

Heuristic Analysis

The best, most basic and easy to understand definition of heuristics is that they are a “rule of thumb” that we should go by under certain circumstances. With that in mind, intuitively it would make sense to find the best “rules of thumb” and combine them into a single evaluation function in order to leverage the best approach under a number of different circumstances. With that in mind, the approach taken for this project has been to identify individual heuristics that are successful on their own and use them to create a single evaluation function; concomitantly, the downside of increasing the complexity of the evaluation function is that the agent will have less time to go “deeper” in the search.

In the interest of “full disclosure” I have not, despite implementing and testing several different heuristics, been able to find one or a combination of heuristics that has a significant impact on the percentage of wins achieved by the agent in the test. At best, perhaps a 5% improvement has been achieved but not consistently.

The heuristics attempted and their results are:

1. **Custom_score:** Identify if there are any “can’t reflect” positions returning the difference between the agent’s and opponent’s quantity of these moves; per the lessons, “can’t reflect” positions are positions on the board that can’t be easily countered/negated by the opponent; *see Figure 1*
2. **Custom_score2:** Legal moves for agent contains center position – the availability of the center position has a significant impact on the likelihood of winning especially as part of an “opening book”; *see Figure 2*
3. **Custom_score3:** Combining logic to of 1 and 2 above; determines if available moves contain the center position and if they contains “can’t reflect” positions; the value is more positively or negatively weighted depending on whether the agent or the opponent has the center position in their list of available moves, respectively; *see Figure 3*

Figure 1 – AB_Custom produces at best 74.3% wins for heuristic #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	9	1	10	0	10	0	10	0
2	MM_Open	8	2	8	2	10	0	9	1
3	MM_Center	9	1	10	0	9	1	8	2
4	MM_Improved	6	4	6	4	7	3	8	2
5	AB_Open	4	6	6	4	5	5	5	5
6	AB_Center	7	3	7	3	6	4	9	1
7	AB_Improved	5	5	5	5	5	5	4	6

Win Rate:		68.6%		74.3%		74.3%		75.7%	

Figure 2 – AB_Custom_2 produces at best 70% wins for heuristic #2

***** 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	9	1	10	0	9	1
2	MM_Open	7	3	7	3	9	1	4	6
3	MM_Center	9	1	9	1	10	0	9	1
4	MM_Improved	7	3	6	4	8	2	6	4
5	AB_Open	5	5	7	3	4	6	4	6
6	AB_Center	7	3	5	5	4	6	5	5
7	AB_Improved	6	4	4	6	4	6	6	4

Win Rate:		72.9%		67.1%		70.0%		61.4%	

Figure 3 AB_Custom_3 produces at best 80% for heuristic #3

***** 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	9	1	10	0	10	0
2	MM_Open	8	2	7	3	9	1	8	2
3	MM_Center	8	2	10	0	8	2	10	0
4	MM_Improved	7	3	7	3	8	2	9	1
5	AB_Open	5	5	5	5	4	6	6	4
6	AB_Center	6	4	3	7	6	4	7	3
7	AB_Improved	7	3	5	5	5	5	6	4

Win Rate:		72.9%		65.7%		71.4%		80.0%	