

Project 2

CPSC 2150

Part 1 Due: Sunday, October 9th at 11:59 pm

Full Project Due: Thursday, October 20th at 11:59 pm

100 pts

Introduction

In this assignment, we will implement the design you created in Project 1. You should be proactive in evaluating and fixing your own design and address any feedback provided by the TAs. Your implemented code should include the three classes described in the Project 1 prompt and should match all requirements from that prompt. Some minor changes are listed below as new requirements.

Again, it is crucial to follow the design and requirements laid out in the Project 1 prompt. Any changes could cause issues with later assignments. While it is important to consider possible future changes and write our code in a way that will make it easier to adapt to those future changes, we should not write code that implements *predicted* future changes. Any deviation from the requirements could result in breaking automated grading scripts and result in losing points due to not following directions.

New Requirements

You must provide an interface called `IGameBoard` that the `GameBoard` class will implement. The `IGameBoard` interface should contain all the methods from Project 1, as well as the following **primary methods**:

```
public int getNumRows() – returns the number of rows in the GameBoard
public int getNumColumns() – returns the number of columns in the GameBoard
public int getNumToWin() – returns the number of tokens in a row needed to win the game
```

For each method, determine whether it is a primary or a secondary method. Any secondary methods in the `IGameBoard` interface should be provided as a `default` method in the interface itself and not overridden in the implementation (unless you gain an efficiency advantage by doing so). Consider whether or not it *can* be secondary and still meet the requirements. If you added private helper functions or additional private data variables, that may have made other methods easier, but by removing them, you may be able to make the method secondary.

- Correctly identifying all the secondary methods and coding them to be `default` methods is a large part of what you will be evaluated on for this assignment. Spend some time considering each method.
- You may choose to override the `default` implementation if you can get an efficiency gain by directly accessing the private data, but you are not required to do so.
- **Example:** You may have come up with a solution to check if there is a tie game by keeping track of the number of markers that have been placed on the board in a private field. You would not be able to access this private field in the interface. However, there is a way to check to see if there is a tie game in the interface without accessing that private variable. You should still provide a `default` implementation to check for a tie

game, and you can choose to override it in `GameBoard` since it would be much faster just to check the private data.

You must add an abstract class called `AbsGameBoard`, which implements `IGameBoard`. `AbsGameBoard` will have no private data and will just provide an overridden implementation of `toString`, which will be implemented by calling primary methods. We are not allowed to override `toString` in our interface (even though it could be implemented as a default method) because an interface does not extend `Object`, and therefore cannot override the `toString` method provided by `Object`. `GameBoard` should extend `AbsGameBoard`.

Contracts, Comments, and formatting

For every function, you should already have Javadoc comments and contracts available. If you made mistakes on these for the Project 1 submission, you should correct them now. Again, you may not have feedback from the TAs on your submission, but while working on your code, you may discover on your own that you made a mistake.

You will need to create a complete interface specification for the `IGameBoard` interface, which includes an abstraction for `IGameBoard`. You have written most of these already, but you need to copy them to the interface file and make the appropriate changes so it uses the new abstraction you have defined and modify your preconditions and postconditions for each method accordingly. The descriptions, `@params`, and `@returns` for each method should remain the same as in Project 1. You do not need to repeat any contracts from the interface in `GameBoard`.

Now that you have an interface specification, **you must provide correspondences and invariants in your `GameBoard` class.**

In general, your code should be well commented. Your Javadoc comments will handle a lot of this, but you will need more comments in longer and more detailed sections of code. Your code should be indented appropriately; you should use good variable names, follow naming conventions, avoid magic numbers, etc. Everything that has been mentioned as a "best practice" in our lectures or in a video should be followed, or you risk losing points on your assignment.

Your code should be easy to read. Ask yourself, would someone with no knowledge of this assignment be able to tell what is happening in the program from quickly reading my code.

