Heuristic Analysis

Heuristic 1:

Heuristic 1 just maximizes the number of moves the agent has against its opponent at the leaves of the search tree. This works under the assumption that having more moves than your opponent means you are winning.

$$score = number\ of\ our\ moves - number\ of\ our\ opponents\ moves$$

Heuristic 2:

Heuristic 2 attempts to prevent the agent from getting stuck in a corner in the late game. The corner avoiding behavior is achieved by first counting the number of moves that are in the corners for each player, and then scaling the difference between the opponent's corner moves and the agents corner moves by *game_state*. The scaling factor, *game_stat*e, is the minimum of the fraction spaces left to total spaces, and a cap (6 in this case). Scaling the corner moves in this way allows the corner strategy to not dominate until late game where it becomes more meaningful, as fewer spaces are available, and capping it prevents the corner moves from over dominating in the late game.

$$game\ state = min(\frac{spaces\ left}{total\ spaces}, 6)$$

$$score = \#\ our\ moves - \#\ opponents\ moves + game\ state * (\#\ opponents\ corners - \#\ our\ corners)$$

Heuristic 3:

Heuristic 3 attempts the same behaviour as Heuristic 2, but uses the distance to the center of the end moves instead of the corner moves. Its behaviour maximizes the number of moves the agent has over its opponent (in the same way as Heuristic 1) while the board is less than 75% filled, and when the board is 75% filled or the number of moves the agent has equals its opponents the heuristic will reward moves that are closer to the center of the board in *block distance* by maximizing the opponents block distance over the agents.

$$block\ distance = |player\ position\ y\ coordinate - center\ y\ coordinate| + |player\ position\ x\ coordinate - center\ x\ coordinate|$$

$$score\ if < 75\%\ used = \#\ of\ our\ moves - \#\ of\ opponents\ moves$$

$$score\ if \geq 75\%\ used = block\ distance(opponent) - block\ distance(us)$$

Decisions:

I would choose use Heuristic 3 because 1.) it seems to perform better in the tests I ran (see figures 1 and 2 for some examples), 2.) it employs knowledge of how the game typically plays out (playing more central moves in the late game to avoid being trapped), 3.) it can easily be expanded on to include opening strategies, which would further improve performance.

In comparison to Heuristic 1, Heuristic 3's strategy is improved by scoring moves by distance when both players have the same number of moves (where Heuristic 1 would return a score of 0 for that move). In comparison to Heuristic 2, the strategy for avoiding corners is more generalized in Heuristic 3 where we reward moves that are more central rather than just not in the corners (hopefully allowing the agent to avoid getting trapped anywhere near a corner).

Match #	Opponent	AB_Improved		AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost	Won	Lost
1	Random	17	3	17	3	15	5	14	6
2	MM_Open	9	11	14	6	15	5	17	3
3	MM_Center	15	5	16	4	15	5	16	4
4	MM_Improved	10	10	11	9	15	5	13	7
5	AB_Open	10	10	14	6	10	10	11	9
6	AB_Center	12	8	9	11	14	6	13	7
7	AB_Improved	12	8	11	9	9	11	10	10
	Win Rate:	60.7%		65.7%		66.4%		67.1%	

Figure 1: Example Run 1

Match #	Opponent	AB_Improved		AB_Custom		AB_Custom_2		AB_Custom_3	
		Won	Lost	Won	Lost	Won	Lost	Won	Lost
1	Random	19	1	16	4	18	2	19	1
2	MM_Open	13	7	14	6	14	6	10	10
3	MM_Center	16	4	15	5	16	4	17	3
4	MM_Improved	13	7	11	9	11	9	14	6
5	AB_Open	11	9	12	8	6	14	10	10
6	AB_Center	13	7	10	10	8	12	11	9
7	AB_Improved	11	9	11	9	9	11	11	9
	Win Rate:	68.6%		63.6%		58.6%		65.7%	

Figure 2: Example Run 2