CS520 - INTRO TO ARTIF INTEL

Final: Question1-Localization

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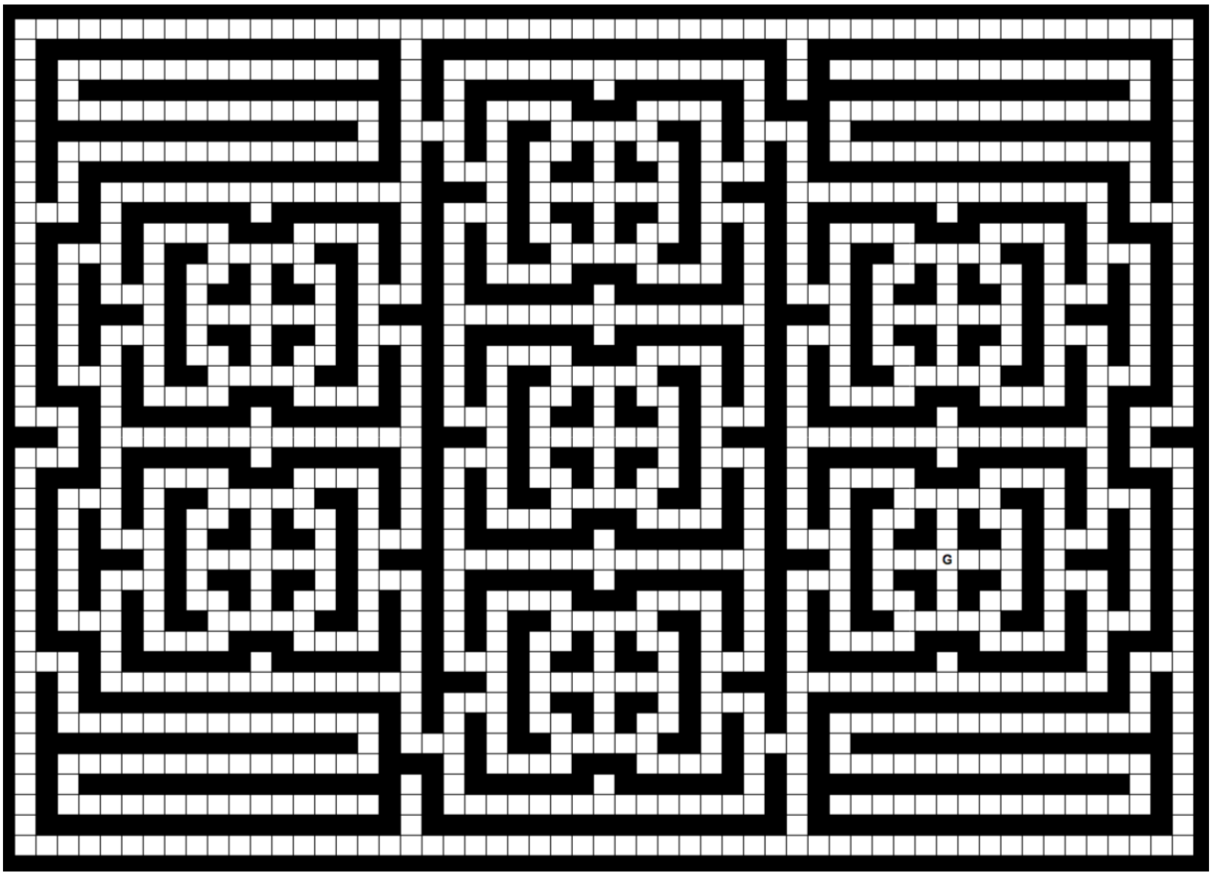


You are a MazeSolvingBot, dropped into the above maze. Unfortunately, while your motors are still functional (and you can tell which direction is north), your sensors are completely inoperable - you are effectively completely blind, and can't even tell if you are running into a wall. All you have available 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?

After statistics, there are 1238 white cells in the maze and 1212 black cells in the maze. So the probability of G being in that place is $\frac{1}{1238}$.

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.

I think of two strategies to solve the problem but have no time to implement with codes.
First one, like what we have done in project 1, we use A*, considering the heuristic distance, as the target distance. And what we do is to recursively find the cells in the maze which is closer to the target. So, we can use the same strategy for the problem. First, we sum all the

Manhattan distance between all the cells and the goals. And we recursively move to make the sum of the distance decrease which is just like what we have done in A*.

Another thought is that we can find the cell with the longest distance from the target. And use that distance as a reference for all the cells moving to the goal.

c) Find the shortest possible sequence of moves that puts you at G regardless of where you started.

I don't have time to implement the thinkings about the algorithm.

d) Suppose that after each move, you receive an observation / feedback of the form Yt = the number of blocked cells surrounding your location. Let Y0 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.For the problem, I write a program to help us calculate the probability of you being in that cell.

