Ahmedabad University

CSE518 : Artificial Intelligence

Project Presentation

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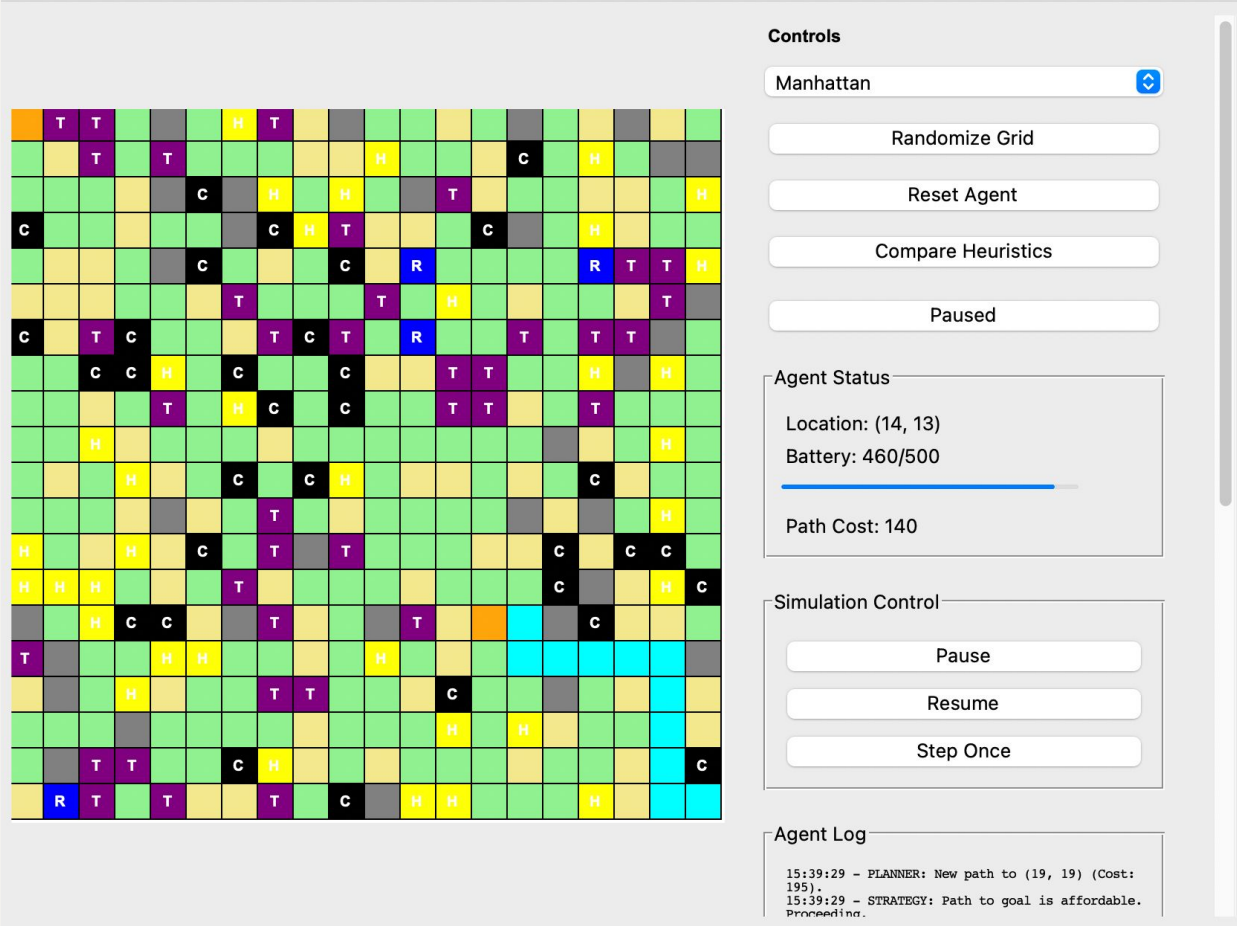
BTech - Computer Science and Engineering

