

Heuristics Analysis

score_center - rewards moves in the center and around the center by adding a bias point after calculating the improved score, which is the different between number of moves the player can make and the number of moves the opponent can make if a specific move is played. I thought that favoring toward the center points of the board will make a better heuristics since those points will have a more possibilities.

score_toward_center - performs a similar heuristic of favoring center moves, but I wanted to experiment to determine the impact of the evaluation function that considers the number of possible moves both for the opponent and the player. It turns out that the evaluation function used in improved score provides a good balance between speed and accuracy. However, calculating the distance from the center is much more efficient, but still provides an acceptable win ratio. I've also normalized the bias to a 0 – 1 range so that it's impact is not too significant when combining it with other methods.

score_ensemble – takes a more holistic approach by trying to combine the two techniques mentioned before. I've derived the concept from ensemble learning by creating ensemble heuristics, which tries to achieve a better win ratio by combining multiple score functions. In practice, a combination of techniques does produce a better results depending on which ones were combined. However, since our heuristics were pretty similar to each other, the ensemble evaluation function ended up performing poorly.

Evaluation Function	Win Ratio
Improved Score	67.50%
Score Center	76.25%
Score Toward Center	70.00%
Ensemble	68.75%

Recommendation:

The **score_center** evaluation function has consistently outperformed the **improved_score** and would be the recommended heuristic to be used in the target game as is used in the **custom_score** method in my submission. Although we're adding a bit more time complexity in calculating the heuristic, we're making a good trade-off in terms of the win ratio.