First, I find the white cells surrounded by five block cells. And I set these places as the initial positions of the person in the maze. Then, before moving the person to its left, I find out whether its left is a wall. And if its left is a wall, he stays in the original place. Otherwise, it moves to his left cell. After moving, I find the person surrounded by five blocked cells. Then, before moving him to his left, I find out whether his left is a wall. And if his left is a wall, he stays in the original place. Otherwise, he moves to its left. Finally, I count the person located in each white cells of the maze. Then use the function to describe the probability of the person being in that cells, $\frac{person\ in\ that\ white\ cell}{num\ of\ cells\ in\ first\ observation}$. I set the number of cells in first observations as the denominator. That's because, before the first move, we only move the person being in the position satisfying the first observations. So, we need to limit the event space to that number.

Before the first left move, we find that there are 428 cells in the position satisfying the first observations.

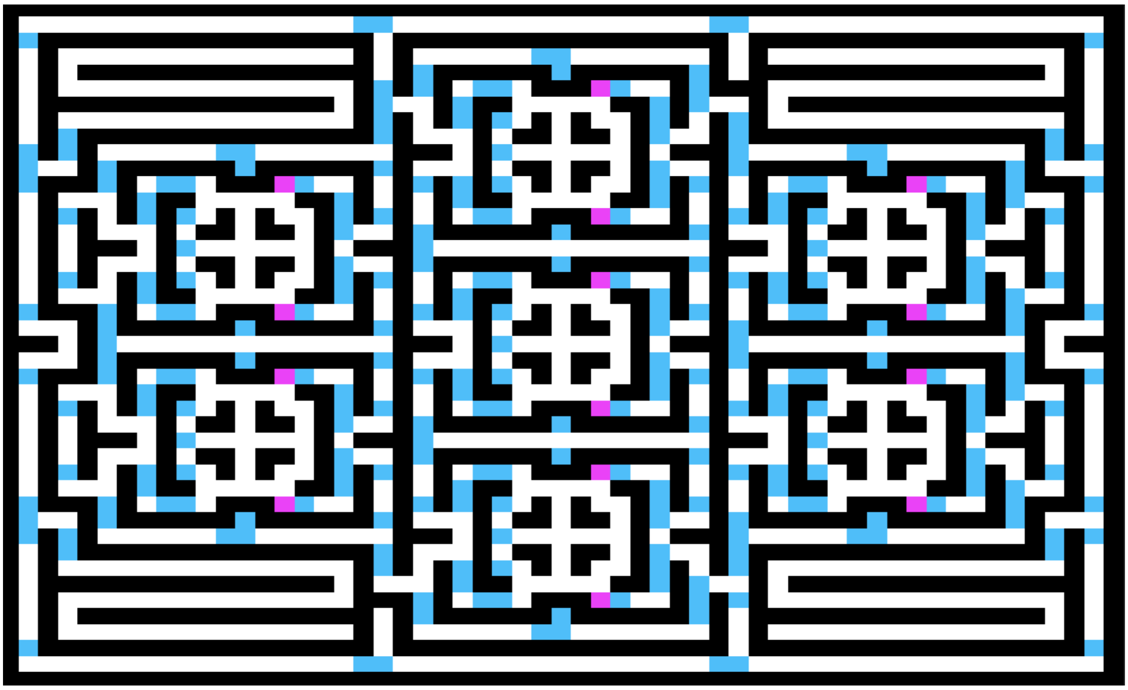
First LEFT move:

After the first left move, the blue cells denotes the positions with only one person standing there with five blocked cells surrounded. With the coordinates shown below.(I select the blocked cell on the upper right corner as (0, 0))

[[1, 18], [1, 19], [2, 1], [2, 55], [3, 27],...,[39, 28], [40, 1], [40, 55], [41, 18], [41, 19], [41, 36], [41, 37]]

