Heuristic Analysis

Three custom heuristics were used for finding the best solution to win the isolation game. The tournament test application ran and tested the effectiveness of the three heuristics compared to an Improved Alpha Beta heuristic.

Playing Matches					
Match #	**Opponent**	**AB_Improved**	**AB_Custom**	**AB_Custom_2**	**AB_Custom_3**
		Won | Lost	Won | Lost	Won | Lost	Won | Lost
1	Random	7 | 3	4 | 6	6 | 4	9 | 1
2	MM_Open	9 | 1	4 | 6	5 | 5	7 | 3
3	MM_Center	9 | 1	6 | 4	2 | 8	6 | 4
4	MM_Improved	5 | 5	3 | 7	1 | 9	8 | 2
5	AB_Open	5 | 5	3 | 7	2 | 8	6 | 4
6	AB_Center	5 | 5	1 | 9	2 | 8	6 | 4
7	AB_Improved	3 | 7	1 | 9	2 | 8	4 | 6
	Win Rate:	61.4%	31.4%	28.6%	65.7%

Figure 1

The last heuristic (AB_Custom_3) performed well against the AB_Improved heuristics while the other two heuristics (AB_Custom & AB_Custom_2) performed worse.

The AB_Custom heuristic adds weight + decay factor to the player or the opponent depending on the whether the x or y in the move is equal to the center x or y, respectively. The decay factor is the ratio of number of blank spaces to the initial available moves. The player has more moves that include the center x or y. As a result, the heuristic seems to favor the opponent more than the player. Also, the decay factor might have penalized the opponent less and contributed to the player's loss.

AB_Custom_2 heuristic uses same logic as AB_Custom_2 without the decay factor. This heuristic performs better than AB_Custom in 4 of the 7 runs. Without the decay factor, the opponent was penalized in more situations than the player; thus, resulting is more wins for the player.

AB_Custom_3 heuristic combines 3 heuristics (Center score, AB_Custom_2 and Improved score) into 1 to increase odds of winning the isolation game. The goal is to use the best heuristic for each criterion. By choosing the center square first, the player will have more mobility on the board than the opponent. When the player has more moves left than the opponent, then we penalize the opponent by adding a weight to the opponent to minimize the effects the opponent has. And finally, the Improved score heuristic is used to handle the remaining scenarios. The weight and center weight parameters can be adjusted to penalized the opponent more and allow player to win more games.

In conclusion, I would recommend AB_Custom_3 heuristic for 3 reasons: 1) the use of different heuristics helps handle more scenarios and thus resulting in more wins. 2) In most cases, AB_Custom_3 performed better than AB_Improved as depicted in Figure 1. and 3) The heuristic has linear complexity - O(n): a) finding center takes O(1), b) player moves left > opponent moves left takes O(n/2) and c) finding the remainder takes O(n/2).