Heuristic Analysis

The `game_agent` in question implements Minimax + AB-pruning on top of it. No opening book, no end game optimisation, no regression, and no game tree hashing / reordering to improve pruning is implemented at this point.

Additional pruning techniques (such as detecting and dropping simmetrical / identical game boards from the search tree) would not affect the comparison of evaluation heuristics since all the heuristics will be applied in the improved algorithm hence have the same performance boost.

The basic `open moves` heuristic performs OK against random and greedy players and can be considered a baseline. `Center` heuristic (calculating distance from field center) doesn't perform significantly better, but `improved` heuristic does: it uses `my open moves - opponend open moves` formula. Let's try and improve over this result.

Three heuristics I've tried didn't achieve very good result, and I will keep trying to improve that when applying to PVP. Rather, I'd like to test if my assumptions were right with these.

Performance comparison

Match # Opponent AB*Improved AB*Custom AB*Custom*2 AB*Custom*3

Won | Lost Won | Lost Won | Lost Won | Lost

1 Random 10 | 0 10 | 0 9 | 1 8 | 2

2 MM*Open 7 | 3 8 | 2 7 | 3 8 | 2*

3 MM*Center 8 | 2 9 | 1 9 | 1 8 | 2*

4 MM*Improved 7 | 3 7 | 3 5 | 5 5 | 5*

5 AB*Open 5 | 5 4 | 6 4 | 6 3 | 7*

6 AB*Center 6 | 4 8 | 2 4 | 6 5 | 5*

7 AB*Improved 5 | 5 5 | 5 3 | 7 4 | 6*

Win Rate: 68.6% 72.9% 58.6% 58.6%

First custom heuristic

Is marginally better than the improved heuristic provided.

Situations where the opponent has limited moves, but there are move points that won't be accessible for the opponent in the next 2 moves (without evaluating the board) are given better score.

It starts off the improved heuristic and adds an extra bonus to some boards characterized by that feature: opponent has too big of a distance to a lot of points.

Second heuristic

Rather stupid attempt: add the count of uniq moves (that the player has but the opponen has not) as a bonus to the improved heuristic.

It doesn't perform well (worse than improved in fact).

Third heuristic: 2x penalize for opponent moves

Nope, doesn't work well either. The idea was to try different weight multipliers for the params of improved heuristic. Doesn't work tho.

Plan: what to try next

From the top shelf: sklearn + reinforcement learning on self plays to get better heuristic weights *and* a decent opening moves book. There's probably a good read about how to implement this somewhere and I'd be grateful if you point me in the right direction.