Evaluation Functions

Evaluation function 1 :
This custom function is similar as in the improved score, the difference is a weight in the number of opponent moves. This will penalizes the plays the players makes, which means that the moves will try to go after the opponent's moves. From a range of values the weight of 3 performed the best.

Evaluation function 2 : This heuristic will count the number of legal moves that lie in the center 3x3 square, since in this area a player has more legal moves available (8 and only at the beginning) and it will give a weight of 3. The number of legal moves that do not lie in this 3x3 square receive a weight of 1. From different weight settings this performed the best.

Evaluation function 3: This heuristic tries to look into the future at every state, it counts the number of possible legal moves of the possible moves at every state. It counts for the player at turn and also the opponent. It returns the difference of the two counts. This is similar to the improved score heuristic.

Match #	Opponent	AB_improved	Eval. 1	Eval. 2	Eval. 3
		WON | LOST	WON | LOST	WON | LOST	WON | LOST
1	Random	50 | 0	48 | 2	45 | 5	48 | 2
2	MM_Open	36 | 14	38 | 12	39 | 11	35 | 15
3	MM_Center	44 | 6	42 | 8	40 | 10	46 | 4
4	MM_improved	35 | 15	35 | 15	36 | 14	40 | 10
5	AB_open	25 | 25	25 | 25	25 | 25	28 | 22
6	AB_center	28 | 22	28 | 22	35 | 15	26 | 24
7	AB_Improved	24 | 26	20 | 30	24 | 26	27 | 23
Totals Win rate		**69.1%**	**67.4%**	**69.7%**	**71.4%**

50 games were simulated against 7 different players,

Eval 1. Performed a little worse that the improved score (number of my moves - number of opponent moves). It seems that the weight in the opponent's movements, didn't result in a improvement.

Eval 2. Performed similar than the improved score heuristic. When playing against the AB_Center, the player with this heuristic performed better than the AB_Improved 35 wins vs 28 wins, respectively. However when random opponent the AB_Improved was able to win all games against only 45.

Evaluation 3 performed better that any heuristic, even better than the improved score. 71.3% win rate vs 69.1%.

Conclusion and recommendation.

From our simulations, we can suggest that:

1. Counting into the number of possible moves in the future (look ahead) are beneficial, and it gives a good heuristic for evaluations of the states. (Example evaluation function 3).
2. Adding a weight into the evaluation function for penalizing or for rewarding, is not an easy task. Fine Tuning this parameter is computed expensive, one good way to choose this parameter is to make a random number of runs for different weights, and see which one performs the best.
3. Information about the opponent sometimes is not needed (evaluation 2) giving some fair results, but when possible it has to be also encoded in a way in the heuristic.