EAST WEST UNIVERSITY

Course Title: CSE366

Semester: Summer 2024

Assignment 01

SUBMITTED TO

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Objective:
The project aims to implement and compare two search algorithms, Uniform Cost Search (UCS) and A* Search, for a robot navigating through a grid with obstacles while managing its limited battery efficiently.

Overview:
The project consists of the following components:

Grid Generation:
Randomly generate a grid with obstacles, start, and goal positions to represent the robot's environment.

Search Algorithms:
Implement UCS and A* Search algorithms, considering the robot's limited battery and aiming to find an optimal path while avoiding obstacles.

Visualization:
Utilize a function called visualize_grid_and_path to visually represent the grid, start and goal positions, and the path taken by the robot.

Battery Management:
Manage the robot's battery level, decreasing it during movement and recharging when it falls below a certain threshold.

Detailed Requirements:

Grid Representation:
Represent the grid as a 2D array, with 1 indicating obstacles and 0 indicating free space. Ensure start and goal positions are obstacle-free.

Search Algorithms:
Implement UCS and A* Search methods within the Robot class, considering the robot's battery constraints.

Battery Management:
Initialize the robot's battery and handle its decrease during movement.
Implement recharging when the battery level is critically low.

Visualization:
Use the visualize_grid_and_path function to create a visual representation of the grid and the robot's path.

Output:
Print the results of each search algorithm, including the path taken, total recharge count, total moves, and final battery percentage.

Implementation Detail:
PriorityQueue Class:
Develop a priority queue utilizing heapq for efficient management of nodes in the search algorithms.

Node Class:
Define a class to represent states in the search tree, including current state, parent node, action taken, and path cost.

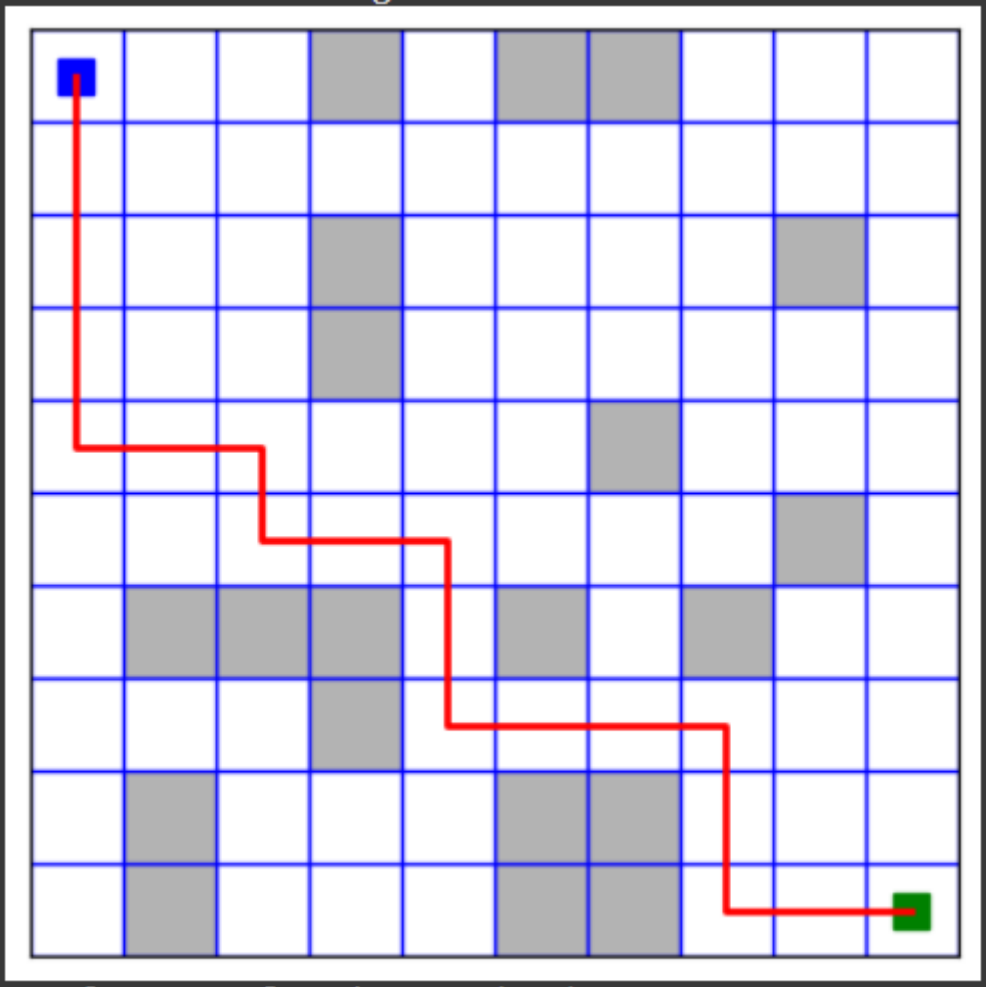
Environment Class:
Create a class to manage the robot's environment, providing methods for actions, result calculations, and goal checking.

