

Test Plan

The objective of testing in this iteration is to get a better grasp on the different parts and regulations of testing (both manual and automatic) by testing the code implemented in the last iteration.

The manual tests will be done in a dynamic manner by following a set of scenarios and analyzing whether the output corresponds to the expected one or not. On the other side, the automatic tests will have a static approach, viewing the system as a white box in order to be able to use mocking for test simplification and specific coverage.

The “Register an account” and “Play Game” Use cases will be tested manually, and the methods for creating categories and populating the word library, as well as others will have automated unit tests (Junit 5).

The method that stores newly registered accounts in the database was tested and a bug was found (the newly registered details override old ones) during testing. The solution (adding the old credentials as well) was implemented in order for the test to succeed but commented out for the sake of the assignment.

Time Plan

Task	Estimated time	Actual Time
Assignment Planning	30m	1h
Code Inspection	1h	1h
Manual TC	1:30h	1h
Running Manual Tests	10m	10m
Unit Tests	3h	4h
Test report	1h	45m

Use Cases

(They are different from the ones in the last iteration since not all the features are implemented yet)

UC 1 Register an account

Precondition: Register screen is accessed.

Postcondition: a **new account** is stored.

Main scenario

1. Starts when a user wants to register a new account
2. The system asks for a username, password and confirmation of password
3. The **User** provides the username, password and confirmation of password
4. The system stores the **account** and displays that it has been stored

Alternate scenarios

3A The username is already registered

- The system shows an error message
- Go to Step 2. In Main Scenario

3B The password and confirmation password do not match

- The system shows an error message
- Go to Step 2. In Main Scenario

UC 2 Play game

Precondition: Game screen is accessed.

Postcondition: The system shows an end screen.

Main scenario

1. Starts when a user selects a category
2. The system shows the “secret” letters, lives remaining and the letters that the user can guess
3. The user guesses a letter from the word
Repeat from step 2 until all the letters are guessed
4. The system shows that the word was guessed and displays the options to keep playing, go back to menu or quit.

Alternate scenarios

2A The user runs out of “lives”

- The system displays a message
- End UC2

3A The username guesses a wrong letter

- The remaining lives decrease by one
- Go to Step 2. In Main Scenario

Manual Test Cases

The two presented use cases will be tested with the help of 5 scenarios, the expected outcome is for all of them to succeed and not show any unexpected behavior. They will be tested through the graphical interface created with JavaFX 11. A test-requirement matrix is included after the tests.

TC 1.1 Should register account when correct input is provided

The main scenario of the UC 1 (Register an account) in which a user registers a new account is tested to assure the functionality of the component

Precondition: There must not be another account with the name "John" in the database.

Test Steps

- Start the game
- Press the "login" button
- Press the "Create Account" button
- Enter the username "john", the password "pony" and the confirmation password "pony"

Expected

- The system shows the text "Account Created!" and the options "go to game", "back to menu" and "quit"

TC 1.2 Should Show message when username is already registered

An alternative scenario of UC 1 (Register an account) in which the username was already used is tested to avoid data-overlapping.

Precondition: There must be another account with the name "Mark" in the database.

Test Steps

- Start the game
- Press the "login" button
- Press the "Create Account" button
- Enter the username "mark", the password "macaroni" and the confirmation password "macaroni"

Expected

- The system shows the text "Username already registered!" and waits for new input or the press of a button

TC 1.3 Should show message when passwords don't match

An alternative scenario of UC 1 (Register an account) in which the passwords entered by the username don't match to avoid mistyping of the password and ensure that the user inputs the intended password.

Precondition: There must not be another account with the name "Peter" in the database.

Test Steps

- Start the game
- Press the "login" button
- Press the "Create Account" button
- Enter the username "peter", the password "rainbow" and the confirmation password "arinbow"

Expected

- The system shows the text "Password do not match!" and waits for new input or the press of a button

TC 2.1 Should play game and win when all letters are guessed

The main scenario of the UC 2 (Play Game) in which the user plays the game and correctly guesses all the letters in the word to verify the functionality of the perfect scenario.

A mockup category "Test" containing just the word "test" was created in order to get rid of the random word generator available in categories with multiple words.

