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Test Smell Game

Co-funded by the European Union

A Game for Learning how to Detect and Fix Test Smells

Test Smell Game

- The presence of test smells related to low-quality test cases is a known factor contributing to problems in maintaining both test suites and production code.
- The TSGame (Test Smell Game) capsule provides a serious game where students can familiarize with test smells by practicing with their detection and removal from JUnit test code.
- TSGame has been implemented as a Web-based application that allows a teacher to assign students test smell detection and refactoring tasks that they have to accomplish in game sessions. Upon completion of the tasks they have the possibility to gain rewards.

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How To Play

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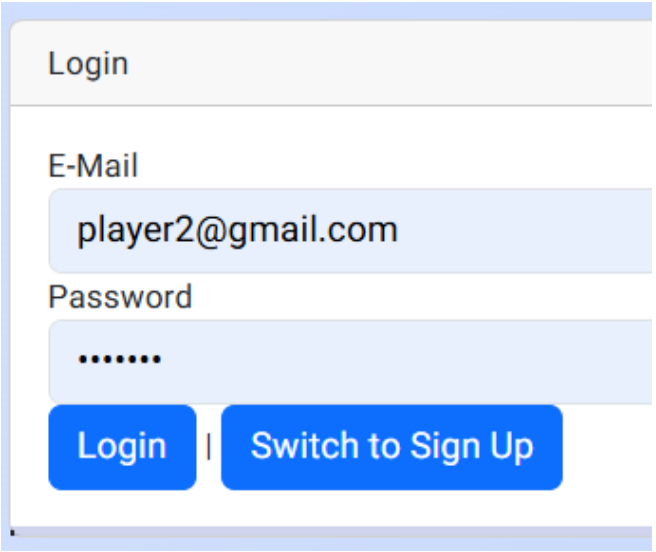
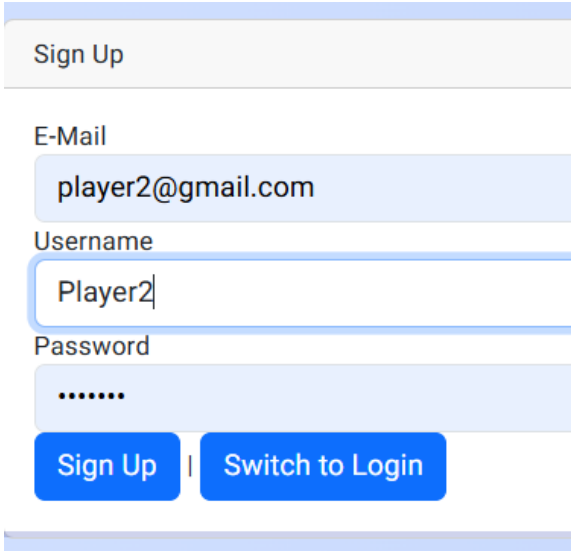
Registration and Login

- The player must register by indicating email, username and password.
- After registration, the player must log in with the same credentials





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Game modes

- There are three game modes:
  - Refactoring : given a test code and a list of smells, the player has to refactor the test class by removing the test smells (trying to avoid code coverage losses)
  - Check Game : given a test code, the player has to guess which test smells occur in the test code
  - Missions : sequences of activities to complete, including small lectures about test smells, refactoring exercises and check games
- Each game mode can provide experience points and rewards

