Heuristic analysis

Udacity - Artificial Intelligence Nanodegree

- custom_score1

In this function, I calculated the distance from center. Because I thought there are a lot of case in the center. So, I thought it could make more efficient move. And then, added basic score: *own_moves_numver - opp_moves_number.* And, when a player lost the game, the agent will get negative reward (-∞). Contrary, when a player win the game, the agent will get positive reward(∞).

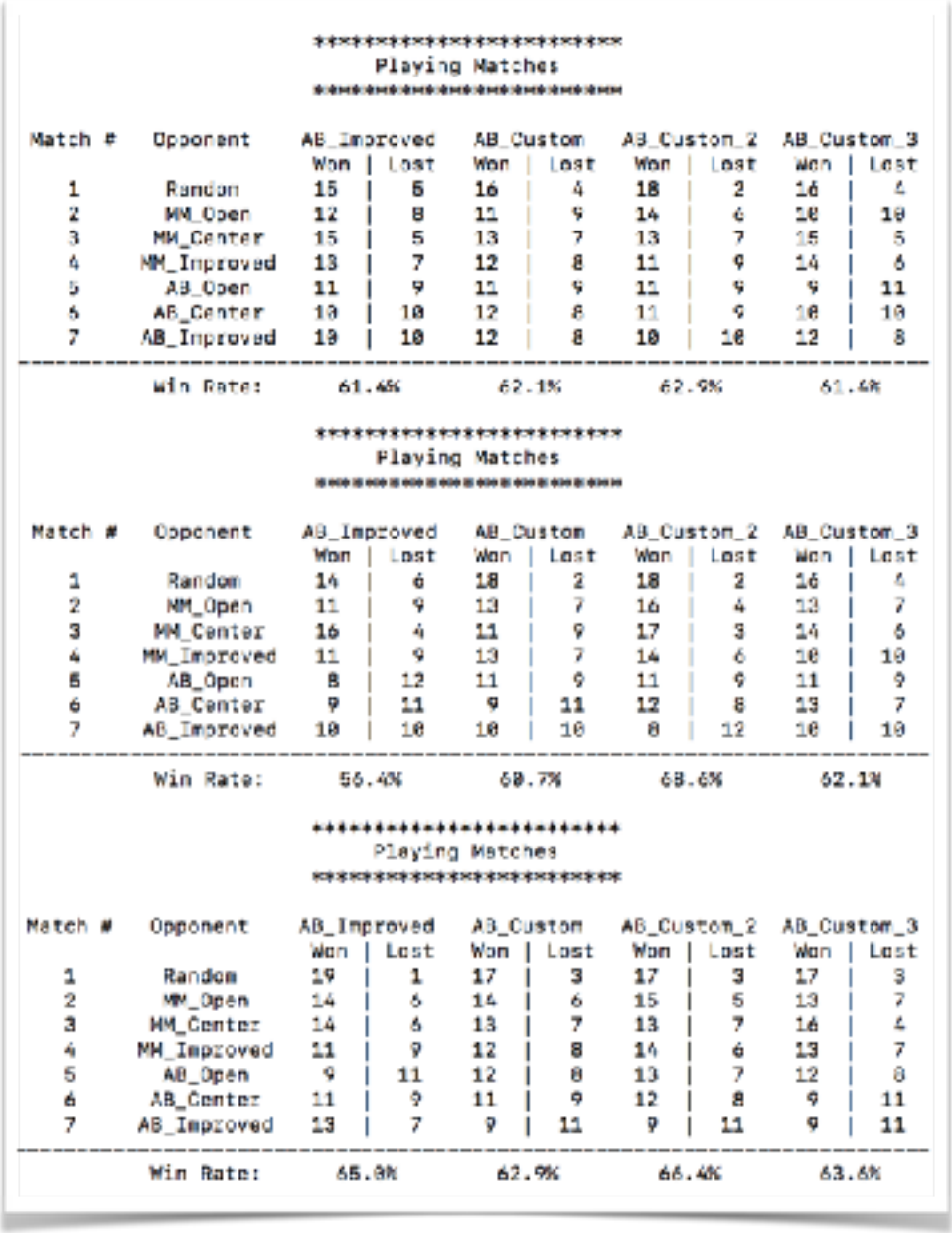
- custom_score2

This function is very similar with 'AB_improved'. I added *blank_spaces.* The Blank spaces means the locations that are still available on the board. So I thought it can helpful for our score. Except this, all of things are same as AB_improved.

