Evaluation Heuristics

The purpose of the game is being the last player to play a legal move, so a good heuristic tries to maximize the number of valid moves available to play. It is also very important to try to minimize the opponent's number of available moves, so that the opponent has always less moves than our AI. A good heuristic that combines the previous ones has been shown previously in the course:

of player's available moves - # of opponent's available moves

This heuristic works alright, nevertheless it assumes that the number of available moves for both the player and opponent are equally important. It could be the case that prioritizing the opponent's number of available moves could give better results, so I decided to test the custom score function with different variations of the following formula:

of player's available moves $-\alpha \times \#$ of opponent's available moves

Where α is a parameter that was varied to find the best results. It is important to mention that if the score being evaluated is a leaf node, it returns infinite if the player wins and minus infinite if the opponent wins.

The following table shows the win rates after trying the new score function for different values:

α	Student %		
1	56.43		
1.5	67.14		
2	67.86		
2.5	61.43		
3	58.57		

According to the results, it is recommended to use the following heuristic to improve the win rate:

of player's available moves $-2 \times \#$ of opponent's available moves

This, given that the heuristic when $\alpha = 2$ has a higher win rate than the rest. Additionally it is equally as hard to compute (it is still a multiplication, no timeouts), and the chance that there's a better value for α that improves over this solution is low, given that several values were tested.

Supporting files

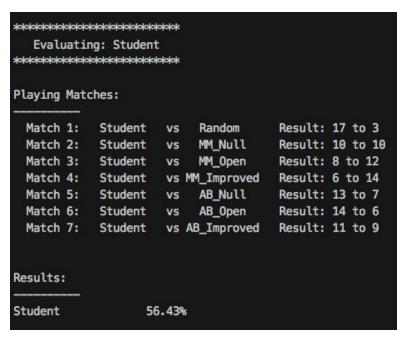


Image 1. Results Alpha equals 1.

```
**************
   Evaluating: Student
*****
Playing Matches:
                                     Result: 19 to 1
 Match 1:
           Student
                     VS
                         Random
                         MM_Null
                                     Result: 17 to 3
 Match 2:
           Student
                     VS
 Match 3:
                                     Result: 12 to 8
           Student
                         MM_Open
                     VS
 Match 4:
           Student
                     vs MM_Improved
                                     Result: 12 to 8
 Match 5:
           Student
                         AB_Null
                                     Result: 11 to 9
                     VS
                                     Result: 9 to 11
 Match 6:
           Student
                     VS
                         AB_Open
                     vs AB_Improved
                                     Result: 14 to 6
 Match 7:
           Student
Results:
Student
                  67.14%
```

Image 2. Results Alpha equals 1,5.

```
****
   Evaluating: Student
***************
Playing Matches:
                                     Result: 20 to 0
  Match 1:
            Student
                          Random
                     V5
  Match 2:
            Student
                          MM_Null
                                     Result: 14 to 6
                     VS
  Match 3:
                          MM_Open
                                     Result: 10 to 10
            Student
                     VS
  Match 4:
            Student
                     vs MM_Improved
                                     Result: 8 to 12
  Match 5:
            Student
                     VS
                          AB_Null
                                      Result: 16 to 4
                          AB Open
  Match 6:
            Student
                                     Result: 12 to 8
                     VS
 Match 7:
                     vs AB_Improved
                                     Result: 15 to 5
            Student
Results:
Student
                   67.86%
```

Image 3. Results Alpha equals 2.

```
*************
  Evaluating: Student
****
Playing Matches:
 Match 1:
            Student
                          Random
                                     Result: 18 to 2
                     VS
 Match 2:
            Student
                          MM_Null
                                     Result: 14 to 6
                     VS
 Match 3:
                          MM_Open
                                     Result: 7 to 13
            Student
                     VS
 Match 4:
                     vs MM_Improved
                                     Result: 13 to 7
            Student
 Match 5:
            Student
                     VS
                          AB_Null
                                     Result: 10 to 10
                          AB_Open
                                     Result: 13 to 7
 Match 6:
            Student
                     VS
                     vs AB_Improved
                                     Result: 11 to 9
 Match 7:
            Student
Results:
Student
                  61.43%
```

Image 4. Results Alpha equals 2,5.

```
Evaluating: Student
<del>lakababababababababababab</del>
Playing Matches:
 Match 1:
            Student
                           Random
                                      Result: 14 to 6
                      VS
                                      Result: 16 to 4
                          MM_Null
 Match 2:
            Student
                      VS
 Match 3:
                           MM_Open
                                       Result: 6 to 14
            Student
                      VS
 Match 4:
            Student
                      vs MM_Improved
                                       Result: 8 to 12
 Match 5:
            Student
                      VS
                           AB_Null
                                       Result: 14 to 6
                                       Result: 10 to 10
 Match 6:
            Student
                           AB_Open
                      VS
 Match 7:
                      vs AB_Improved
                                      Result: 14 to 6
            Student
Results:
Student
                   58.57%
```

Image 5. Results alpha equals 3