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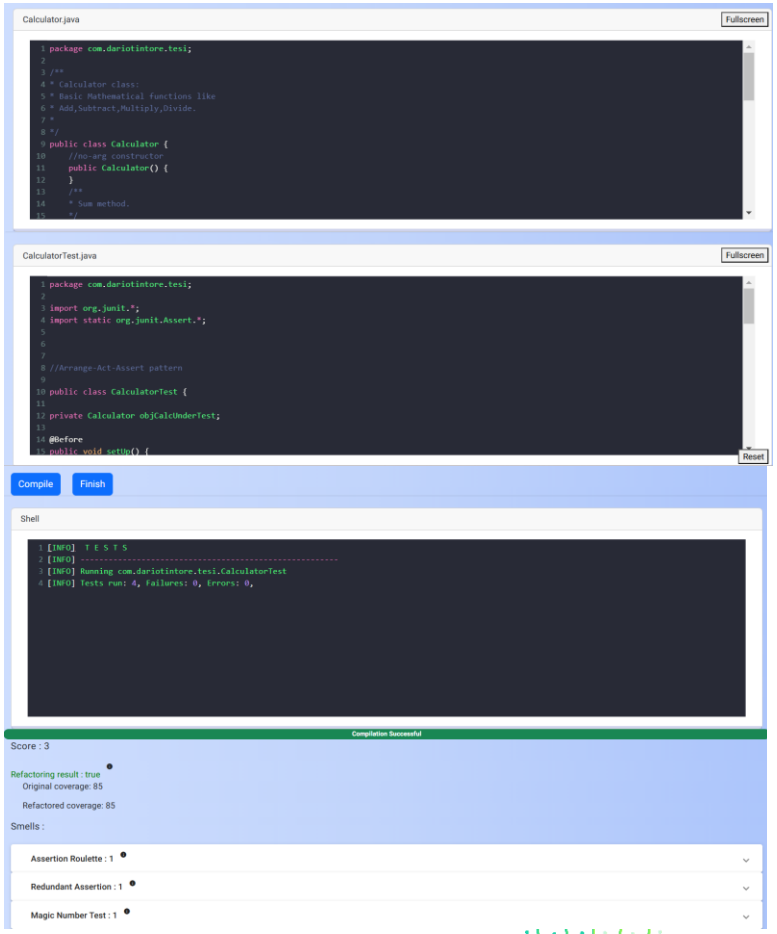
Refactoring Game Mode

- In this game mode the GUI show the code of a class under test and the corresponding code of a test class
- Clicking on Compile the test class will be executed and a list of the existing smells will be shown



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Refactoring Game Mode

- With the help of the tool that notifies which methods contains test smells, the player has to refactor the test code for removing the smell's causes
- After the player has modified the code by clicking Compile it is possible to know if the smells have been removed

- Note: smells could be removed simply by deleting code. This solution is considered valid by the system only if there is not a sensible reduction in code coverage

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Calculator.java

```java
    public Calculator() {
    }
    /**
    * Sum method.
    */
    public int add(int a, int b) {
    return a + b;
    }
    /**
    * Subtract method.
    */
    public int subtract(int a, int b) {
    return a - b;
    }

```

Class under Test

Compile Button

Compile | Save in Solution Repository

Shell

```
[INFO]  T E S T S
[INFO] -------------------------------------------------------
[INFO] Running com.dariotintore.tesi.CalculatorTest
[INFO] Tests run: 5, Failures: 0, Errors: 0,
```

Test Compile Results

CalculatorTest.java

```java

    @Test
    public void testAdd() {
        int a = 15;
        int b = 20;
        int expectedResult = 35;
        // Act
        long result = objCalcUnderTest.add(a, b);
        // Assert
        assertEquals(expectedResult, result);
        assertEquals(result, result);
    }

    @Test
    public void testSubtract() {
```

Test class with smells

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Results

Exercise Compilation Summary

Coverage Loss Acceptable: true

Original Coverage: **100**
Refactored Coverage: **100**

Smells Allowed: 3

Your refactored code has **4** smells remaining — too many to pass! The limit is 3

Remaining Smells

Remaining Smells

Assertion Roulette : 1

testAdd

Redundant Assertion : 1

Magic Number Test : 1

Lazy Test : 1

Example

- **In this example the Redundant Assertion has been refactored by removing it and without losses in code coverage**

```java
@Test
public void testAdd() {
    int a = 15;
    int b = 20;
    int expectedResult = 35;
    // Act
    long result = objCalcUnderTest.add(a, b);
    // Assert
    assertEquals(expectedResult, result);
    assertEquals(result, result);
}
```

```java
@Test
public void testAdd() {
    int a = 15;
    int b = 20;
    int expectedResult = 35;
    // Act
    long result = objCalcUnderTest.add(a, b);
    // Assert
    assertEquals(expectedResult, result);
    //assertEquals(result, result);
}
```