Preconditions: none

Test Steps

- Start the game
- Press the "login" button
- Enter the username "admin", the password "test" and press the login button
- Select the "Test" category
- Press the keys "t", "e", "s"

Expected

- The system shows the text "Congratulations!" and displays the buttons "keep playing", "back to menu" and "quit"

TC 2.2 Should play game and lose when there are no more lives left

An alternative scenario of UC 2 (Play Game) in which the user guesses more than 6 wrong letters to make sure that the game ends when the user runs out of lives.

A mockup category "Test" containing just the word "test" was created in order to get rid of the random word generator available in categories with multiple words.

Preconditions: none

Test Steps

- Start the game
- Press the "login" button
- Enter the username "admin", the password "test" and press the login button
- Select the "Test" category
- Press the keys "a", "b", "c", "d", "f", "g"

Expected

- The system shows the text "Game over, the word was: test" and displays the buttons "keep playing", "back to menu" and "quit"

Test	Requirement
TC 1.1	Register an account with correct credentials (username & password)
TC 1.2	Stop from registering with already used username
TC 1.3	Stop from registering with erroneous password confirmation
TC 2.1	Win the game by playing a round and guessing the prompted word
TC 2.2	Lose the game by playing a round and running out of lives by making 6 mistakes

Test-requirement matrix

Unit Tests

The first class tested is called “Category”. The focus is on the constructor as it is the most important part of this class. The constructor is tested with 3 methods (shouldCreateCategoryFromFile, shouldThrowErrorForEmptyFile and shouldThrowErrorForNoWords). These methods are orthogonal and cover all the branches of the method (except for the FileNotFoundException).

```
CategoryTest.java
13 Scanner input;
14 Category testCategory;
15
16 @Test
17 void shouldCreateCategoryFromFile() {
18     //Mock category file containing the title "Test" and the word "test"
19     File f = new File("src\\testData\\goodCategory.txt");
20     testCategory = new Category(f.getAbsolutePath());
21
22     String expectedName = "Test";
23     String[] expectedArray = {"test"};
24
25     assertTrue(testCategory.categoryName.equals(expectedName));
26     assertEquals(testCategory.words.toArray(), expectedArray);
27
28
29 @Test
30 void shouldThrowErrorForEmptyFile() {
31     //Empty Text file
32     File f = new File("src\\testData\\emptyFile.txt");
33
34     //Check if error is thrown
35     RuntimeException thrown = assertThrows(RuntimeException.class,
36     () -> testCategory = new Category(f.getAbsolutePath()), "no error thrown");
37
38     //Check if the error thrown is the one intended
39     assertTrue(thrown.getMessage().contains("File is empty"));
40
41
42 @Test
43 void shouldThrowErrorForNoWords() {
44     File f = new File("src\\testData\\namedOnlyCategory.txt");
45
46     //Check if error is thrown
47     RuntimeException thrown = assertThrows(RuntimeException.class,
48     () -> testCategory = new Category(f.getAbsolutePath()), "no error thrown");
49
50     //Check if the error thrown is the one intended
51     assertTrue(thrown.getMessage().contains("Category doesn't contain words"));
52
53
54 @Test
55 void shouldAccessName() {
56     //Mock test file containing the title "Animals"
57     File f = new File("src\\testData\\goodCategory2.txt");
58     testCategory = new Category(f.getAbsolutePath());
59
60     String expectedName = "Animals";
61
62     assertTrue(testCategory.getName().equals(expectedName));
63
64
Category.java
1 package basicGame;
2
3 import java.io.File;
4
5 public class Category {
6
7     String categoryName;
8     ArrayList<String> words = new ArrayList<String>();
9
10    /*
11     * In campaign mode, after a word is guessed it is removed from the list
12     * the progress is initial size-current size / initial size * 100;
13     * in Hard mode, if a word is not guessed, it adds to the wrongGuesses parameter
14     * that keeps track of the mistakes
15     */
16
17    //Constructor that takes a category from a text file.
18    public Category(String path) {
19        File f = new File(path);
20        Scanner input;
21        try {
22            input = new Scanner(f);
23            if(!input.hasNext())
24                throw new RuntimeException("File is empty");
25        } else {
26            categoryName = input.nextLine();
27            if(!input.hasNext())
28                throw new RuntimeException("Category doesn't contain words");
29        } else {
30            while(input.hasNext())
31                words.add(input.nextLine());
32        }
33    } catch (FileNotFoundException e) {
34        e.printStackTrace();
35    }
36
37    public ArrayList<String> getWords() {
38        return words;
39    }
40
41    public String getName() {
42        return categoryName;
43    }
44
45    public int getSize() {
46        return words.size();
47    }
48
49 }
```