Semester - 5

Project Title : Planetary Exploration Rover

Python-based simulation Rover avoids traps Smart movement logic



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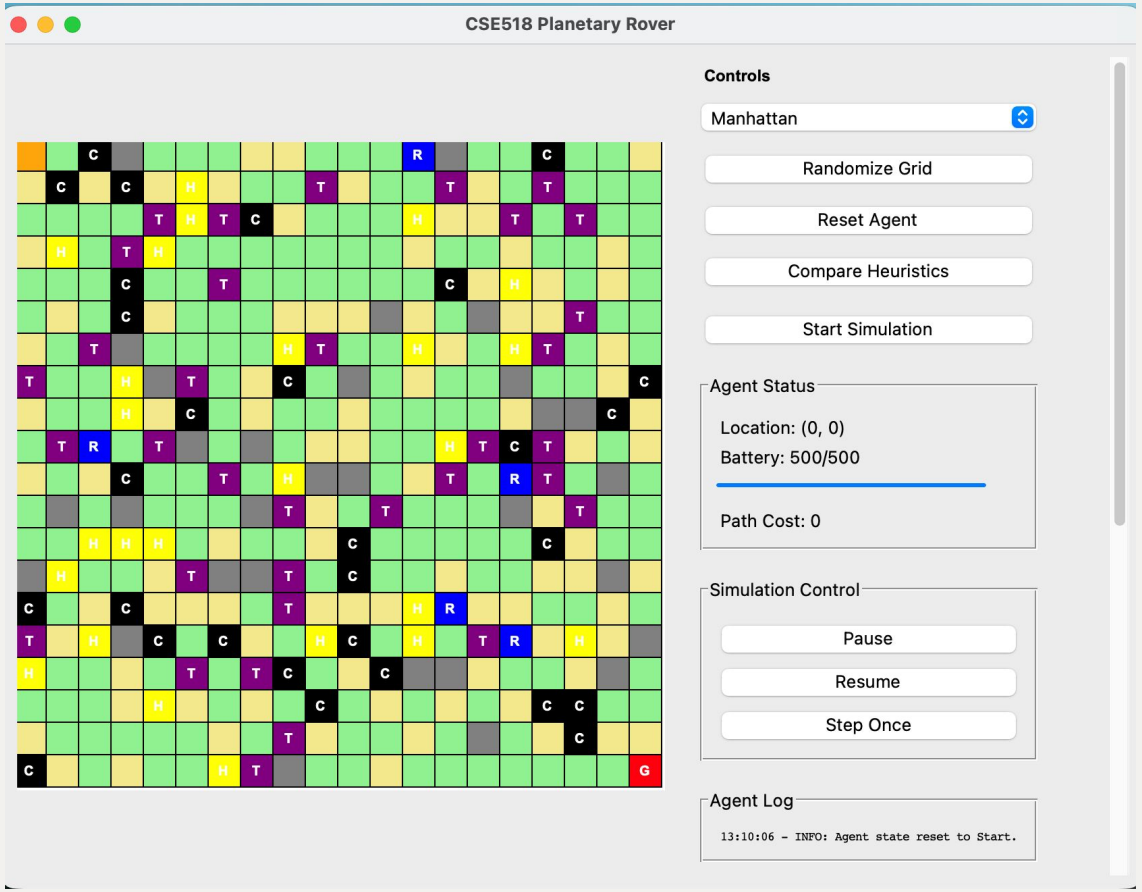
CORE FEATURES



- Autonomous rover navigation
- A* path planning with multiple heuristics
- Grid-based movement with terrain cost
- Trap & hazard detection
- Automatic trap avoidance and backtracking
- Battery-aware navigation (recharge logic)
- Randomized terrain generation
- Tracks visited cells & learned hazards
- Stops safely at dead-ends

