SOFE 3980U: Software Quality
Assignment 1: Choosing the right software process to build good-quality software, and ensuring quality using test automation

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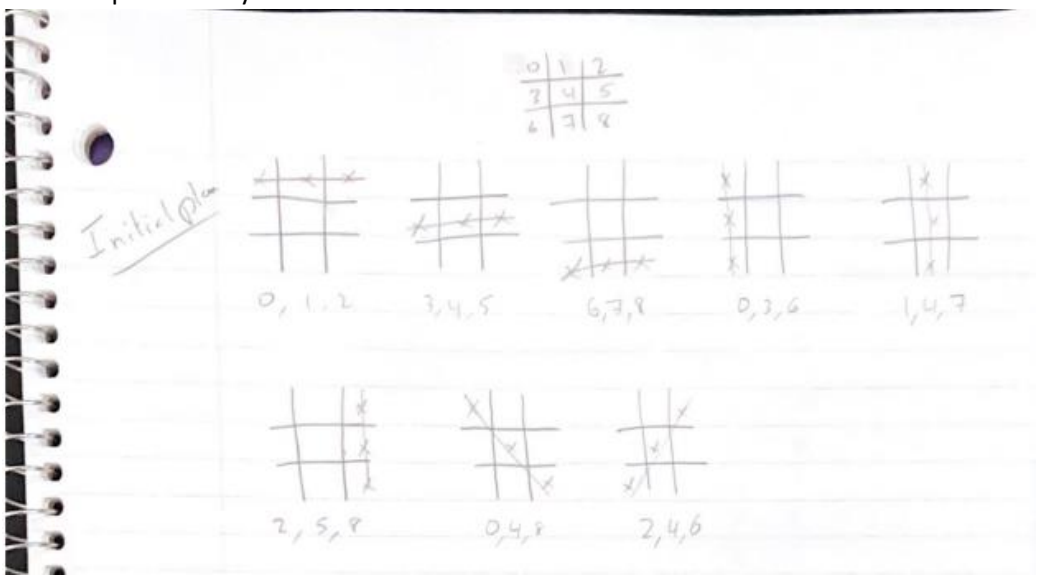
Explain reasonings behind particular software process

After deciding to create a tic-tac-toe game in java, I began the research into the possible ways to create one. Initially, I was following the geeksforgeeks guide (https://www.geeksforgeeks.org/tic-tac-toe-game-in-java/), where the game is run in the console, with taking input by typing in which location on the board to place the symbol. How it looked like:

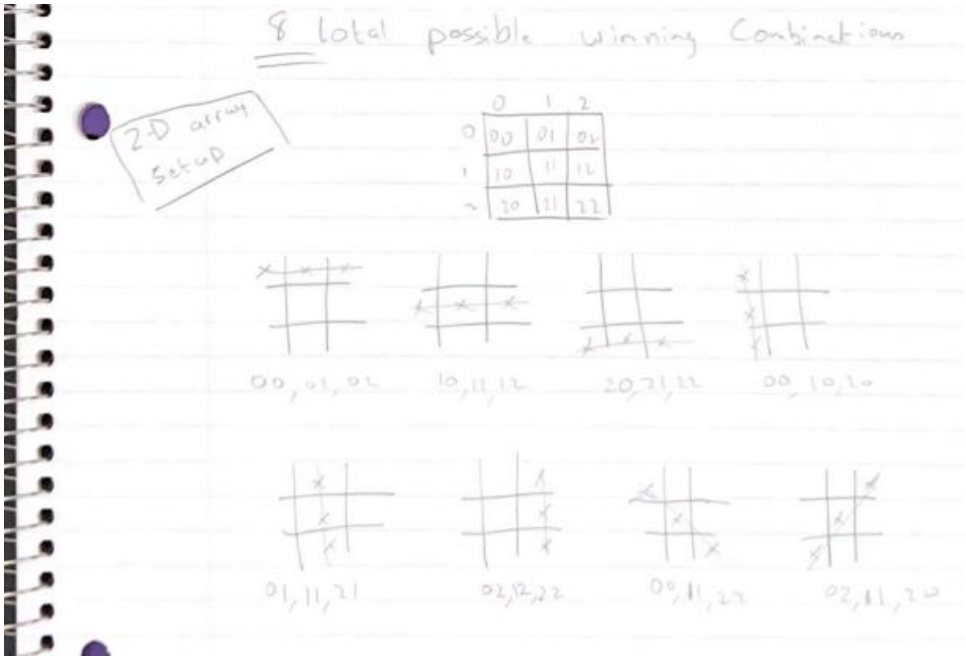


After studying the functionality of the code, I decided to transform the game into a GUI based version. Thus, I began looking into using Swing/Jframe in java. After spending a couple of hours learning it, I began changing how to improve the initial game. I decided to change it the board being based on a 2-D array instead. During the whole process I had used many references to see how to create the game, all of which are listed in the references section at the bottom of the report. The final functionality of the game are that when launched, a window pops up with a 3x3 board. The "X" player is always the starting one. With every turn, the player is switched and the program checks for a winner. In addition, the window has a menu bar with two option. The first being to start a new game, and the second being to quit the game. A breakdown of the methods used are explained below.

