Heuristic analysis

Match #	Opponent	AB_Improved		AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost	Won	Lost
1	Random	97	3	92	8	94	6	90	10
2	MM_Open	73	27	71	29	67	33	74	26
3	MM_Center	88	12	84	16	85	15	86	14
4	MM_Improved	67	33	74	26	64	36	75	25
5	AB_Open	49	51	43	57	47	53	45	55
6	AB_Center	53	47	57	43	50	50	47	53
7	AB_Improved	58	42	45	55	41	59	48	52
	Win Rate:	69.3%		66.6%		64.0%		66.4%	

Table 1: 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.