HexBots – AI Grid Conquest

1. Project Overview

HexBots is an interactive AI-powered hexagonal grid strategy game built using Python and Streamlit. The game offers three distinct modes:

i. Manual Mode (Human vs Human)
ii. User vs AI (Human vs multiple AI bots)
iii. AI vs AI (automated simulation)

Players take turns capturing cells on a 6x6 or 7x7 board to expand their territory. Each AI can represent different decision models (LLaMA, Mistral, DeepSeek), generating moves through logic or language model prompts.

2. Technologies Used

Technology Used	Name
Frontend	Streamlit
Backend	Python (with NumPy and modular architecture)
AI Logic	Goal-based agent logic, Minimax with Alpha-Beta pruning, l LLM prompt-based simulation
Visualization	Matplotlib
AI Models	**1. LLaMA:** meta-llama/llama-4-scout-17b-16e-instruct **2. Mistral:** mistral-saba-24b **3. DeepSeek:** deepseek-r1-distill-llama-70b
AI Cloud Platform	Groq

3. Game Modes and Mechanics

1. Manual Mode: Players click to conquer grid cells. No AI involved.
2. User vs AI: Human plays alongside AI bots with simulated response delays.
3. AI vs AI: Multiple AI bots play autonomously, displaying AI-generated reasoning.

4. AI Logic and Methodology

The AI uses a combination of:

1. Goal-based agent behaviors
2. Minimax algorithm with Alpha-Beta Pruning
3. Heuristic evaluation based on:
   - Controlled territory
   - Blocking potential
   - Proximity to key tiles

4. LLM-based prompts to simulate reasoning

5. Generative AI

5. Complexity Analysis

1. Minimax complexity: O(b^d)
2. Alpha-beta pruning reduces it to: O(b^(d/2))
Where **b =** branching factor, **d =** depth of search tree
multi-agent turns increase exponential state growth due to simultaneous moves.

6. Notable Features and Achievements

- Custom AI logic for various player types
- Grid cell click detection with validation
- Animated moves and AI response dialogs
- Auto-play simulation with per-turn updates
- multi-player support (2–4)
- Winner detection and live score tracking

- AI models playing with users or with one another in real time

7. Future Enhancements

- Integrate real-time multiplayer
- Enable difficulty levels for AI

- Add dark/light mode toggles
- Store leaderboard and game history
- Use RAG (Retrieval-Augmented Generation) for enhanced move suggestions