# Heuristic analysis

match # 
Opponent 
Random 
W_Open 
mm Center 
"L Improved 
AB_open 
AB Center 
AB_Improved 
Win Rate: 
AB_1mproved 
AB Custom 
AB Custom 2 
AB Custom 3 
Won 
97 
73 
88 
67 
49 
53 
58 
I Lost 
27 
12 
33 
51 
47 
42 
Won 
92 
71 
84 
74 
43 
57 
45 
I Lost 
29 
16 
57 
55 
Won 
94 
67 
85 
64 
47 
41 
I Lost 
33 
15 
36 
53 
59 
Won 
90 
74 
86 
75 
45 
47 
48 
I Lost 
le 
26 
14 
25 
55 
53 
52 
69.3% 
66.6% 
66.4% 

Table : Heuristic Analysis

## Heuristic design

### Heuristic 1 (Custom\_3)

Get blank spaces, then calculate which rows and column have the most blanks squares if the player’s location is near the row and column have the most blanks squares, return higher score on the base of the improved score. The reason given a higher score is because around the player may contain more blanks. When comparing to AB\_Improved, this evaluation function won 48 out of 100 games, which is about to equal.

### Heuristic 2(Custom\_2)

If the player’s location is on one of the legal move locations of the opponent, return higher score. Because the player can keep following the opponent, reduce one of the opponent’s possible moves. If the player’s location is one square away from the opponent, return lower but still positive score, because on the next move, no matter where the opponent goes, the player can occupy one of the legal move locations of the opponent or simply follows the opponent. When comparing to AB\_Improved, this evaluation function won 41 out of 100 games; it’s hard to say which heuristic function is better without running more experiments and perform a hypothesis test.

### Heuristic 3(Custom\_1)

Heuristic 3 combines the heuristic 1 and heuristic 2. When comparing to AB\_Improved, this evaluation function won 45 out of 100 games, which is about to equal.

The heuristic function for isolation game is hard to design because the way to win the game is to live (move) longer than the opponent. Without lookahead, it’s hard for the heuristic to provide how long can the player survive. One observation to support this theory is to look at Table 1: Heuristic Analysis. The 4 evaluation functions (AB\_Improved, AB\_Custom,…) against AB\_Open, AB\_center, and AB\_Improved. All of the winning rates is about 50/50. However, AB\_Center evaluation function doesn’t make much sense, it just gives squares far from the center higher score, the reason AB\_center can beat other evaluation functions half of the times is because alpha-beta (look at MM\_Center against another heuristics, which only wins 10 to 15 out 100 games) and iterative deepening that lookahead as further as possible. This observation shows that heuristic function for isolation games should be simple and make some sense. In fact, this is the reason why AB\_Improved is hard to beat because it’s simple and make much sense. A simple heuristic can have more search-depths than complex heuristic.

## Recommendation

Heuristic 3 (Custom\_1)’s win rate is 66.6%, which is slightly higher than other heuristic function. Which is my choice of the evaluation. The reasons being:

1. During my test of the evaluation, this heuristic outperforms all other evaluation functions most of the time.
2. The evaluation contains more information than all another heuristic; it knows how to tail opponent when in the right situation (which, by my game playing experience, is a good strategy). It also knows to go near the more blanks squares neighborhood.
3. The heuristic only depends on current game state and no lookahead required.