Heuristic analysis

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This article is my review for AIND-Isolation project. Below the content, there are three evaluation functions I developed for my game agent.

I chose three of the best function from my work. The three custom functions are similar with each other. Each of them are based on a previous thinking before.

AB\_custom

The first function is based on the code given in the sample\_players.py. It is the combination of center\_score and improved\_score. The center\_score evaluate from how long the player away from the center. The nearer player in center, the more chances can it move. Then, the imporved\_score is based on how many opening moves the player have against opponent. I think both them are good evaluation function. So, I combine them together, that is the AB\_custom.

AB\_custom2

The second evaluation function is the reform for AB\_custom. In my opinion, if it is good for the player keeping himself around center, keeping the opponent away from the center is always a good decision. So, I added the feature to encourage the player not only stay at center but also tend to force the opponent away from the center. But in testing, it performs a little bit worse than the AB\_custom.

AB\_custom3

In searching function, the time is always limited. As quicker algorithm can spend less time. And then, the function will iterate more times and may find a better solution. Reducing the time usage per calculation is what the third evaluation function to do. Following this viewpoint, I tried to simplify the algorithm in third evaluation to let the CPU do fewer calculations. I remove the square and root extracting in distance calculation functions in order to save more time. To make this work, I replace Euclid distance with Manhattan distance

Match # Opponent AB\_Improved AB\_Custom AB\_Custom\_2 AB\_Custom\_3

Won | Lost Won | Lost Won | Lost Won | Lost

1 Random 35 | 5 40 | 0 38 | 2 33 | 7

2 MM\_Open 30 | 10 32 | 8 25 | 15 22 | 18

3 MM\_Center 30 | 10 37 | 3 29 | 11 31 | 9

4 MM\_Improved 23 | 17 29 | 11 23 | 17 24 | 16

5 AB\_Open 19 | 21 25 | 15 21 | 19 22 | 18

6 AB\_Center 23 | 17 19 | 21 24 | 16 24 | 16

7 AB\_Improved 19 | 21 17 | 23 19 | 21 14 | 26

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Win Rate: 63.9% 71.1% 63.9% 60.7%

Figure 1

The graph (Figure 1) shows about each opponent verses different game agents. We can see that all of the agents can defeat the random-choice agent very well. Furthermore, the game agents using Alpha-Beta pruning get a better winning rate against the player just using the Minimax tree. But it appeared fierce competitions on alpha-beta pruning functions. So I make another 100 rounds for each of my evaluation functions against AB\_improved function (Figure 2).

Match # Opponent AB\_Custom AB\_Custom\_2 AB\_Custom\_3

Won | Lost Won | Lost Won | Lost

1 AB\_Improved 53 | 47 52 | 48 49 | 51

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Win Rate: 53.0% 52.0% 49.0%

Figure 2

As we can see, it is still hard to guarantee which one is better because my custom agent just has a slightly winning rate. But we can say all of them should be a good algorithm in this game.

To compete with other agents，if player evaluate the winning rate just according to the result upon. AB\_custom agent will be the best one. But in realistic competition, each side will not just use min/max strategy, so I decide to use AB\_custom2 due to its better performance against all alpha-beta pruning strategy. If the player concentrates on the implement difficulty, AB\_custom3 will be a good choice because of the single structure. It can be easily to compute using some optimize hardware structures. AB\_custom2 is the best potential strategy to improve, because it considers more than other two. In further research, I will choose it to be my base thinking to develop.

To draw a conclusion, it is still hard to defeat just a simple evaluation function in real applications. We need an algorithm, to avoid pruning good potential result. In further research, choose cross-validation to weight each part of algorithm will be a better choice.