Machine Learning Engineer Nanodegree
Capstone Proposal - Robot Motion Planning

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Plot and Navigate a Virtual Maze

Domain Background

This project was inspired from Micromouse competitions originated in the 1970s, wherein a robot mouse is given the task of running multiple time in a given maze and plotting the best path from a corner of the maze to its center. The robot mouse discovers the maze during the first run and using the planned best path it has previously learned to reach the center of the maze in subsequent runs.

In this project, a simplified model of the world is provided along with specifications for the maze and robot. The goal of this project is to obtain the fastest times possible in a series of test mazes by controlling the navigation of a virtual robot in a virtual maze.

Problem Statement

On any given maze, the robot must complete two runs. The starting point and the goal room are "known" to the mouse before it starts. The starting point is always in a left corner and is always surrounded by three walls. The goal room is four center blocks of the maze. In the first run, the robot is allowed to freely roam, explore, and analyze the maze to determine the best path plans to reach the center of the maze. To finish the first run, it must enter the goal room during its exploration. After entering the goal room, the robot is free to continue exploring the maze and may choose to end its exploration at any time. The robot is then moved back to the starting position and orientation for its second run. Its objective now is to go from the start position to the goal room in the fastest time possible. The robot's score for the maze is equal to the number of time steps required to execute the second run, plus one-thirtieth the number of time steps needed to execute the first run.

A maximum of one thousand time steps is allowed to complete both runs for a single maze. Rotation is expected to be an integer taking one of three values: -90, 90, or 0, indicating a counterclockwise, clockwise, or no rotation. A robot mouse cannot move diagonally but can move forward, backward or turn 90 degrees (clockwise or counterclockwise) with a maximum of three squares.

Datasets and Inputs

(approx. 2-3 paragraphs)

In this section, the dataset(s) and/or input(s) being considered for the project should be thoroughly described, such as how they relate to the problem and why they should be used. Information such as how the dataset or input is (was) obtained, and the characteristics of the dataset or input, should be included with relevant references and citations as necessary It should be clear how the dataset(s) or input(s) will be used in the project and whether their use is appropriate given the context of the problem.

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

(approx. 1-2 paragraphs)

In this section, propose at least one evaluation metric that can be used to quantify the performance of both the benchmark model and the solution model. The evaluation metric(s) you propose should be appropriate given the context of the data, the problem statement, and the intended solution. Describe how the evaluation metric(s) are derived and provide an example of their mathematical representations (if applicable). Complex evaluation metrics should be clearly defined and quantifiable (can be expressed in mathematical or logical terms).

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.

Before submitting your proposal, ask yourself. . .

- Does the proposal you have written follow a well-organized structure similar to that of the project template?
- Is each section (particularly Solution Statement and Project Design) written in a clear, concise and specific fashion? Are there any ambiguous terms or phrases that need clarification?
- Would the intended audience of your project be able to understand your proposal?
- Have you properly proofread your proposal to assure there are minimal grammatical and spelling mistakes?
- Are all the resources used for this project correctly cited and referenced?