Hex-Draughts – A Strategic AI Game on a Hexagonal Board

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Course: AI

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1. Project Overview

- Project Topic:
  A web-based implementation of the traditional Draughts game with a modified hexagonal board layout. The game includes an AI opponent that can play against the human player.
- Objective:
  To implement a playable Draughts game on a hexagonal board and integrate AI using the Minimax algorithm with Alpha-Beta pruning for decision making.

2. Game Description

- Original Game Background:
  Draughts (also known as Checkers) is a classic two-player strategy game played on an 8x8 grid with diagonal movement and mandatory captures. The goal is to eliminate all opponent pieces or block them from moving.
- Innovations Introduced:
  - The board layout is changed to a hexagonal grid instead of the traditional square grid.
  - Players move pieces diagonally (adjusted to hex neighbors), and standard rules such as capturing and kinging apply with suitable modifications.
  - This board shape introduces a unique perspective on strategy and mobility.

3. AI Approach and Methodology

- AI Techniques to be Used:
  - Minimax Algorithm
  - Alpha-Beta Pruning

- Heuristic Design:
  The evaluation function will consider piece count, king count, proximity to promotion, and central control, adjusted for the hex board structure.
- Complexity Analysis:
  Time complexity increases with branching factor. Alpha-Beta pruning will reduce the number of evaluated nodes. Complexity also arises from adapting movement and capturing logic to the hexagonal layout.

4. Game Rules and Mechanics

- Modified Rules:
  - Movement and capturing rules will be adapted to work with hexagonally arranged cells.
  - The rest of the traditional rules such as forced capture and kinging will be preserved.
- Winning Conditions:
  - A player wins by eliminating all opponent pieces or leaving them with no legal moves.
- Turn Sequence:
  - Players alternate turns, starting with the human player.

5. Implementation Plan

- Programming Language: Python
- Libraries and Tools:
  - Pygame (for game rendering and interaction)
  - Python standard libraries (for logic and AI)
- Milestones and Timeline:
  - Week 1-2: Game design and hex board setup
  - Week 3-4: Game rules implementation
  - Week 5-6: AI strategy development and testing
  - Week 7: AI integration and player vs AI testing
  - Week 8: Final testing, bug fixing, and report preparation

6. References

- Wikipedia – English Draughts
- Red Blob Games – Hexagonal Grids Guide
- TutorialsPoint – Minimax Algorithm