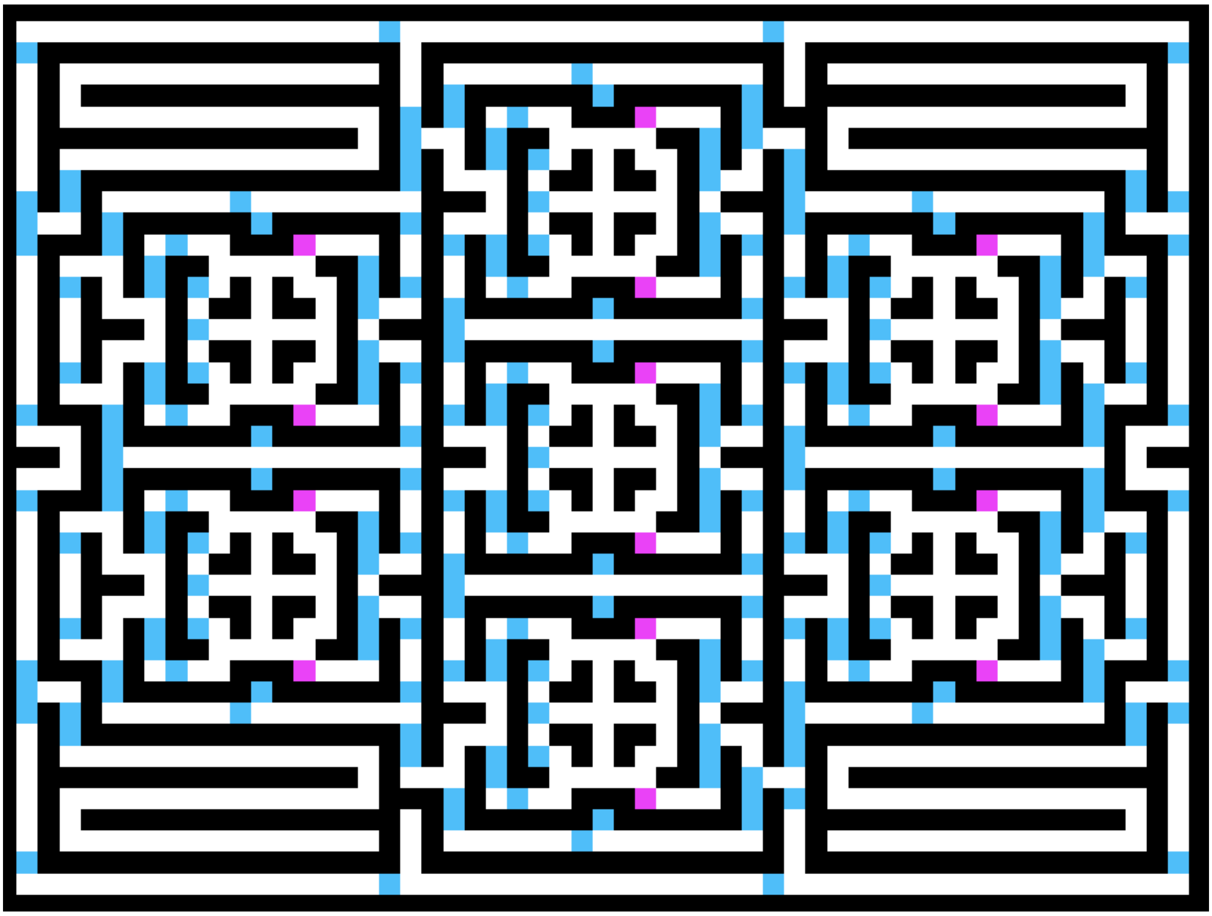
Because there is only one person standing in this positions, the probability is $\frac{1}{428}$.

And the pink cells indicates the positions with two person standing there with five blocked cells surrounded. With the coordinates shown below.
[[5, 30], [11, 14], [11, 46], [13, 30], [17, 30], [19, 14], [19, 46], [23, 14], [23, 46], [25, 30], [29, 30], [31, 14], [31, 46], [37, 30]]
Because there are two person standing in this positions, the probability is $\frac{2}{428}$.



Second Left move:
After the second left move, the blue cells denotes the positions with only one person standing there with five blocked cells surrounded. With the coordinates shown below.(I select the blocked cell on the upper right corner as (0, 0))
[[1, 18], [1, 36], [31, 46], [31, 51], [31, 55],..., [37, 37], [38, 21], [38, 28], [38, 35], [39, 27], [40, 1], [41, 36]]
Because there are only one person standing in this positions, the probability is $\frac{1}{428}$.

And the pink cells indicates the positions with three person standing there with five blocked cells surrounded. With the coordinates shown below.
[[5, 30], [11, 14], [11, 46], [13, 30], [17, 30], [19, 14], [19, 46], [23, 14], [23, 46], [25, 30], [29, 30], [31, 14], [31, 46], [37, 30]]
Because there are three person standing in this positions, the probability is $\frac{3}{428}$.



d.2) Write an algorithm to take a sequence of observations {Y0,Y1,...,Yn} and asequence of actions {A0,A1,...,An−1} and returns the cell you are most likely to be in. I have explained the algorithm I used for (d) problems in d.1). Between d.1) and d.2), the only difference is that I extend two Left moves to a sequence of {A0,A1,...,An−1} which is corresponding to a sequence of observations {Y0,Y1,...,Yn}. Actually, I have implemented the algorithm in our program when doing d.1). So, I don't describe it in details. And I just try a sequence of A and a sequence of Y with some results.

