

Energetic Pathfinding and Perceptual Heuristics in Manhattan Navigation

CIS 667: Term Project Proposal

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2025-11-01

Introduction

Subject Area

Artificial Intelligence — heuristic search, knowledge representation, and perception-based reasoning.

Problem Statement

Classical pathfinding optimizes distance or time and ignores the sensory complexity of real urban spaces. In Manhattan, crowding, traffic flow, and visual noise impose energetic and cognitive costs on pedestrians. The project asks: *How can an intelligent agent internalize these perceptual cues while searching for a route?*

Aim

Design, implement, and evaluate an A*-based navigation agent whose heuristic adapts energetic path cost using vision-derived features from NYC traffic-camera data.

Objectives

- | # | Objective |
|---|---|
| 1 | Model Manhattan grid intersections and legal moves. |
| 2 | Build symbolic knowledge base from traffic-camera detections. |
| 3 | Learn perceptual cost weights; embed in admissible heuristic. |
| 4 | Compare perceptual A* vs Manhattan baseline on metrics. |
| 5 | Visualize impact of sensory context on route cost. |

Team Information

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Project Type & Rationale

Applied project — applies informed search methods to a realistic navigation scenario, demonstrating how perception can modify symbolic reasoning.

Work Plan (High-Level)

Phase	Focus
Data Acquisition	Export and annotate traffic-camera frames; validate feature channels.
Knowledge Base	Serialize detections into symbolic predicates for each intersection state.
Baseline System	Implement classical A* with Manhattan heuristic for benchmarking.
Perceptual System	Learn weights, integrate perceptual heuristic, assure admissibility.
Evaluation	Run experiments, collect metrics (nodes expanded, path cost, MAE).
Documentation	Prepare report, visualizations, and presentation artifacts.

(Solo project: all tasks executed by the author; no shared responsibilities.)

Methodology Overview

The agent follows the PEAS model. Performance: minimize energetic cost; Environment: Manhattan grid with dynamic sensory states; Actuators: move N/S/E/W; Sensors: vision-derived features fused with static map data. Constraint logic disables infeasible actions. The heuristic combines Manhattan distance with a weighted sum of sensory costs while retaining admissibility bounds.

Expected Contributions

Demonstrate perception-aware heuristic search yielding human-aligned routes. Provide reusable pipeline linking traffic-camera data to symbolic search. Offer interpretable

feature weights revealing environment-navigation links.

References

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