Element	Coverage	Covered Instructions	Missed Instructions	Total Instructions
CategoryTest.java	92.2%	148	18	166
Category.java	95.1%	58	3	61

The 2nd class tested is called “WordLibrary” and its role is to store all the categories as well as provide a random word from a specific category. The main method tested takes all the files from a directory and creates Category objects from them. The two test methods focus on covering both the main functionality and the Exception throwing in case of an empty directory.

```
WordLibraryTest.java
1 package basicGame;
2
3 import static org.junit.jupiter.api.Assertions.*;
4
5 class WordLibraryTest {
6
7     WordLibrary library;
8
9     @Test
10    void shouldPopulateCategories() {
11        //Create a library's Category List using the constructor
12        library = new WordLibrary("src\\testData\\testCategoryFolder");
13
14        //Create a library's Category List manually
15        ArrayList<Category> expectedCategoryArray = new ArrayList<Category>();
16        expectedCategoryArray.add(new Category("src\\testData\\testCategoryFolder\\cat1.txt"));
17        expectedCategoryArray.add(new Category("src\\testData\\testCategoryFolder\\cat2.txt"));
18
19        //Since the (to be compared) arrays are of type Category, all the fields need to be checked
20        for(int i = 0; i < expectedCategoryArray.size(); i++) {
21            assertTrue(library.categories.get(i).categoryName.equals(expectedCategoryArray.get(i).categoryName));
22            assertEquals(library.categories.get(i).words.toArray(), expectedCategoryArray.get(i).words.toArray());
23        }
24
25 @Test
26 void shouldThrowErrorWhenFolderIsEmpty() {
27     RuntimeException thrown = assertThrows(RuntimeException.class, () -> library = new WordLibrary("src\\testData\\emptyTest"));
28
29     assertTrue(thrown.getMessage().contains("There are no categories for this path"));
30
31
32 @Test
33 void shouldReturnWordFromCategory() {
34     library = new WordLibrary("src\\testData\\testCategoryFolder");
35
36     char[] expectedWord = "one".toCharArray();
37     char[] wordGiven = library.getWord(library.categories.get(0));
38
39     assertEquals(Arrays.equals(expectedWord, wordGiven));
40
41
WordLibrary.java
1 package basicGame;
2
3 import java.io.File;
4
5 public class WordLibrary {
6
7     /*
8     * This will eventually keep track of the words guessed
9     */
10    ArrayList<Category> categories = new ArrayList<Category>();
11
12    public WordLibrary(String path) {
13        File categoryFolder = new File(path);
14        File[] fileNames = categoryFolder.listFiles();
15        if(fileNames.length > 0)
16            for(File file : fileNames)
17                categories.add(new Category(file.getAbsolutePath()));
18        else
19            throw new RuntimeException("There are no categories for this path");
20
21    public char[] getWord(Category cat) {
22        ArrayList<String> words = cat.getWords();
23        Random ran = new Random();
24        int randomNumber = ran.nextInt(words.size());
25        return words.get(randomNumber).toCharArray();
26    }
27
28 }
```

Element	Coverage	Covered Instructions	Missed Instructions	Total Instructions
WordLibraryTest.java	92.7%	101	8	109
WordLibrary.java	100.0%	68	0	68

Finished after 0.154 seconds

Runs: 4/4 Errors: 0 Failures: 1

Failure Trace

```

44:AssertionFailedError: expected: <true> but was: <false>
   at DatabaseTest.ShouldUpdateDatabaseAfterMultipleRegisters(D
   at java.util.stream.ReferenceOps.forEachOrdered(ReferenceOps
   at java.util.stream.ReferencePipeline$S21.accept(ReferencePip
   at java.util.Iterator.forEachRemaining(Iterator.java:133)
   at java.util.Spliterators$IteratorSpliterator.forEachRemaining(Splite
   at java.util.stream.AbstractPipeline.copyInto(AbstractPipeline.java:
   at java.util.stream.AbstractPipeline.wrapAndCopyInto(AbstractP
   at java.util.stream.ForEachOps$ForEachOp.evaluateSequentialFor
   at java.util.stream.ForEachOps$ForEachOp$OfRef.evaluateSequen
   at java.util.stream.ReferencePipeline$S21.accept(ReferencePip
   at java.util.Iterator.forEachRemaining(Iterator.java:133)
   at java.util.Spliterators$IteratorSpliterator.forEachRemaining(Splite
   at java.util.stream.AbstractPipeline.copyInto(AbstractPipeline.java:
   at java.util.stream.AbstractPipeline.wrapAndCopyInto(AbstractP
   at java.util.stream.ForEachOps$ForEachOp.evaluateSequentialFor
   at java.util.stream.ForEachOps$ForEachOp$OfRef.evaluateSequen

