Introduction to Artificial Intelligence HW#1

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# Abstract

This project employs Uniform Cost Search and A\* Search algorithms to solve a maze, visualized through PyMaze on a 20x20 grid generated via DFS backtracking. Initially, it visualizes each algorithm's search process, revealing exploration steps before highlighting the optimal path. The final visualization accentuates the chosen path with circles, displaying the associated costs. This concise showcase not only illustrates the algorithms' effectiveness but also emphasizes the cost considerations in maze solving, offering insights into algorithmic efficiency in navigational challenges.

# Introduction

This report explores how I used two methods, Uniform Cost Search and A\* Search, to find the best path through a maze. The maze is a 20x20 grid and moving up or down costs a little more (1.1) than moving side to side (0.9). I added these methods to PyMaze that works with mazes.

Uniform Cost Search looks for the cheapest path, thinking about how much each step costs. A\* Search is a bit different because it tries to guess how far it is to the end, making it faster. It also uses the same step costs.

I’ll talk about how I put these methods into our program and compare them to see which one does better in finding a way through the maze. I'll look at how many steps they take and how good the paths they find are.

# Definition

**Uniform Cost Search (UCS)**: The algorithm that always finds the least cost path from a start node to a goal node, assuming that the cost of each step is non-negative, and all nodes are accessible.

**A\* Search**: The algorithm that finds the most efficient path from a start node to a goal node by combining the cost to reach a node and an estimate of the cost to reach the goal from that node.

**Manhattan distance**: The metric that calculates the total distance between two points in a grid-based system by summing the absolute differences of their x and y coordinates.

**Step**: The movement from one cell or position to an adjacent cell, counted as a single action taken by the search algorithm in its process of navigating from the start to the goal within the maze.

**Cost**: The cumulative value associated with traversing from the start position to the goal, calculated based on predetermined values assigned to each type of movement.

**Optimal path**: The most cost-effective route from the starting point to the goal within the maze, considering the predefined costs of vertical and horizontal movements.

**Optimality**: The strategy guaranteed to find the lowest cost path to a goal state.

# Methodology

Describe the algorithms' principles, functionalities, implementation details, and the data used for testing.

In my algorithm, I can get searching step, search path, optimal path, optimal path cost

# Testing and Validation

Detail your testing framework, test cases, benchmarks, datasets, and validation methods.

# Results and Discussion

Present and discuss your findings, including performance analysis and visualizations of the algorithms' outputs.

# Conclusion

Summarize the key findings, their implications, and discuss the potential for future work.

# References

List all the sources cited in your report in a consistent format.

# Appendices

Include any additional material that supports your report, such as extended data tables or full code listings.