

Heuristic Analysis – Isolation Board Game

Heuristic I (Close and Run): This heuristic uses the first 30 steps of the game to get away from the opponent (as far as possible). This behavior is used to eventually close all the spaces in the opposite direction of the opponent. In the final steps of the game the improved score is used to corner and block off the opponent. I recommend this heuristic because it consistently stays ahead of the other three heuristics with a median of 50 wins per tournament and consistently outperforming the improved heuristic in win rate as shown in Fig I. Also the variance of wins per tournament is less in this heuristic compared to improved score heuristic. The best tournament results are shown below(See Appendix-II for all 20 tournament results).

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	10	0	10	0
2	MM_Open	8	2	10	0	10	0	8	2
3	MM_Center	10	0	10	0	8	2	9	1
4	MM_Improved	6	4	8	2	9	1	10	0
5	AB_Open	5	5	9	1	3	7	6	4
6	AB_Center	7	3	7	3	6	4	7	3
7	AB_Improved	5	5	5	5	5	5	4	6
Win Rate:		72.9%		84.3%		72.9%		77.1%	

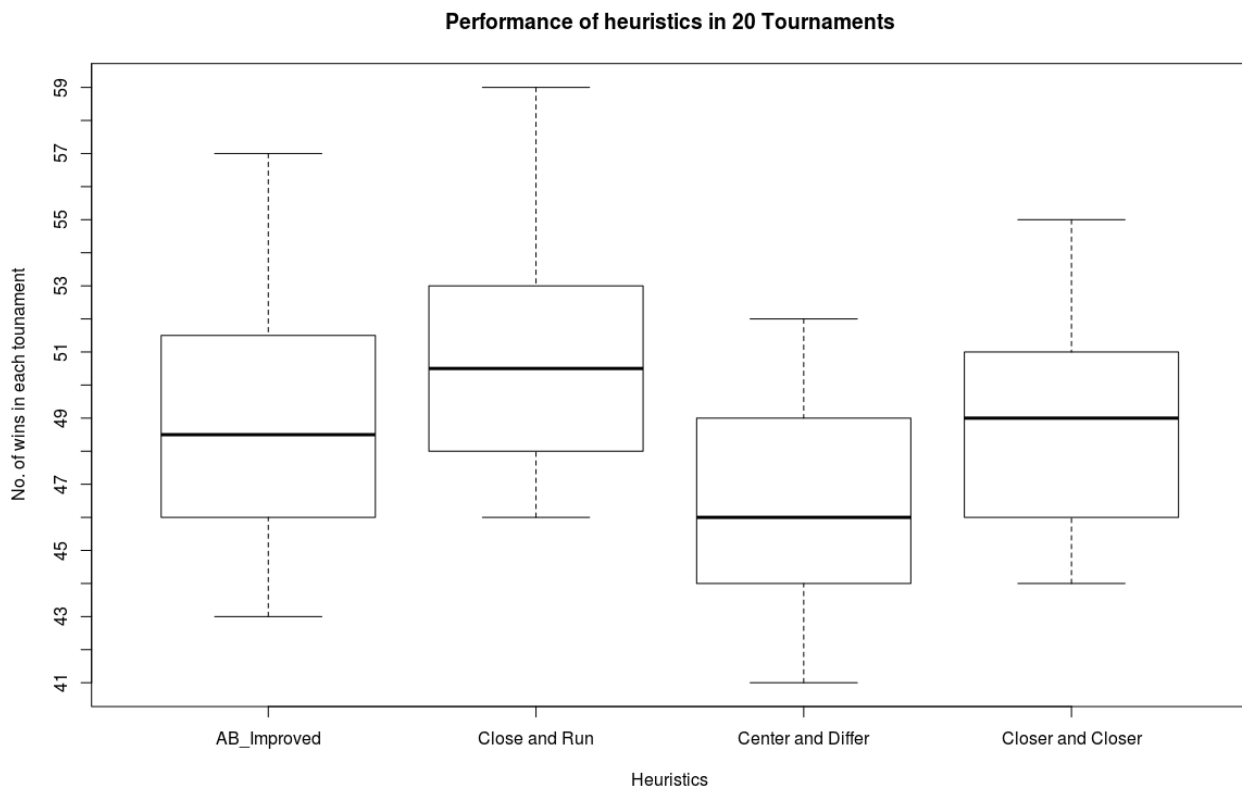


Fig I. Performance of the heuristics in 20 straight tournaments.

