Custom Heuristic Performance in Knight Tour Isolation

Match #	Opponent	AB_Improved Won	Lost	AB_Custom Won	Lost	AB_Custom_2 Won	Lost	AB_Custom_3 Won	Lost
1	Random	10	0	10	0	9	1	9	1
2	MM_Open	6	4	7	3	9	1	6	4
3	MM_Center	9	1	9	1	10	0	8	2
4	MM_Improved	9	1	9	1	7	3	4	6
5	AB_Open	4	6	4	6	7	3	3	7
6	AB_Center	9	1	7	3	8	2	5	5
7	AB_Improved	7	3	3	7	5	5	5	5
	Win Rate:	77.1%		70.0%		78.6%		57.1%	

General Overview

Each of the heuristics has a different performance based on its opponent, which can be due to time restrictions, causing iterative deepening to perform only shallow depths. An example of this comes from play against the "Improved" heuristic. This adversarial heuristic causes a greater reduction in move availability than other opponents, thus forcing us to go to a greater depth to find possible positive outcomes. If time limitations were more relaxed, we could modify alpha-beta to account for board state to set a better starting depth, have greater complexity in the heuristics(such as adaptive heuristic switching), and/or generally start at a greater depth.

Custom 1: Open Moves with Distance away from Center

The basis of this heuristic is to improve move availability while staying away from the center of the board. By doing this, the player is able to complete squares with lower starting availability. As the amount of moves is reduced, the heuristic switches to overall move availability, to prevent it from getting stuck in a corner trying to complete possible moves, which would allow an adversarial opponent to easily capitalize on its diminishing move availability. However, this also causes a pure open move opponent to perform better, as it will naturally complete the center squares(those with highest move availability) while the player is only partially completing the outside ring because of heuristic switching.

Custom 2: Adversarial Distance from Center

The basis of this heuristic is to maximize move difference with an opponent, while staying away from the center of the board. As in Custom 1, it causes the player to complete naturally low availability squares near the edges and corners, but differs in that it will also change to a more adversarial approach as the move difference increases. This causes the heuristic to perform well against open move heuristics, which would normally perform well late game against an edge prioritized heuristic.

Custom 3: Open Moves with Distance closest to Center
The basis of this heuristic is to improve move availability while staying close to the center of the board. This causes the heuristic to complete the naturally high availability squares(those in the middle 4 rows/columns), and switch to open move availability as center decreases. To accomplish this, we weight the center value lower than open move availability by 25%. This stops the player from forcing center moves once the availability drops on them. As with Custom 1, this heuristic becomes vulnerable to adversarial opponents, as when move availability drops, the opponent will attempt to reduce move availability by taking potential squares, which have been greatly reduced by the player's own heuristic. This also results in poor performance against purely open move opponents, who will initially compete for the center high available moves, then move toward the edges as the center fills, while the player will still partially gravitate toward the center.

Conclusion
The Custom 2 heuristic outperformed Custom 1, Custom 2, and Improved(own_moves - opponent_moves) consistently across multiple tournament tests, thus it is the heuristic that would be chosen for this current state of the isolation game. It is computationally cheap, allowing it to evaluate with enough time to provide greater depth. In addition, the implementation of the heuristic is simple, consisting of basic function calls for player positioning, open moves, and basic algebra.

Note: The word "Naturally" is denoted here to mean calculated mathematically rather than logically.