HEURISTICS

- **Manhattan Distance -** Ideal for 4-directional grids:

$$h_M = |x_1 - x_2| + |y_1 - y_2|$$

- **Euclidean Distance -** Straight-line estimate:

$$h_E = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

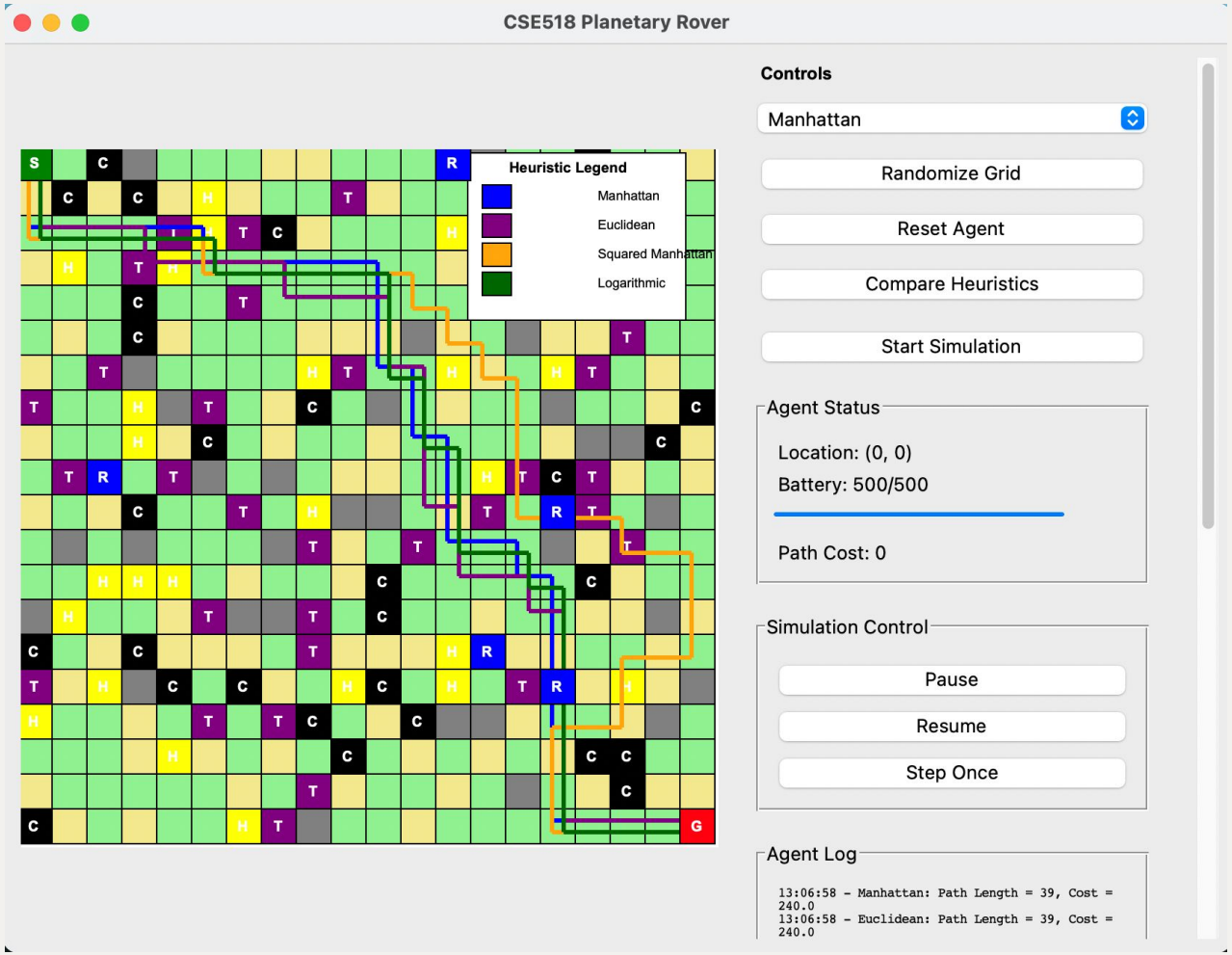
- **Squared Manhattan -** More aggressive goal-seeking:

