Building An Isolation Game Playing Agent
Udacity AI Nanodegree Project Report

Introduction:

Aim is to develop an adversarial search agent to play the game "Isolation". Isolation is a deterministic, two-player game of perfect information in which the players alternate turns moving a single piece from one cell to another on a board. Whenever either player occupies a cell, that cell becomes blocked for the remainder of the game. The first player with no remaining legal moves loses, and the opponent is declared the winner.

This project uses a version of Isolation where each agent is restricted to L-shaped movements (like a knight in chess) on a rectangular grid (like a chess or checkerboard). The agents can move to any open cell on the board that is 2-rows and 1-column or 2-columns and 1-row away from their current position on the board. Movements are blocked at the edges of the board (the board does not wrap around), however, the player can "jump" blocked or occupied spaces (just like a knight in chess).

Additionally, agents will have a fixed time limit each turn to search for the best move and respond. If the time limit expires during a player's turn, that player forfeits the match, and the opponent wins.

Objectives of this project:

1)Implement MinMax Search Algorithm to search the game tree.

2)Implement Alpha-Beta Pruning algorithm to improve the performance of the MinMax game tree.

3)Implement Iterative Depth Search along with Alpha-Beta algorithm to return the best move within the stipulated time limit.

4)Develop different Heuristic evaluation functions which perform comparably or better than provided heuristic evaluation functions.

Heuristics:

1)Custom Score Heuristic: Num of own_moves-2*(Num of opp moves)
2)Custom2 Score Heuristic:Weighted Own moves Score – Weighted Opp moves score
Below is the table representing weight of each location on the board:

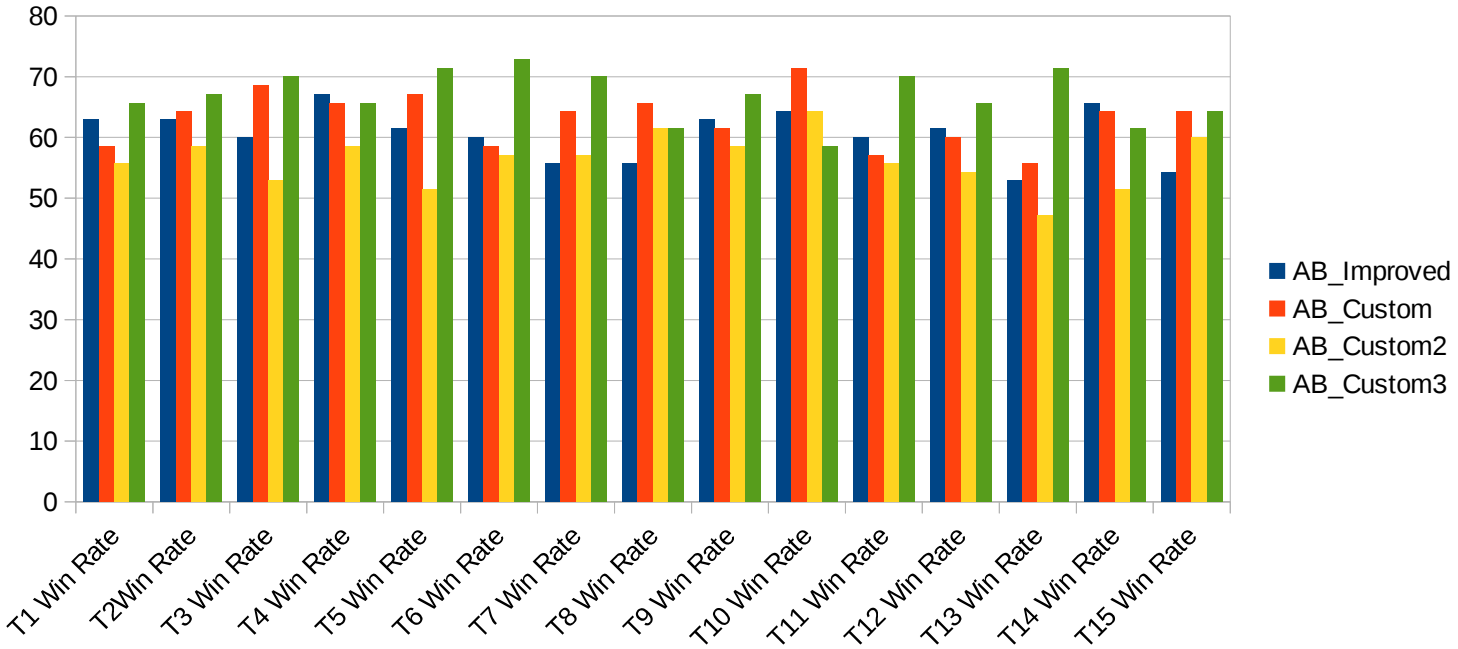
2	3	4	4	4	3	2
3	4	6	6	6	4	3
4	6	8	8	8	6	4
4	6	8	8	8	6	4
4	6	8	8	8	6	4
3	4	6	6	6	4	3
2	3	4	4	4	3	2

Note:Positions near to center of board weighs more compared to positions near to edges of board.
3)Custom3 Heuristic: Num of own moves one ply ahead – Num of opp moves one ply ahead

Results From Different Tournaments:

Tournament	AB_Improved	AB_Custom	AB_Custom2	AB_Custom3
T1 Win Rate	62.9	58.6	55.7	65.7
T2Win Rate	62.9	64.3	58.6	67.1
T3 Win Rate	60	68.6	52.9	70
T4 Win Rate	67.1	65.7	58.6	65.7
T5 Win Rate	61.4	67.1	51.4	71.4
T6 Win Rate	60	58.6	57.1	72.9
T7 Win Rate	55.7	64.3	57.1	70
T8 Win Rate	55.7	65.7	61.4	61.4
T9 Win Rate	62.9	61.4	58.6	67.1
T10 Win Rate	64.3	71.4	64.3	58.6
T11 Win Rate	60	57.1	55.7	70
T12 Win Rate	61.4	60	54.3	65.7
T13 Win Rate	52.9	55.7	47.1	71.4
T14 Win Rate	65.7	64.3	51.4	61.4
T15 Win Rate	54.3	64.3	60	64.3
Mean	60.48	63.14	56.28	66.8466666667
Stdev	4.2000340135	4.4573855245	4.3897933567	4.1904426406

Chart representing results of the different tournaments:



Conclusion:

Above Table and chart gives the information about the winning rates along with Statistics from 10 tournaments.

From the above results,we observe that the Custom3 Heuristic performed better than the AB_Improved except in two tournaments marked in red.

From the statistics,it is clear that the mean winning rate of Custom3 Heuristic is higher that AP_Improved and also than that of remaining custom heuristics.

Custom 3 heuristic explores the search tree one level ahead of next available positions of current positions of players naturally predicts better than AB improved heuristic which explores the tree only one level next to current position of the players.

Also,the computation complexity of Custom 3 Heuristic is comparable to that of AB Improved heuristic. At the beginning of the game, as there are more legal moves available to each player,Custom3 Heuristic takes little more time compared to AB Improved heuristic. But,as the game progresses,the number of legal moves available to each player decreases which in turn reduces the time required to explore one more level ahead of the next available positions.

So,taking into account of the statistics of simulation test results,level of depths of search performed and the computational complexity,Custom3 heuristic is recommended for this game playing agent.