

National University of Computer & Emerging Sciences
Karachi Campus



Three Player Connect 4 AI Bot

Project Report
Artificial Intelligence
Section: B

Group Members:

| | |
|------------------------|----------------------------|
| <u>22k-0504</u> | <u>Abdul Tawab</u> |
| <u>22k-4549</u> | <u>Muzaffar Ali</u> |
| <u>22k-4570</u> | <u>Sahir Hassan</u> |

Project Overview

This project implements a **Connect 4 game with 3-player support**, featuring AI-powered opponents, a dynamic graphical interface, and multiple gameplay modes. The game is designed using **Python's Pygame library** for the GUI and leverages the **Minimax algorithm with Alpha-Beta Pruning** for AI decision-making.

Key Features

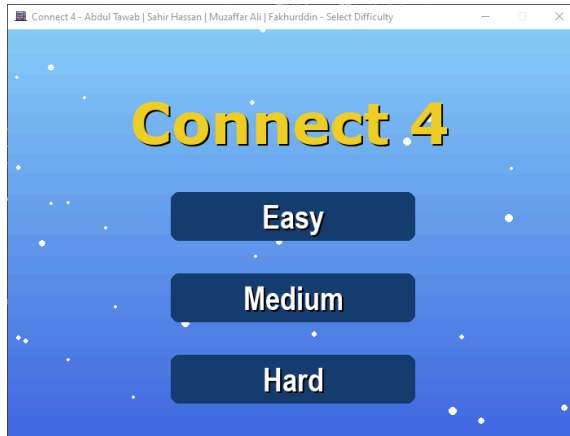
- **Three-Player Support:** Innovative extension of traditional Connect 4 rules to support 3 players.
- **AI Integration:** AI players powered by Minimax with Alpha-Beta Pruning for efficient and competitive gameplay.
- **Graphical User Interface (GUI):** Built using Pygame with interactive buttons, smooth animations, and intuitive visuals.
- **Menu-Based Navigation:** Layered menu system for selecting difficulty, player count, and player configuration.
- **Interactive Controls:** Simple mouse-based interactions for ease of play.
- **Audio Feedback:** Integrated sound effects for actions like piece drops, victories, and ties.
- **Endgame Screens:** Displays for victory and tie outcomes with aesthetic transitions.

Technologies Used

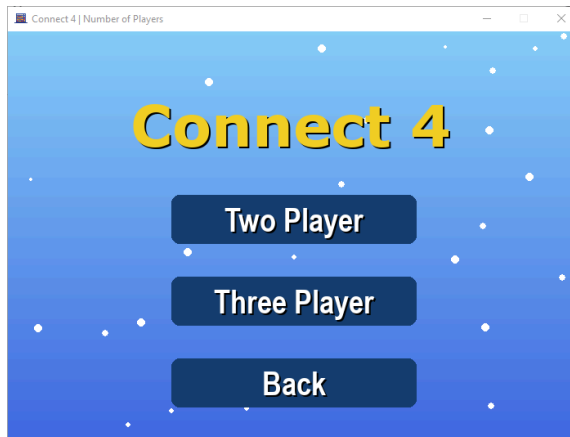
| Component | Technology |
|--------------|------------------------------|
| Programming | Python |
| GUI Library | Pygame |
| AI Algorithm | Minimax + Alpha-Beta Pruning |
| Sound | Pygame.mixer |

