Heuristic analysis

Let's analyze performance of CustomPlayer agent from the game_agent.py and different heuristic functions by running tournament.py. First, the script runs CustomPlayer agent with improved score heuristic function. Second, it runs CustomPlayer agent with custom_score heuristic function defined in the game_agent.py. There are three experiments with different implementations of custom_score heuristic functions: null score, open move score and improved score.

Null score

This heuristic presumes no knowledge for non-terminal states, and returns the same uninformative value for all other states.

```
***********************
 Evaluating: ID_Improved
***********************
Playing Matches:
----------
  Match 1: ID_Improved vs   Random        Result: 19 to 1
  Match 2: ID_Improved vs   MM_Null       Result: 19 to 1
  Match 3: ID_Improved vs   MM_Open       Result: 16 to 4
  Match 4: ID_Improved vs   MM_Improved   Result: 18 to 2
  Match 5: ID_Improved vs   AB_Null       Result: 18 to 2
  Match 6: ID_Improved vs   AB_Open       Result: 19 to 1
  Match 7: ID_Improved vs   AB_Improved   Result: 18 to 2
Results:
----------
ID_Improved        90.71%


***********************
   Evaluating: Student
***********************
Playing Matches:
----------
  Match 1:  Student  vs   Random        Result: 17 to 3
  Match 2:  Student  vs   MM_Null       Result: 16 to 4
  Match 3:  Student  vs   MM_Open       Result: 16 to 4
  Match 4:  Student  vs   MM_Improved   Result: 10 to 10
  Match 5:  Student  vs   AB_Null       Result: 19 to 1
  Match 6:  Student  vs   AB_Open       Result: 11 to 9
  Match 7:  Student  vs   AB_Improved   Result: 11 to 9
Results:
----------
Student            71.43%
```

From the statistical information above, we can conclude that improved score heuristic function outperforms null score heuristic one by approximately 20%. So that, improved

score function is much more preferable than null score one, as the difference in winning rate is significant.

Open move score

The basic evaluation function described in lecture that outputs a score equal to the number of moves open for your computer player on the board.

```
***********************
 Evaluating: ID_Improved
***********************
Playing Matches:
----------
  Match 1: ID_Improved vs  Random        Result: 17 to 3
  Match 2: ID_Improved vs  MM_Null        Result: 20 to 0
  Match 3: ID_Improved vs  MM_Open        Result: 16 to 4
  Match 4: ID_Improved vs  MM_Improved    Result: 15 to 5
  Match 5: ID_Improved vs  AB_Null        Result: 19 to 1
  Match 6: ID_Improved vs  AB_Open        Result: 16 to 4
  Match 7: ID_Improved vs  AB_Improved    Result: 16 to 4
Results:
----------
ID_Improved      85.00%


***********************
  Evaluating: Student
***********************

Playing Matches:
----------
  Match 1:  Student  vs  Random         Result: 19 to 1
  Match 2:  Student  vs  MM_Null        Result: 20 to 0
  Match 3:  Student  vs  MM_Open        Result: 18 to 2
  Match 4:  Student  vs  MM_Improved    Result: 17 to 3
  Match 5:  Student  vs  AB_Null        Result: 20 to 0
  Match 6:  Student  vs  AB_Open        Result: 17 to 3
  Match 7:  Student  vs  AB_Improved    Result: 18 to 2
Results:
----------
Student          92.14%
```

From the second run, we see that the winning rate of the improved score heuristic function is decreased by 5.71%. As there is no information about the mean and standard deviation, we can assume that 85% lies in one standard deviation from the mean. The more interesting fact is about the winning rate of the open move heuristic function. It is 92.14%, which is much higher than the winning rate of the null score heuristic function and higher than improved score heuristic function (in average). So that, we can inductively conclude that open move score heuristic function performs not worse than improved score heuristic function.

Improved score

The "Improved" evaluation function discussed in lecture that outputs a score equal to the difference in the number of moves available to the two players.

```
***********************
 Evaluating: ID_Improved
***********************
Playing Matches:
----------
  Match 1: ID_Improved vs   Random          Result: 18 to 2
  Match 2: ID_Improved vs   MM_Null         Result: 18 to 2
  Match 3: ID_Improved vs   MM_Open         Result: 16 to 4
  Match 4: ID_Improved vs   MM_Improved     Result: 18 to 2
  Match 5: ID_Improved vs   AB_Null         Result: 20 to 0
  Match 6: ID_Improved vs   AB_Open         Result: 19 to 1
  Match 7: ID_Improved vs   AB_Improved     Result: 15 to 5
Results:
----------
ID_Improved     88.57%


***********************
  Evaluating: Student
***********************
Playing Matches:
----------
  Match 1:  Student  vs   Random          Result: 18 to 2
  Match 2:  Student  vs   MM_Null         Result: 18 to 2
  Match 3:  Student  vs   MM_Open         Result: 15 to 5
  Match 4:  Student  vs   MM_Improved     Result: 14 to 6
  Match 5:  Student  vs   AB_Null         Result: 18 to 2
  Match 6:  Student  vs   AB_Open         Result: 20 to 0
  Match 7:  Student  vs   AB_Improved     Result: 16 to 4
Results:
----------
Student         85.00%
```

From the third experiment, we see that the winning rate of the ID_Improved and Student agents is almost the same, because both of them use improved score heuristic function.

Conclusion

From the three experiments above, we can conclude by induction that for the game of isolation where each agent is restricted to L-shaped movements, the open move heuristic function outperforms both null score and improved score heuristic functions.
Thus, open move heuristic function is the choice for the submitted agent.