Heuristic II (Center and Differ): The idea of this heuristic is to fill up the center squares in the first half of the game and rotate in the space left after the center portion is filled. However this is the least performing heuristic with a median of 46 wins per tournament. This is probably due to the high bias towards the center which gives the opponent a very good chance to block the player in a corner. The best tournament results are shown below.

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	7	3	10	0
2	MM_Open	8	2	8	2	9	1	8	2
3	MM_Center	9	1	9	1	9	1	10	0
4	MM_Improved	8	2	10	0	9	1	6	4
5	AB_Open	5	5	3	7	7	3	6	4
6	AB_Center	8	2	3	7	4	6	6	4
7	AB_Improved	5	5	6	4	7	3	4	6
Win Rate:		74.3%		65.7%		74.3%		71.4%	

Heuristic III (Closer and Closer): This heuristic uses a sum of normalized distances. The first distance is the player-player distance and the second is the player-center distance. The idea is to stay away from the center and be in the opposite end of the player effectively creating partitions in the board. The IQR of the wins per tournament is identical to the improved heuristic (See Appendix - I for the complete statistics).

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	10	0	9	1
2	MM_Open	7	3	9	1	6	4	10	0
3	MM_Center	10	0	8	2	7	3	9	1
4	MM_Improved	7	3	9	1	7	3	9	1
5	AB_Open	5	5	4	6	6	4	6	4
6	AB_Center	6	4	6	4	5	5	8	2
7	AB_Improved	5	5	4	6	4	6	4	6
Win Rate:		68.6%		70.0%		64.3%		78.6%	

Appendix – I

Note: Wins per tournament statistics

AB_improved	Close.and.Run	Center.and.Differ	Closer.and.Closer
Min. :43.00	Min. :46.0	Min. :41.0	Min. :44
1st Qu.:46.00	1st Qu.:48.0	1st Qu.:44.0	1st Qu.:46
Median :48.50	Median :50.5	Median :46.0	Median :49
Mean :49.30	Mean :50.9	Mean :46.5	Mean :49
3rd Qu.:51.25	3rd Qu.:53.0	3rd Qu.:49.0	3rd Qu.:51
Max. :57.00	Max. :59.0	Max. :52.0	Max. :55

Appendix – II

Note: AB_Custom – Heuristic I, AB_Custom_2 – Heuristic II, AB_Custom_3 – Heuristic III
1)

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	9	1
2	MM_Open	9	1	7	3	5	5	9	1
3	MM_Center	9	1	9	1	9	1	9	1
4	MM_Improved	9	1	8	2	8	2	8	2
5	AB_Open	5	5	5	5	5	5	4	6
6	AB_Center	6	4	6	4	5	5	8	2
7	AB_Improved	4	6	6	4	2	8	4	6
Win Rate:		72.9%		72.9%		62.9%		72.9%	

2)

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	10	0	8	2
2	MM_Open	9	1	8	2	6	4	9	1
3	MM_Center	10	0	10	0	7	3	9	1
4	MM_Improved	8	2	9	1	8	2	6	4
5	AB_Open	5	5	5	5	6	4	5	5
6	AB_Center	4	6	9	1	5	5	4	6
7	AB_Improved	6	4	5	5	7	3	4	6
Win Rate:		72.9%		78.6%		70.0%		64.3%	

3)

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	10	0	10	0
2	MM_Open	8	2	10	0	9	1	7	3
3	MM_Center	8	2	10	0	10	0	9	1
4	MM_Improved	8	2	10	0	7	3	9	1
5	AB_Open	6	4	2	8	5	5	4	6
6	AB_Center	3	7	4	6	3	7	6	4
7	AB_Improved	5	5	7	3	4	6	6	4
Win Rate:		68.6%		75.7%		68.6%		72.9%	

