```

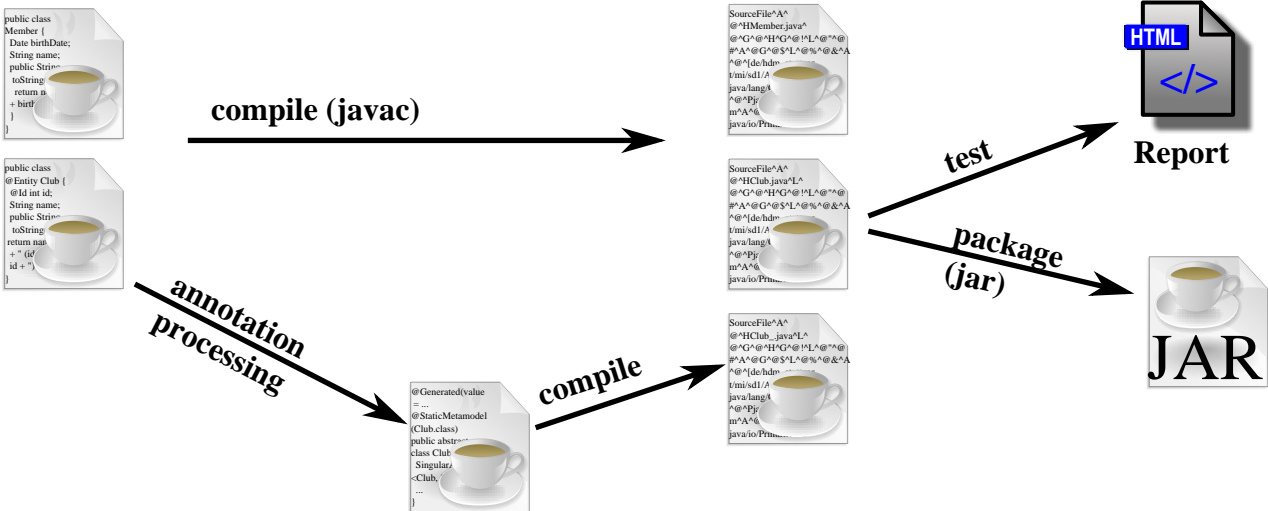
Phases



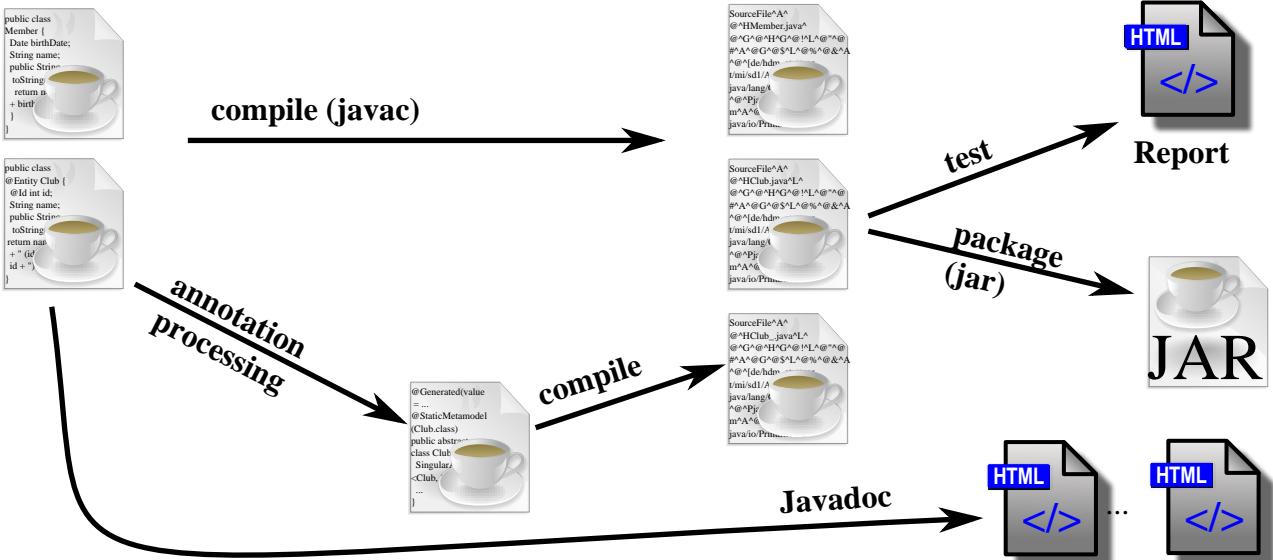
Phases



Phases



Phases



Maven lifecycles 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

```
<pl ugi n>
  <gr oupI d>com mysena. naven</gr oupI d>
  <art i fact I d>apt - naven- pl ugi n</art i fact I d>
  <versi on>1. 1. 3</versi on>
  <execut i ons>
    <execut i on>
      <i d>process</i d>
      <goal s>
        <goal >process</goal >
      </goal s>
      <phase>generat e- sources</phase>
    <conf i gur at i on>
      <out put Di rect ory>${proj ect . bui l d. di rect ory} /net anodel </out put Di rect ory>
      <processor>com mysena. query. apt. j pa. JPAAnnot at i onProcessor</processor>
    </conf i gur at i on>
    . . .
```