

National University of Computer & Emerging Sciences
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Three Player Connect 4 AI Bot

Project Proposal
Artificial Intelligence
Section: B

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Introduction

The **3 Player Connect 4 AI Bot** is an AI-driven system designed to play a modified version of the classic **Connect 4** game with three players instead of two. The system will feature an intelligent AI opponent capable of strategic decision-making using game tree search algorithms. The AI will analyze the board state and select the best possible move, ensuring a challenging and engaging experience for human players.

Existing System

Currently, **Connect 4** is widely available as a two-player game, both in physical form and digital versions. AI opponents exist for two-player Connect 4 using algorithms like Minimax with Alpha-Beta Pruning and Monte Carlo Tree Search (MCTS). However, most implementations focus solely on two-player interactions and do not account for a three-player variant.

Limitations of Existing Systems:

1. **Two-Player Constraint:** Most AI bots are designed for two-player gameplay and cannot handle additional complexity.
2. **Limited Strategy Depth:** AI implementations often rely on standard heuristics rather than advanced learning techniques.
3. **Lack of Dynamic Gameplay:** Existing systems do not support multi-player AI interaction, reducing strategic depth.

Problem Statement

The traditional **Connect 4 AI** is optimized for two players, meaning it does not cater to a three-player environment where additional strategic complexity is introduced. The primary challenges include:

1. **Turn-Based Strategy:** Handling three players dynamically and ensuring fairness.
2. **Game Tree Complexity:** Expanding AI search techniques to efficiently handle a larger decision space.

Proposed Solution

Our **3 Player Connect 4 AI Bot** will address these challenges by implementing a robust AI capable of competing in a three-player setting. The AI will:

1. Use **Monte Carlo Tree Search (MCTS)** combined with **Alpha-Beta Pruning** to optimize decision-making.
2. Implement **heuristic evaluation functions** that adapt to three-player scenarios.
3. Introduce a **balanced turn system** ensuring fairness among all players.
4. Optimize computational performance using parallel processing for move calculations.
5. Feature an intuitive **graphical user interface (GUI)** for human interaction.

Salient Features

- **Three-Player Game Mode:** Supports gameplay for three players (AI vs AI vs Human or Human vs Human vs AI).
- **AI Opponent:** Utilizes **Monte Carlo Tree Search (MCTS)** and **Minimax Algorithm** for intelligent decision-making.
- **Customizable Difficulty Levels:** Users can adjust AI difficulty based on search depth and heuristic evaluation.

Tools & Technologies

- **Programming Language:** Python
- **Frameworks & Libraries:** Tkinter, Pygame (for GUI), NumPy (for calculations), anything else needed.
- **Operating Systems:** Windows, Linux, Mac OS
- **Version Control:** GitHub for source code management
- **Development Environment:** Visual Studio Code