Analysis of heuristics. Isolation game.

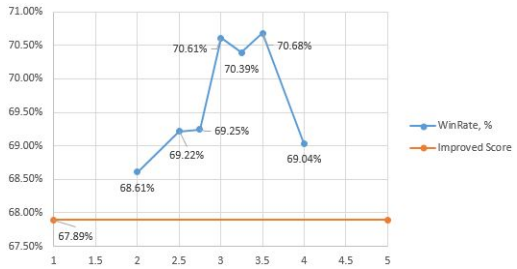
Heuristics 1.

The idea* of heuristics used is an elaboration of Improved Score, or

$$IS = my\_moves - opp\_moves$$

Proposed heuristics is $(my\_moves - \alpha * opp\_moves) * filled\_spaces$

Ideally it should catch board availability and we should be able to manipulate player strategy by choosing best α. To choose alpha let's perform test and choose most significant α. We won't be performing any statistical tests mainly for 2 reasons: firstly, each round is costly to compute in terms of time and secondly, there are different opponents with agent performs better with one type and worst with another meaning inconsistency within final win ratio. So we will try to run a set of games and will choose best α in terms of win ratio. We will be running our experiment on a set of 400 games against each opponent (NUM_MATCHES = 100) for different α .Through the performed experiment, average win ratio for a player with Improved Score evaluation function was approximately 67.89%. On the chart below depicted the win ratio for each α in {2, 2.5, 2.75, 3, 3.25, 3.5, 4}** with blue line and Improved score over the course of the tournaments with orange line.



We will be choosing α equal to 3 for simplicity sake and because difference in win ratio between 3 and 3.5 is insignificant. So the overall win ratio is 70.61%.

**Credit of the idea to https://github.com/on2valhalla/Isola*

*** Values less than 1 produced worse results.*

Heuristics 2

The idea of heuristics is that we want to force opponent to as less moves as possible while keeping our options open. This can be possible if we will be trying to seek our options close to center. Creating utility function we can either by assigning different values to the board cells or just create an evaluation function to reflect difference in distances to the board center for each player. The latter is more convenient within the scope of the task. Alongside with that we want to have already good Improved Score evaluation function, so final utility is

$V = (my\_moves - \alpha * opp\_moves) + (my\_center\_dist - opp\_center\_dist)$ where $\alpha = 3$. The overall score of this heuristic on a limited sample of 100 games is 70.50%.

Heuristics 3
Thus heuristics is about exploration one level further. Instead evaluating Improved Score, we want to explore a possible moves one level deeper and take a difference between possible moves of a player and the opponent at new level. It is a costly function (obviously) so I intend to use it together with heuristic 1 after a 70% of a board is filled. This resulted in 71.43% in win rate.

Decision.
In my opinion the best choice is to go with a heuristic 3. First of all, this has a higher win rate. Secondly, its construction and design suggests that higher score means a lot less space for the opponent than for the player (now and in the near future) and it should be considered as highly correlated with probability to win. Lastly, due to it's nature it searches to similar depth as others heuristics and as Improved Score heuristics, and on the later stages it seems that computation complexity matters less and less. The one downside is that heuristic_3 is just an improvement of Improved Score idea, so it's potential is clearly limited

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