CS5800 ALGORITHMS - PROJECT

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1. Project Context

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As someone with a background in electronics and telecommunication, the intersection of maze generation and solving using algorithms like Kruskal's and breadth-first search is particularly fascinating to me. Kruskal's algorithm, known for its efficiency in finding minimum spanning trees, holds relevance not only in computer science but also in telecommunications, where it's utilized for network optimization. The application of these algorithms extends beyond traditional computer science domains, playing a crucial role in optimizing routes for signal transmission or data flow in telecommunications networks. Understanding maze generation and solving algorithms not only enhances problem-solving skills but also offers insights into optimizing pathways, which directly translates into improved network efficiency and performance in the telecommunications industry. Exploring these concepts further allows me to bridge my background in electronics with newfound knowledge in computer science, creating innovative solutions for real-world challenges in network optimization. In this group project, my teammates and I will be further exploring maze generation based on Kruskal's algorithm along with solving capabilities based on BFS, DFS and A* algorithms, and discuss the implementation and potential areas of improvement of this topic.

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2. Objective

This project aims to address the challenge of maze generation and solving algorithms in the context of our algorithms course project. Our primary objective is to develop a comprehensive maze-solving simulation that will serve as an invaluable tool for exploring various algorithms, including Breadth-First Search (BFS), Depth-First Search (DFS), A*. By undertaking this project together, we seek to deepen our collective understanding of algorithmic principles and gain practical experience in applying these concepts to solve real-world problems, particularly in maze navigation scenarios.

3. Scope

Within the scope of our project, we plan to develop a maze generation system utilizing Kruskal's algorithm to create solvable mazes of varying complexities. This endeavor will require us to delve into graph theory and data structures to effectively represent the maze environment. Additionally, we will implement multiple pathfinding algorithms to navigate these mazes, considering factors such as optimality, efficiency, and computational complexity. Through our collaborative efforts, we aim to explore different strategies for maze-solving and analyze the strengths and weaknesses of each algorithm. Furthermore, we intend to create a user-friendly interface for visualizing the maze generation process and the execution of pathfinding algorithms, thus facilitating experimentation and learning for both our team and potential users.

4. Methodology

(1) **Maze Generation:** We have explored multiple maze generating algorithms, mainly Kruskal's algorithm to generate mazes. This will involve creating a graph representation of the maze and employing disjoint-set data structures to manage the maze's edges and cells.
(2) **Pathfinding Algorithms:** We aim to implement Breadth-First Search (BFS), Depth-First Search (DFS), and A* algorithms to solve the generated mazes. We will analyze the performance of these algorithms in terms of path length, computational complexity, and optimality.

5. References

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(4) Reif, John H. 1983. Depth-first search is inherently sequential, Harvard University
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