8-Queens Problem Solved Using Genetic Algorithm

1. Problem Description

The 8-Queens problem is a classic AI challenge: - Place 8 queens on a standard 8x8 chessboard - No two queens may attack each other (no same row, column, or diagonal)

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2. Why Genetic Algorithm?

Genetic Algorithm (GA) is a metaheuristic inspired by natural selection. It's useful when: - The search space is large - An optimal or near-optimal solution is acceptable - Traditional methods (e.g., backtracking) are too slow or memory-intensive

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3. How GA Works Here

Each solution is encoded as a chromosome: - Example: `[4, 6, 1, 5, 2, 0, 3, 7]` - Index = column, Value = row position of the queen

The algorithm includes: - Fitness Function → max score = 28 (no attacking pairs) - Selection → Tournament Selection - Crossover → Single Point - Mutation → Random swap with small probability

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4. Implementation Overview

Main files:

- `genetic.py`: Defines all core GA logic (generation, fitness, selection, crossover, mutation)
- `main.py`: Runs the simulation and visualizes results
- `visualize.py`: Draws the chessboard with queens and fitness graph

Technologies used: - Python - matplotlib - `.venv` for environment isolation - `requirements.txt` & `.gitignore`

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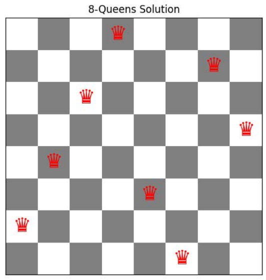
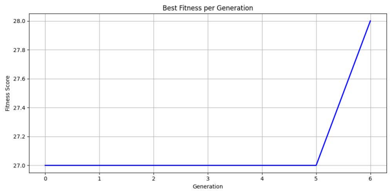
5. Outputs



Sample Final Sdution

Solution (queens):
`[4, 6, 1, 5, 2, 0, 3, 7]`

Chessboard Visualization:
`solution.png`



Fitness Progress:
`fitness_progress.png`

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6. Conclusion

GA successfully finds non-attacking queen placements. - Efficient for small N - May need tuning for large N (mutation/crossover rates)

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7. GitHub Repository

https://github.com/ismailzohari/The-8-Queens
