Assignment 3

Deadline: Friday, 30 October 2020 at 6pm

Before you start: create a new folder, called "*Assignment_3*" for this assignment in your GitHub repository. Before starting the assignment, copy the code developed for *Assignment 2* in this new folder.

Please note that the folder used in *Assignment 2* must still contain the original code. Do **not** delete or modify the folder used for *Assignment 2*.

Exercise 1 (10 points)

In this week's assignment, we ask you to finish implementing the battleship game to obtain a playable game. To achieve this aim, you must implement:

1. A computer that plays against the user. At the beginning of the game, the computer will position its boats on the board (without revealing their positions to the user) randomly selecting a starting and final block for each boat. Although the position of each boat is selected randomly, it must follow the rules of the game and it can not violate the following constraints: (1) the computer must respect the size of each boat, (2) it can not place them outside the board, (3) boats can not overlap, and (4) boats can not be placed diagonally.

2. A scoreboard that displays how many boats the player has destroyed and how many of the player's boats still remain.
   The figure below shows an example of how the game looks like after the user has positioned all their boats.

```
Your board is:

   |[A][B][C][D][E][F][G][H][I][L]
---|------------------------------
[0]|[P][P][ ][S][ ][ ][B][B][B][B]
[1]|[ ][ ][ ][S][ ][ ][ ][ ][ ][ ]
[2]|[B][ ][ ][S][ ][S][S][S][ ][P]
[3]|[B][ ][ ][ ][ ][ ][ ][ ][ ][P]
[4]|[B][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[5]|[B][ ][ ][ ][ ][P][ ][ ][ ][S]
[6]|[ ][ ][ ][ ][ ][P][ ][ ][ ][S]
[7]|[P][P][ ][ ][ ][ ][ ][ ][ ][S]
[8]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

The opponent's board is:

   |[A][B][C][D][E][F][G][H][I][L]
---|------------------------------
```

```
[0]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[1]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[2]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[3]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[4]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[5]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[6]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[7]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[8]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Your scoreboard:
   -  Player remaining boats: 10
   -  Enemy boats destroyed: 0
```

3. At each turn, the player selects a position within the board to attack. The computer randomly selects positions of the user's board. If the place was already chosen before, the game considers the position invalid and asks for another position.

4. If a boat is hit in the computer's board, an **X** will appear in the position the bomb was thrown. Otherwise, an O should be shown. Once all positions of a ship are hit, the boat is destroyed and the **X**'s should be replaced by the boat's initial letter to reveal itself to the opponent. For example, a submarine could be represented by a sequence of `[S][S][S]`.

In the example below, the user hit a computer's ship in A0 (without destroying it), did not hit anything in C0, and destroyed a submarine in C2-E2. Please note that the scoreboard has been updated accordingly.

```
Your board is:

   |[A][B][C][D][E][F][G][H][I][L]
---|------------------------------
[0]|[P][P][ ][S][ ][ ][B][B][B][B]
[1]|[ ][ ][ ][S][ ][ ][ ][ ][ ][ ]
[2]|[B][ ][ ][S][ ][S][S][S][ ][P]
[3]|[B][ ][ ][ ][ ][ ][ ][ ][ ][P]
[4]|[B][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[5]|[B][ ][ ][ ][ ][P][ ][ ][ ][S]
[6]|[ ][ ][ ][ ][ ][P][ ][ ][ ][S]
[7]|[P][P][ ][ ][ ][ ][ ][ ][ ][S]
[8]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

The opponent's board is:

   |[A][B][C][D][E][F][G][H][I][L]
---|------------------------------
[0]|[X][ ][O][ ][ ][ ][ ][ ][ ][ ]
[1]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[2]|[ ][ ][S][S][S][ ][ ][ ][ ][ ]
[3]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[4]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[5]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
```

```
[6]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[7]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[8]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Your scoreboard:
   -  Player remaining boats: 10
   -  Enemy boats destroyed: 1
```

5. If a ship is hit in your board, the boat's initial letter will be replaced by **X**. Otherwise, an **O** should be shown.

