Connect Four AI Game – Project Documentation

1. Project Idea

AI **Connect Four** game. The game lets human to play against the computer (AI). The goal is to connect four discs of the same color vertically, horizontally, or diagonally. The project demonstrates the use of **search-based decision making** in a simple and interactive game.

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2. Algorithms Used

The project uses simple and clear AI algorithms suitable for the game as :

- **Heuristic-Based Search**:
  Simple heuristics are applied where winning moves have the highest priority, followed by blocking the opponent.
- **Random Move Selection (Easy Mode):**
  In easy mode, the AI selects a random valid column.

These algorithms keep the project easy, better to understand.

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3. System Design Outline

The system is divided into the following components:

- **Game Logic:**
  - Board representation using a 2D NumPy array.
  - Functions to drop discs, check valid moves, and detect wins or draws.
- **AI Module:**

- Determines the best column to play based on the selected difficulty level.

- **Graphical User Interface (GUI):**
  - Built using **matplotlib** and **ipywidgets**.
  - Buttons allow the user to choose columns, difficulty level, starting player, and reset the game.

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4. How to Run the Project

1. Install the required libraries:
2. pip install numpy matplotlib ipywidgets notebook (which can be available easily on google colab) .
3. Open **Jupyter Notebook**.
4. Create a new Python notebook.
5. Copy and paste the source code into one cell.
6. Run the cell.
7. Start playing the game from the available buttons of gui .

⚠️ Note: This project must be run in **Jupyter Notebook or JupyterLab** because it uses interactive widgets.

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5. Input / Output Samples

Input:

- User (which is the red one)select a column button (Col 1 – Col 7).
- User selects difficulty (Easy / Hard).

Output:

- The AI game(which is the yellow one) board updates visually.
- Messages displayed at the top:
  - "Your Turn"
  - "AI Turn"
  - "You Win!"
  - "AI Wins!"
  - "Draw!"

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6. Testing Results

The project was tested under the following conditions:

- All columns filled → Draw detected correctly (which means no one win or fails).
- Horizontal, vertical, and diagonal wins → Detected correctly(win).
- Easy mode → AI plays randomly.
- Hard mode → AI blocks and wins when possible.
- Reset button → Game restarts successfully.

All tests passed successfully, and the game runs without errors.

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7. Libraries Used

- Python 3
- NumPy

- Matplotlib
- ipywidgets
- IPython.display

All external libraries are open-source and are clearly mentioned as required.

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8. Team Members Roles

All the team members collaborate at doing the code of the project and detect, fix any error and checked that the game runs correctly .