- custom_score 3

In this case, I calculated same spaces in legal moves between own player and opponent player. I thought occupying same legal space first can make reduced opponent's legal moves number. So I thought it can be efficient measure.

- Conclusion



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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          15  |  5        16  |  4        18  |  2        16  |  4
    2     MM_Open         12  |  8        11  |  9        14  |  6        10  |  10
    3     MM_Center       15  |  5        13  |  7        13  |  7        15  |  5
    4     MM_Improved     13  |  7        12  |  8        11  |  9        14  |  6
    5     AB_Open         11  |  9        11  |  9        11  |  9         9  |  11
    6     AB_Center       10  |  10       12  |  8        11  |  9        10  |  10
    7     AB_Improved     10  |  10       12  |  8        10  |  10       12  |  8
--------------------------------------------------------------------------------
          Win Rate:      61.4%            62.1%           62.9%           61.4%

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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          14  |  6        18  |  2        18  |  2        16  |  4
    2     MM_Open         11  |  9        13  |  7        16  |  4        13  |  7
    3     MM_Center       16  |  4        11  |  9        17  |  3        14  |  6
    4     MM_Improved     11  |  9        13  |  7        14  |  6        10  |  10
    5     AB_Open          8  |  12       11  |  9        11  |  9        11  |  9
    6     AB_Center        9  |  11        9  |  11       12  |  8        13  |  7
    7     AB_Improved     10  |  10       10  |  10        8  |  12       10  |  10
--------------------------------------------------------------------------------
          Win Rate:      56.4%            60.7%           68.6%           62.1%

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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          19  |  1        17  |  3        17  |  3        17  |  3
    2     MM_Open         14  |  6        14  |  6        15  |  5        13  |  7
    3     MM_Center       14  |  6        13  |  7        13  |  7        16  |  4
    4     MM_Improved     11  |  9        12  |  8        14  |  6        13  |  7
    5     AB_Open          9  |  11       12  |  8        13  |  7        12  |  8
    6     AB_Center       11  |  9        11  |  9        12  |  8         9  |  11
    7     AB_Improved     13  |  7         9  |  11        9  |  11        9  |  11
--------------------------------------------------------------------------------
          Win Rate:      65.0%            62.9%           66.4%           63.6%
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I set number of matches in tournament.py as 10. And the following table is that summarized result.

	AB_Improved	distance from center	blank spaces	similar moves
Run 1	61.4%	62.1%	62.9%	61.4%
Run 2	56.4%	60.7%	68.6%	62.1%
Run 3	65.0%	62.9%	66.4%	63.6%
Average	**60.9%**	**61.9%**	**66.0%**	**62.4%**

In random algorithm, all of the scores are quite well. But in Minimax or Alpha-beta pruning, little different. Here is the result except random situation.

	AB_Improved	distance from center	blank spaces	similar moves
Run 1	59.2%	59.2%	58.3%	58.3%
Run 2	54.1%	55.8%	65.0%	59.2%
Run 3	60.0%	59.2%	63.3%	60.0%
Average	**57.8%**	**58.1%**	**62.2%**	**59.2%**

In this case, only custom_score 2 has over 60.0% average. So in my case, added blank spaces is better than AB_Improved. And this score is easy to understand and implement. Sometimes it had poor score than others. But, generally it was best. Actually I thought score 3 is better than others. So, I understood there is not perfect solution. It depended on situations.