Robot Motion Planning Capstone Project

Plot and Navigate a Virtual Maze

# Capstone Proposal

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## Domain Background

*(approx. 1-2 paragraphs)*

In this section, provide brief details on the background information of the domain from which the project is proposed. Historical information relevant to the project should be included. It should be clear how or why a problem in the domain can or should be solved. Related academic research should be appropriately cited in this section, including why that research is relevant. Additionally, a discussion of your personal motivation for investigating a particular problem in the domain is encouraged but not required.

## Problem Statement

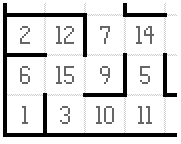
This project is tasked with solving the problem of a robot mouse agent plotting a path from the bottom left corner of a maze to its center. The agent is allowed to embark on two runs of any given maze. The first run of the maze, the agent will explore, map, and analyze the environment to determine the best path plans to reach the center of the maze. The second run of the same maze, the agent will attempt to navigate the environment as quickly and efficiently as possible in order to reach the center of the maze.

## Datasets and Inputs

The dataset and inputs for this project consists of the environment, the maze. The maze is an environment of an n x n grid of squares, where n is even. The environment can have an n value range of twelve to sixteen. The environments are accessed through text files. The first line of the text file is a number which describes the number of n squares within the environment. The first data row in the text file is the leftmost column of the environment, with the first element being the bottom-left corner of the environment. The remaining n lines will be n comma-delimited numbers which describe the passible (open) edges of the environment. Each number represents a four-bit number that has a bit value of 0 if an edge is impassible (closed) and 1 if an edge is passible (open). The 20 is the upward side, 21 is the right side, 22 is the bottom side, 23 is the left side.

Ex. 1010 ⬄ (23 + 0 + 21 + 0) ⬄ (8 + 0 + 2 + 0) ⬄ 10

{Left: Open, Bottom: Closed, Right: Open, Upward: Closed}



The environment will always have impassible walls on the outer board of the grid, which blocks all movement. Walls will be placed throughout the environment to block movement of the agent, creating a maze. The robot agent will always start in the bottom-left corner square of the environment grid, and be oriented upwards. The starting square will always have walls on the left, right, and bottom, which will allow for the first action to always be upwards. The environment will have a center within the environment grid consisting of a 2 x 2 square, this is the goal for the agent to position itself within the center 2 x 2 square.

## Solution Statement

*(approx. 1 paragraph)*

In this section, clearly describe a solution to the problem. The solution should be applicable to the project domain and appropriate for the dataset(s) or input(s) given. Additionally, describe the solution thoroughly such that it is clear that the solution is quantifiable (the solution can be expressed in mathematical or logical terms) , measurable (the solution can be measured by some metric and clearly observed), and replicable (the solution can be reproduced and occurs more than once).

## Benchmark Model

*(approximately 1-2 paragraphs)*

In this section, provide the details for a benchmark model or result that relates to the domain, problem statement, and intended solution. Ideally, the benchmark model or result contextualizes existing methods or known information in the domain and problem given, which could then be objectively compared to the solution. Describe how the benchmark model or result is measurable (can be measured by some metric and clearly observed) with thorough detail.

## Evaluation Metrics

The agent will explore multiple environments and must complete two runs on each. During the first run of the environment, the agent will be allowed to freely explore in order to build a map of the environment. At someone point during the exploration, the agent must enter the goal area but, the agent is free to continue exploring the environment after entering the goal area.

The second run of the environment, the agent will be returned to the starting position and orientation. The agent’s goal is to then navigate to the goal area in fastest time possible, minimizing actions (time steps) taken by the agent.

The agent’s score is the number of time steps required to execute the second run, plus one thirtieth the number of actions taken during the first run. The maximum actions allowed for a completion of both runs is one thousand actions for both runs for a single environment.

Score = #actions2 + (1/13) \* #actions1

where lower Score is better

## Project Design

*(approx. 1 page)*

In this final section, summarize a theoretical workflow for approaching a solution given the problem. Provide thorough discussion for what strategies you may consider employing, what analysis of the data might be required before being used, or which algorithms will be considered for your implementation. The workflow and discussion that you provide should align with the qualities of the previous sections. Additionally, you are encouraged to include small visualizations, pseudocode, or diagrams to aid in describing the project design, but it is not required. The discussion should clearly outline your intended workflow of the capstone project.

## References

<https://docs.google.com/document/d/1ZFCH6jS3A5At7_v5IUM5OpAXJYiutFuSIjTzV_E-vdE/pub>