# Heuristics Analysis for Adversarial Isolation Game Playing Agent

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***Abstract*— this review presents the Heuristics techniques used in Adversarial Isolation Game developed as part of the project "*Building a Game Playing Agent*" for Artificial Intelligence Nanodegree, Udacity. Three promising heuristics techniques for the Isolation Game is presented. The technique that minimizes opposition moves and selects moves closer to center of the board achieves the best winning percentage of 67.1%.**

***Index Terms*—Adversarial Agent, Heuristic Analysis.**

## I. INTRODUCTION

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 game 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.

## II. KEY TAKE-AWAYS

Understand the concepts of **Evaluation Function, MiniMax Algorithm, Alpha-Beta Pruning and Iterative Deepening.**

## III. HEURISTICS

### A. *Abbreviations and Acronyms*

AB Prefix – Alpha Beta.

MM Prefix – Minimax.

### B. *AB_CUSTOM*

- This heuristics combines the goodness of both improved heuristics and AB_Custom3 heuristics. Improved heuristics uses my_move (my player) to opponents moves metric to maximize the my_moves and penalize for more opponents moves. Read more one AB_Custom3 heuristics below. By combining the heuristics, the AB_Custom heuristics is able to achieve superior winning rate compared to benchmarked AB_Improved player.
- heuristic = min ( improved_heuristics() , AB_CUSTOM3() )

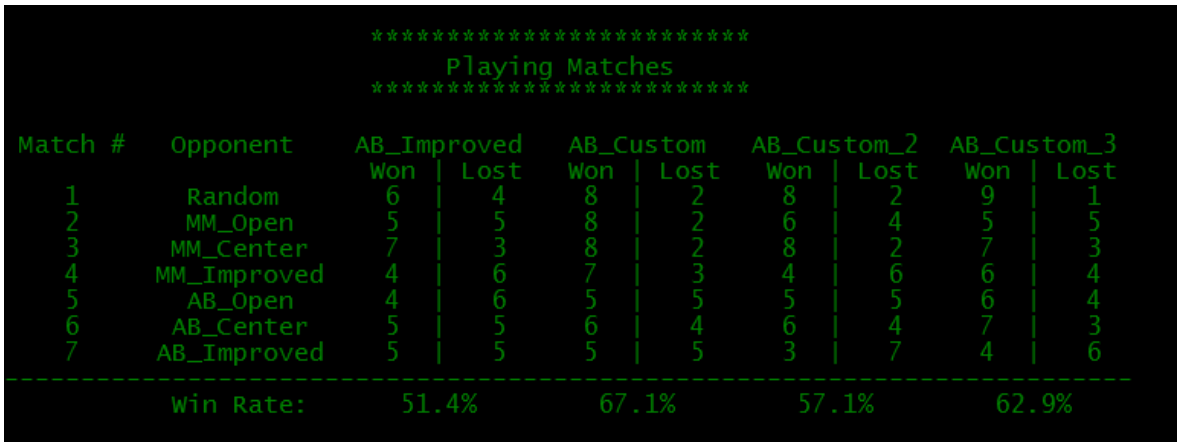
### C. *AB_CUSTOM2*

- This heuristics tries to contain my player's choice of board positions close to center of the board using Euclidean distance measurement between the center of the board to the player's locations. This also uses the inverted center score technique to score higher for location closer to the center and lower for locations on the edges. The final score uses a factor of the improved heuristic score and inverted Euclidean distance score. This heuristics though does not perform well because the Euclidean movement does not reflect the movement of our player.
- heuristic = ( (my_moves - opp_moves) * inverted_eucledian_score )

### D. *AB_CUSTOM3*

- This heuristic implementation is similar to the AB_Custom2 heuristics but the distance measurement is done using the Manhattan Distance since the movement of our players is similar. This heuristics also tries to score higher for the moves closer to the center of the board and uses inverted center scoring technique. The final score uses a factor of the improved heuristic score and inverted Manhattan Center score. This heuristics has performed better against most players and has a better winning margin compared to the benchmarked AB_Improved Player.
- heuristic = ( ( my_moves - 2 * opp_moves ) * invert_mahnattan_centre_score )

*E. Figures*





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## REFERENCES


[1] Artificial Intelligence A Modern Approach – Russel & Norvig

[2]http://theory.stanford.edu/~amitp/GameProgramming/Heuristics.html#diagonal-distance