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Tic-Tac-Toe - README

Overview

This project is a web-based Tic Tac Toe game that lets users either play interactively as a human vs AI, or run an AI vs AI match with two algorithms competing against each other. The AI uses adversarial search strategies, Minimax and Alpha-Beta Pruning, to make optimal moves. The game also tracks algorithm performance metrics, such as decision time and nodes evaluated.

Technologies Used

• Frontend: HTML, CSS, JavaScript
• Backend: Python (Flask)
• Algorithm: Minimax and Alpha-Beta Pruning

Features

• Human vs AI gameplay mode
• AI vs AI mode with selectable algorithm for each player
• Timer to show AI move computation time
• Node counter for performance analysis
• Dynamic scoreboard tracking wins, losses, draws
• Win-line animation on victory
• Turn indicator with colored X and O

Algorithms Used

Minimax

A standard adversarial search algorithm that explores the entire game tree to determine the optimal move for the current player, assuming both players play optimally.

Alpha-Beta Pruning

An optimized version of Minimax that prunes branches that cannot affect the final decision, resulting in faster computation. Alpha and Beta values are used to track the minimum and maximum scores the players are guaranteed.

Both algorithms are deterministic and guarantee optimal play.

Key Implementation Highlights

• The frontend is implemented using semantic HTML and styled with CSS. JavaScript handles game logic and stat tracking.

• The Flask backend handles the AI logic, executing the selected algorithm and returning the AI's move, computation time, and node count.

• A stats display shows the algorithm used, total decision time, number of moves made, and average decision speed for both X and O.

How to Run

1. Make sure Python 3 is installed on your system.
2. Install the required libraries:

   pip install flask
3. Open a terminal and navigate to the project folder.
4. Run the application using:

   python app.py
5. Open your browser and go to:

   http://127.0.0.1:5000

Or the URL provided in the terminal.