Project Report

Along with your "code" you must submit a well-formatted report with the following parts:

Requirements Analysis

Fully analyze the requirements of this program. Express all functional requirements as user stories. Remember to list all non-functional requirements of the program as well. (**Note:** these should only change if you identify a mistake you made)

Design

Create a UML class diagram for each class and interface in the program. Also, create UML Activity diagrams as specified in the above directions. All diagrams should be well formatted and easy to read. I recommend [Diagrams.net](https://diagrams.net) (formally Draw.io) as a program to create the diagrams. **You should**

now draw activity diagram(s) for GameScreen. Spend some time thinking about how you will implement the game using the other interfaces and classes before you draw your diagram.

The activity diagrams for `GameBoard` should already be completed from the Project 1 submission. However, once you implement and test your code, you may discover you made a mistake. If so, you should correct the error in your code and update the diagrams. Check to see that when you move a method to the `interface` as a `default` method, you no longer are accessing the private data. As software engineers, we use UML diagrams not just as a design tool but as a way to document our code, so other software engineers have reference materials to help them when they need to maintain, fix, test, or build off of our code.

Deployment

You must include a `makefile` with the following targets:

- `default`: compiles your code. Runs with the `make` command.
- `run`: runs your code. Runs with the `make run` command.
- `clean`: removes your compiled (`.class`) files. Runs with the `make clean` command.

Your project report should include instructions on how to use the `makefile` to compile and run your program.

General Notes and Additional Requirements

- If it does not compile, it is a zero. Make sure it will compile on SoC Unix machines.
- You will need to place the Java files in the following package structure. `GameScreen` should be placed in `cpssc2150.extendedTicTacToe` and `BoardPosition`, `IGameBoard`, `AbsGameBoard`, and `GameBoard` should be placed under `cpssc2150.extendedTicTacToe.models`
- Remember our "best practices" that we've discussed in class. Use good variables, avoid magic numbers, etc.
- Start early. You have time to work on this assignment, but you will need time to work on it.
- Starting early means more opportunities to go to TA or instructor office hours for help
- The instructor and TAs have lives as well, so don't expect email responses late at night. If you need help, you must start early enough to ask for help.
- Start by analyzing the requirements of this program to ensure you understand what you are designing.
- Remember, this class is about more than just functioning code. Your design and quality of code are essential. Remember the best practices we are discussing in class. Your code should be easy to change and maintain. You should not be using magic numbers. You should be considering Separation of Concerns, Information Hiding, and Encapsulation when designing your code. You should also be following the idea and rules of design by contract.
- Your UML Diagrams must be made electronically. I recommend the freely available program `Diagrams.net` (formally `Draw.io`), but if you have another diagramming tool you prefer, feel free to use that. It may be faster to draw rough drafts by hand, and when you have the logic worked out, create the final version electronically.

- While you need to validate all input from the user, you can assume that they are entering numbers or characters when appropriate. You do not need to check to see that they entered 6 instead of "six."
- You may want to call one `public` method from another `public` method. We can do this, but we have to be very careful about doing this. Remember that during the process of a public method, we cannot assume that the invariant is true, but at the beginning of one, we assume that it is true. So, if we want to call one public method from inside another, we need to be sure that the invariants are true and the preconditions of the method we are calling.
- Activity Diagrams should be detailed. Every decision that is made should be shown, not just described in one step. In other words, it is not sufficient to have one step/activity in the diagram say, "Check if the input is valid and prompt again if it is not." You need to show the logic for that check. Calling another method can be a single step in the activity diagram since it will have its own diagram. The activities in the diagrams do not need to be written as code. It is fine to write "Check if X is in position i, j" instead of "if ('X' == board[i][j])"
- `GameScreen` is the only class that should get input from the user or print to the screen.
- 0,0 should be the top left of the board. If you do not make 0,0 at the top left of the board, it could cause issues with the scripts the TA will use to grade the assignment.
- If you identify any mistakes in your design while implementing it, make sure to correct your diagrams in the project report to ensure it matches your code.
- You should not have any "Dead Code" in your code. "Dead Code" is code that is commented out because it is no longer used.
- You should fix everything that the TAs have indicated to be incorrect from your Project 1 submissions. **Failure to do so will result in deductions in the final submission for Project 2.**

Before Submitting

You need to make sure your code will run on SoC Unix machines and create a `makefile`. Include your name as a comment at the top of each Java file.