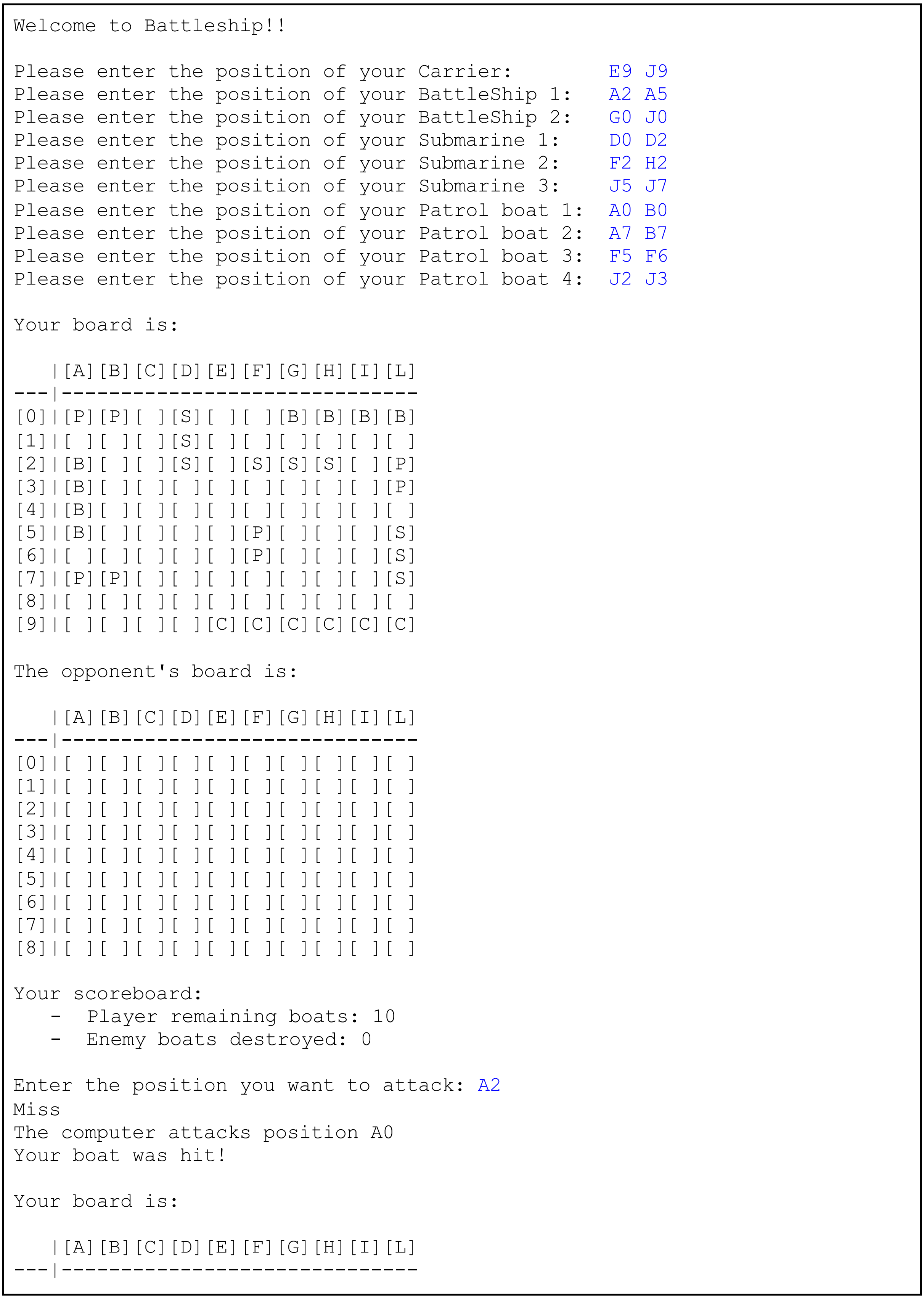
   In the example below, the opponent hit the player's boat in A0, missed in B2 and completely destroyed the submarine in D0-D2. Please note that the scoreboard is updated accordingly.

```
Your board is:

   |[A][B][C][D][E][F][G][H][I][L]
---|------------------------------
[0]|[X][P][ ][X][ ][ ][B][B][B][B]
[1]|[ ][ ][ ][X][ ][ ][ ][ ][ ][ ]
[2]|[B][O][ ][X][ ][S][S][S][ ][P]
[3]|[B][ ][ ][ ][ ][ ][ ][ ][ ][P]
[4]|[B][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[5]|[B][ ][ ][ ][ ][P][ ][ ][ ][S]
[6]|[ ][ ][ ][ ][ ][P][ ][ ][ ][S]
[7]|[P][P][ ][ ][ ][ ][ ][ ][ ][S]
[8]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

The opponent's board is:

   |[A][B][C][D][E][F][G][H][I][L]
---|------------------------------
[0]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[1]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[2]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[3]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[4]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[5]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[6]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[7]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[8]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Your scoreboard:
   -  Player remaining boats: 9
   -  Enemy boats destroyed: 0
```

Use the following design patterns to either re-structure your old code or implement the new functionalities. In your implementation, you should use the following design patterns at least one time:

