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Car Path Finding

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Section:C4

Car Path Finding AI

🚗 Car Path Finding

📌 Project Overview This project compares three AI approaches for pathfinding on a grid. BFS guarantees optimal solutions, A* improves efficiency using heuristic guidance, while the Genetic Algorithm provides a stochastic optimization approach without guaranteeing optimality.

🎯 Project Goal We compare all algorithms based on: ⚡ Execution time Memory usage (number of visited nodes) ✅ Ability to reach the goal ⭐ Optimality of the solution (shortest path)

 Algorithm Details

- BFS: explores all nodes uniformly, guarantees shortest path, high memory usage
- A*: uses heuristic (Manhattan distance) to guide search, faster than BFS
- GA: evolves paths using selection, crossover, and mutation; may not find optimal path

🗺️ Example Grid S = Start, G = Goal, X = Obstacle [['S', '.', '.', 'X', '.'], ['.', 'X', '.', 'X', '.'], ['.', '.', '.', '.', '.'], ['X', '.', 'X', '.', 'G'], ['.', '.', '.', '.', '.']]

```
# BFS

bfs_path, bfs_visited = bfs(grid, start, goal)

# A*

astar_path, astar_visited = astar(grid, start, goal)

# GA

ga_moves = genetic_algorithm(grid, start, goal)

ga_path = ga_path_to_positions(ga_moves, start)
```

Algorithm	Description	Advantages	Disadvantages
BFS	Uninformed search exploring all nodes uniformly	Guarantees shortest path	High memory usage
A*	Informed search using Manhattan heuristic	Faster than BFS, explores fewer nodes	Needs heuristic
GA	Stochastic optimization via selection, crossover, mutation	Flexible, can find paths in complex grids	May not find shortest path

🗁 How to Run

- Run in Python: python main.py
- Or run in Google Colab
- Output: paths for BFS, A*, GA and visualizations saved as PNG files

👥 Team Members

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