# **HexBots – AI Grid Conquest**

## **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.

## **Technologies Used**

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| **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