CPSC-57200 Artificial Intelligence 2

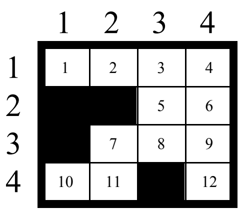
Homework #2

Introduction

For this assignment, you can use any programming language to simulate a robot environment.

Environment Description (based on AIMA textbook - see pgs. 581-2)

The robot exists in a 4x4 grid environment with some obstacles as shown below:



The robot can move in four possible directions, but only to locations without obstacles. There are 12 such locations, numbered 1 through 12, corresponding to the following coordinates: (1,1), (1,2), (1,3), (1,4), (2,3), (2,4), (3,2), (3,3), (3,4), (4,1), (4,2), (4,4). Initially, there is an equal chance the robot is in any of the locations. With each step, the robot moves to one of the possible adjacent locations (i.e., those without obstacles), with each one having equal chance. For example, if the robot is in location 7, in the next time step, there is a 50% probability the robot will move to 11 and a 50% probability the robot will move to 8.

The robot has four sensors that can each detect a wall in one of the four directions: North, South, East, and West. We can represent these sensed values as a four element bit vector (NSEW). For example: 1100 represents a wall to the North and South, but no wall to the East and West. However, the sensors are noisy and each one has an independent error rate of ϵ. Let d_{it} be the number of differences between the true values at state i and the sensed value at time t. For example, if we observe a wall only to the north and south, then we can represent this as 1100, but if we are actually in state 7, then the walls should be to the north and west, which we can represent as 1001; so the number of difference is 2. Then, the probability that a robot in square i would receive a sensor reading e_t is

$$P(E_t = e_t | X_t = i) = \boldsymbol{O}_{t_{ii}} = (1-\epsilon)^{4-d_{it}}\epsilon^{d_{it}}.$$

Requirements

1) Model the robot localization environment specified above.

2) Assume that after six time steps, the robot receives the following observations: NSW, SE, NW, S, E, E. Implement the HMM state estimation algorithm and use it to predict the current state.

3) Determine the localization distribution and the most likely location on the last step, for different values of the error rate.

4) Write a report detailing your implementation and execution. Visualize and discuss the results. Attach your code along with the PDF of the report.