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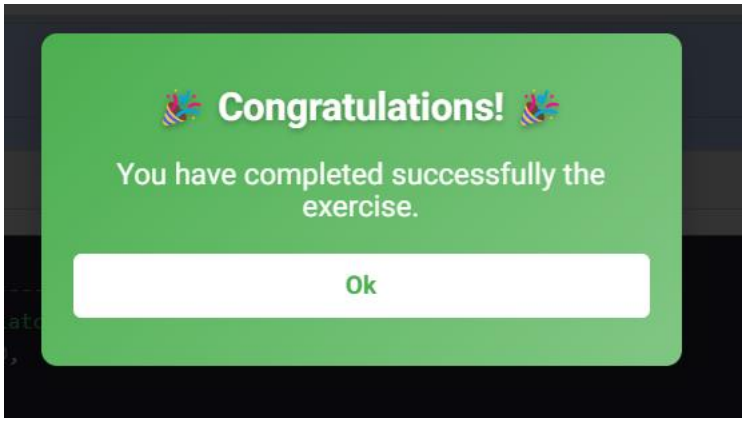
Refactoring Game Mode

- The game can be terminated in any moment by clicking Finish
  - Conventionally, the system considered valid an exercise with few remaining smells (the number of allowed smells is different for each exercise)
- The system will download four files (Class code, Test Code, Shell Code and Results)
- The system will return to the main screen, but other solutions to the same exercise can be submitted further: new solutions update the previous solution



Collaborative Mode

- In some refactoring games, it is possible to share our solutions with other players, in order to understand other possible solutions to the same problem

- Code in the solution repository can be read by players and also commented

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Solution Repository

Class Refactored by the Player

Original Class under Test

player2

Score : 1

Monday, May 12, 2025 at 2:20:52 PM GMT+02:00

Fullscreen

```
16
17    @Test
18    public void testAdd() {
19        int a = 15;
20        int b = 20;
21        int expectedResult = 35;
22        // Act
23        long result = objCalcUnderTest.add(a, b);
24        // Assert
25        assertEquals(expectedResult, result);
26        assertEquals(result, result);
27    }
28
29    @Test
30    public void testSubtract() {
```

```
16
17    @Test
18    public void testAdd() {
19        int a = 15;
20        int b = 20;
21        int expectedResult = 35;
22        // Act
23        long result = objCalcUnderTest.add(a, b);
24        // Assert
25        assertEquals(expectedResult, result);
26        //assertEquals(result, result);
27    }
28
29    @Test
30    public void testSubtract() {
```

Refactoring result : true

Smells :

