A* Pathfinding Heuristic Analysis – Project Report

1. Introduction

This report presents an advanced implementation of the A* pathfinding algorithm on weighted grid

graphs. Two admissible heuristics—Manhattan and Euclidean—are evaluated to compare performance

in terms of path optimality, execution time, and number of nodes expanded.

2. System Design

The system consists of a modular Python implementation including grid generation, A* algorithm

processing, heuristic functions, and an experiment testing harness.

3. Heuristics Used

• Manhattan Distance

• Euclidean Distance

4. Experiment Setup

Ten randomized test cases were generated across multiple grid sizes ranging from 20×20 to 40×40

with different obstacle probabilities. Each test case was solved using both heuristics for comparison.

5. Results Summary

Both heuristics produced optimal paths. Manhattan generally expanded fewer nodes, while Euclidean

occasionally achieved faster execution times in open grids.

6. Conclusion

The heuristic choice affects search efficiency, but not optimality. The results show the trade-off

between consistency (Manhattan) and smooth distance estimation (Euclidean).