TIC TAC TOE

17 March, 2025

Team Members

Maitree Pandey (44)

Tanvi S Patil (50)

Shivani Pawar(54)

Laxmi Ranjvan(59)

Under Guidences of

Prof.Dr.Anita More

Introduction

Tic Tac Toe Game

Tic Tac Toe is a classic two-player game played on a 3x3 grid. Players take turns marking a square with their symbol (usually "X" for one player and "O" for the other). The objective is to be the first to get three of their symbols in a row, either horizontally, vertically, or diagonally. If all squares are filled without a winner, the game ends in a draw

Basic Rules:

1.The game is played on a 3x3 grid.

2. Players alternate turns.

3. A player wins by placing three of their marks in a row (horizontally, vertically, or diagonally).

4.If all squares are filled and no player has three in a row, the game is a draw.

Objective

- *Design and implement a Tic Tac Toe game with AI capabilities.*
- *Provide two game modes:*
  - *Player vs. Player (Two human players)*
  - *Player vs. AI (Human vs. AI-powered opponent)*
- *Use Python and Minimax Algorithm to ensure AI plays optimally.*

Key Features

- *Graphical User Interface (GUI) using Tkinter.*
- *AI that never loses, ensuring a challenging experience.*
- *User-friendly design, making the game interactive and engaging.*

Technology used

Programming Language: Python

- **Simple, readable, and widely used in AI applications.**
- **Provides powerful libraries like Tkinter for GUI and NumPy for matrix operations.**

GUI Library: Tkinter

- **Built-in Python library for creating graphical applications.**
- **Allows users to click, restart, and interact with the game.**

Algorithm: Minimax

- **AI analyzes all possible moves and selects the best one.**
- **Ensures the AI never loses and plays optimally.**

Minimax Algorithm

The Minimax algorithm is a decision-making algorithm commonly used in two-player games, such as chess, tic-tac-toe, and checkers. It is designed to minimize the possible loss for a worst-case scenario while maximizing the potential gain.

Game Tree Representation:

The game is represented as a tree structure where each node represents a game state. The root node is the current state of the game, and each child node represents a possible move from that state.

Maximizing and Minimizing:

The maximizer's goal is to choose the move that leads to the highest possible score, while the minimizer's goal is to choose the move that leads to the lowest possible score for the maximizer.

The algorithm recursively explores all possible moves and their outcomes, alternating between maximizing and minimizing at each level of the tree.

Leaf Nodes and Evaluation:

The algorithm continues to explore the tree until it reaches a terminal state (a win, loss, or draw) or a predefined depth limit.

At the leaf nodes, an evaluation function is used to assign a score to the game state. This score reflects how favorable the state is for the maximizer (positive values) or the minimizer (negative values).

Backtracking Scores:

- Once the leaf nodes are evaluated, the algorithm backtracks through the tree
- For maximizer nodes, it selects the child node with the highest score.
- For minimizer nodes, it selects the child node with the lowest score.

Graphical User Interface (GUI) Implementation

- **Main Menu**
  - Options to Start Game (Player vs. AI / Two Players), Exit, or Restart.
  - Clean and simple design to keep focus on gameplay.

- **Game Board**
  - A 3x3 grid created using buttons that update when clicked.
  - Uses labels to indicate the current player’s turn.

- **User Interactions**
  - Click-based moves: Users can click on empty cells to play their turn.
  - Game feedback: Displays messages for wins, losses, or draws.
  - Restart button: Allows players to reset the game at any time.

Game Working

1. Main Menu

Components:

- Play with AI Button – Opens AI mode.
- Two-Player Mode Button – Opens multiplayer mode.
- Exit Button – Closes the application.

Design Elements:

- Tkinter Frames & Buttons for layout.
- Color theme: #A2B5CD (soft blue).
- Full-Screen Mode improves experience.
  - Exit full-screen with Escape key.

