Homework 6

16-311: Introduction to Robotics

Contents

Learning Objectives

1. Practice graph search algorithms.
2. Complete a sample localization problem.

1 Graph Search

In this section, we will use breath-first search, depth-first search and A* to find a path from start to goal.

1.1 A Short Path?

We know you can get to A, we want to plan a path from H to A first using DFS. However, we are going to change our rule for getting from one node to the other. Instead of visiting nodes based on the alphabet, we are going to visit nodes based on distance to the node (so you would visit nodes with a smaller edge number first, only using alphabetical ordering to break ties). The distance between nodes is indicated by the number over each arrow. For this problem, we want you to use a very simple hill climbing algorithm (just look for the smallest edge distance and go to that node). Do not keep track of your past decisions and compare them to what you have now (best first). When you get to A, stop. Please list the path you took from H to A. Think about if this was the shortest distance with respect to path length.

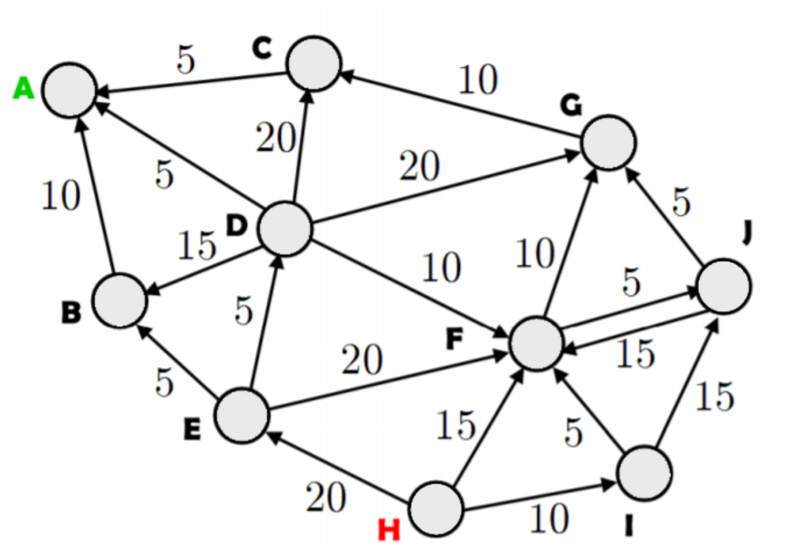

Figure 1: Graph with edge weights.

2 Localization

For this problem, we want you to simulate a robot's prediction of where it is in the map shown in Figure 2. The map is an overhead view of a building with two hallways. Assume that the edges of this map are walls. You cannot drive through walls. Demonstrate areas of high probability for the robot's location by putting dots on the map. This is very approximate. There is no correct number of dots or exact placements.

Figure 2 shows the robot's prediction of where it is at the start (note that it has no strong prediction of where it is in the grid so the dots are just a uniform distribution that considers a minimum distance based on the robot's radius). You do not know the robot's starting orientation, either. The robot to the left is just to demonstrate the shape, its location is not outside of the hallways.

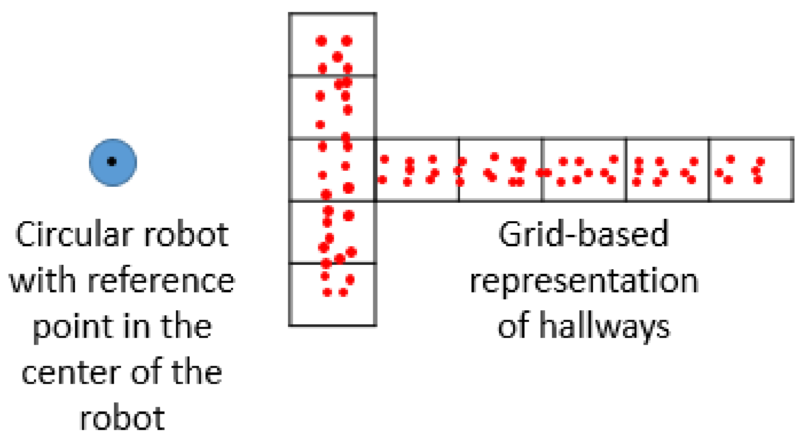

Figure 2: Original robot prediction.

Now draw (by hand, using an image editor, etc.) the prediction of where the robot is currently if it has moved (successfully without hitting a wall) 4 blocks forward. This is the motion update step of our model.

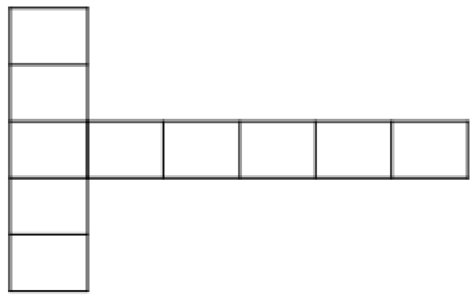

Figure 3: Fill in prediction after motion.

Now draw the prediction of where the robot is currently if it senses a wall directly in front of it, i.e. the robot is facing a wall of the grid square it is in. Assume the robot has not turned since moving in the previous step. This is the sensor update step for our model.

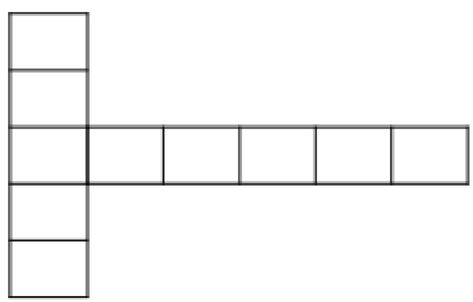

Figure 4: Fill in prediction after sensor reading.

Do we know definitively where the robot is now? Why or why not?

What To Submit

Submissions are due on Gradescope by the date specified in the Syllabus.

1. Create a .pdf file with the written answers ALL THE SECTIONS named hw6.pdf.

2. Ensure that your .pdf contains the answers for Part 1 and two images plus the answer to the question for Part 2.