- Singleton
- Observer
- Iterator

Write a natural language description of **why** and **how** the patterns are implemented in your code. Address these points in a **ANSWERS.md** file and add it to the assignment folder. The following Figure shows an example of the game flow.



```
Welcome to Battleship!!

Please enter the position of your Carrier:        E9 J9
Please enter the position of your BattleShip 1:   A2 A5
Please enter the position of your BattleShip 2:   G0 J0
Please enter the position of your Submarine 1:    D0 D2
Please enter the position of your Submarine 2:    F2 H2
Please enter the position of your Submarine 3:    J5 J7
Please enter the position of your Patrol boat 1:  A0 B0
Please enter the position of your Patrol boat 2:  A7 B7
Please enter the position of your Patrol boat 3:  F5 F6
Please enter the position of your Patrol boat 4:  J2 J3

Your board is:

   |[A][B][C][D][E][F][G][H][I][L]
---|------------------------------
[0]|[P][P][ ][S][ ][ ][B][B][B][B]
[1]|[ ][ ][ ][S][ ][ ][ ][ ][ ][ ]
[2]|[B][ ][ ][S][ ][S][S][S][ ][P]
[3]|[B][ ][ ][ ][ ][ ][ ][ ][ ][P]
[4]|[B][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[5]|[B][ ][ ][ ][ ][P][ ][ ][ ][S]
[6]|[ ][ ][ ][ ][ ][P][ ][ ][ ][S]
[7]|[P][P][ ][ ][ ][ ][ ][ ][ ][S]
[8]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[9]|[ ][ ][ ][ ][C][C][C][C][C][C]

The opponent's board is:

   |[A][B][C][D][E][F][G][H][I][L]
---|------------------------------
[0]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[1]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[2]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[3]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[4]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[5]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[6]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[7]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[8]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Your scoreboard:
   -  Player remaining boats: 10
   -  Enemy boats destroyed: 0

Enter the position you want to attack: A2
Miss
The computer attacks position A0
Your boat was hit!

Your board is:

   |[A][B][C][D][E][F][G][H][I][L]
---|------------------------------
```

```
[0]|[X][P][ ][S][ ][ ][B][B][B][B]
[1]|[ ][ ][ ][S][ ][ ][ ][ ][ ][ ]
[2]|[B][ ][ ][S][ ][S][S][S][ ][P]
[3]|[B][ ][ ][ ][ ][ ][ ][ ][ ][P]
[4]|[B][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[5]|[B][ ][ ][ ][ ][P][ ][ ][ ][S]
[6]|[ ][ ][ ][ ][ ][P][ ][ ][ ][S]
[7]|[P][P][ ][ ][ ][ ][ ][ ][ ][S]
[8]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[9]|[ ][ ][ ][ ][C][C][C][C][C][C]

The opponent's board is:

   |[A][B][C][D][E][F][G][H][I][L]
---|------------------------------
[0]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[1]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[2]|[O][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[3]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[4]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[5]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[6]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[7]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
[8]|[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Your scoreboard:
   -  Player remaining boats: 10
   -  Enemy boats destroyed: 0

Enter the position you want to attack: …
...
```

After the player places all their boats, the game asks them to specify the position they want to attack (A2 in the example). After the player inserts the desired position on the board, the game returns one of three possible messages:

1. If the position is empty (no opponent's boats are placed there), the game returns "`Miss`", as in the example above.
2. If a boat has been hit, the game returns the message "`You hit a boat!`".
3. If the player hits a boat and the boat is completely destroyed, the game returns the message "`You destroyed a [boat name]`". In this case, remember to update the scoreboard accordingly.

The opponent's board shown to the player should be updated accordingly. Then, the computer randomly selects a position on the board to attack and the game communicates the selected position to the user as shown in the example above.

Then, one of three possible messages is shown to the player:

1. If the position is empty (none of the player's boats is placed there), the game returns the message "`The computer missed`".
2. If one of the player's boats has been hit, the game returns the message "`Your boat was hit!`", as in the example above.

3. If the player hits a boat and the boat is completely destroyed, the game returns the message "*Your [boat name] was destroyed*". In this case, remember to update the scoreboard accordingly.

Then, the game prints the updated player's board, opponent's board, and scoreboard and starts a new turn.

When all of the player's or the computer's boats are destroyed, the game terminates. Before terminating, the game should print "*Congratulations, you won!*" if the player successfully destroyed all the computer's boats, or "*Sorry, you lost!*", if all the player's boats were destroyed.

Important notes

Write all your answers in the **ANSWERS.md** file. Do not use a file with a different name. Also, please ensure that it is clear which answers belong to each exercise of the assignment.

Please note that no commits can be added to the assignment folder on GitHub after the deadline. Any commit added after the deadline **will not** be counted in the evaluation of the assignment.