Use the command "`zip -r Project2.zip cpsc2150 makefile report.pdf`" to zip up all the code, `makefile` and project report. Don't forget the `-r` to make sure it includes the subdirectories as well. **NOTE:** Copying and pasting this command may cause issues because Windows encodes the `-` symbol differently from Unix.

Submission

To ensure that you do not wait until the last minute to start the assignment, we are requesting two submissions for this assignment. There will be separate links for you to submit your files on Gradescope by the specified due date. **Late submissions will not be accepted.**

For part 1, you will submit an updated PDF with the completed class and activity diagrams for `IGameBoard`, `AbsGameBoard`, `GameBoard`, `GameScreen`, and `BoardPosition` (class diagram only). Many of these diagrams were done in Project 1, so you may only need to make minor updates based on the feedback you received. In addition to this, you should create an `IGameBoard`, `AbsGameBoard`, and `GameScreen` Java files and move (or add) complete Javadoc + contracts. You should also add invariants and correspondences to `GameBoard`. Create a zip file with the command provided in the section above and submit it to Gradescope. This part will be due Sunday, October 9th at 11:59 pm.

For the full project submission, you should have one zipped folder to submit. Inside of that folder, you'll have your package directory (which will contain your code), your report (a pdf file), and your `makefile`. Make sure your code is your Java files and not your `.class` files. The TA should be able to unzip your folder and type `"make"`, `"make run"` to start running your code and `"make clean"` to remove any compiled (`.class`) files. This part will be due Thursday, October 20th at 11:59 pm.

NOTE: Always check your submissions on Gradescope to ensure you uploaded the correct files and it is in the proper format. **I wouldn't wait until the last minute to submit as Gradescope could take a few minutes to display the results.** Notify your course instructor immediately of any Gradescope issues.

Disclaimer:

It is possible that these instructions may need to be updated. As students ask questions, I may realize that something is not as straightforward as I thought, and I may add detail to clarify the issue. Changes to the instructions will not change the assignment drastically and will not require reworking code. They would just be made to clarify the expectations and requirements. If any changes are made, they will be announced on Canvas.

Checklist

Use this checklist to ensure you are completing your assignment. **Note:** this list does not cover all possible reasons you could miss points but should cover a majority of them. I am not intentionally leaving anything out, but I am constantly surprised by some of the submissions we see that are wildly off the mark. For example, I am not listing "Does my program play Tic Tac Toe?" but that does not mean that if you turn in a program that plays Checkers, you can say, "But it wasn't on the checklist!" The only complete list that would guarantee that no points would be lost would be an incredibly detailed and complete set of instructions that told you exactly what code to type, which wouldn't be much of an assignment.

- Is my `Gameboard` the correct size?
- Do players need 5 in a row to win?
- Does my game have 2 players?
- Do my classes have invariants?
- Does my `GameBoard` class have correspondences?
- Does my game allow players to play again?
- Are my methods reasonably efficient? You don't need to take this to the extreme, but obvious inefficiencies should be corrected.
- Does my game take turns with the players?
- Does my game correctly identify wins?
- Does my game correctly identify tie games?
- Does my game run without crashing?
- Does my game validate user input?
- Did I protect my data by keeping it private, except for `public static final` (constant) variables?
- Did I encapsulate my data and functionality and include them in the correct classes?
- Did I follow Design-By-Contract?

- Did I provide contracts for each method?
- Did I comment my code?
- Did I provide Javadoc comments for each method?
- Did I avoid using magic numbers?
- Did I use good variable names?
- Did I follow best practices?
- Did I remove "Dead Code?" Dead Code is old code that is commented out.
- Did I make any additional helper functions I created in `GameScreen` private?
- Did I use the `static` keyword correctly?
- Did I express all functional requirements as user stories?
- Did I create my activity diagrams for all methods?
- Did I create a class diagram for each class?
- Did I provide a working `makefile`?
- Does my code compile and run on Unix?
- Is my program written in Java?
- Does my output look like the provided examples?
- Did I create my `interface` and write the full interface specification?
- Did I add my `abstract class`?