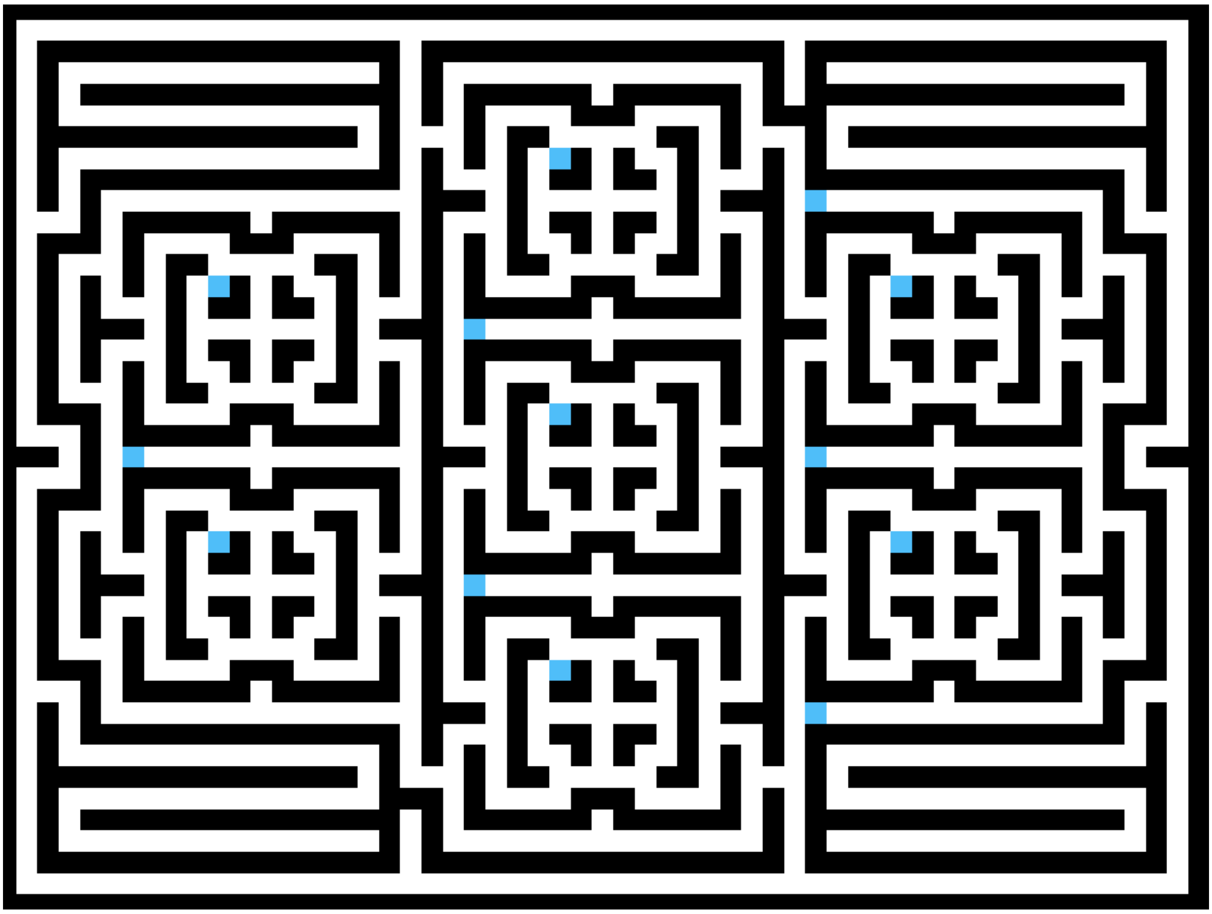
Actually, I have explained the algorithm in d.1), so I won't tell in details now.
Experiment:

observations O= [5, 5, 5, 4]
actions A = ['L','U','R']

Most number of the person standing in the same position satisfying the observations O, after a sequence of moving A: 1
The most likely positions being in together with probability:
[7, 26], 0.07692307692307693
[9, 38], 0.07692307692307693
[13, 10], 0.07692307692307693
[13, 42], 0.07692307692307693
[15, 22], 0.07692307692307693
[19, 26], 0.07692307692307693
[21, 6], 0.07692307692307693

[21, 38], 0.07692307692307693
[25, 10], 0.07692307692307693
[25, 42], 0.07692307692307693
[27, 22], 0.07692307692307693
[31, 26], 0.07692307692307693
[33, 38], 0.07692307692307693

Actually, after the moving, the location of the person satisfying the observation sequences O shares the same amount of person staying in that position which is 1 with the same probability of $\frac{1}{428}$. It is because, for all the persons, the sequences of Movements and the observations are hard to satisfy.



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?

The problem is just like the kids lost his toys somewhere and can't find it. So where should he go to know where his original position. I think the area should be the center of the maze because it is the most special cell in the maze.