4)

Match #	Opponent	AB_Improved		AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost	Won	Lost
1	Random	9	1	8	2	8	2	9	1
2	MM_Open	9	1	9	1	9	1	8	2
3	MM_Center	10	0	9	1	7	3	10	0
4	MM_Improved	8	2	8	2	9	1	8	2
5	AB_Open	6	4	5	5	6	4	4	6
6	AB_Center	6	4	5	5	4	6	5	5
7	AB_Improved	5	5	5	5	3	7	3	7
Win Rate:		75.7%		70.0%		65.7%		67.1%	

5)

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	9	1	7	3
2	MM_Open	7	3	7	3	8	2	9	1
3	MM_Center	9	1	9	1	10	0	10	0
4	MM_Improved	9	1	9	1	5	5	9	1
5	AB_Open	6	4	4	6	2	8	6	4
6	AB_Center	9	1	7	3	5	5	5	5
7	AB_Improved	7	3	6	4	3	7	3	7
Win Rate:		80.0%		74.3%		60.0%		70.0%	

6)

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	10	0	10	0
2	MM_Open	8	2	9	1	8	2	5	5
3	MM_Center	10	0	9	1	9	1	8	2
4	MM_Improved	9	1	6	4	9	1	9	1
5	AB_Open	7	3	3	7	4	6	4	6
6	AB_Center	3	7	8	2	5	5	7	3
7	AB_Improved	5	5	5	5	4	6	4	6
Win Rate:		72.9%		70.0%		70.0%		67.1%	

7)

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	9	1
2	MM_Open	8	2	8	2	8	2	7	3
3	MM_Center	7	3	10	0	9	1	10	0
4	MM_Improved	5	5	8	2	10	0	10	0
5	AB_Open	7	3	5	5	3	7	3	7
6	AB_Center	4	6	8	2	4	6	5	5
7	AB_Improved	6	4	7	3	4	6	5	5
Win Rate:		65.7%		80.0%		68.6%		70.0%	

8)

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	9	1	10	0
2	MM_Open	6	4	7	3	5	5	6	4
3	MM_Center	10	0	7	3	10	0	8	2
4	MM_Improved	8	2	10	0	5	5	9	1
5	AB_Open	2	8	5	5	6	4	4	6
6	AB_Center	4	6	6	4	5	5	6	4
7	AB_Improved	6	4	3	7	5	5	3	7
Win Rate:		65.7%		68.6%		64.3%		65.7%	

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	7	3	10	0
2	MM_Open	8	2	8	2	9	1	8	2
3	MM_Center	9	1	9	1	9	1	10	0
4	MM_Improved	8	2	10	0	9	1	6	4
5	AB_Open	5	5	3	7	7	3	6	4
6	AB_Center	8	2	3	7	4	6	6	4
7	AB_Improved	5	5	6	4	7	3	4	6
Win Rate:		74.3%		65.7%		74.3%		71.4%	

10)

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	10	0	10	0
2	MM_Open	7	3	8	2	6	4	9	1
3	MM_Center	9	1	8	2	8	2	10	0
4	MM_Improved	9	1	7	3	8	2	10	0
5	AB_Open	5	5	6	4	5	5	6	4
6	AB_Center	6	4	6	4	8	2	5	5
7	AB_Improved	2	8	3	7	5	5	4	6
Win Rate:		67.1%		67.1%		71.4%		77.1%	

11)

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	10	0	10	0
2	MM_Open	8	2	10	0	10	0	8	2
3	MM_Center	10	0	10	0	8	2	9	1
4	MM_Improved	6	4	8	2	9	1	10	0
5	AB_Open	5	5	9	1	3	7	6	4
6	AB_Center	7	3	7	3	6	4	7	3
7	AB_Improved	5	5	5	5	5	5	4	6
Win Rate:		72.9%		84.3%		72.9%		77.1%	

12)

