Project Proposal: Strategic Mancala AI Game

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Course: AI

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# 1. Project Overview

## ● Project Topic:

I have chosen the classic board game Mancala and implemented an AI-enhanced version of it. The innovation involves integrating a strategic AI opponent using the Minimax algorithm with Alpha-Beta pruning to create a challenging gameplay experience.

## ● Objective:

The goal is to develop a strategic AI opponent that plays Mancala optimally against a human player. The AI uses Minimax with Alpha-Beta pruning and heuristics to simulate future game states and determine the best moves.

# 2. Game Description

## ● Original Game Background:

Mancala is a two-player turn-based game where players take turns picking stones from one of their pits and sowing them counterclockwise across the board. The aim is to collect the most stones in your store. (0-5) My turn, (7-12) AI Turn

## ● Innovations Introduced:

○ Integration of AI using Minimax with Alpha-Beta pruning for a more challenging single-player experience.

○ Turn-based interaction with automatic detection of endgame and winner.

○ Heuristic evaluation function to simulate intelligent decision-making.

○ Increased game complexity through decision-tree depth and evaluation.

# 3. AI Approach and Methodology

## ● AI Techniques to be Used:

○ Minimax Algorithm (standard 2-player adversarial search).

○ Alpha-Beta Pruning (used to reduce the search space).

## ● Heuristic Design:

○ The heuristic function calculates the difference in the number of stones between the AI's store and the human player's store.

## ● Complexity Analysis:

○ Time complexity is O(b^d), where b is the branching factor (number of legal moves) and d is the depth of the search tree. Alpha-Beta pruning significantly reduces the number of nodes evaluated.

# 4. Game Rules and Mechanics

## ● Modified Rules:

○ The game follows traditional Mancala rules but adds an AI opponent for solo gameplay.

## ● Winning Conditions:

○ The player with the most stones in their store at the end of the game wins.

## ● Turn Sequence:

○ Player 1 (Human) moves first, followed by Player 2 (AI). If a player ends in their store, they get another turn.

# 5. Implementation Plan

Programming Language: Python

Libraries and Tools:

○ Tkinter (for GUI)

○ Built-in libraries (for core logic and data handling)

## ● Milestones and Timeline:

○ Week 1-2: Game design and rule finalization

○ Week 3-4: AI strategy development (Minimax and heuristics)

○ Week 5-6: Coding and testing the game mechanics

○ Week 7: AI integration and testing

○ Week 8: Final testing and report preparation

# 6. References

● https://en.wikipedia.org/wiki/Mancala

● Russell, S., & Norvig, P. (2010). Artificial Intelligence: A Modern Approach.

● Various online resources on Minimax and Alpha-Beta pruning.