Analysis of evaluation functions for the game of *Isolation*

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1 Introduction

A good or bad heuristic or evaluation functions for determining the value of a given game board for a player decides about how well it plays against it's opponent. A strong heuristic rightly makes the algorithm descend to the optimal branches whereas a weak heuristic may bait the agent into bad decisions.

2 Analysis

In order to find heuristics to use, the variables of the game board were examined and only two seemed directly viable: *mobility* and *distance to board center*. Mobility depicts the moves that a player has left.

By letting agents with these different evaluation functions compete against each other, the most accurate seemed to be a *weighted mobility difference*, where the weighted mobility of the opponent is subtracted from the weighted own mobility. Weighing the own mobility half and the opponent's mobility double seemed to give the best results. This was examined by systematically changing these weights and letting the agents play against each other.

2.1 Tables

The following table shows the win-loss ratio of the agents with the self-defined heuristics (at the top) vs. agents with heuristics that were provided by the Udacity team. The agent with the heuristic called "AB_Improved" also played against these, to give a baseline to compare against.

2.2 Conclusion

As best evaluation function I chose the one with the highest win rate, which was the weighted mobility difference. Further improvements could be made by using machine learning techniques or gathering more expert knowledge in the game of *Isolation*.

Match#	Opponent	A		B		C		D	
		won	lost	won	lost	won	lost	won	lost
1	Random	38	2	38	2	39	1	38	2
2	MM_Open	39	1	38	2	38	2	37	3
3	MM_Center	40	0	39	1	38	2	40	0
4	MM_Improved	39	1	39	1	40	0	38	0
5	AB_Open	21	19	23	17	18	22	23	17
6	AB_Center	25	15	26	14	18	22	22	18
7	AB_Improved	19	21	18	22	18	22	21	19
Win Rate:		78.9%		78.9%		74.6%		78.2%	

Table 1: Wins and Losses of a game playing agent using Minimax strategy with alpha-beta pruning and different evaluation functions. Agent *A* is equivalent to opponent *AB_Improved*, *B* uses a difference of weighted own moves and weighted opponent moves, agent *C* evaluates the distance to the board center and agent *D* uses the unweighted mobility difference.