```

```

DatabaseTest.java %
30 import static org.junit.jupiter.api.Assertions.*;
11
14 class DatabaseTest {
15     File f = new File("src\\testData\\dbTest.txt");
16
17     @Test
18     void ShouldUpdateDatabaseAfterMultipleRegisters() throws FileNotFoundException {
19
20         //Preparing the database by clearing the file
21         clearFile(f);
22         Database db = new Database("src\\testData\\dbTest.txt");
23
24         //Registering two users
25         db.register("mark", "rainbow");
26         db.register("john", "border");
27
28         //This is how they should be stored
29         String expectedFileContent = "mark rainbow\r\njohn border\r\n\r\n";
30
31         //Importing the file to be analyzed
32         File f = new File("src\\testData\\dbTest.txt");
33         Scanner input = new Scanner(f);
34
35         String actualFileContent = "";
36
37         //Reading the names from file for ease of comparing
38         while(input.hasNext())
39             actualFileContent += input.next() + " " + input.next() + "\r\n";
40
41         //The expected string should match the string generated from the file
42         assertTrue(actualFileContent.equals(expectedFileContent));
43         input.close();
44
45     @Test
46     void shouldTakeDataFromFile() {
47
48         //Since the updateData method is private, we test the constructor that calls this method
49         //This file contains one user, (parker princess)
50         Database db = new Database("src\\testData\\dbTest2.txt");
51
52         ArrayList<String> expectedUsername = new ArrayList<String>();
53         expectedUsername.add("parker");
54         ArrayList<String> expectedPassword = new ArrayList<String>();
55         expectedPassword.add("princess");
56
57         //Use test helper method gets the information from the file correctly
58         assertTrue(Arrays.equals(db.usernameList.toArray(), expectedUsername.toArray()));
59         assertTrue(Arrays.equals(db.passwordList.toArray(), expectedPassword.toArray()));
60     }
61 }

```

```

Database.java %
1 package basicGame;
2
3 import java.io.File;
4
5 public class Database {
6
7     File f;
8     ArrayList<String> usernameList = new ArrayList<String>();
9     ArrayList<String> passList = new ArrayList<String>();
10
11     public Database(String path) {
12         f = new File(path);
13         updateData();
14     }
15
16     //Updating the database (from file to program)
17     private void updateData() {
18         try {
19             Scanner in = new Scanner(f);
20             while(in.hasNext()) {
21                 usernameList.add(in.next());
22                 passList.add(in.next());
23             }
24             in.close();
25         } catch (FileNotFoundException e) {
26             e.printStackTrace();
27         }
28     }
29
30     //--REGISTERING A NEW USER-- Buggy method
31     //This should also print the previous users as the print writer overwrites the file
32     public void register(String name, String pass) {
33         try {
34             PrintWriter pw = new PrintWriter(f);
35             //--BUG FIX--
36             for(int i = 0; i < usernameList.size(); i++)
37                 pw.print(usernameList.get(i) + " " + passList.get(i) + "\r\n");
38             pw.print(name + " " + pass + "\r\n");
39             pw.close();
40         } catch (FileNotFoundException e) {
41             e.printStackTrace();
42         }
43         updateData();
44     }
45 }

```

Coverage Console

DatabaseTest (Mar 8, 2019 5:19:16 PM)

Element	Coverage	Covered Instructions	Missed Instructions	Total Instructions
DatabaseTest.java	91.0 %	142	14	156
Database.java	93.7 %	89	6	95

Finished after 0.147 seconds

Run: 7/7 Errors: 0 Failures: 0

ProcessorTest (Runner: JUnit 5) (0.028 s)

- shouldReturnCurrentPrintString() (0.016 s)
- shouldDoABunchOfStuffOnLetterGuessed() (0.002 s)
- shouldReturnTrueIfGameOn() (0.001 s)
- shouldGiveEndScreenMessage() (0.001 s)
- shouldReturnWord() (0.001 s)
- shouldUpdateParametersOnConstructorCall() (0.001 s)
- shouldReturnLivesLeft() (0.006 s)

