CS 5180 Project Proposal

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Team Members:

The team members will distribute tasks evenly, with each member responsible for topic research, environment testing, basic algorithm development, algorithm enhancement, advanced algorithm design, presentation, and the final report.

Project Topic:

Exploring Q-Learning and DQN Algorithms for Simulated Home Robot Control in Custom Environments

Introduction:

Nowadays home robots are becoming more and more popular. Safety and Efficiency are the major concerns of most households. In our project, we aim to delve deep into maze-related challenges, with a specific focus on home robot vacuuming and mopping. Our primary objective is to develop an algorithm that can significantly enhance the performance of these home robots.

This problem can be modeled as a Markov Decision Process (MDP), as the mobile robot must make decisions at each step based on the current policy. This is a Markov-decision-process (MDP) because the mobile robot needs to choose a suitable action at each step under the current policy. The layout of the environment, representing the home, remains relatively the same, with key fixtures such as the TV, sofa, dining table.

We will simulate a Home Robot in a custom environment created using DeepMind Lab. Our team's primary areas of focus will include the Q-learning algorithm, the DQN (Deep Q-Network) algorithm, and a thorough comparison between them.

Our approach involves training the robot to learn when and where cleaning is most frequently required. The robot will be rewarded for cleaning dirt and trash, while negative rewards will be assigned for colliding with furniture or running out of battery. The distribution of dirt and trash will be modeled according to a reasonable pattern. Furthermore, if time permits, we will consider roadblocks and stairs that would consume more power. What's more, we will take the homeowner's daily routine into account so home robots can only work when the people at home are not active. This learned schedule can then be employed to optimize the robot's efficiency in future cleaning tasks.

Ideal Outcome:

Make sure the robots will not dead during the mission. Use less time to collect all the trash. The expectation is that our home robot can clean rooms in time without damaging walls and furniture.

Week-by-week Plan:

Week1	Topic and Algorithm Research
Week2	Learn and Test Environment
Week3	Find and Deploy potential improvement
Week4	Debug and Test
Week5	Make Presentation and Report