Project Flow

1. Difficulty Selection Menu

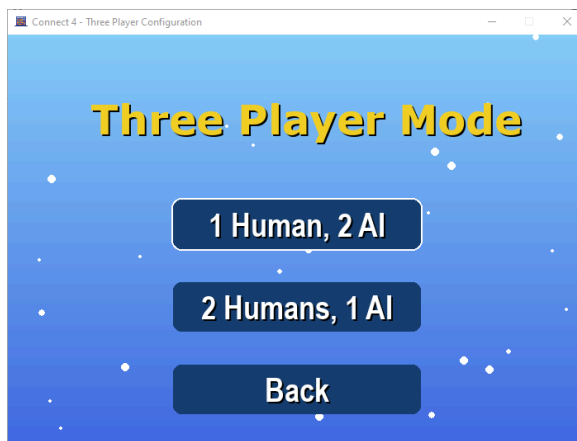


2. Player Count Selection Menu



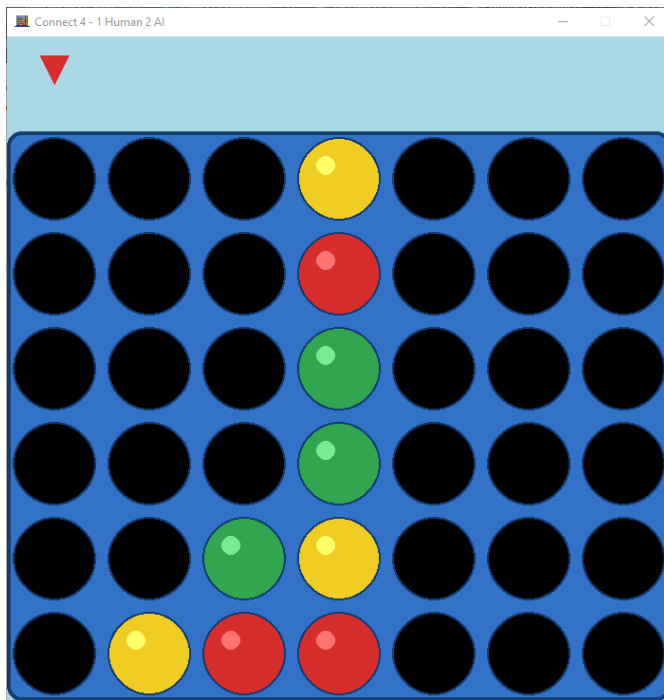
3. 3-Player Configuration Menu

- 2 AI vs 1 Human
- 1 AI vs 2 Humans



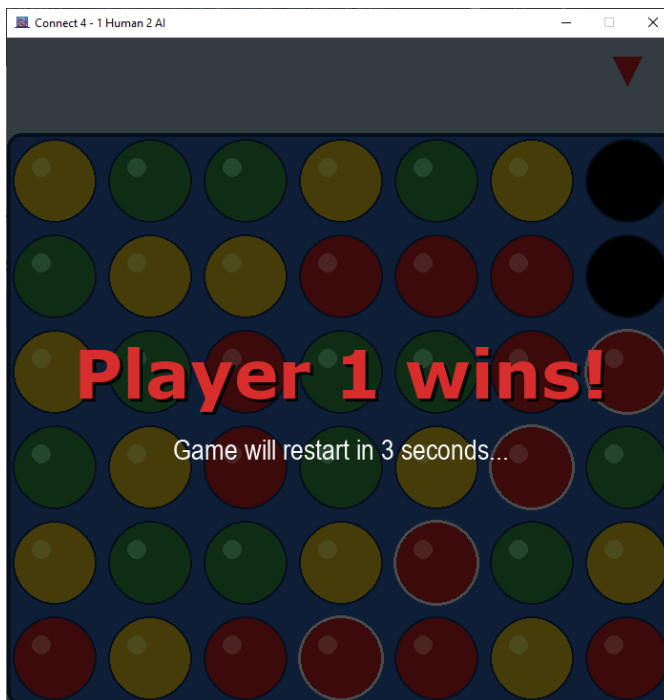
4. Game Board

- Interactive game environment
- Turn-based play with AI and human integration



5. Match Status

- win detection, tie detection



AI Implementation

The AI uses the **Minimax algorithm with Alpha-Beta Pruning**, which enhances decision-making speed by pruning suboptimal branches in the game tree.

- **Evaluation Function:** Assesses board positions based on potential winning lines.
- **Depth Limiting:** Controls AI search depth to balance performance and computation time.
- **Multi-Player Adaptation:** The AI accounts for multiple opponents, modifying traditional 2-player minimax strategies to accommodate 3-player game dynamics.

GUI Design

- **Menu System:** Buttons and navigation transitions.
- **Board Graphics:** Color-coded pieces for each player.
- **Responsive Cursor:** Cursor changes on hover for interactivity.
- **Sound Integration:** Distinct sounds for piece drops, wins, and draws.
- **Winning Animation:** Highlights winning sequence with celebratory sounds.

Gameplay Modes

- **1 AI vs 1 Human**
- **2 AI vs 1 Human**
- **1 AI vs 2 Humans**
- Optional difficulty settings influence AI depth and response time.

Conclusion

This project successfully demonstrates a creative and technical approach to extending Connect 4 into a 3-player game, combining AI, GUI design, and intuitive game mechanics. It provides an engaging user experience through a polished interface and intelligent AI opponents.