

National University of Computer & Emerging Sciences
Karachi Campus



Connect 4 with AI opponent

Project Proposal
Artificial Intelligence
Section: E

Group Members:

22k-4561 Rayyan Zafar Jaffery

22k-4164 Kashan Alam

22k-4401 Anas Hussain

Project Proposal

Introduction

This project aims to develop a **Connect 4 game with an AI opponent** using **Unity for visuals** and **Pygame for AI implementation**. The game will allow a human player to compete against an AI, which will use the **Minimax algorithm with Alpha-Beta pruning** to make strategic decisions. The objective is to create an engaging, interactive board game that demonstrates **artificial intelligence in decision-making** while utilizing the **powerful graphics engine of Unity** to enhance user experience.

Existing System

Several versions of Connect 4 exist, including:

- **Physical Board Game:** Traditional Connect 4 played with discs in a vertical grid.
- **Online Connect 4 Games:** Websites and apps allow players to play against each other or AI.
- **AI-Based Connect 4:** Some implementations use basic rule-based AI or reinforcement learning.

However, many existing implementations do not optimize AI strategies efficiently, leading to predictable and non-challenging gameplay. Furthermore, many implementations lack high-quality visuals and animations that improve the overall user experience.

Problem Statement

Existing AI opponents in Connect 4 games often lack strategic depth, making them either too easy to defeat or overly difficult without a balanced approach. Additionally, many implementations lack visually appealing graphics, making the gameplay less immersive.

This project seeks to improve AI performance by implementing a **Minimax algorithm with Alpha-Beta pruning**, which allows the AI to think ahead and make more human-like decisions. The Unity engine will be used to develop **high-quality**

visuals, animations, and a user-friendly interface, making the game more engaging.

Proposed Solution

To address these issues, we propose to:

- Implement an **AI opponent using Minimax with Alpha-Beta pruning** in Python with Pygame.
- Develop the **game visuals and UI in Unity**, ensuring a smooth and appealing user experience.
- Design an **user-friendly interface**
- Improve game flow with **smooth player and AI movements**.
- Optimize the AI difficulty level to make it **challenging but fair**.
- Integrate **Pygame's AI logic with Unity's game mechanics**, allowing seamless communication between both components.

Salient Features

- **Single-player mode** against an AI opponent.
- **Minimax algorithm with Alpha-Beta pruning** for intelligent AI decision-making.
- **High-quality game visuals** developed in Unity.
- **Graphical animations for dropping pieces** and win/loss effects.
- **Turn-based mechanics** following Connect 4 rules.
- **Real-time board updates**
- **Win detection system** to identify game-ending moves.
- **Adaptive AI difficulty** based on game progress.
- **Seamless integration between Unity and Pygame** for AI processing.

Tools & Technologies

- **Programming Language:** Python (for AI logic), C# (for Unity game development)
- **Frameworks:** Pygame (AI Implementation), Unity (Game Development)
- **AI Algorithm:** Minimax with Alpha-Beta Pruning
- **Graphics Engine:** Unity (for UI, animations, and game rendering)

- **Operating System:** Cross-platform (Windows, Linux, macOS)
- **Development Tools:** Unity Editor, Visual Studio Code
- **Unity Asset Integration:** Free assets from the Unity Asset Store for game visuals

This proposal outlines the plan to develop an AI-based Connect 4 game that will be both **challenging and visually engaging** for players. The integration of **optimized AI algorithms** with **Unity's advanced graphics engine** ensures a **competitive and immersive pleasing gaming experience**.