Isolation game - AI heuristic analysis

This document compares three different heuristics in the Isolation game. Comparison is made using pre-made python script

`tournament.py`

which is bundled in the Isolation project sources. Comparison is made against result of agent with 'improved score' heuristic used as a benchmark which takes computer performance into account.

Heuristic 1 - Count number of blank spaces around legal moves

This heuristic takes into account number of blank spaces around each possible legal move in given move. The idea behind this heuristic is that the more blank spaces are around legal moves the more moves will be possible to play in the future and vice versa for opponent, where we are trying to minimize number of blank moves around him. The priority for minimizing blank spaces for opponent is slightly higher than maximizing blank spaces for player.

Heuristic 2 - Check for corners and walls

This heuristic is an improved version of 'Improved score' which takes into account count of player and opponent legal moves. The improvement is made by checking if landing moves are near walls and corners for the opponent as this will further limit possibility for moves in the future. The resulting effect of this heuristic is we are actively trying to chase opponent into board corners.

Heuristic 3 - Combined heuristic

This heuristic is the combination of the previous two and thus is the most complex. In early stages of the game, we use the second heuristic as it's faster than the other one. In later stages of the game we try to count blank spaces around every move. Combination of these two metrics yields better results overall.

Results

As the best heuristic was selected heuristic AB_Custom - Combined heuristic which had better overall performance than other heurisic functions.

Match #	Opponent	AB_Improved	AB_Custom	AB_Custom_2	AB_Custom_3
1	Random	9 - 1	8 - 2	6 - 4	7 - 3
2	MM_Open	2 - 8	5 - 5	2 - 8	5 - 5
3	MM_Center	6 - 4	4 - 6	7 - 3	6 - 4
4	MM_Improved	3 - 7	3 - 7	3 - 7	5 - 5
5	AB_Open	5 - 5	9 - 1	5 - 5	6 - 4
6	AB_Center	5 - 5	5 - 5	4 - 6	7 - 3
7	AB_Improved	5 - 5	5 - 5	3 - 7	6 - 4
	Win Rate:	50.0%	55.7%	42.9%	60.0%

The main reasons for choosing this heuristics are:

1. Score - this heuristic function achieved 10% better score than "Improved" heuristic function
2. Complexity - there are more features which are used for score calculation than in the other heuristic functions. Because of this, agent can make more informed decisions.
3. Performance - This heuristic is relatively simple to calculate and is optimized for different stages of game - in the early stages, less demanding calucations are made (checking for legal move count and wall and corner proximity). In later stages, more demanding heuristic is used (counting blank spaces around each landing move) but due to the fact the players have less options for legal moves, it doesn't have high performance impact.