**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.

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Evaluating: ID\_Improved

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Playing Matches:

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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:

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ID\_Improved 90.71%

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Evaluating: Student

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Playing Matches:

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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:

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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.

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Evaluating: ID\_Improved

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Playing Matches:

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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:

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ID\_Improved 85.00%

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Evaluating: Student

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Playing Matches:

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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:

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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.

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Evaluating: ID\_Improved

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Playing Matches:

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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:

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ID\_Improved 88.57%

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Evaluating: Student

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Playing Matches:

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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:

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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.