

HEURISTIC ANALYSIS

ISOLATION PLAYING AGENT

Artificial Intelligence Nanodegree

Heuristic 1:

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moves_left_player - aggression_factor*moves_left_opponent;
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The first heuristic computed the number of moves left for the player and subtracted the number of moves left for the opponent multiplied by a constant value. The aggression_factor was experimented with and kept at 3, 4, 5 or 20 with the following results. The rows correspond to the respective values

Playing Matches									

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

Win Rate:		58.6%		55.7%		64.3%		62.9%	

Playing Matches									

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

Win Rate:		55.7%		70.0%		61.4%		58.6%	

An aggressive play using a factor as 4 gave a stable win rate of around 60-64% whereas increasing it further, reduced the win rate.

Heuristic 2:

Moves_left_player / blanks_left

In this heuristic, the number of blanks were considered and the evaluation function returned what fraction of the blanks were the next moves for the player. AB_Custom_3 represents this evaluation function in both the pictures given below. AB_Custom represents heuristic 1 with aggression value 4.

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

Win Rate:		62.9%		62.9%		61.4%		62.9%	

Match #	Opponent	AB_Improved		AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost	Won	Lost
1	Random	9	1	7	3	9	1	8	2
2	MM_Open	6	4	7	3	7	3	6	4
3	MM_Center	5	5	7	3	8	2	8	2
4	MM_Improved	5	5	6	4	6	4	6	4
5	AB_Open	6	4	8	2	2	8	5	5
6	AB_Center	4	6	6	4	4	6	4	6
7	AB_Improved	6	4	6	4	4	6	4	6
Win Rate:		58.6%		67.1%		57.1%		58.6%	

Heuristic 3:

$$\text{Moves_left_player} / 1 + \text{Moves_left_opponent}$$

This heuristic, represented by AB_Custom_3 was tried out to factor in the moves left by opponent in the denominator, to give a lower score when more moves for the opponent were left.

As can be seen from the result, it performed at the same level as the previous heuristic.

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	8	2	9	1	6	4	5	5
3	MM_Center	6	4	6	4	8	2	8	2
4	MM_Improved	6	4	5	5	6	4	5	5
5	AB_Open	3	7	5	5	4	6	5	5
6	AB_Center	5	5	6	4	4	6	6	4
7	AB_Improved	4	6	8	2	5	5	5	5
Win Rate:		58.6%		68.6%		60.0%		60.0%	

Conclusion:

In all the games played, AB_Custom represented the first heuristic and always did better or the same as AB_Improved. Hence, that heuristic was chosen as the evaluation function.