Analysis of the Heuristics

Following heuristics were chosen and implemented

- **H1** (AB_Custom): *# of player's moves – 2 x # of opponent's moves*
- **H2** (AB_Custom_2): *The square of the distance between the player and the opponent, calculated as*
  y_i, x_i = game.get_player_location(i) , where i is either the player or the opponent
  score = (y_pl - y_opp)2 + (x_pl - x_opp)2

- **H3** (AB_Custom_3): *# of player's moves / # of opponent's moves*
  If # of player's moves = 0, player loses
  If # of opponent's moves = 0, opponent loses

The results of the tournament with these heuristics are as follows:

Table 1 Results of the Tournament

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                          Playing Matches
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 Match #   Opponent    AB_Improved   AB_Custom   AB_Custom_2  AB_Custom_3
                        Won | Lost   Won | Lost   Won | Lost   Won | Lost
    1       Random      10  |   0     9  |   1     8  |   2    10  |   0
    2       MM_Open      8  |   2     6  |   4     5  |   5     6  |   4
    3      MM_Center     7  |   3     9  |   1     9  |   1    10  |   0
    4     MM_Improved    6  |   4    10  |   0     7  |   3     8  |   2
    5       AB_Open      5  |   5     7  |   3     3  |   7     4  |   6
    6      AB_Center     2  |   8     5  |   5     4  |   6     8  |   2
    7     AB_Improved    4  |   6     6  |   4     4  |   6     7  |   3
--------------------------------------------------------------------------
           Win Rate:      60.0%        74.3%        57.1%        75.7%
```

As it can be seen **H1** performed quite well, as it aggressively tries to minimize opponent's available moves (hence the factor 2). In fact, **H1** is very similar to AB_Improved, but is more aggressive because of the factor 2. Hence compared to AB_Improved, **H1** has been more successful against the other opponents:

	AB_Improved	H1	H2	H3
Random	100.0%	90.0%	80.0%	100.0%
MM_Open	80.0%	90.0%	50.0%	60.0%
MM_Center	70.0%	90.0%	90.0%	100.0%
MM_Improved	60.0%	100.0%	70.0%	80.0%
AB_Open	50.0%	70.0%	30.0%	40.0%
AB_Center	20.0%	50.0%	40.0%	80.0%
AB_Improved	40.0%	60.0%	40.0%	70.0%
Overall	60.0%	74.3%	57.1%	75.7%

On the other hand, **H1** vs. AB_Improved provided mixed results. In certain cases, both were equally successful (5-5), in certain cases **H1** had more wins, in certain cases, AB_Improved.

One can also observe that **H3** performs quite well against AB_Improved. This is probably due to the fact that it is actually a simpler heuristic than AB_Improved (and **H1**), which allows the search to go deeper.

Overall, **H3** seems to be the best heuristic, as

1) it is very simple to calculate (low complexity) and hence it's execution time is shorter
2) it performs better on average (overall higher win-rate of 75.7%) and
3) with alpha-beta pruning it can explore the three deeper
4) it takes advantage of the opponent's moves
5) performs better against AB_Improved