**Analysis of Isolation Heuristic Functions**

**Description of Heuristic Functions**

Baseline – AB\_Improved:

This function calculates the difference between the available moves for the active player and for the opponent. It rewards moves that allow the active player to have more options to occupy the board, and penalizes moves otherwise.

AB\_Custom:

Instead of using L1 distance in the AB\_Improved, this heuristic uses L2 distance between the available moves of the player and her opponent.

AB\_Custom\_2:

Similar to AB\_Improved, this heuristic penalizes a player’s move that would increase her opponent’s number of moves. However, the penalty coefficient gradually increases from 1 as the board get more crowded and is capped at 3.

AB\_Custom\_3:

In addition to AB\_Improved, this heuristic also rewards a player’s move that position herself closer to the center of the board, and penalizes a move that would allow her opponent to do so.

**Results**

The three customized heuristic functions are competed against the baseline improved function in a tournament format over 200 games for each cpu agent. The results are shown in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **AB\_Improved** | **AB\_Custom** | **AB\_Custom\_2** | **AB\_Custom\_3** |
| **Random** | 93% | 94% | 95% | 94% |
| **MM\_Open** | 73% | 79% | 76% | 73% |
| **MM\_Center** | 84% | 85% | 87% | 89% |
| **MM\_Improved** | 68% | 78% | 75% | 69% |
| **AB\_Open** | 53% | 51% | 50% | 51% |
| **AB\_Center** | 52% | 56% | 50% | 56% |
| **AB\_Improved** | 52% | 44% | 47% | 50% |
| **Avg. Winning Pct** | 67.4% | 69.4% | 68.1% | 68.6% |
| **Std. Deviation** | 16.5% | 19.0% | 19.6% | 17.9% |
| **Ratio** | 4.07 | 3.65 | 3.47 | 3.83 |

All three heuristics have a few percentages of improvements over AB\_Improved, with AB\_Custom has the highest average winning percentage 69.4%, an improvement of 2%.

AB\_Custom is particularly good at competing against MM\_Open and MM\_Improved because it penalizes moves that favor the opponent and it uses alpha-beta pruning.

I’m a little surprised that the AB\_Custom\_2 has an overall lower winning percentage than that of AB\_Custom. Probably because the decaying factor needs to be fine-tuned.

The standard deviations are also compared, it appears that all heuristics have higher variances than AB\_Improved, and hence lower Winning Percetage/S.D. ratios. Though, more games might be needed for the variance analysis.

AB\_Custom\_3 has the best ratio among the three. It is particularly good at competing against MM\_CENTER and AB\_CENTER because it penalizes moves that favor the opponent and it also combines with the improved\_score heuristic.

**Recommendations**

AB\_Custom\_3 is the best option from the three heuristics.

1. It has substantial improvement over AB\_Improved, 1.2%.
2. It has at least 50% winning probability against any of the competing strategies.
3. It’s particularly great competing against MM\_CENTER, AB\_CENTER.