Results Summary

Magic Number Test

testDivide

Lazy Test

divide

0 0

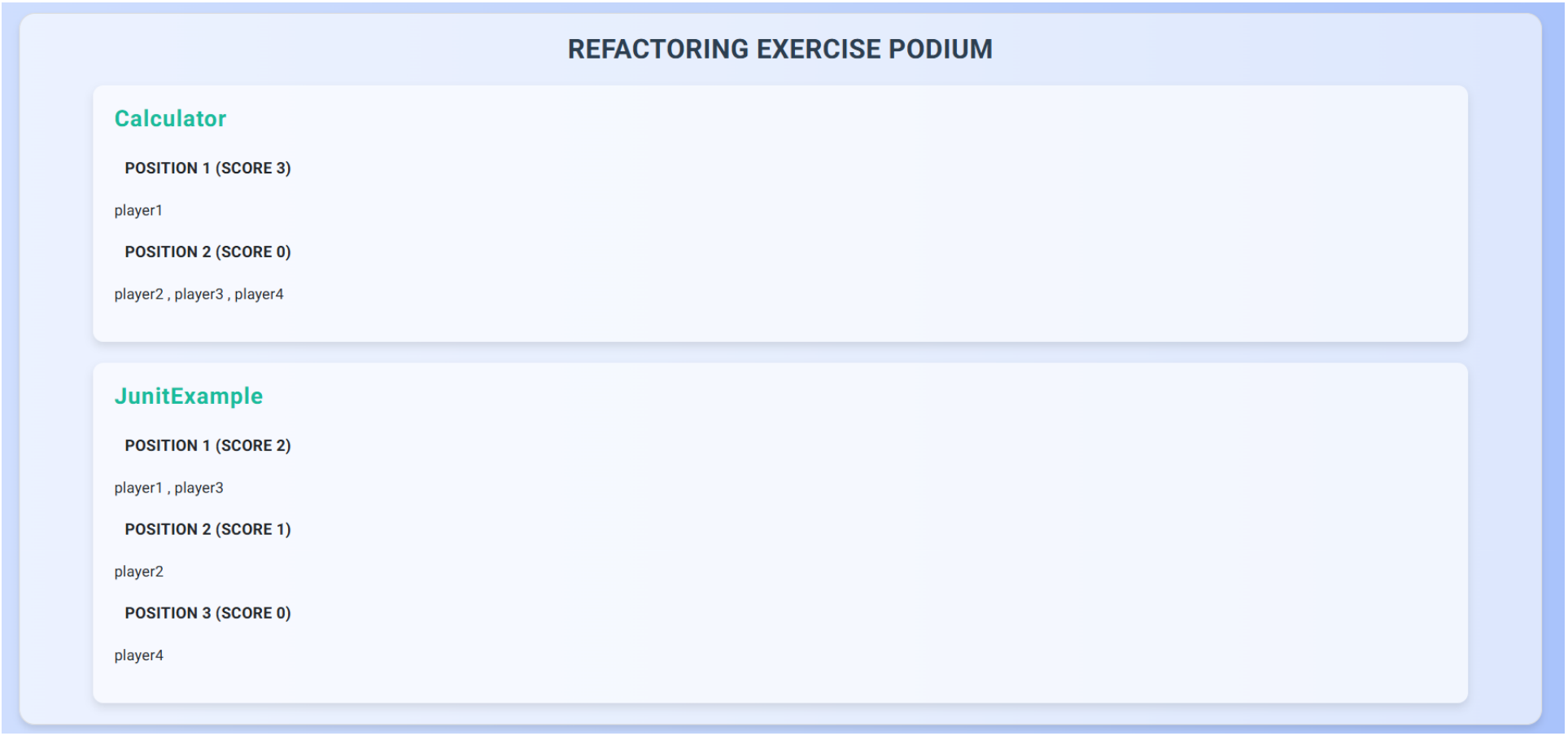
Comments

Comments

Write a comment

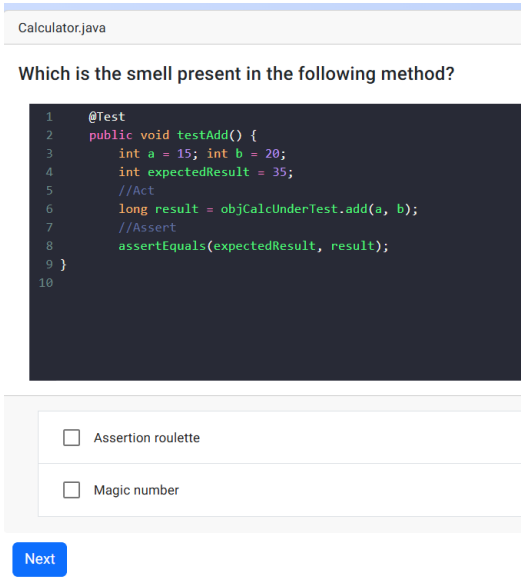
Leaderboard

- In competitive games, a leaderboard of the better solutions is maintained



Check Game Mode

- In this game mode, a sequence of questions is posed to the player
- In each question a test class is shown : the player has to recognize which types of test smells occurs in that class
- A list of possible test smells type is reported
- Each class may contain zero, one or more than one type of test smells
- The player has to recognize all the test smells in order to win the game