Description of functionalities of software and code

- Game written in Java, with the GUI portion being written using Swing and JFrame.
- The code was written by breaking down the functionality into a couple of methods.
- The main methods written for the game were:
    - TicTacToeGui extending JFrame: The class containing all the below methods. It initializes all the variables being used in the program as well as the 10 Booleans used for testing purposes (being checked in the Junit testing)
    - TicTacToeGui: sets up the functionality of the GUI
    - setMenuBar: which was responsible for having the functionality of
        - newGame: which when selected, resets/clears the Tic-tac-toe board
        - quit: which closes the game process
    - resetBoard: which contains the functionality of resetting the board, which is done by clearing the 2-D array

- setupBoard: contains the portion responsible for setting up the 2-D array for the game. It checks for when one of the buttons in the 3x3 grid is pressed, after which it checks if a winner is found, switching the current player as well as incrementing the turn counter.
- switchPlayer: switches the current player based on who last placed the symbol on the board
- checkWinner: It checks through the 9 different possibilities (8 possible win scenarios and a draw scenario). If a winner is found, it displays a pop-up with the winner. If the game reaches 9 turns with no winner still detected, a pop-up displaying a draw is reached.



  - Case 1; Top row horizontal win
  - Case 2; Middle row horizontal win
  - Case 3; Bottom row horizontal win
  - Case 4; Left vertical win
  - Case 5; Middle vertical win
  - Case 6; Right vertical win
  - Case 7; Diagonal win top left to bottom right
  - Case 8; Diagonal win top right to bottom left
  - Case 9; Checks if after 8 turns have passed with no winner, thus meaning it's a draw

Challenges faced during test automations

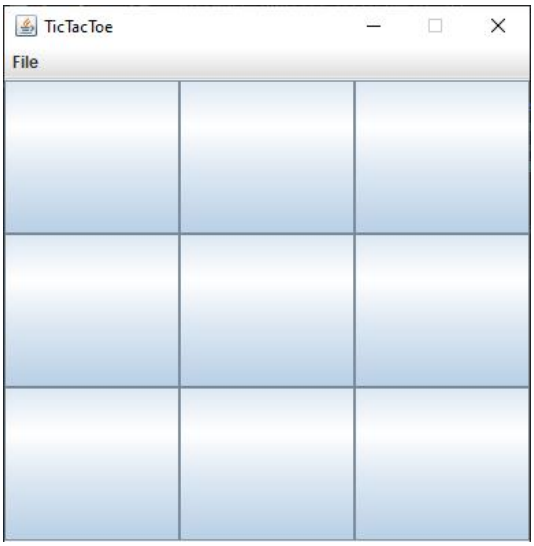
With this being my first project where I need to implement automated testing, I faced lots of challenges in trying to test the game. Since we were taught the basics in class using Junit, I decided to try to use it. I was facing quite a number of issues trying to get the tests to work. A couple of the methods in the program were initially written as private void methods, and thus I began looking into possible ways to test them. Leading me to using Maven After spending a couple of hours learning the framework and trying to write the tests in Maven using Mockito without much luck, I decided to go back to just Junit testing. Finally, I had began understanding further how to better write the testing for it to run properly.

The testing is setup by first calling a BeforeEach statement to call the program a new time. After which, a total of 15 test cases where written to test all the functionalities of the game. The test cases are:

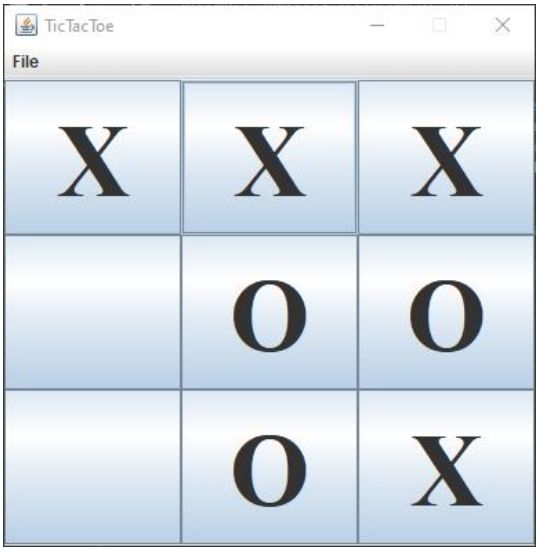
- emptyBoardWinner: which checks when a new game is launched if a winner is found
- testResetBoard: which checks that when the board method of resetting the board, the board does get reset
- testTurnCounterReset: checks to make sure that when the resetting of the board is called, the turn counter does go back to 0
- checkNoWinner: checks that after 3 turns (X then O then X) in the same vertical column, that no winner is found. This is done to make sure that the game is able to recognize that different symbols don't cause a win
- Next, there are testWinCase1 to testWinCase8: which goes through the previously mentioned win cases and test each one out to make sure that all the win cases occur.
- testCase9; which goes through and fill the board so no winner is possible to make sure a draw is reached
- testSwitchPlayer: checks that after running the switchPlayer method, that the current player does switch to O
- testStartPlayer: checks that the start player is always X

