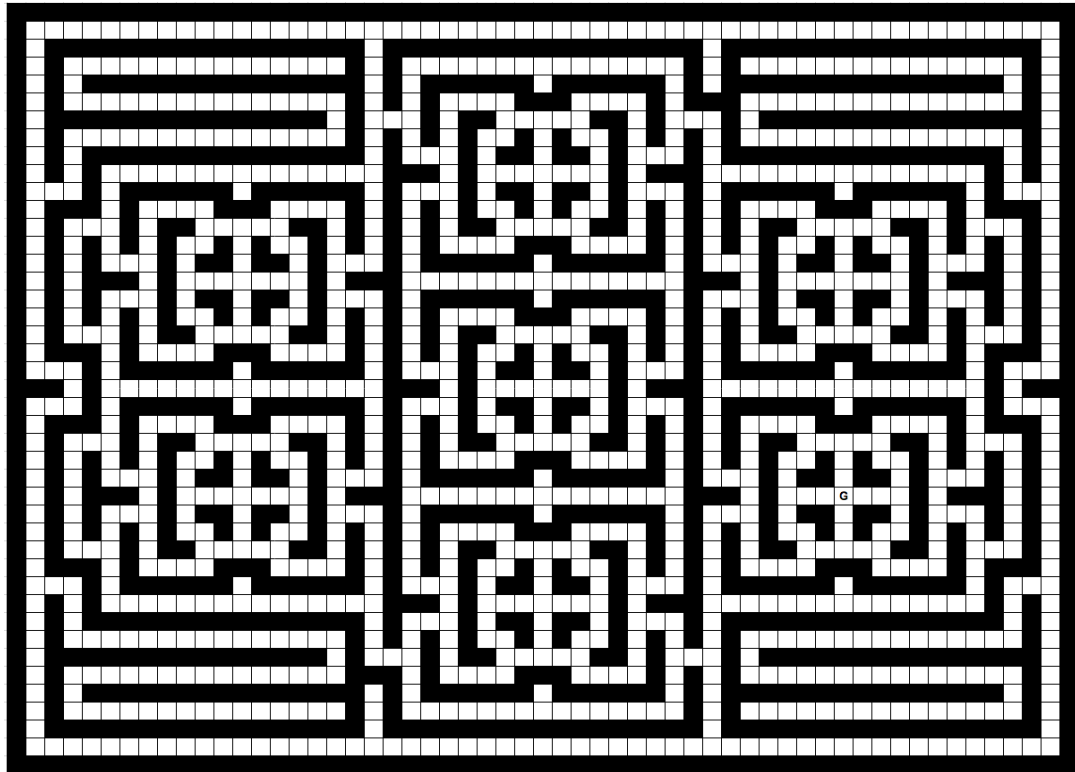


CS 520 Final: Question 1 - Localization

16:198:520

You cannot be graded on what you don't write down. Complete each question to the best of your ability. If you write code to solve one of the problems, you must submit that code along with your final answers. Explain your process and algorithms. Be explicit. Answers, without evidence of the thought and process that led to them, will not earn credit.



You are a **MazeSolvingBot**, dropped into the above maze. Unfortunately, while your motors are still functional (and you can tell which direction is north), your sensors are completely inoperable - you are effectively completely blind, and can't even tell if you are running into a wall. All you have available to you (as a knowledge base) is the above map. You are free to move between adjacent white cells (up/down/left/right) but black cells are blocked.

- a) You are somewhere in the above maze, with no prior knowledge. What is the probability you are at G ?
- b) You can try to move **UP**, **DOWN**, **LEFT**, **RIGHT**. If you are not blocked in that direction, you successfully move. If you are blocked, you stay in the same place. You receive no feedback. Give a (short) sequence of moves that will with probability at least $1/2$ end with you at G .
- c) Find the shortest possible sequence of moves that puts you at G regardless of where you started.
- d) Suppose that after each move, you receive an observation / feedback of the form $Y_t = \text{the number of blocked cells surrounding your location}$. Let Y_0 be the number of blocked cells surrounding your starting location. Again, you get no feedback if the move was successful or not, simply the number of blocked cells surrounding your current location.

- d.1) You initially observe that you are surrounded by 5 blocked cells. You attempt to move **LEFT**. You are surrounded by 5 blocked cells. You attempt to move **LEFT**. You are surrounded by 5 blocked cells. Indicate, for each cell, the final probability of you being in that cell.
- d.2) Write an algorithm to take a sequence of observations $\{Y_0, Y_1, \dots, Y_n\}$ and a sequence of actions $\{A_0, A_1, \dots, A_{n-1}\}$ and returns the cell you are most likely to be in.

Bonus: G was chosen arbitrarily. In the no-feedback case, if you want to determine where you are as efficiently as possible, what square should you try to get to, and what moves should you take to get there?