2. AI Mode

- **Checks for a winning move – AI wins if possible.**
- **Simulates all possible moves – Considers the best possible future outcomes.**
- **Assigns a score to each move – High scores indicate better moves.**
- **Chooses the best move – Ensures AI plays optimally.**

Game Working

3. Winner Determination

The program checks rows, columns, and diagonals for three matching symbols.

Winning Patterns:

- *Rows: (0,1,2), (3,4,5), (6,7,8).*
- *Columns: (0,3,6), (1,4,7), (2,5,8).*
- *Diagonals: (0,4,8), (2,4,6).*

Tie Condition

- *If no winning pattern is found and no moves are left, the game ends in a draw.*

4. Restart ,Back (Game Controls)

- **Turn Indicator – Shows the current player.**
- **Restart Button – Resets the board without changing the selected mode.**
- **Back Button – AI Mode → Returns to AI selection.**

– Two-Player Mode → Returns to main menu.

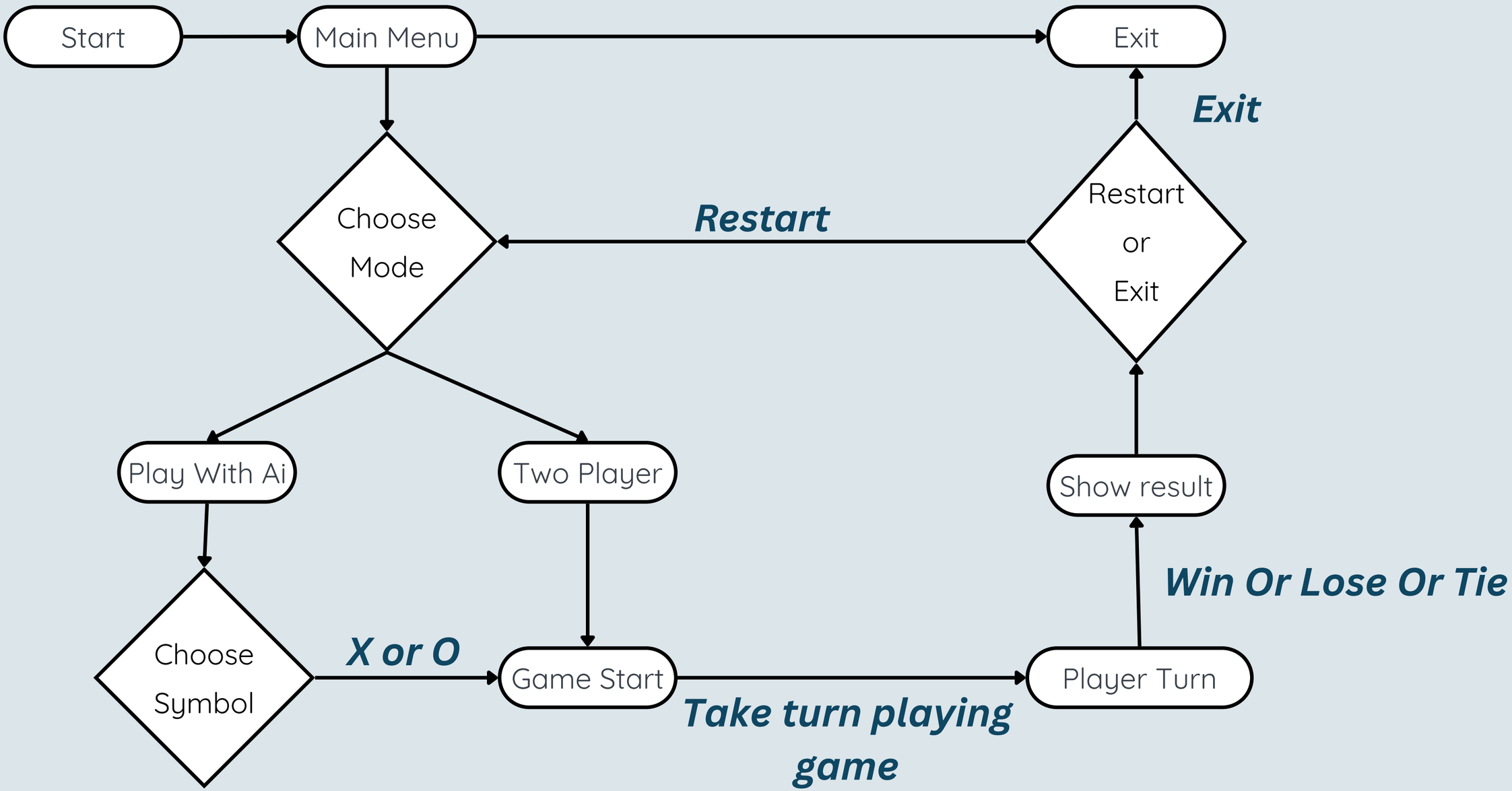
Code Explanation

- **Initializing the Game**
  - *Setting up the Tkinter window and defining the 3x3 board.*
  - *Initializing variables for player turns and AI processing.*

- **Handling Player Moves**
  - Button click detection updates the board with X or O.
  - Turn switching mechanism allows smooth gameplay.

- **Checking for a Winner**
  - Condition checks for rows, columns, and diagonals to detect a winner.
  - Ends the game and displays a message if someone wins or the game is a draw.

- **AI Move Execution**
  - Calls the Minimax algorithm to determine the best move.
  - Updates the board with AI’s move and switches turns.


Start
Main Menu
Exit
Exit
Choose Mode
Restart
Restart or Exit
Play With Ai
Two Player
Show result
Win Or Lose Or Tie
Choose Symbol
X or O
Game Start
Player Turn
Take turn playing game

Game Features

- Graphical User Interface (GUI)
  Built with Tkinter, providing a smooth and interactive experience.

- Two Playing Modes:
  Play with AI – The player can choose X or O, and AI will play strategically.
  Two Player Mode – Two players take turns playing on the same system.

- AI Implementation:
  Uses Minimax Algorithm to make optimal moves.
