

ABOUT THE PROJECT

Connect 4 is a strategic two-player board game in which players aim to be the first to align four of their coloured discs—horizontally, vertically, or diagonally—on a 6×7 grid.

The project explores the development of an artificial intelligence opponent that can play the game at a high level, using classical search strategies.

PROJECT GOAL

Develop an intelligent Connect 4 opponent capable of competing with human players.

Implement and compare the performance of various search algorithms including:

- Minimax
- Alpha-Beta Pruning
- Iterative Deepening Alpha-Beta

Our AI guarantees a draw or win using optimal decision-making techniques.

PROBLEM FORMULATION

1. Initial State: An empty 6×7 board
2. Actions: Drop a disc into any non-full column
3. Transition Model: Disc falls to the lowest available cell
4. Goal Test: Four aligned discs of the same colour
5. Utility Function: $+\infty$ (win), $-\infty$ (loss), 0 (draw)
6. Path Cost: Each move costs 1 step



CONNECT 4 Game

GRAPHICAL INTERFACE

The interface includes a main menu with options: Human vs AI, AI vs AI, and Quit. The AI algorithm selection screen shows three options: MINIMAX, ALPHA-BETA, and ITERATIVE DEEPENING. The MINIMAX screen describes it as "Perfect play but slower, Uses full depth search." The ALPHA-BETA screen describes it as "Optimal moves, faster, Prunes unnecessary branches." The ITERATIVE DEEPENING screen describes it as "Balanced, time-limited, Gradually increases depth." The game board view shows a 6x7 grid with colored discs (Red, Yellow, Green, Blue) and player statistics.

AI ALGORITHMS USED

1. Minimax Algorithm

- Evaluates all possible moves assuming both players act optimally
- Guarantees the best result but is computationally heavy

2. Alpha-Beta Pruning

- Optimises Minimax by cutting off unnecessary branches
- Significantly improves performance without sacrificing accuracy

3. Iterative Deepening Alpha-Beta

- Combines iterative deepening with pruning
- Supports time-limited search with progressively deeper levels
- Ideal for real-time AI decision making



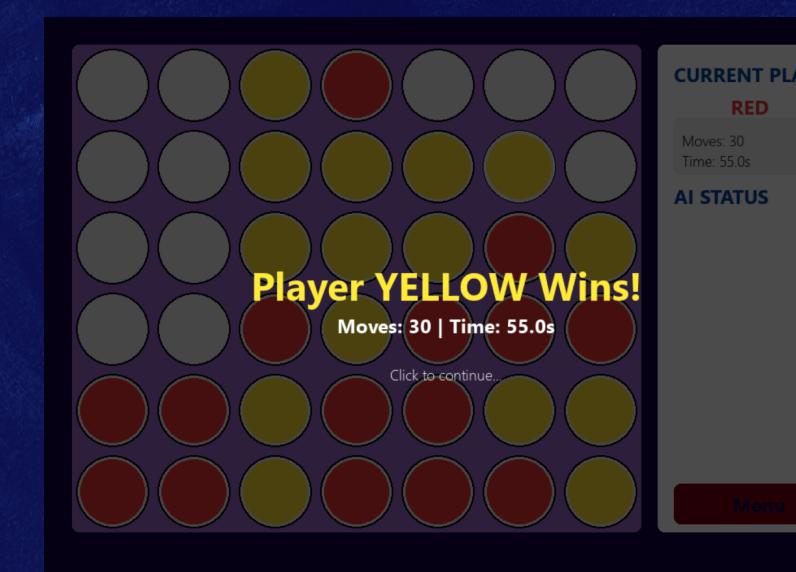
Supervisor
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RESULT

MINIMAX



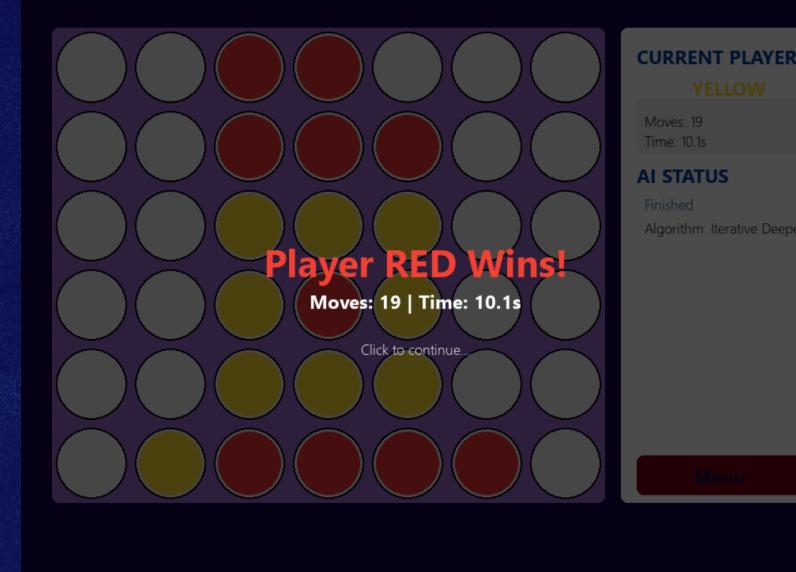
ID ALPHA-BETA



ALPHA-BETA



AI VS AI



CONCLUSION



AI Game Result, All three algorithms made the AI unbeatable (never lost). Minimax and Alpha-Beta always win or draw. Iterative Deepening can sometimes draw if time is too short, but still performs well. Final Decision, After comparing results, we chose Iterative Deepening Alpha-Beta, as it is the most suitable for real-time Connect 4 play, combining efficiency and strong gameplay.

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