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 legal move cases in the center. I thought it could make more efficient move. The closer to the center, The player will get high score. So contrary to other scores, I set minus to own_distance_from_center. And I also set plus to opp_distance_from_center. Because those values mean distance from center.

-own_distance_from_center + opp_distance_from_center + own_moves - opp_moves

In this case, the agent will get reward And then, added basic score. 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(∞).

But, I wasn't as efficient asI thought. It was very similar to AB_improved. Because opponent's algorithm also find center position. So, each distance from center wasn't significant difference. So it was almost same as AB_improved.

- 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.

blank_spaces + own_moves - opp_moves

In my case, it was efficient. In previous score, I expected more space make more chance to win. It's correct. But, It doesn't means the player always locate in center position. As the game progresses, center position couldn't guarantee more legal movements. It depend on game situation. So, I think calculating blank spaces is more efficient than calculating distance from center.

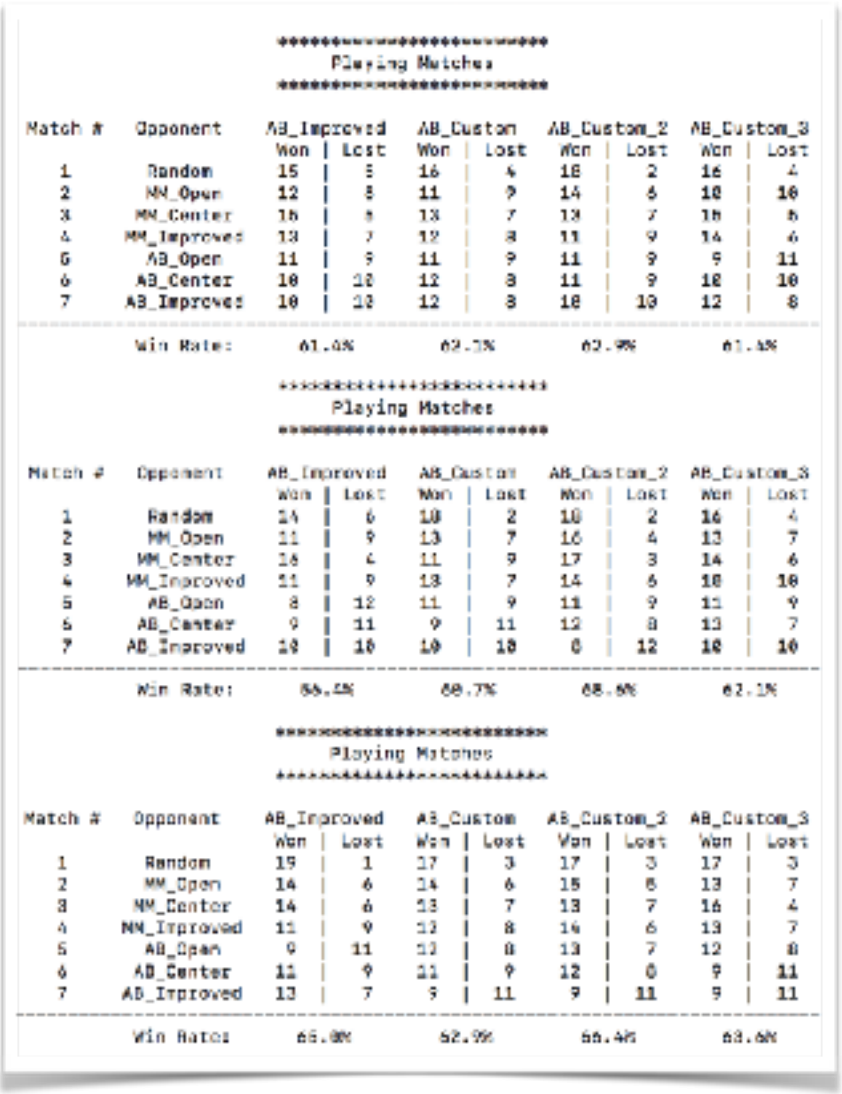
- custom_score 3

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. It can remove opponent player's movements. So I thought it can be efficient measure.

own_moves - opp_moves + similar_count

Actually I thought score 3 is better than others. But, score 2 was best. So, I understood there is not perfect solution. It depended on situations. And, I think it isn't efficient for big isolation game. Because it has loop part.

- Conclusion



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                        *************************
                             Playing Matches
                        *************************

 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%

                        *************************
                             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%

                        *************************
                             Playing Matches
                        *************************

 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%
```

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	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 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	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%**

So, I choose custon_score 2: added black spaces. Because

1. Only custom_score 2 has over 60.0% average. Sometimes it had poor score than others. But, generally it was best.
2. This score is easy to understand and implement. Just
3. It just check current state. It is efficient because some algorithm should check previous state. Then it can cause lack of memory or overhead.