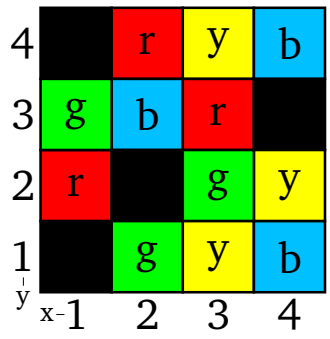
CSCE 790 (Spring 2023) Mini Project 2

This assignment is about the Hidden Markov model (HMM) and Viterbi algorithm. Consider a toy robot wandering through a small world shown below:



The robot can only occupy the colored squares. At each time step, the robot attempts to move up, down, left, or right, where the choice of direction is made at random. If the robot attempts to move onto a black square, or to leave the confines of its world, its action has no effect, and it does not move at all. The robot can only sense the color of the square it occupies. However, its sensor sometimes produces inaccurate color sensing results. The robot begins each walk in a randomly chosen colored square.

In this problem, state refers to the location of the robot in the world in x:y coordinates, and output refers to a perceived color (r, g, b, or y). Thus, a typical random walk looks like this:

3:3 r
3:3 r
3:4 y
2:4 b
3:4 y

Here, the robot begins in square 3:3 perceiving red, attempts to make an illegal move (to the right), so stays in 3:3, still perceiving red. On the next step, the robot moves up to 3:4 perceiving yellow, then left to 2:4 perceiving blue (erroneously), and so on.

Download the example code and data CSCE790_Mini_Project2.zip from the Blackboard and unzip it. You will find a robot_perception_train.dat file with the random walk of the robot consisting of 200 steps. You can also run the code hmm_viterbi.m (or, .py) to read the x, y, color information from this file. You will use this file to learn the environment. *You will need to write a program inside hmm_viterbi.m (or, .py) that takes input the training file and builds an HMM model of this world, i.e., it builds state transition and emission probability matrices. You will then expand your program and implement a Viterbi algorithm so that given only the sensor information (i.e., a sequence of colors), your program will reconstruct an estimate of the actual path taken by the robot through its world*.

To test the accuracy of your code, you can use the robot_perception_test.dat file.

Submission

Create a zip file containing the following:

(1) robot_perception_train.dat, robot_perception_test.dat, hmm_viterbi.m

Name the zip file as YOURLASTNAME_CSCE790_Mini_Project2.zip (YOURLASTNAME in all caps), and upload it on the Blackboard.