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Check Game Example

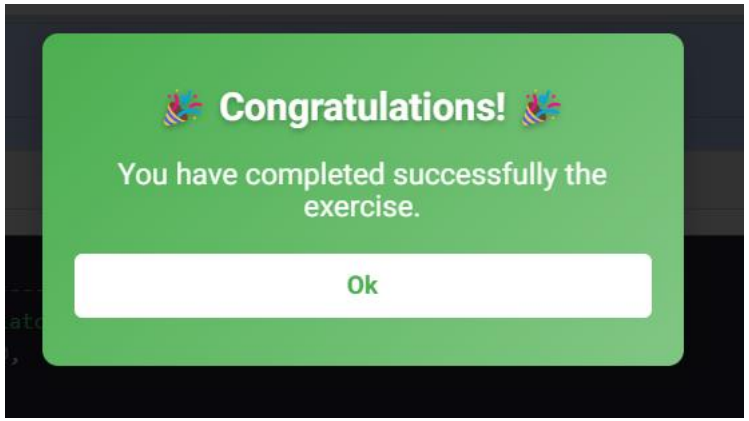
Which is the smell present in the following method?

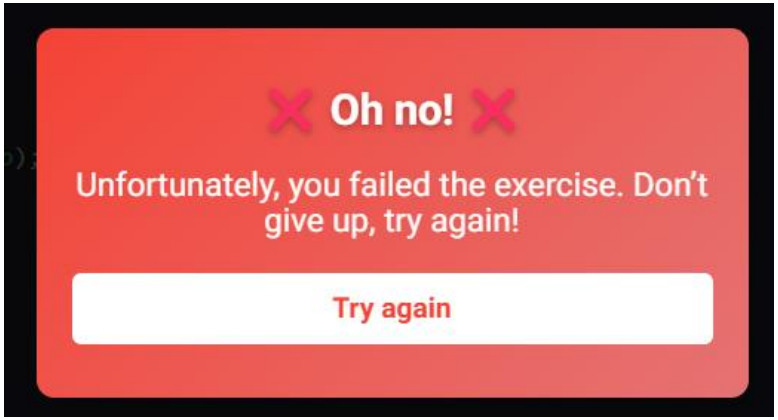
```
@Test
public void testAdd() {
    int a = 15; int b = 20;
    int expectedResult = 35;
    //Act
    long result = objCalcUnderTest.add(a, b);
    //Assert
    assertEquals(expectedResult, result);
}
```

- [ ] Empty Test
- [ ] Redundant Assertion
- [ ] No smell present

Check Game Results

- Check Games can be repeated until all the correct answers are provided





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Mission Game Mode

- In the Mission Game Mode, the player has to accomplish a sequence of activities, including:
  - Learning about specific test smells;
  - Refactoring specific test smells from test code;
  - Recognizing test smells in test code
- The accomplishment of each new mission gives experience points and/or rewards

