

Heuristic Analysis

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For my heuristic analysis, I implemented 4 different heuristic functions:

4 heuristic functions:

Defensive

$$\text{score} = \text{float}(2 * \text{own_moves} - \text{opp_moves})$$

This style of play favors maximizing the amount of available moves that you have throughout the game

Aggressive

$$\text{score} = \text{float}(\text{own_moves} - 2 * \text{opp_moves})$$

This style of play favors minimizing the amount of available moves that the opponent has throughout the game. It is possible that an overly aggressive strategy might backfire, as the agent is not optimizing for his own available moves as tries to hard to confine the opponent. If the opponent manages to escape the player could be left in a bad position.

Center play

$$\text{final_score} = \text{own_moves} - \text{opp_moves} + \text{from_center}(\text{game}, \text{game.get_player_location}(\text{player}))$$

This heuristic adds another feature, which is calculating the distance of the player's current position from the center. In Isolation, it is probably favorable to play near the center of the board to avoid being confined.

Defensive to aggressive

$$\text{final_score} = \text{own_moves} * \text{num_blanks} / 3 + \text{opp_moves} * 3 / \max(1, \text{num_blanks})$$

This style of play plays defensive at the beginning of the game and grows more aggressive as the game progresses, becoming very aggressive at the end. This heuristic could potentially be very good because it tries to maximize the available squares at the beginning. As the number of blank spaces decreases, the AI will grow more aggressive and go for the kill.

My hypothesis is that there is an optimum balance between defensiveness and aggressiveness. By trying out differing amounts, I should be able to find the optimum weights to balance the two. In isolation, the goal is to "isolate" the opponent by getting them into a position where they can no longer make any more moves. Therefore, it makes sense that an aggressive strategy could potentially be very effective.

Results:

Match #	Opponent	AB_Improved		defensive		aggressive		center play		defensive to aggressive	
		Won	Lost	Won	Lost	Won	Lost	Won	Lost	Won	Lost
1	Random	42	8	44	6	43	7	39	11	40	10
2	MM_Open	32	18	36	14	32	18	31	19	26	24
3	MM_Center	39	11	36	14	40	10	36	14	34	16
4	MM_Improved	32	18	29	21	31	19	29	21	27	23
5	AB_Open	30	20	32	18	25	25	24	26	21	29
6	AB_Center	31	19	32	18	31	19	28	22	22	28
7	AB_Improved	18	32	25	25	23	27	24	26	15	35

Win Rate:		64.0%		66.9%		64.3%		60.3%		52.9%	

In terms of overall performance, the defensive heuristic performed the best.

In order of performance, **defensive > AB_improved > aggressive > center play > defensive to aggressive**.

The defensive heuristic was the only one that performed at least as well as AB_improved. The center play heuristic didn't perform as well as expect, but perhaps it could perform better with some more fine tuning of the weights. The defensive to aggressive heuristic performed the worse. It is possible that it could perform better with some of the feature weights adjusted.

It turns out that a very simple defensive heuristic outperformed any of the more elaborate heuristics that I created, as well as the aggressive heuristic. The reasons for the defensive heuristic performing the best out of all could be the following:

1. The game of Isolation perhaps favors a more defensive style of play, any attempts at being more aggressive could possibly backfire with the opponent escaping your attempts to contain him, leaving you in a bad position
2. Poor coded heuristics. I am not a very good Isolation player so perhaps I don't have enough domain knowledge to come up with very good heuristics
3. The overly complicated heuristics require more computation and may have timed out a few times, result in less search depth.