

Analysis of Heuristics used in Isolation Game

I tried various heuristics and ended up choosing following 3 for the custom scores. Some of the things which were tried were corner weights, border weights, center weights, assigning different weights to number of self and opponent moves and a combination of all of the above.

Other considerations which I discarded included partitioning since this game involved knight moves and thus partitioning wouldn't stop any player from proceeding. Also, reflecting opponent's moves did not make sense here. I also considered using the other heuristic in case first heuristic returned 0 score, but it didn't give good results.

Custom_score (Heuristic One)

This heuristic scores the board based on the difference of number of player moves and opponent moves as follows:

A weighted difference of # of player moves(10) - # of opponent moves(1)

Rationale Behind the heuristic

As much as the simplicity of this heuristic, this one gives the best results amongst all things I tried. By the nature of the game, we will win if we are able to reduce the number of possible moves for opponents to zero while still having moves for ourselves. Thus, we need to reward for our moves and penalize for opponent moves. Here, we penalize the number of opponent moves by 10 times more than our moves. This makes it more aggressive to win the game than defend and hence gives good results.

Tournament Results:

1. Vs Random: 20 to 0
2. Vs MM_Open: 18 to 2
3. Vs MM_Center: 19 to 1
4. Vs MM_Improved: 17 to 3
5. Vs AB_Open: 13 to 7
6. Vs AB_Center: 11 to 9
7. Vs AB_Improved: 11 to 9

Overall, I got a win rate of **78%** using this heuristic.

Custom_score2 (Heuristic Two)

This heuristic evaluates the board state two folds. Firstly, it scores the board based on the difference of number of player moves and opponent moves. Secondly,

Two heuristics have been used:

- a. # of player moves - # of opponent moves

b. Player's distance from the center of the board
It is a weighted sum of A(20) and B(1).

Rationale Behind the heuristic

We should reward for our moves and penalize for opponent moves. The difference of the two is the first part of heuristic. Also, it is better to stay closer to the center of the board especially at the initial phase of the game as it will lead to more moves. However, based on the runs, this heuristic is given lesser weight as its value decreases as the game proceeds.

Tournament Results:

1. Vs Random: 19 to 1
2. Vs MM_Open: 18 to 2
3. Vs MM_Center: 19 to 1
4. Vs MM_Improved: 16 to 4
5. Vs AB_Open: 10 to 10
6. Vs AB_Center: 12 to 8
7. Vs AB_Improved: 9 to 11

Overall, I got a win rate of **74%** using this heuristic

Custom_score3 (Heuristic Three)

Apart from difference in number of moves, I normalized it by the manhattan distance between the two players as follows:.

(A weighted difference of # of player moves - # of opponent moves(2))/Manhattan distance between two players

Rationale Behind the heuristic

By now I had realized that difference in number of moves was too important an evaluation criteria to let go of while developing a heuristic. So, I played with it along with the distance between the two players. Since the closer the opponent is, the more can we block him by capturing his moves, we reward for their closeness and penalize for far-ness.

Tournament Results

1. Vs Random: 20 to 0
2. Vs MM_Open: 17 to 3
3. Vs MM_Center: 20 to 0
4. Vs MM_Improved: 17 to 3
5. Vs AB_Open: 11 to 9
6. Vs AB_Center: 14 to 6
7. Vs AB_Improved: 10 to 10

I got a win rate of **~78%** using this heuristic

Conclusion

AB_Improved gave better results than any of the custom scores. I found that the distance between the two players played a very important role in winning the matches. I got better results when I penalized the opponent moves more than player moves. This is quite intuitive since we want to make the opponent's moves scarcer to win the match.