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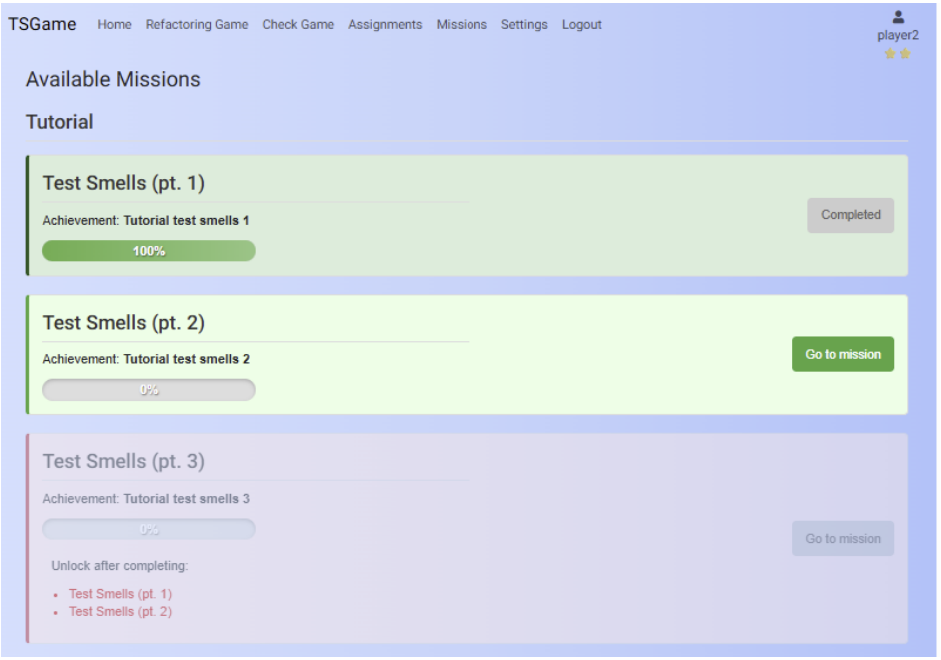
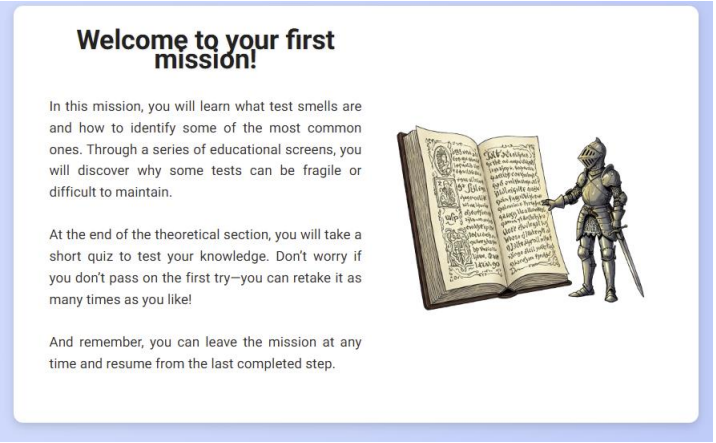
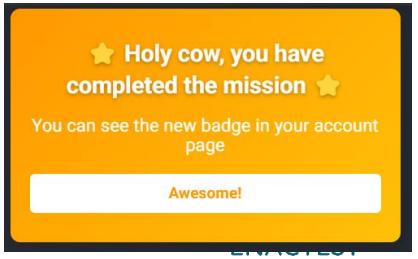
Mission Game Mode



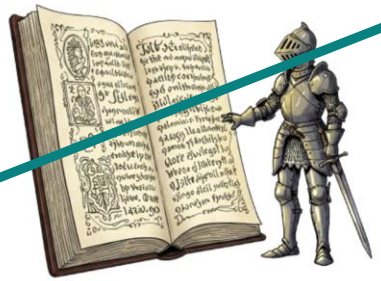




Mission Game Mode

What is a test smell?

Test smells are defined as bad programming practices in unit test code (such as how test cases are organized, implemented and interact with each other) that indicate potential design problems in the test source code.



Learning

Refactoring

Check Game

Calculator.java

```
1 package com.dariotintore.tesi;
2
3 /**
4 * Calculator class:
5 * Basic Mathematical functions like
6 * Add,Subtract,Multiply,Divide.
7 *
8 */
9 public class Calc[illegible]or {
10     //no-ar[illegible]ctor
11     [illegible]ic Calculator() {
12     }
13     /**
14     * Sum method.
15     */
```

CalculatorTest.java

```
6
7
8 //Arrange-Act-Assert pattern
9
10 public class CalculatorTest {
11
12 private Calculator objCalcUnderTest;
13
14 @Before
15 public void setUp() {
16 //Arrange
17 objCalcUnderTest = new Calculator();
18 }
19
20     @Test
```

Compile

Step 8

Which is the smell present in the following method?

```
1 @Test
2 @Ignore
3 public void testSubtract() {
4     int a = 25; int b = 20;
5     int expectedResult = 5;
6     long result = objCalcUnderTest.subtract(a, b);
7     assertEquals(expectedResult, result);
8 }
9
```

- [ ] Ignored Test
- [ ] Redundant Print
- [ ] Empty Test

Back Next Submit Next

Exercise Compilation Summary

Coverage Loss Acceptable: true

Original Coverage: **85**
Refactored Coverage: **85**

Smells Allowed: 3

Your refactored code has 3 smells remaining, staying within the allowed limit of 3.

