Heuristic Analysis

1. Evaluation function

a.   Custom_score

Use Aggressive evaluation function, but using minus, not multiply to calculate the score.:

float(own_moves - opp_moves - 20).

b.   Custom_score_2

left_s is the number of blank space in game board. :   **float(- opp_moves +left_s),**

c.   Custom_score_3

If the position of between player1 and player is in the 3*3, They will affect each other.

  Use Aggressive evaluation function : **float(own_moves - opp_moves - 20),**

or Use Open evaluation function **: float(own_moves).**

2. Playing matches

This picture shown below: evaluates the performance of the custom_score evaluation function against a baseline agent using alpha-beta search and iterative deepening (ID) called `AB_Improved`. The three `AB_Custom` agents use ID and alpha-beta search with the custom_score functions defined in game_agent.py, show in above evaluation function (a,b,c).

First: Number of matches = 5,the first Custom_score evaluation function got 60% win rate

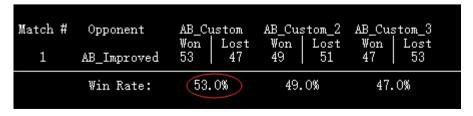| Match #	Opponent	AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost
1	AB_Improved	6	4	4	6	2	8
	Win Rate:	60.0%		40.0%		20.0%	

picture 1

Second: Number of matches = 10, the first Custom_score evaluation function got 55% win rate

Match #	Opponent	AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost
1	AB_Improved	11	9	9	11	9	11
	Win Rate:	55.0%		45.0%		45.0%	

picture 2

Third : Number of matches = 50, the first Custom_score evaluation function got 53% win rate

Match #	Opponent	AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost
1	AB_Improved	53	47	49	51	47	53
	Win Rate:	53.0%		49.0%		47.0%	

picture 3

3. Conclusion

The above picture show custom_score evaluation function got better win rates than baseline agent "AB_Improved". custom_score_2 evaluation function is same computation as custom_score, But the custom_score_2 gets lower win rate than custom_score. custom_score_3 evaluation function need more computation to get the distance between two players, when using ID to search with custom_score_3,every iterative will take more time to calculate the score of cutoff, it means the less time to search deeper. In custom_score evaluation function, Minus operation can reduce the cost of computation, So it can give more time to search deeper. So I make a recommendation that a customer_score evaluation should be used.