Heuristics Analysis

INITIAL HEURISTICS (ones used in previous submission)

1. Heuristic for custom_score():
Difference in player moves. If players have the same number of moves, difference of the **euclidean** distance of the players from the center of the board is evaluated as the further they are from the center, the fewer moves they will have in end game.

2. Heuristic for custom_score_2():
The positive **euclidean** distance of player from opponent on the board.

3. Heuristic for custom_score_3():
The negative **euclidean** distance of player from opponent from board.

RESULTS OF INITIAL HEURISTICS

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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           9   |  1       9   |  1     9   |  1     8   |  2
   2      MM_Open          7   |  3       7   |  3     5   |  5     6   |  4
   3      MM_Center        7   |  3       9   |  1     9   |  1     7   |  3
   4      MM_Improved      5   |  5       6   |  4     7   |  3     8   |  2
   5      AB_Open          4   |  6       5   |  5     3   |  7     4   |  6
   6      AB_Center        3   |  7       4   |  6     7   |  3     6   |  4
   7      AB_Improved      4   |  6       4   |  6     6   |  4     3   |  7
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          Win Rate:      55.7%          62.9%         65.7%         60.0%
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Though the custom heuristics were computationally inexpensive and performed better than 50% on average, it was clear that they could be improved further, especially custom_score_3. One aspect I felt could be improved was to use Manhattan distance instead of Euclidean distance as since our agent moves in right angles, the Manhattan metric would be a better predictor of success than the conventional euclidean distance metric.

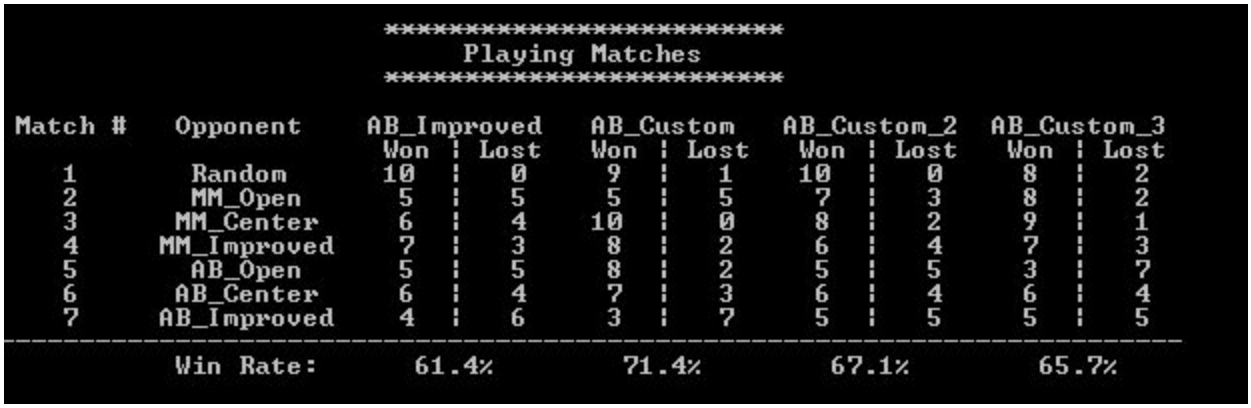
FINAL HEURISTICS

1. Heuristic for custom_score():
Difference in player moves. If players have the same number of moves, difference of the **manhattan** distance of the players from the center of the board is evaluated as the further they are from the center, the fewer moves they will have in end game.

2. Heuristic for custom_score_2():
The positive **euclidean** distance of player from opponent on the board.

3. Heuristic for custom_score_3():
The **manhattan** distance of player from opponent from board.

RESULTS OF FINAL HEURISTICS



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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	10	0	8	2
2	MM_Open	5	5	5	5	7	3	8	2
3	MM_Center	6	4	10	0	8	2	9	1
4	MM_Improved	7	3	8	2	6	4	7	3
5	AB_Open	5	5	8	2	5	5	3	7
6	AB_Center	6	4	7	3	6	4	6	4
7	AB_Improved	4	6	3	7	5	5	5	5
	Win Rate:	61.4%		71.4%		67.1%		65.7%	

It is clearly seen the improved evaluation functions outperform the previous one! As stated above, it looks like my intuition of using manhattan distance from the center of the board instead of euclidean distance **after** checking if both players have the same number of legal moves was on the right track. Though they still fail to consistently beat AB_Improved, I'm sure that can be done after incorporating additional parameters like depth of the search tree.

In conclusion, the reasons for selecting the second set of evaluation functions was:

- Computationally inexpensive
- Manhattan distance seems to be better suited for this game as agent can't move in a straight line
- Better performance in tournament by a factor of 10% on average