Score: 0

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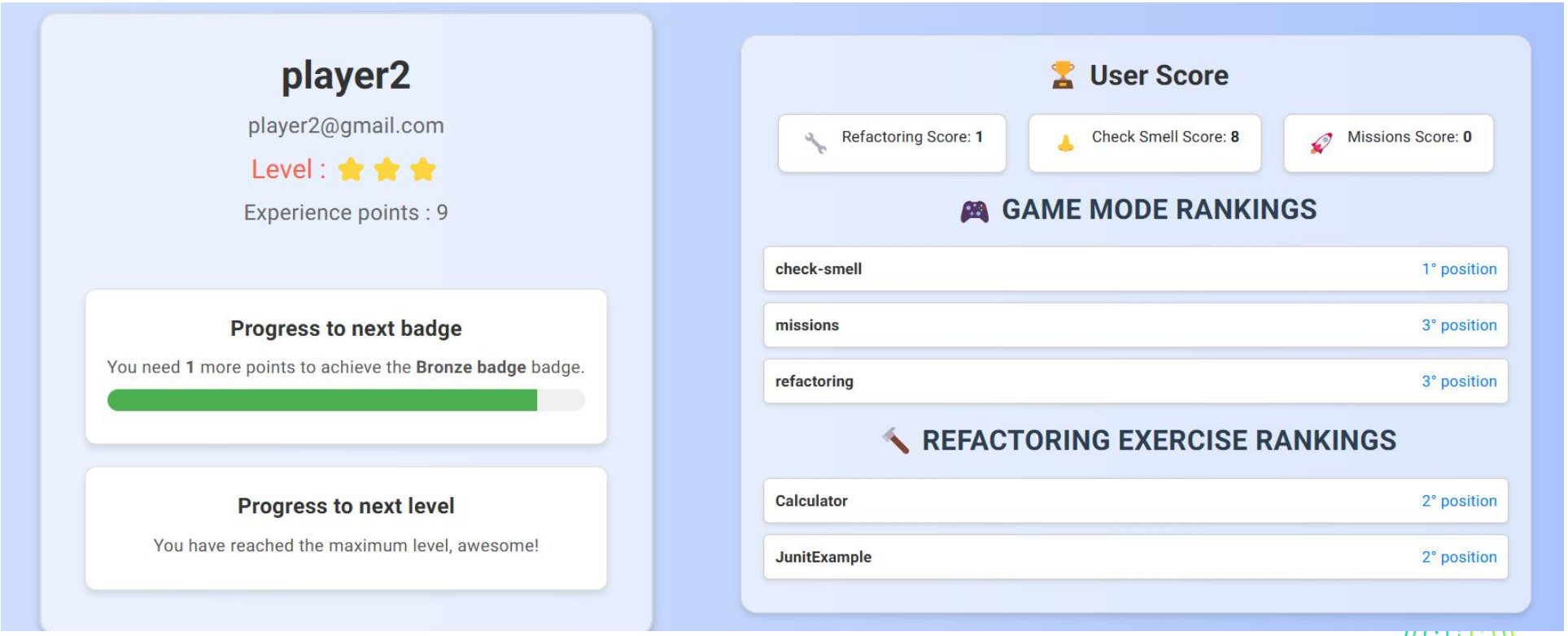
Experience points and Rewards



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Assignment

- In addition, there is an Assignment mode that can be used by teachers that want to assign specific exercises to specific players