

Coursework 2 – Tic-Tac-To: Markov Decision Processes & Reinforcement Learning (worth 25% of your final mark)

VALUE ITERATION

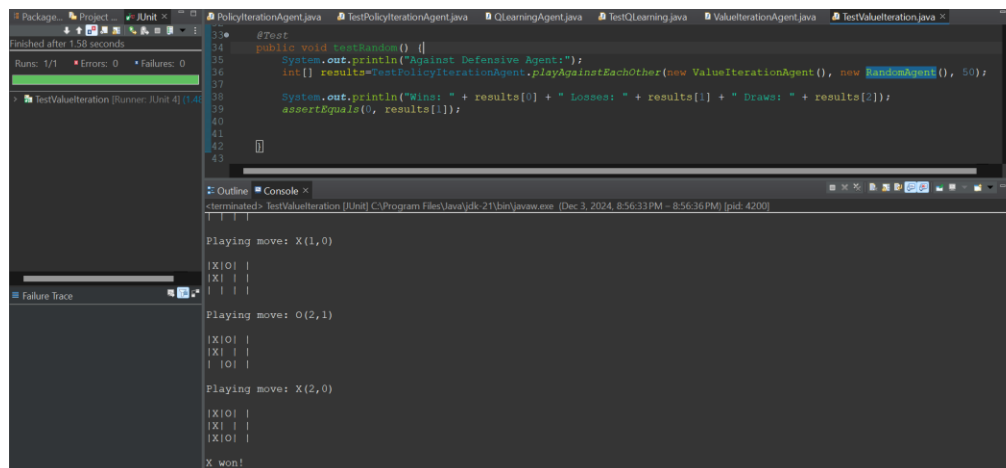
Question 2 (1 point): Test your Value Iteration Agent against each of the provided agents 50 times and report on the results – how many games they won, lost & drew against each of the other rule based agents. The rule based agents are: *random*, *aggressive*, *defensive*.

Ans:

- Iterate(): Performs k iterations of value iteration and calculates the optimal value for each game state using the Bellman equation.
- extractPolicy(): identifies the best move by calculating the expected value of all possible moves and updates the policy.

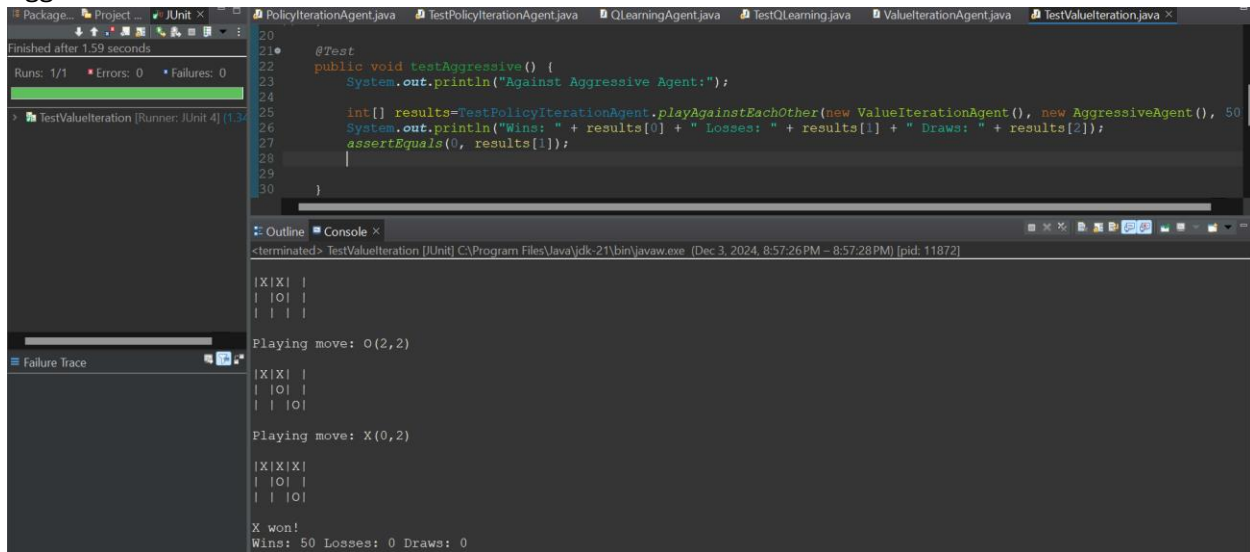
	WINS	LOSS	DRAWS
RANDOM	50	0	0
AGRESSIVE	50	0	0
DEFENSIVE	46	0	4

Random:



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Finished after 1.58 seconds
Runs: 1/1 Errors: 0 Failures: 0
> TestValueIteration [Runner: JUnit 4] [1.4]
33
34 @Test
35 public void testRandom() {
36     System.out.println("Against Defensive Agent:");
37     int[] results = testPolicyIterationAgent.playAgainstEachOther(new ValueIterationAgent(), new RandomAgent(), 50);
38     System.out.println("Wins: " + results[0] + " Losses: " + results[1] + " Draws: " + results[2]);
39     assertEquals(0, results[1]);
40 }
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```

Aggressive:



```
20
21  @Test
22  public void testAggressive() {
23      System.out.println("Against Aggressive Agent:");
24
25      int[] results=TestPolicyIterationAgent.playAgainstEachOther(new ValueIterationAgent(), new AggressiveAgent(), 50);
26      System.out.println("Wins: " + results[0] + " Losses: " + results[1] + " Draws: " + results[2]);
27      assertEquals(0, results[1]);
28  }
29
30
```

Finished after 1.59 seconds
Runs: 1/1 Errors: 0 Failures: 0

TestValueIteration [Runner: JUnit 4] (1.34)

Outline Console

<terminated> TestValueIteration [JUnit] C:\Program Files\Java\jdk-21\bin\javaw.exe (Dec 3, 2024, 8:57:26 PM – 8:57:28 PM) [pid: 11872]

```
|X|X| |
| |O| |
| | | |

Playing move: O(2,2)

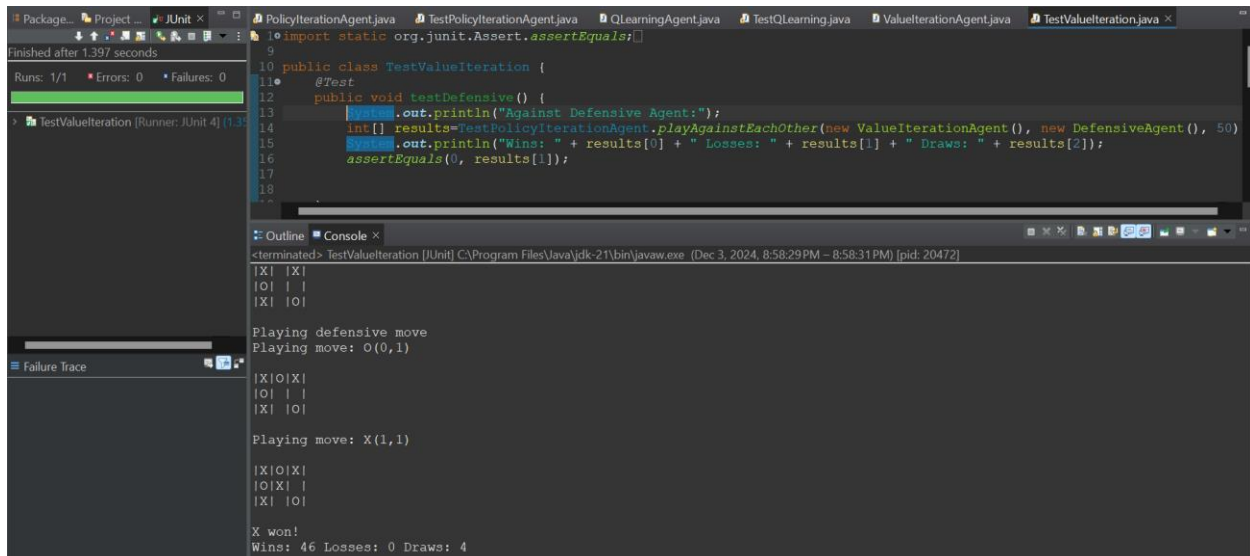
|X|X| |
| |O| |
| | |O|

Playing move: X(0,2)

|X|X|X|
| |O| |
| | |O|

X won!
Wins: 50 Losses: 0 Draws: 0
```

Defensive:



```
9
10 public class TestValueIteration {
11     @Test
12     public void testDefensive() {
13         System.out.println("Against Defensive Agent:");
14         int[] results=TestPolicyIterationAgent.playAgainstEachOther(new ValueIterationAgent(), new DefensiveAgent(), 50);
15         System.out.println("Wins: " + results[0] + " Losses: " + results[1] + " Draws: " + results[2]);
16         assertEquals(0, results[1]);
17     }
18 }

```

Finished after 1.397 seconds
Runs: 1/1 Errors: 0 Failures: 0

TestValueIteration [Runner: JUnit 4] (1.34)

Outline Console

<terminated> TestValueIteration [JUnit] C:\Program Files\Java\jdk-21\bin\javaw.exe (Dec 3, 2024, 8:58:29 PM – 8:58:31 PM) [pid: 20472]

```
|X| |X|
|O| | |
|X| |O|

Playing defensive move
Playing move: O(0,1)

|X|O|X|
|O| | |
|X| |O|

Playing move: X(1,1)

|X|O|X|
|O|X| |
|X| |O|

X won!
Wins: 46 Losses: 0 Draws: 4
```