

## Board Margin Heuristic

Board margin uses the difference in player and opponent moves, multiplied (scaled) by the number of open spaces on the board. This should have the effect of weighting any advantage that either side has based on how early the game is, or how open the board is. However, because we're using the number of open spaces without knowing how accessible they are to either player, the scaling might not capture relative advantage of either player. Its performance seems to be slightly lower than the improved (my moves – opponent moves) heuristic with single level iterative deepening. This seems most likely due to its insensitivity to the distribution of remaining spaces—whether those spaces are more accessible to one player or the other.

Player wins out of 20 vs. Opponent	ID_Improved (wins)	Student (wins)
Random	20	17
MM_Null	14	12
MM_Open	10	9
MM_Improved	10	7
AB_Null	13	12
AB_Open	9	12
AB_Improved	11	10
Total	62.14%	56.43%

## My\_moves Heuristic

'My moves' is the heuristic first introduced in the advanced game playing lectures. It's simply a measure of how many moves the player has available on their turn. Its performance in our player seems improved relative to the ID\_Improved baseline bot. Given that our heuristic probably isn't quite as good as the improved heuristic in ID\_Improved, the slightly better performance of our bot is probably due to variation in randomized initial conditions. However unlikely it may seem, 'my\_moves' may indeed be more reliable in some situations, since there are situations where the opponent may appear to have fewer moves in a particular round than they actually will in subsequent rounds. When this is the case, as long as we're conservative with the actual moves we have left, we can consistently outperform them as long as we have better opening moves and play optimally more of the time. In other words, if we have carefully maintained as much open space for ourselves as possible throughout play, we might find the other side is not as careful.

Player wins out of 20 vs. Opponent	ID_Improved (wins)	Student (wins)
Random	18	19
MM_Null	13	15
MM_Open	9	10
MM_Improved	8	8
AB_Null	12	15

AB_Open	14	9
AB_Improved	8	15
Total	58.57%	65.00%

### Moves\_difference

This time, we use the improved heuristic (my moves minus opponent moves) which we refer to as 'moves\_difference'. It would appear our performance is slightly lower than that of the baseline. We would expect our heuristic to be identical to that of the baseline, the improved heuristic discussed in the lectures, and we'd expect alpha-beta pruning iterative deepening search to perform equally well with both bots. This discrepancy could be a matter of having an unusually bad string of 'rolls' from the random number generator which selects opening positions for our matches, and our performance is statistically indistinguishable from that of the baseline. Other possibilities are incorrect implementation of the heuristic, or poor selection of an “opening book” of early moves.

Player wins out of 20 vs. Opponent	ID_Improved	Student
Random	17	18
MM_Null	12	12
MM_Open	9	10
MM_Improved	10	7
AB_Null	15	12
AB_Open	13	8
AB_Improved	11	13
Total	62.14%	57.14%

Ultimately, my\_moves was chosen as the preferred heuristic for this embodiment of the Isolation-playing bot. The possibility that it is more conservative with its moves, preserving its own options, without relying on a potentially transient disadvantage of the other side is its redeeming characteristic. Using the difference in moves between sides has the possibility of deemphasizing how many moves the opponent will have at a later state, and increasing the likelihood we will choose a less conservative move as a result. On the other hand, my\_moves will consistently report how many moves we have at a particular time, and as long as we use these sparingly, we should always have at least this many available. For example, take two game states—one where we have 4 moves and our opponent has 3, and another where we have 3 and our opponent has 1. The difference heuristic would have us choose the latter, even though it is likely to leave fewer options for us, without any certification that our opponent will indeed continue to have fewer options than we do. The simpler my\_moves heuristic would have us choose the former, since we'd have 4 rather than 3 moves, which ensures we have more options regardless of what it appears our opponent has available.