  AI always plays the best possible move, making it hard to defeat.

- User-Friendly Features:
  Restart and Back buttons for easy navigation.
  Displays whose turn it is at every stage of the game.

Challenges

Challenge 1: Making AI Unbeatable

- Problem: AI sometimes made incorrect or Random moves.
- Solution: Implemented Minimax correctly with base cases.

Challenge 2: Full-Screen Mode & Centering

- Problem: Game was misaligned and too small.
- Solution: Enabled full-screen mode and dynamic centering.

Challenge 4: Restart & Back Buttons

- Problem: Players had to restart the app to replay.
- Solution: Added Restart and Back buttons for smooth navigation.

Challenge 5: Choosing X or O

- Problem: Players were always assigned ‘0’.
- Solution: Added selection screen for player choice.

Future Improvements

Enhanced AI

- Implement advanced algorithms for a more challenging AI.
- Introduce difficulty levels:
  - Easy: AI makes random moves.
  - Medium: AI plays logically but not optimally.
  - Hard: AI uses Minimax .

Multiple Game Modes

- 3D Tic-Tac-Toe: Play across multiple layers.
- Larger Grids: Expand to 4x4 or 5x5 for added complexity.
- Timed Matches: Set a time limit per move for a fast-paced challenge.

Customization & Experience

- Custom Themes: Enhance visuals with theme options.
- Sound Effects: Add immersive audio feedback for moves and game events.

Conclusion

In conclusion, while Tic-Tac-Toe may seem like a simple game at first glance, there is substantial potential for innovation and improvement. By addressing its limitations, enhancing AI capabilities, expanding multiplayer options, and focusing on user experience, developers can transform Tic-Tac-Toe into a more engaging and versatile game.

The incorporation of educational elements, community features, accessibility options, and cross-platform support can further enrich the experience, ensuring that Tic-Tac-Toe remains a beloved classic while evolving to meet the expectations of modern players.

Ultimately, these enhancements can lead to a more dynamic and enjoyable gaming experience, fostering a new generation of Tic-Tac-Toe enthusiasts.

Thank You