

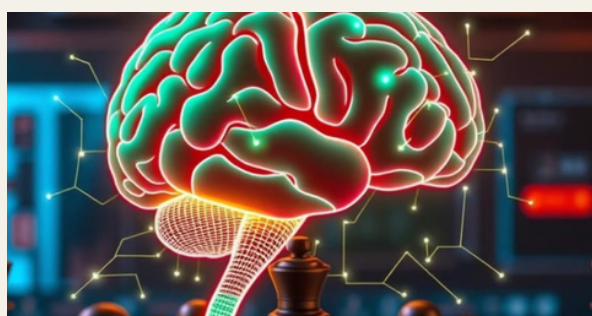
Outthink the Machine: Challenge Our Chess AI!

"Think ahead, move smart — AI has already made its move!"

Introduction

Chess is the ultimate battle of strategy and intelligence. Our **AI-Based Chess Game** brings a whole new dimension to this timeless classic by integrating **Artificial Intelligence**.

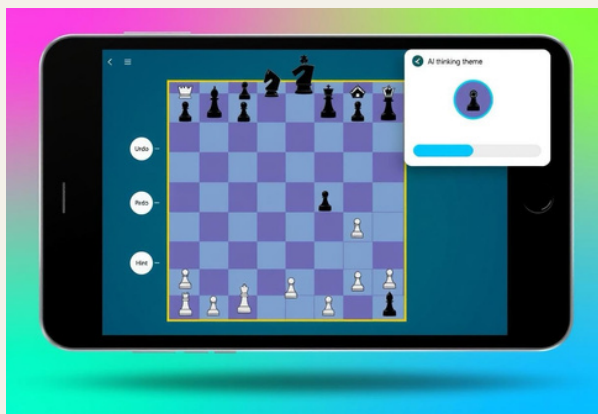
Using **Python**, **Pygame**, and the **Minimax algorithm with Alpha-Beta Pruning**, we have designed a dynamic chess experience where players can challenge an intelligent and adaptive opponent. This project is not just a game — it is a platform to learn, improve, and experience the power of AI-driven decision making.



Functional Needs

Our game combines **smooth gameplay** with **advanced AI** features:

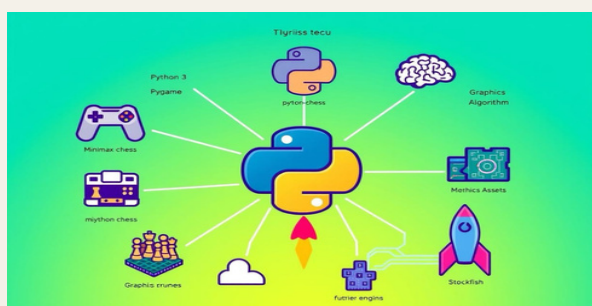
- **Move Validation:** Ensures only legal moves using python-chess.
- **Intelligent AI:** AI searches multiple moves ahead before making decisions.
- **Undo and Redo:** Players can take back moves to correct mistakes.
- **Dynamic Theme Switching:** Players can customize board and pieces in real-time.
- **Real-time Hints:** Highlights selected pieces and possible valid moves.
- **Game Status Display:** Real-time updates like "Your Turn", "AI Thinking", "Checkmate", or "Stalemate".



Tech Stack

We use a strong combination of tools and technologies:

- Programming Language:** Python 3
- GUI Development:** Pygame
- Chess Engine:** python-chess library
- AI Techniques:** Minimax Algorithm with Alpha-Beta Pruning
- Graphics Assets:** Custom piece images and board themes
- Future Scope:** Integration with stronger engines like Stockfish



Objectives

The project aims to:

- Develop an intelligent chess-playing opponent using **Minimax** and **Alpha-Beta Pruning**.
- Create a **user-friendly graphical interface** with smooth interactions.
- Allow **customization** through aboard themes and piece styles.
- Enable users to **undo moves**, **switch sides**, and **flip the board** for better control.
- Provide a platform where players can **improve strategic thinking** while enjoying gameplay.

AI Move Prediction: Visualizing the Thinking Process

In our AI-Based Chess Game, the AI doesn't just react — it predicts the future. Using the Minimax algorithm with Alpha-Beta Pruning, the

AI explores multiple possible move combinations several steps ahead, evaluating each future board state for the best possible outcome.

This deep foresight allows the AI to anticipate player strategies, defend against attacks, and create winning opportunities, making every move a product of real-time strategic thinking — just like a human grandmaster planning moves ahead.



Workflow

The core logic follows a simple but powerful workflow:

- 1.Player Move:**
Player selects a piece and clicks to move.
- 2.AI Decision-Making:**
AI simulates possible future moves using Minimax. It evaluates:
 - 1.Material balance
 - 2.Mobility (number of legal moves)
 - 3.Pawn structure (penalizes doubled pawns)
- 3.Best Move Execution:**
The AI chooses the best move and updates the board.
- 4.Game Progression:**
The system automatically detects check, checkmate, or stalemate, and displays the result.
- 5.Customization:**
Players can change themes or flip the board anytime without interrupting gameplay.



Advantages

- AI uses deep search, not random moves — making gameplay realistic and competitive.
- User-friendly GUI with intuitive controls.
- Real-time feedback with move highlights.
- Customization options to enhance user engagement.
- Lightweight setup requiring only Python and Pygame to run.

Scalability and Cost

- **Scalability:**
Easily upgradable to include stronger engines (e.g., Stockfish) or even multiplayer online features.
- **Cost Efficiency:**
Built with open-source libraries, making it lightweight, cost-free, and accessible on any system supporting Python.
- **Portability:**
Can be run across different operating systems without major modifications.



Real-Time Applications

This project has a wide range of useful applications:

- Skill Development:** Train strategic thinking by practicing against a smart AI.
- Learning Platform:** New players can learn from their mistakes using the undo feature.
- Entertainment:** Offers engaging chess matches offline without needing an internet connection.
- Research Base:** Acts as a base project for testing new AI enhancements and search algorithms.



Conclusion

The **AI-Based Chess Game** brings a smart, thinking opponent to life, blending the timeless strategy of chess

with the power of Artificial Intelligence. By using **Minimax** with **Alpha-Beta Pruning**, it challenges players to think deeper, plan better, and sharpen their decision-making skills with every move.

Beyond just a game, it serves as a **learning tool** and a **platform for AI experimentation**, offering smooth gameplay, intelligent responses, and real-time feedback. Its scalable and lightweight design promises endless opportunities for future enhancements like **stronger engines**, **online multiplayer**, and **tournament play**.

- This project proves that with AI, even a centuries-old game like chess can be made **smarter, more dynamic, and endlessly exciting** — truly redefining the future of strategic gaming.

Team

MEMBER 1: RA2311056010154(Sanjeev A)
MEMBER 2: RA2311056010149(M Abdul Aatif)
MEMBER 3: RA2311056010171(D.Guru Prasaath)

YEAR AND SECTION : 2ND YEAR(AN-1)

SECTION)

COURSE FACULTY: Dr.Nadana Ravishankar T