Failure Trace

```

ProcessorTest.java 83
67 test4.remainingLetters = 0; //Fake guess all letters
68 assertTrue(test4.gameOn());
69
70
71 @test
72 void shouldGiveEndScreenMessage() {
73     Processor test5 = new Processor("chicken".toCharArray());
74     //We assume that the game ended, there are two outcomes:
75
76     String expectedOutcome1 = "Congratulations!\nYou guessed the word \"chicken\"";
77     String expectedOutcome2 = "Game over, the word was: chicken";
78     //Outcome one, wrong guesses < 6
79     for(int i = 0; i < 6; i++) {
80         test5.wrongGuesses = i;
81         assertEquals(test5.printResult(), expectedOutcome1);
82     }
83
84     //Outcome two, wrong guesses = 6
85     test5.wrongGuesses = 6;
86     assertEquals(test5.printResult(), expectedOutcome2);
87 }
88
89 @test
90 void shouldReturnWord() {
91     Processor test6 = new Processor("mayonnaise".toCharArray());
92     assertEquals(test6.toString(), "mayonnaise");
93 }
94
95 @test
96 void shouldDoABunchOfStuffOnLetterGuessed() {
97     Processor test7 = new Processor("green".toCharArray());
98
99     //We will test this by guessing 2 letters, one "correct" and one "wrong"
100    //After every guess, we compare behavior with what we expect
101
102    //Correct guess
103    test7.guessLetter('e');
104    assertTrue(test7.isInWord());
105    assertEquals(test7.remainingLetters, "green".length()-2);
106
107    boolean[] expectedGuess = {false, false, true, true, false};
108    assertTrue(Arrays.equals(test7.guessed, expectedGuess));
109
110    //Incorrect guess
111    test7.guessLetter('z');
112    assertTrue(test7.isInWord());
113    assertEquals(test7.remainingLetters, "green".length()-2); //same length
114
115    //Same guessed array
116    assertTrue(Arrays.equals(test7.guessed, expectedGuess));
117    assertEquals(test7.wrongGuesses, 1);
118

```

Coverage 100% Console

ProcessorTest (Mar 8, 2019 6:03:12 PM)

Element	Coverage	Covered Instructions	Missed Instructions	Total Instructions
ProcessorTest.java	97.2 %	243	7	250
Processor.java	100.0 %	174	0	174

The 5th class of the system (the GUI) was not tested since I don't yet have the knowledge of test graphical output.

Test Result/Report

The manual tests covered 5 different scenarios from 2 use cases, they were done through the graphic interface. All of them ended with the expected outcomes.

Test	UC 1	UC 2	Comments
TC 1.1	1/OK	0	
TC 1.2	1/OK	0	
TC 1.3	1/OK	0	
TC 2.1	0	1/OK	
TC 2.2	0	1/OK	
Coverage & Success	3/OK	2/OK	

Manual Test Cases

For the automated tests, a coverage has been included in every screenshos, all the classes of the system (except for the GUI) were tested with over 90% instructions coverage (I didn't know how to test Exceptions that are contained in a try & catch block). The classes have dependencies (except DataBase, which is connected only to the GUI for now, but will store the progress given from the WordLibrary in the future).

TestClass	Class covered	Coverage (%)	Success (%)	Comments
CategoryTest	Category	95.1	100%	
WordLibraryTest	WordLibrary	100	100%	
DataBaseTest	DataBase	93.7	75%	BUG FOUND
ProcessorTest	Processor	100	100%	
Average Coverage & Success		97.2	94	

Unit Tests

Reflection

Manual tests were really fun to do and check, because they cover the GUI, but the previously created use cases were aimed towards the final application, not the current state of it, which meant I had to make new use cases.

The automated tests were difficult to implement because the methods in the word-processing class don't have simple input-output and I don't know how to test the GUI. I focused on testing the details the system will ask for at start (getting the categories) and storing them in the system as well as the credential storing methods. But in the end I was pretty happy with the coverage of my tests and I will definitely have testing in mind from now on when I code.

This part of the course felt useful directly towards my system and the following projects/work environments. The assignment instructions were clear, and the Greeter example was really useful to have as a starting point. The only problem I came across was the fast transition from the last part of the course to this one, with no additional time to develop the game.