$$h_S = (|x_1 - x_2| + |y_1 - y_2|)^2.$$

- **Logarithmic Heuristic -** Promotes exploration:

$$h_L = log_2(1 + |x1 - x2| + |y1 - y2|)$$

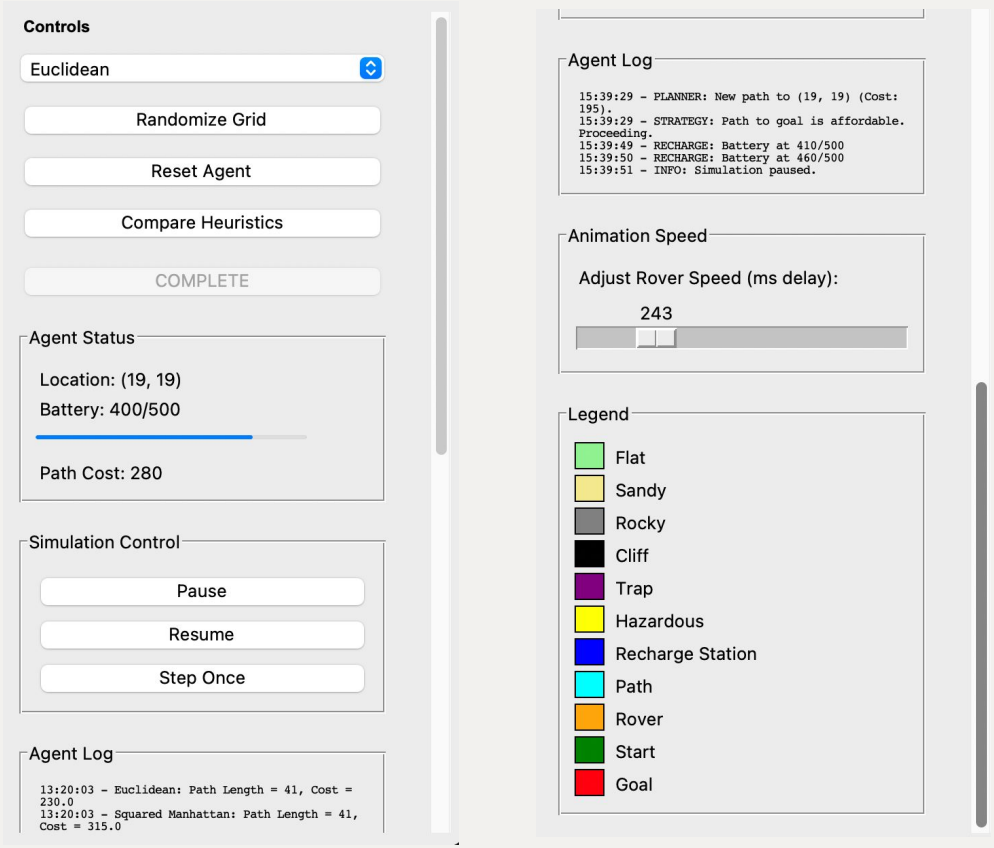
COMPARE HEURISTICS



COMPARE HEURISTICS

Heuristic	Behavior	Computation	Best Scenario
Manhattan	Grid-aligned, stable	Linear distance	Regular 4-way grids
Euclidean	Smooth convergence	Straight-line distance	Open maps
Squared Manhattan	Very goal-driven	Squared grid distance	Fast but less optimal routes
Logarithmic	Broad early exploration	Logarithmic scaling	Obstacle-heavy, irregular grids

EXTRA FUNCTIONAL FEATURES



- Live rover status panel showing position, battery, and path cost
- Adjustable animation speed using a slider
- Quick controls: Randomize Grid, Reset Agent, Compare Heuristics
- Simulation controls for Pause, Resume, and Step Once
- Automatic comparison of heuristic path length and cost
- Dynamic battery bar with visual updates
- Real-time hazard alerts in the log

Thank You