Robot Class:
Manage the robot's actions, including search algorithms, battery management, path reconstruction, and visualization.

Conclusion:
The project successfully implements and compares UCS and A* Search algorithms for navigating a grid with obstacles and a limited battery. Visualization aids understanding, and the project offers insights into efficient pathfinding and battery management for autonomous robots.

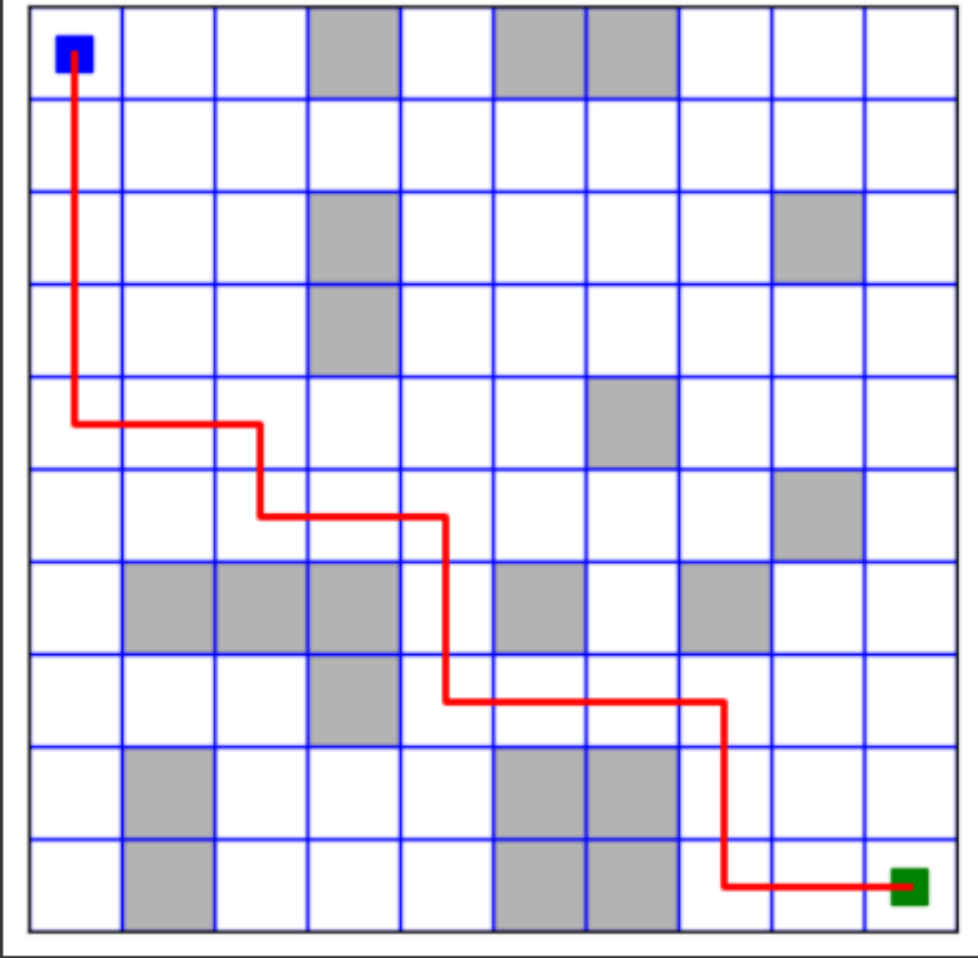
Suggestions for improvement include additional search algorithms and dynamic obstacle handling.

Robot Movement using UCS:



Total Count of recharges (UCS): 7
Total Moves (UCS): 74
Final Battery Percentage (UCS): 60

Robot Movement using A*:



Total Count of recharges (A*): 7
Total Moves (A*): 74
Final Battery Percentage (A*): 60