DA221 Lab Report

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1 Introduction

The game of Tic-Tac-Toe is played with simplicity, but still reflects some important fundamental concepts.Here, the generated game is a 2 player game with the concept of zero-sum and players using the tokens 'X' and 'O'. Both the players try to play optimally in order to win or have a draw.

2 Minimax Algorithm

This algorithm operates on the principle of minimizing the possible loss for a worst-case scenario. The algorithm searches the game tree by looking ahead at all possible moves and their consequences, down to terminal states of the game (win, lose, or draw). It then backtracks and makes a decision that maximizes the agent's chances of winning while minimizing the opponent's chances.

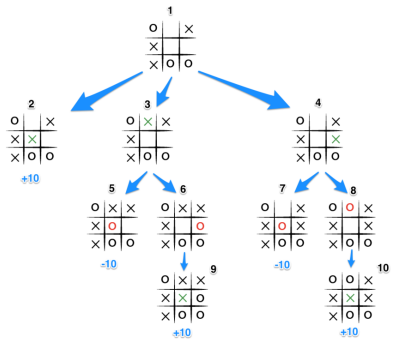

Figure 1: *Tic-Tac-Toe*

3 Alpha Beta Pruning

It is an optimization technique for the Minimax Algorithm. It helps in reducing the number of states or nodes that are to be evaluated in the search tree. Its basic concept is to avoid examing brances in the search tree that won't affect the final decision.

4 Evaluation

We observe from the graphs given below, that the number of game states traversed greatly varies by the use of alpha beta pruning. This verifies that alpha beta pruning indeed helps in cutting off a huge search space making the algorithm more efficient.

This figure gives the average total states for minimax algorithm without applying alpha beta pruning and after applying alpha beta pruning. Data from 5 test cases was collected and the average was plotted to get an overall idea. We can clearly see that the states reduced hugely in minimax algorithm with alpha beta pruning optimization.

Test Cases	Minimax Algorithm	Alpha-Beta Pruning
1.	678350	27637
2.	689230	29659
3.	678310	33108
4.	670458	27039
5.	689784	33765

Table 1: *Experimental Results*

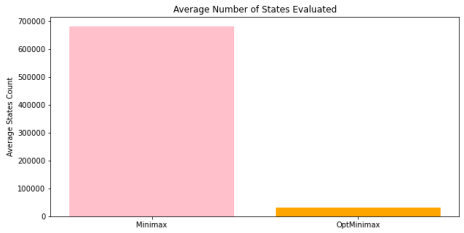

Figure 2: *Average Game States*

This figure shows the exact data for 5 test cases, showing that the states traversed by minimax algorithm is consistently much more than those traversed by optimised minimax algorithm.

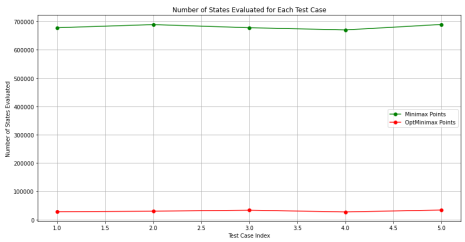

Figure 3: *Experimental 5 test cases results*

5 References

- Artificial Intelligence: A modern approach By Russell and Norvig
- GFG reference for Minimax Algorithm