Documenting detail instructions with snapshots

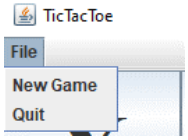
Game GUI new game:



Gui during plays (when boxes are clicked):



Winning Screen:

Menu bar: 

How to use software and test automation framework with sample test run

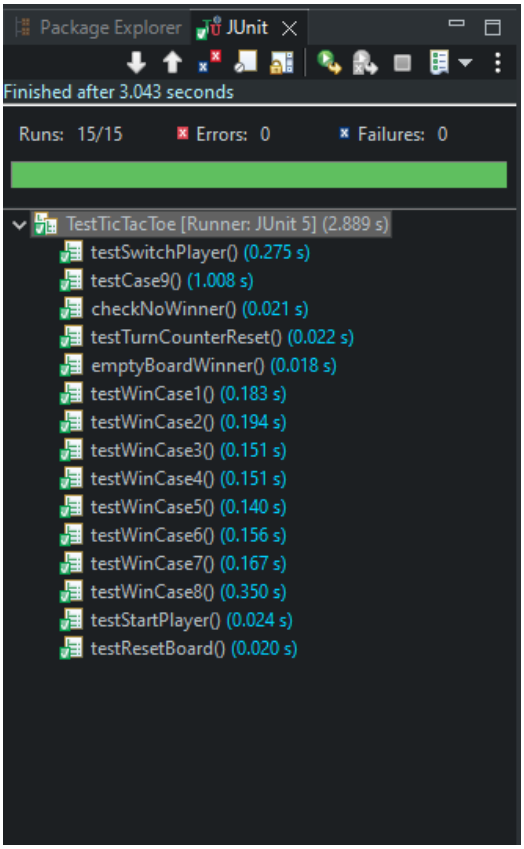
To run the game, you just need to run the MainGui.java class. It contains the main portion that starts the game (included is a demo video of how to run the game and playing it). To run the tests, you need to run the TestTicTacToe.java class and all 15 test cases should run (included is a demo of running the test cases). Below are the screenshots for the coverage as well as the result of the test cases. Note: that the MainGui.java shows 0.0% coverage due to the coverage being run using the TestTicTacToe class, which calls the TicTacToeGui. The last 5% for the TicTacToeGui not being covered are due to them being the portions of the GUI button listeners, since I was not able to run test cases to simulate the buttons being pressed.

Code coverage when running the TestTicTacToe.java:

TestTicTacToe (Feb 18, 2022 12:07:50 PM)

Element	Coverage	Covered Instructions	Missed Instructions	Total Instructions
TicTacToe	96.8 %	1,554	52	1,606
src	96.8 %	1,554	52	1,606
Game	96.8 %	1,554	52	1,606
TicTacToeGui.java	94.7 %	684	38	722
MainGui.java	0.0 %	0	14	14
TestTicTacToe.java	100.0 %	870	0	870

Test Cases Results:



Instructions to run:

1. Create a java project (Making sure Java 1.8 is included)

2. Create a package called "Game"

3. Drag and drop onto the "Game" package the three classes: MainGui.java, TestTicTacToe.java, TicTacToeGui.java

4. Make sure to add the JUnit library to the java project

5. Now you could run the MainGui.java to try out the game

6. Could also run the TestTicTacToe.java, which goes through and tests all the 15 test-cases

7. In addition, you could check coverage for the classes as well

To add the JUnit Library to the java project:

1. Right click the java project
2. Select "Build Path"
3. Choose "Add Libaries..."
4. Select "JUnit"
5. Choose "JUnit 5"
6. Hit "Finish"

References

References used to code the game:

- https://www.guru99.com/java-swing-gui.html
- https://www.javatpoint.com/java-swing
- https://www.javatpoint.com/java-jframe
- https://www.guru99.com/java-swing-gui.html
- https://www.javatpoint.com/java-jmenuitem-and-jmenu
- The series by: https://www.youtube.com/watch?v=YMeVSoNumAg
- https://www.javatpoint.com/java-jbutton
- https://www.javatpoint.com/java-actionlistener
- https://www.tabnine.com/code/java/methods/javax.swing.JFrame/getContentPane
- https://www.javamex.com/tutorials/threads/invokelater.shtml
- https://www.tutorialspoint.com/what-is-the-importance-of-swingutilities-class-in-java
- https://stackoverflow.com/questions/39945881/java-tic-tac-toe-game-using-2 dimensional-array
- https://stackoverflow.com/questions/23233456/tic-tac-toe-in-java-using-2-d-arrays

References used to code the testing:

- https://www.vogella.com/tutorials/JUnit/article.html
- https://junit.org/junit4/javadoc/latest/org/junit/Assert.html
- https://www.softwaretestinghelp.com/junit-assertions/
- https://howtodoinjava.com/junit5/before-each-annotation-example/
- https://spring.io/guides/gs/maven/
- https://www.tutorialspoint.com/mockito/mockito_junit_integration.htm
- https://www.vogella.com/tutorials/Mockito/article.html
- https://www.javatpoint.com/mockito