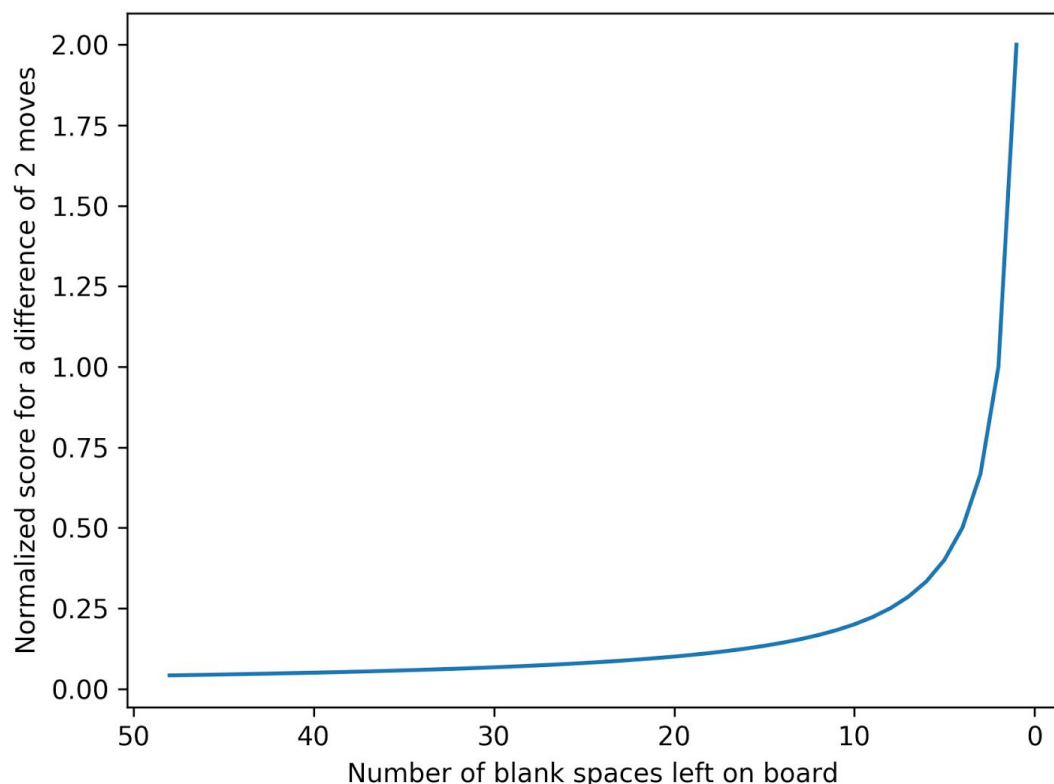


Analysis of custom heuristics :

Submitted in partial fulfillment of Udacity's AI Nanodegree requirement

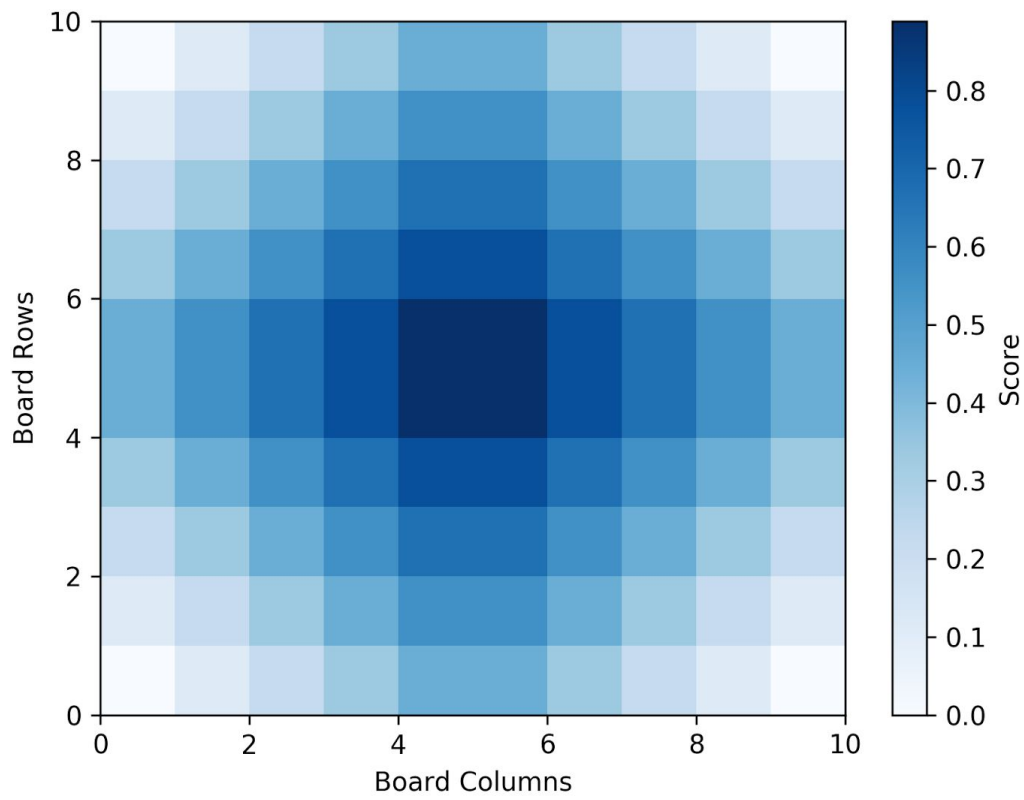
I formulated 3 heuristics:

- 1) `custom_score_normalizedByBlankSpaces` - calculates the score as the difference between the number of available moves between the players normalized by the number of blank spaces left on the board (NBS). Here I used NBS as a surrogate for game time - the more moves the players take (longer the game time), lesser the NBS. The intuition was that the same difference between the number of moves later in the game scores higher (because of lower NBS) than earlier in the game (because of higher NBS)



- 2) `custom_score_edgeAndCornerLimiting` - calculates score by penalizing moves close to edges and corners of self but encouraging moves that leaves opponent moves close to edges and corners. The intuition is that moves at edges and corners can limit the moves available between 0.5% (at edges) to 0.25% (at corners). The scores were normalized by the number of blank spaces for the same reason as explained above.
- 3) `custom_score_distaceWeightedPositions` - calculates score by penalizing moves that stray away from the center. Scores are calculated as the ratio of weighted sum of self scores (moves close to center are encouraged) to the weighted sum of opponent moves (opponent moves away from center are encouraged), all normalized by the

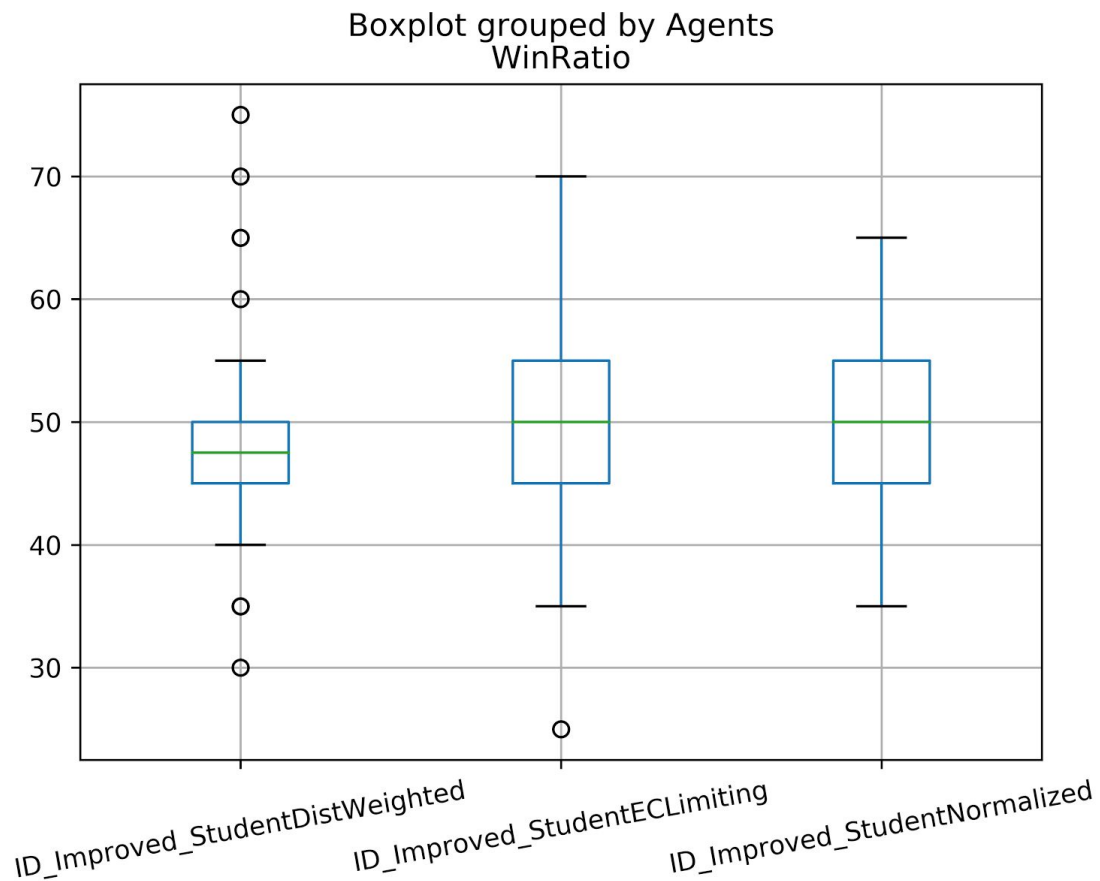
number of blank spaces for the same reason as explained above.



Summary of Performance:

All 3 heuristics performed equally well against Null, Open and Improved agents. With respect to the Improved agent, the win-loss ratio was on average 50%. With the default game board width and height of 7, the ratio of perimeter to area was about 50% (24/49) and the heuristics 2 and 3 that rewarded (or penalized) moves close to center (or edges) did not perform as well as expected. I increased the board sizes to 50x50 and noticed increased win-loss ratio of >80%. Here is a boxplot showing the performance of the ID_Improved agent against agents using the three custom heuristics. The games were between agents using the each of the 3 custom heuristics against the ID normalized heuristic. Heuristics 2 and 3

show comparable average but more variable performance compared to Heuristic 1.



Heuristics to explore:

I hope to experiment with a metric that rewards chasing the opponent piece (weighted by distance to opponent moves). This in conjunction with the distance weighted heuristic should help corner the opponent.

Recommended Heuristic:

I wish to go with heuristic 3, custom_score_distaceWeightedPositions based on

- 1) its consistent performance (based on a small set of games- large board games take long times to complete) on large boards.
- 2) Its comparable average performance (but highly variable) to the other heuristics.
- 3) The general idea behind the heuristic