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	10	0	10	0
2	MM_Open	8	2	7	3	7	3	7	3
3	MM_Center	10	0	7	3	8	2	7	3
4	MM_Improved	9	1	8	2	7	3	6	4
5	AB_Open	5	5	5	5	5	5	5	5
6	AB_Center	5	5	5	5	8	2	8	2
7	AB_Improved	5	5	5	5	5	5	3	7
Win Rate:		74.3%		67.1%		71.4%		65.7%	

13)

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	10	0	10	0
2	MM_Open	8	2	9	1	6	4	8	2
3	MM_Center	8	2	9	1	8	2	9	1
4	MM_Improved	7	3	9	1	7	3	6	4
5	AB_Open	4	6	6	4	3	7	6	4
6	AB_Center	6	4	7	3	6	4	5	5
7	AB_Improved	5	5	4	6	4	6	4	6
Win Rate:		65.7%		75.7%		62.9%		68.6%	

14)

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	8	2	10	0
2	MM_Open	7	3	8	2	7	3	10	0
3	MM_Center	8	2	8	2	9	1	7	3
4	MM_Improved	8	2	9	1	8	2	9	1
5	AB_Open	5	5	3	7	6	4	5	5
6	AB_Center	7	3	5	5	5	5	6	4
7	AB_Improved	4	6	4	6	3	7	6	4
Win Rate:		70.0%		67.1%		65.7%		75.7%	

15)

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	10	0	9	1
2	MM_Open	7	3	9	1	6	4	10	0
3	MM_Center	10	0	8	2	7	3	9	1
4	MM_Improved	7	3	9	1	7	3	9	1
5	AB_Open	5	5	4	6	6	4	6	4
6	AB_Center	6	4	6	4	5	5	8	2
7	AB_Improved	5	5	4	6	4	6	4	6
Win Rate:		68.6%		70.0%		64.3%		78.6%	

16)

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	10	0
2	MM_Open	6	4	10	0	6	4	6	4
3	MM_Center	9	1	10	0	9	1	9	1
4	MM_Improved	7	3	6	4	6	4	7	3
5	AB_Open	5	5	6	4	8	2	4	6
6	AB_Center	9	1	8	2	6	4	7	3
7	AB_Improved	3	7	3	7	2	8	2	8
Win Rate:		68.6%		74.3%		65.7%		64.3%	

17)

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	8	2
2	MM_Open	8	2	8	2	7	3	6	4
3	MM_Center	8	2	9	1	8	2	9	1
4	MM_Improved	6	4	8	2	6	4	6	4
5	AB_Open	4	6	6	4	4	6	5	5
6	AB_Center	5	5	9	1	4	6	6	4
7	AB_Improved	3	7	5	5	2	8	5	5
Win Rate:		61.4%		78.6%		58.6%		64.3%	

18)

Match #	Opponent	AB_Improved		AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost	Won	Lost
1	Random	10	0	8	2	9	1	10	0
2	MM_Open	10	0	8	2	5	5	10	0
3	MM_Center	9	1	10	0	9	1	10	0
4	MM_Improved	9	1	9	1	7	3	7	3
5	AB_Open	6	4	3	7	4	6	4	6
6	AB_Center	8	2	7	3	4	6	7	3
7	AB_Improved	5	5	5	5	3	7	3	7
Win Rate:		81.4%		71.4%		58.6%		72.9%	

19)

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	7	3	10	0
2	MM_Open	7	3	10	0	9	1	9	1
3	MM_Center	9	1	9	1	9	1	9	1
4	MM_Improved	8	2	7	3	5	5	8	2
5	AB_Open	4	6	4	6	4	6	4	6
6	AB_Center	2	8	5	5	6	4	6	4
7	AB_Improved	6	4	3	7	4	6	4	6
Win Rate:		64.3%		68.6%		62.9%		71.4%	

20)

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	10	0	10	0
2	MM_Open	9	1	9	1	7	3	7	3
3	MM_Center	7	3	9	1	8	2	7	3
4	MM_Improved	8	2	8	2	8	2	6	4
5	AB_Open	5	5	5	5	6	4	3	7
6	AB_Center	4	6	5	5	5	5	6	4
7	AB_Improved	3	7	6	4	5	5	5	5
Win Rate:		65.7%		74.3%		70.0%		62.9%	