

Report – Assignment 5

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1 Introduction

In this assignment, we have to code a bot to win the game of Othello. Given a board configuration and a turn, the bot will return a valid move. The game ends when neither of the players can make a valid move. The player with the maximum number of coins is the winner.

2 Algorithms and Heuristic Functions

2.1 Minimax Algorithm

The min max algorithm in AI, popularly known as the minimax, is a backtracking algorithm used in decision making, game theory and artificial intelligence (AI). It is used to find the optimal move for a player, assuming that the opponent is also playing optimally.

2.2 Alpha Beta Pruning

Alpha-beta pruning is a modified version of the minimax algorithm. It is an optimization technique for the minimax algorithm. This is a technique by which without checking each node of the game tree we can compute the correct minimax decision, and this technique is called pruning. This involves two threshold parameter Alpha and beta for future expansion, so it is called alpha-beta pruning.

2.3 Heuristic Functions

This heuristic returns the lead of the player with respect to their opponent.

Heuristic 1:

LeadCoin(position)

```
if position.turn == Black then
    return board.getBlackCount() - board.getRedCount()
else
    return board.getRedCount() - board.getBlackCount()
```

This heuristic tries to improve our possibilities to make a best move.

Heuristic 2:

Mobility(position)

```
int Player_2_moves = board.getValidMoves(other(this->turn)).size();
int Player_1_moves = board.getValidMoves(this->turn).size();
int Moves_differ = Player_1_moves - Player_2_moves;
return Moves_differ
```

3 Winning Criteria

The time constraint to play the next move gives the Alpha Beta bot the advantage of exploring greater depths compared to the Minimax Bot. When time constraints are relaxed, both the bots are ideally expected to play equally well. The comparison between the bots is made using the same heuristic. the two bots play nearly equally well and there is a general trend of the winning bot being the one that starts the game first.

4 Space and Time Complexity

Alpha Beta Pruning algorithm has less time complexity as it moves because it eliminates worse states that need not be explored, the space complexity is also reduced in comparison to Minimax.