Sample input and output:

```

0|1|2|3|4|5|6|7|
0| | | | | | | |
1| | | | | | | |
2| | | | | | | |
3| | | | | | | |
4| | | | | | | |

```

```

Player X Please enter your ROW
12
Player X Please enter your COLUMN
5

```

```

0|1|2|3|4|5|6|7|
0| | | | | | | |
1| | | | | | | |
2| | | | | | | |
3| | | | | | | |
4| | | | | | | |

```

```

That space is unavailable, please pick again
Player X Please enter your ROW
5
Player X Please enter your COLUMN
12

```

```

0|1|2|3|4|5|6|7|
0| | | | | | | |
1| | | | | | | |

```

```
2| | | | | | | |
3| | | | | | | |
4| | | | | | | |
```

That space is unavailable, please pick again

Player X Please enter your ROW

4

Player X Please enter your COLUMN

2

```
  0|1|2|3|4|5|6|7|
0| | | | | | | |
1| | | | | | | |
2| | | | | | | |
3| | | | | | | |
4| | |X| | | | |
```

Player O Please enter your ROW

0

Player O Please enter your COLUMN

0

```
  0|1|2|3|4|5|6|7|
0|O| | | | | | |
1| | | | | | | |
2| | | | | | | |
3| | | | | | | |
4| | |X| | | | |
```

Player X Please enter your ROW

3

Player X Please enter your COLUMN

2

```
  0|1|2|3|4|5|6|7|
0|O| | | | | | |
1| | | | | | | |
2| | | | | | | |
3| | |X| | | | |
4| | |X| | | | |
```

Player O Please enter your ROW

2

Player O Please enter your COLUMN

2

```
  0|1|2|3|4|5|6|7|
0|O| | | | | | |
1| | | | | | | |
2| | |O| | | | |
3| | |X| | | | |
4| | |X| | | | |
```

Player X Please enter your ROW

4
Player X Please enter your COLUMN

1
0|1|2|3|4|5|6|7|
0|O| | | | | | |
1| | | | | | | |
2| | |O| | | | |
3| |X| | | | | |
4|X|X| | | | | |

Player O Please enter your ROW

1
Player O Please enter your COLUMN

1
0|1|2|3|4|5|6|7|
0|O| | | | | | |
1| |O| | | | | |
2| | |O| | | | |
3| |X| | | | | |
4|X|X| | | | | |

Player X Please enter your ROW

2
Player X Please enter your COLUMN

2
0|1|2|3|4|5|6|7|
0|O| | | | | | |
1| |O| | | | | |
2| | |O| | | | |
3| |X| | | | | |
4|X|X| | | | | |

That space is unavailable, please pick again

Player X Please enter your ROW

2
Player X Please enter your COLUMN

3
0|1|2|3|4|5|6|7|
0|O| | | | | | |
1| |O| | | | | |
2| | |O|X| | | | |
3| |X| | | | | |
4|X|X| | | | | |

Player O Please enter your ROW

3
Player O Please enter your COLUMN

3
0|1|2|3|4|5|6|7|
0|O| | | | | | |


```
1| |O| | | | | |
2| | |O|X| | | |
3| | |X|O| | | |
4| |X|X| | | | |
```

Player X Please enter your ROW

1

Player X Please enter your COLUMN

4

```
0|1|2|3|4|5|6|7|
0|O| | | | | | |
1| |O| | |X| | |
2| | |O|X| | | |
3| | |X|O| | | |
4| |X|X| | | | |
```

Player O Please enter your ROW

4

Player O Please enter your COLUMN

4

Player O wins!

```
0|1|2|3|4|5|6|7|
0|O| | | | | | |
1| |O| | |X| | |
2| | |O|X| | | |
3| | |X|O| | | |
4| |X|X| |O| | |
```

Would you like to play again? Y/N

n