

HEURISTIC ANALYSIS

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As explained during the lectures, a good evaluation function can be expressed in the form of

$$\#PLAYER\ MOVES - \#OPPONENT\ MOVES$$

Nevertheless, this function assumes that each the total number of moves is equally weighted for the player and the opponent.

In order to evaluate different functions and scenarios, I have **assigned weights (α)** in the following way:

$$\#PLAYER\ MOVES - \alpha * \#OPPONENT\ MOVES$$

Changing the value of α will result in a game agent more or less aggressive. Indeed, higher the value of α , more aggressive will be our game.

Therefore, I implemented three evaluation function:

HEURISTIC 1

```
player_moves = len(game.get_legal_moves(player))
opponent_moves = len(game.get_legal_moves(game.get_opponent(player)))
return float(player_moves - 1.5 * opponent_moves)
```

HEURISTIC 2

```
player_moves = len(game.get_legal_moves(player))
opponent_moves = len(game.get_legal_moves(game.get_opponent(player)))
return float(player_moves - 3 * opponent_moves)
```

HEURISTIC 3

```
player_moves = len(game.get_legal_moves(player))
opponent_moves = len(game.get_legal_moves(game.get_opponent(player)))
return float(player_moves - 2 * opponent_moves)
```

The results of the three heuristic functions are tested as following:

Playing Matches									

Match #	Opponent	AB_Improved		AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost	Won	Lost
1	Random	10	0	10	0	7	3	9	1
2	MM_Open	5	5	3	7	4	6	2	8
3	MM_Center	7	3	7	3	5	5	9	1
4	MM_Improved	3	7	5	5	3	7	4	6
5	AB_Open	7	3	3	7	5	5	4	6
6	AB_Center	5	5	5	5	7	3	4	6
7	AB_Improved	3	7	6	4	3	7	3	7

Win Rate:		57.1%		55.7%		48.6%		50.0%	

Figure 1: Simulation with Heuristic Functions. AB_Custom ($\alpha=1.5$), AB_Custom2($\alpha=3$), AB_Custom3($\alpha=2$)

According to the simulation, the heuristic function with $\alpha = 1.5$ provides overall better result. Thus, I advise to utilize $\alpha = 1.5$. Having an approach slightly aggressive and “chasing” the opponent seems to be more effective than a neutral approach ($\alpha=1$) or extremely aggressive ($\alpha=3$).

Moreover, the computation time of these functions is equal for each one, therefore choosing the one with higher winning rate do not imply additional computing time.

REASON OF THE CHOSEN HEURISTIC FUNCTION

The chosen function is the “Heuristic 1” above illustrated ($\alpha = 1.5$).

Some of the main advantages are considered as following:

- The chosen heuristic function is relatively simple to implement and provides a good performance
- The chosen heuristic function does not require high computing time, thus it is appropriate for an agent that needs to return a move in a short period of time
- If compared to the other α tested, the chosen $\alpha (=1.5)$ provides better results
- Compared to the other heuristic functions tested, the computing time remains the same, but as we have seen it provides higher winning rate.