Heuristic Analysis of Isolation Playing Agents

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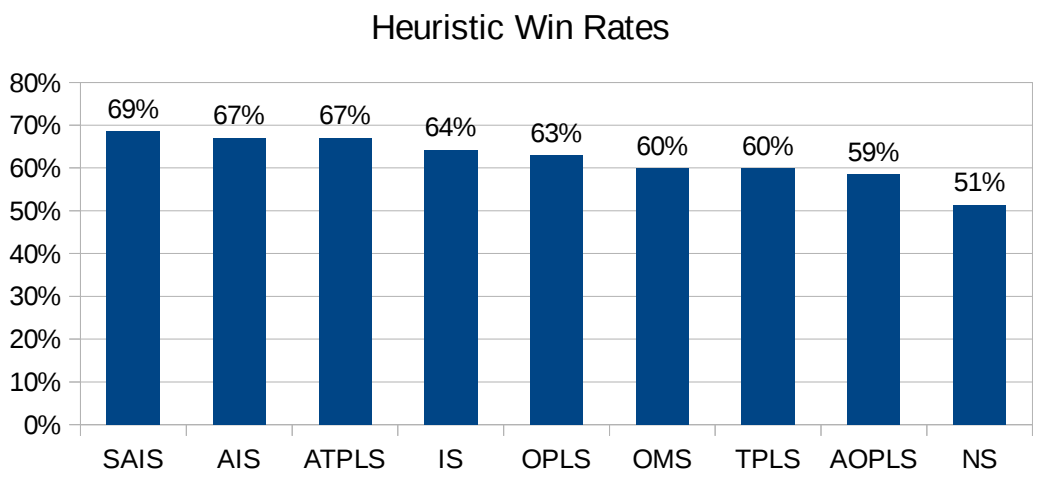
The following contains a high level analysis that drove the decision to choose the scoring heuristics used in the AI agents playing the game Isolation. Several scoring heuristics were analyzed, including:

- **Naive score (NS)**: the value one.
- **Improved score (IS)**: the difference between the number of current player moves minus current opponent moves.
- **Aggressive improved score (AIS)**: same as improved score with 2:1 ratio applied to the opponent's move.
- **Super aggressive improved score (SAIS)**: same as improved score with 3:1 ratio applied to the opponent's move.
- **Open move score (OMS)**: the number of current player moves.
- **One ply lookahead score (OPLS):** the sum of the number of moves in the first ply of the current player minus the same sum of the opponent.
- **Aggressive one ply lookahead score (AOPLS)**: the same as one ply lookahead score with 2:1 ratio applied to the opponent's move.
- **Two ply lookahead score (TPLS)**: the sum of the number of moves in the second ply of the current player minus the same sum of the opponent.
- **Aggressive two ply lookahead score (ATPLS)**: same as two ply lookahead score with 2:1 ratio applied to the opponent's move.

Below is a chart illustrating the win rates for the aforementioned heuristic scores.



As you can see in the chart above, the super aggressive improved score provided the best win rate. It's interesting to see that each type of improved score ranked in the very top along with the aggressive two ply lookahead score. Not surprising that the naive score ranked at the bottom as it doesn't include any information about the current game play. However, it is surprising that it was able to win more than half of the matches. These results show that exploring more "aggressiveness" factors for the improved score could show promise in further improving the win rate.

I believe the performance of the different types of improved scores did better than the other scores because the point of the game is to remove all possible moves from the opponent while preserving as many as possible for our agent. Since these improved scores help in maximizing the difference between our agent and the opponent, it makes sense that they would do well. The aggressive versions did better because the opponent is in a way getting a “handicap” by having the agent believe it has more moves than it really does, thus choosing only the moves that will aggressively widen the score’s difference. This shows to be the case when looking at how much better SAIS and AIS did than IS.

Interestingly, the aggressive two ply lookahead score (ATPLS) did very well while its other versions didn’t do as well. I don’t know why this is the case, but we do see the same effect when applying an “aggressiveness” factor improves the family of scores performance. Unfortunately, this can’t be said for the one ply lookahead scores.

In the end, I would suggest one to use the super aggressive improved score because out of all of the scores evaluated it produced the best win rate, it takes into account the goal of the game in simple way, and it only needs to look at the next possible moves (i.e., the next ply) without having to heavily traverse the tree which could cause reduced time performance. Again, it would be interesting to experiment with different “aggressiveness” factors to determine which value would provide the best performance on average when playing the game Isolation.