Heuristic Analysis

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AB_Custom:

return a * len(own_moves) – b * len(opponent_moves)

The first custom evaluation function differs from the improved_score because it weights the number of own moves and opponent moves. This seems a good evaluation function because improved_score is simple and adding weights to it you can choose the weights that makes you win more games. Choosing the best weights is difficult, but you can have at least two strategies to it. The first strategy is to make a grid search in the number of weights playing a number of games and choose as final weights the ones that resulted in the maximum number of wins. The second strategy is to use a evolutionary algorithm, like GA, to find the best weights. This two strategies are time consuming. In my case, I choosed weights **a** and **b** equals to 1 and 2. This was done to try to make my player more aggressive and always look for moves that has more options than the opponent.

AB_Custom_2:

return 1 – IoU if Union > 0 else INF

IoU → Intersection over Union of the number of own_moves and opponent_moves

The second custom evaluation function is inspired by the Intersection over Union (IoU) metric used in image detection. But in this case, I am trying to choose the moves that has a “bad” IoU for image detection because I will considerer intersection as being a bad thing, since this moves are also moves to the opponent. The idea is to find moves that will lead to partitions in the board.

AB_Custom_3:

return 1 / Intersection if Intersection > 0 else 2 * (len(own_moves) - len(opponent_moves))

This custom evaluation function is also inspired by the idea of trying to find moves that lead to partitions in the board. In this case, the greater the intersection of moves of the two players the worst the score, but when there is no intersection the score returned is equals to the difference of own_moves and opponent moves. This is done because if the intersection is zero because of a partition, is better to choose the moves that has more moves to my player in the partition, because it will lead to a win.

Experiments:

1) In the first experiment, the three custom evaluation functions were evaluated against all present in the tournament playing 5 games as player 1 and 5 games as player 2. In this experiment, all custom evaluation functions performed better than the AB_improved, but none of the three had a number of wins greater than losses against AB_Improved. The results are shown below.

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   Playing Matches
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Match #	Opponent	AB_Improved	AB_Custom	AB_Custom_2	AB_Custom_3
		Won | Lost	Won | Lost	Won | Lost	Won | Lost
1	Random	7 | 3	8 | 2	8 | 2	10 | 0
2	MM_Open	6 | 4	8 | 2	6 | 4	7 | 3
3	MM_Center	9 | 1	8 | 2	8 | 2	9 | 1
4	MM_Improved	5 | 5	8 | 2	6 | 4	8 | 2
5	AB_Open	5 | 5	6 | 4	5 | 5	4 | 6
6	AB_Center	6 | 4	4 | 6	4 | 6	5 | 5
7	AB_Improved	3 | 7	4 | 6	5 | 5	5 | 5
	Win Rate:	58.6%	65.7%	60.0%	68.6%

Your agents forfeited 247.0 games while there were still legal moves available to play.

2) In the second experiment, the three custom evaluation functions were evaluated against the MM_Improved and AB_Improved playing 15 games as player 1 and 15 games as player 2. This was done to evaluate better (30 games) against the two best players. In this experiment the AB_Custom had the best performance winning 23 games and losing 7 games against MM_Improved and winning 14 games and losing 16 games against AB_Improved resulting in 61.7% wins. This experiment shows that AB_Custom is a good evaluation function. The results are shown below.

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**************************
   Playing Matches
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Match #	Opponent	AB_Improved	AB_Custom	AB_Custom_2	AB_Custom_3
		Won | Lost	Won | Lost	Won | Lost	Won | Lost
1	MM_Improved	19 | 11	23 | 7	16 | 14	14 | 16
2	AB_Improved	15 | 15	14 | 16	13 | 17	15 | 15
	Win Rate:	56.7%	61.7%	48.3%	48.3%

Your agents forfeited 240.0 games while there were still legal moves available to play.

3) In the last experiment, the three custom evaluation functions plus AB_Improved were evaluated playing 15 games as player 1 and 15 games as player 2 against each other. In this experiment, the AB_Custom again had the better performance, winning 54.2% of the games and only having a number of losses greater than number of wins against AB_Custom_3. The results are shown below.

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Playing Matches

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Match #	Opponent	AB_Improved		AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost	Won	Lost
1	AB_Improved	16	14	16	14	11	19	11	19
2	AB_Custom	16	14	18	12	11	19	13	17
3	AB_Custom_2	17	13	17	13	13	17	18	12
4	AB_Custom_3	15	15	14	16	18	12	19	11
	Win Rate:	53.3%		54.2%		44.2%		50.8%	