UNIVERSITY OF MALAYA

Activity 3: Heuristic Analysis Report

Name: Muhammad Aliff Danial Bin Mohd Zahiruddin

Matric Number: WID170030 / 17121897/2

Lecturer: Prof. DR. Loo Chu Kiong

Custom Heuristics

The idea

I want to add the sense of time. This can be calculated by getting the ratio of the blank space to the size of board. With the time value, I make a condition of when the agent will be defensive, and when the agent will be aggressive. To make the agent defensive, I add weight to the number of the legal moves of the agent and minus the number of legal moves of the opponents. This will make the heuristic value will always be positive unless the number of legal moves of the opponent is high. Hence, the agent can avoid from doing that move. To make the agent aggressive, weight will be added to the opponent. Hence, the agent will only get a positive heuristic value when the number of legal moves is high. Hence, the agent will only make a move when the legal number of moves is very high. This can be expressed as:

$$Agent\ Movement, AP = \ number\ of\ legal\ move\ for\ agent$$

$$Opponent\ Movement, AP = \ number\ of\ legal\ move\ for\ opponent$$

$$Current\ state\ board\ ratio, \qquad m = \frac{total\ number\ of\ blank\ space\ available}{size\ of\ board}$$

$$H(t) = \begin{cases} (OP * 2) - AP, & if\ m \leq \ 0.5 \\ OP - (AP * 2), & if\ m > 0.5 \end{cases}$$

Pseudocode

1. Check the whether the player wins or loses the game. If Win, return positive infinity, else return negative infinity.
2. Calculate the number of legal movements for both player and opponent.
3. Calculate the current state of the board.
4. Calculate the heuristics value.

Results:

Result of each agents is as follows:

Agent	Performance
ID_Improved	59.29%
Student1	66.79%
Student2	66.43%
Student3	64.29%
Student4	64.64%
Student5	62.86%
Student6	66.43%
Custom Heuristic (Aliff)	68.21%
Amin	66.79%
Akif	67.86%
Feddelic	79.64%

The performance is calculated by dividing the number of wins with the total of match played. In this test, the agent only plays for 10 matches.

Appendices

```
************************
 Evaluating: ID_Improved
************************

Playing Matches:
----------
  Match 1: ID_Improved vs Random        Result: 36 to 4
  Match 2: ID_Improved vs MM_Null       Result: 29 to 11
  Match 3: ID_Improved vs MM_Open       Result: 16 to 24
  Match 4: ID_Improved vs MM_Improved   Result: 14 to 26
  Match 5: ID_Improved vs AB_Null       Result: 28 to 12
  Match 6: ID_Improved vs AB_Open       Result: 25 to 15
  Match 7: ID_Improved vs AB_Improved   Result: 18 to 22


Results:
----------
ID_Improved         59.29%
```

```
************************
  Evaluating: Student1
************************

Playing Matches:
----------
  Match 1: Student1 vs Random   Result: 36 to 4
  Match 2: Student1 vs MM_Null  Result: 28 to 12
  Match 3: Student1 vs MM_Open  Result: 27 to 13
  Match 4: Student1 vs MM_Improved      Result: 21 to 19
  Match 5: Student1 vs AB_Null  Result: 30 to 10
  Match 6: Student1 vs AB_Open  Result: 22 to 18
  Match 7: Student1 vs AB_Improved      Result: 23 to 17


Results:
----------
Student1            66.79%
```

```
************************
  Evaluating: Student2
************************

Playing Matches:
----------
  Match 1: Student2 vs Random   Result: 29 to 11
  Match 2: Student2 vs MM_Null  Result: 29 to 11
  Match 3: Student2 vs MM_Open  Result: 26 to 14
  Match 4: Student2 vs MM_Improved      Result: 20 to 20
  Match 5: Student2 vs AB_Null  Result: 30 to 10
  Match 6: Student2 vs AB_Open  Result: 26 to 14
  Match 7: Student2 vs AB_Improved      Result: 26 to 14


Results:
----------
Student2            66.43%
```

```
************************
  Evaluating: Student3
************************

Playing Matches:
----------
  Match 1: Student3 vs Random   Result: 33 to 7
  Match 2: Student3 vs MM_Null  Result: 30 to 10
  Match 3: Student3 vs MM_Open  Result: 23 to 17
  Match 4: Student3 vs MM_Improved      Result: 19 to 21
  Match 5: Student3 vs AB_Null  Result: 27 to 13
  Match 6: Student3 vs AB_Open  Result: 25 to 15
  Match 7: Student3 vs AB_Improved      Result: 23 to 17


Results:
----------
Student3            64.29%
```

```
************************
  Evaluating: Student4
************************

Playing Matches:
----------
  Match 1: Student4 vs Random   Result: 33 to 7
  Match 2: Student4 vs MM_Null  Result: 25 to 15
  Match 3: Student4 vs MM_Open  Result: 22 to 18
  Match 4: Student4 vs MM_Improved      Result: 19 to 21
  Match 5: Student4 vs AB_Null  Result: 28 to 12
  Match 6: Student4 vs AB_Open  Result: 28 to 12
  Match 7: Student4 vs AB_Improved      Result: 26 to 14


Results:
----------
Student4            64.64%
```

```
************************
  Evaluating: Student5
************************

Playing Matches:
----------
  Match 1: Student5 vs Random   Result: 33 to 7
  Match 2: Student5 vs MM_Null  Result: 26 to 14
  Match 3: Student5 vs MM_Open  Result: 18 to 22
  Match 4: Student5 vs MM_Improved      Result: 21 to 19
  Match 5: Student5 vs AB_Null  Result: 29 to 11
  Match 6: Student5 vs AB_Open  Result: 26 to 14
  Match 7: Student5 vs AB_Improved      Result: 23 to 17


Results:
----------
Student5            62.86%
```

```
 ************************
   Evaluating: Student6
 ************************

 Playing Matches:
 ----------
   Match 1: Student6 vs Random   Result: 32 to 8
   Match 2: Student6 vs MM_Null  Result: 32 to 8
   Match 3: Student6 vs MM_Open  Result: 22 to 18
   Match 4: Student6 vs MM_Improved      Result: 22 to 18
   Match 5: Student6 vs AB_Null  Result: 28 to 12
   Match 6: Student6 vs AB_Open  Result: 27 to 13
   Match 7: Student6 vs AB_Improved      Result: 23 to 17


 Results:
 ----------
 Student6           66.43%
```

```
************************
  Evaluating: My_score
************************

Playing Matches:
----------
  Match 1: My_score vs Random   Result: 33 to 7
  Match 2: My_score vs MM_Null  Result: 29 to 11
  Match 3: My_score vs MM_Open  Result: 20 to 20
  Match 4: My_score vs MM_Improved      Result: 29 to 11
  Match 5: My_score vs AB_Null  Result: 32 to 8
  Match 6: My_score vs AB_Open  Result: 24 to 16
  Match 7: My_score vs AB_Improved      Result: 24 to 16


Results:
----------
My_score           68.21%
```