Analysis of Evaluation Function

Restrict Opponent

As an easy introduction I tried a slightly modified version of the improved score. This change was also suggested during the lectures.

own_moves - (2 * opp_moves)

It's focus is to minimize the opponent's move as much as possible.
The performance against the test opponents was under 50% and performed considerably worse than the original improved score evaluation, which showed a performance of 70.71%, whereas ID_Improved showed a performance of 72.86%. The values of ID_Improve over all tournaments seem to vary between 5-6% points.

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

Playing Matches:
----------
  Match 1:   Student   vs   Random        Result: 5 to 15
  Match 2:   Student   vs   MM_Null       Result: 10 to 10
  Match 3:   Student   vs   MM_Open       Result: 7 to 13
  Match 4:   Student   vs MM_Improved     Result: 5 to 15
  Match 5:   Student   vs   AB_Null       Result: 9 to 11
  Match 6:   Student   vs   AB_Open       Result: 9 to 11
  Match 7:   Student   vs AB_Improved     Result: 8 to 12


Results:
----------
Student             37.86%

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

Playing Matches:
----------
  Match 1: ID_Improved vs   Random        Result: 19 to 1
  Match 2: ID_Improved vs   MM_Null       Result: 14 to 6
  Match 3: ID_Improved vs   MM_Open       Result: 10 to 10
  Match 4: ID_Improved vs MM_Improved     Result: 11 to 9
  Match 5: ID_Improved vs   AB_Null       Result: 14 to 6
  Match 6: ID_Improved vs   AB_Open       Result: 16 to 4
  Match 7: ID_Improved vs AB_Improved     Result: 18 to 2


Results:
----------
ID_Improved         72.86%
```

3/2 Ratio

Since the “Restrict Opponent” performed badly, it is only logical to adapt the ration of my_moves and opponent_moves in the opposite way:

(3 * own_moves) - (2 * opp_moves)

Although it still lays an emphasis on the reduction of the opponents moves, its main objective is to maximize my possibilities. The results are promising. Surprisingly, the algorithm performed flawlessly against AB_Improved. Overall there is a 10 %-points performance increase over ID_Improved.

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

Playing Matches:
----------
  Match 1:   Student   vs   Random        Result: 18 to 2
  Match 2:   Student   vs   MM_Null       Result: 15 to 5
  Match 3:   Student   vs   MM_Open       Result: 14 to 6
  Match 4:   Student   vs MM_Improved     Result: 16 to 4
  Match 5:   Student   vs   AB_Null       Result: 17 to 3
  Match 6:   Student   vs   AB_Open       Result: 15 to 5
  Match 7:   Student   vs AB_Improved     Result: 20 to 0


Results:
----------
Student             82.14%

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

Playing Matches:
----------
  Match 1: ID_Improved vs   Random        Result: 16 to 4
  Match 2: ID_Improved vs   MM_Null       Result: 17 to 3
  Match 3: ID_Improved vs   MM_Open       Result: 14 to 6
  Match 4: ID_Improved vs MM_Improved     Result: 12 to 8
  Match 5: ID_Improved vs   AB_Null       Result: 15 to 5
  Match 6: ID_Improved vs   AB_Open       Result: 12 to 8
  Match 7: ID_Improved vs AB_Improved     Result: 15 to 5


Results:
----------
ID_Improved         72.14%
```

3/2 Late-Game Variation

As in late-game it might be advantageous to increase the focus on limiting your opponents possibilities, a variation was examined where the focus on the opponents move is linearly increased by the move counter of the game.

(3 * own_moves) - ((2 + (game.move_count / 15)) * opp_moves)

The evaluation function performed worse than ID_Improved but still better than the first heuristic:

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

Playing Matches:
----------
  Match 1:   Student   vs   Random        Result: 13 to 7
  Match 2:   Student   vs   MM_Null       Result: 17 to 3
  Match 3:   Student   vs   MM_Open       Result: 13 to 7
  Match 4:   Student   vs MM_Improved     Result: 9 to 11
  Match 5:   Student   vs   AB_Null       Result: 14 to 6
  Match 6:   Student   vs   AB_Open       Result: 10 to 10
  Match 7:   Student   vs AB_Improved     Result: 14 to 6


Results:
----------
Student             64.29%

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

Playing Matches:
----------
  Match 1: ID_Improved vs   Random        Result: 16 to 4
  Match 2: ID_Improved vs   MM_Null       Result: 17 to 3
  Match 3: ID_Improved vs   MM_Open       Result: 13 to 7
  Match 4: ID_Improved vs MM_Improved     Result: 13 to 7
  Match 5: ID_Improved vs   AB_Null       Result: 17 to 3
  Match 6: ID_Improved vs   AB_Open       Result: 13 to 7
  Match 7: ID_Improved vs AB_Improved     Result: 17 to 3


Results:
----------
ID_Improved         75.71%
```

Final Choice

In the end, the only wise choice is to go with the “3/2 Ratio” evaluation function. It has performed outstandingly well with an 10 %-point increase over ID_Improved and more +20 improvement over the other heuristics. It is hard to say why the “3/2 Ratio” outperforms the other options. Without further empirical testing, a final verdict is not possible.