

# AIND Heuristic Analysis: Isolation

Three heuristic functions were implemented for this project:

- **custom\_score**  
Improved heuristic plus a one-step lookahead. The heuristic checks if the current player can make a winning move and scores accordingly.
- **custom\_score\_2**  
Exponential (or minus exponential) of the Improved Heuristic plus a distance from center measure. The exponentiation gives more importance to the number of moves, especially when the difference is large.
- **custom\_score\_3**  
Difference of centrality between the two players.

## Matches

Opponent	AB_Improved	AB_Custom	AB_Custom_2	AB_Custom_3
<i>Random</i>	9 – 1	10 – 0	8 – 2	8 – 2
<i>MM_Open</i>	7 – 3	5 – 5	4 – 6	7 – 3
<i>MM_Center</i>	9 – 1	8 – 2	8 – 2	8 – 2
<i>MM_Improved</i>	4 – 6	5 – 5	8 – 2	5 – 5
<i>AB_Open</i>	5 – 5	7 – 3	6 – 4	4 – 6
<i>AB_Center</i>	4 – 6	9 – 1	5 – 5	4 – 6
<i>AB_Improved</i>	5 – 5	6 – 4	6 – 4	6 – 4
<i>Win Rate:</i>	61.4%	71.4%	64.3%	60.0%

The data shows that both the lookahead (AB\_Custom) and the inclusion of the centrality metric together with Improved (AB\_Custom\_2) provide **useful information to win more often than just Improved**.

On the other hand, the difference of centralities (AB\_Custom\_3) doesn't seem to be all too useful.

The next step was to try and mix AB\_Custom and AB\_Custom\_2 into a single super heuristic, but the results were disappointing.

Opponent	AB_Improved	AB_Custom (1 + 2)
<i>Random</i>	10 – 0	9 – 1
<i>MM_Open</i>	8 – 2	4 – 6
<i>MM_Center</i>	8 – 2	7 – 3
<i>MM_Improved</i>	5 – 5	4 – 6
<i>AB_Open</i>	5 – 5	4 – 6
<i>AB_Center</i>	7 – 3	3 – 7
<i>AB_Improved</i>	5 – 5	2 – 8
<i>Win Rate:</i>	68.6%	47.1%

In order to get a better heuristic function, another attempt was made, where instead of scaling up the *Improved* part with an exponential, the distance from center metric was scaled down by a factor of  $1/n$ ,

where  $n$  is the number of moves. This restricts its impact to the early game and keeps it from ruining end-game scenarios.

The updated results are shown below:

Opponent	AB_Improved	AB_Custom*
<i>Random</i>	8 – 2	9 – 1
<i>MM_Open</i>	7 – 3	6 – 4
<i>MM_Center</i>	8 – 2	8 – 2
<i>MM_Improved</i>	4 – 6	6 – 4
<i>AB_Open</i>	5 – 5	5 – 5
<i>AB_Center</i>	2 – 8	8 – 2
<i>AB_Improved</i>	5 – 5	7 – 3
<i>Win Rate:</i>	55.7%	70.0%

This is the preferred heuristic, since its distance-from-the-center factor makes it **more stable over different runs** than the original AB\_Custom, while still **outperforming Improved** by **making use of more information** which is also easy to compute.