INF552: Programming Assignment 7 [Hidden Markov Models]

Part 1: Implementation [7 points]

The file **hmm-data.txt** contains a map of a 10-by-10 2D grid-world. In it, the top-left corner cell has coordinates *(0, 0)*. The *i*th row has *x* coordinate *i*, and the *j*th column has *y* coordinate *j*. The row and column indices start from *0*. The free cells are represented as *1*s and the obstacles are represented as *0*s. There are four towers, one in each of the four corners, as indicated in the data file. Your task is to use a Hidden Markov Model to figure out the most likely trajectory of a robot in this grid-world. Assume that the initial position of the robot has a uniform prior over all free cells. In each time-step, the robot moves to one of its neighboring free cells chosen uniformly at random. At a given cell, the robot measures L_2 distances (Euclidean distances) to each of the towers. For a true distance *d*, the robot records a noisy measurement chosen uniformly at random from the set of numbers in the interval $[0.7d, 1.3d]$ with one decimal place. These measurements for *11* time-steps are also provided in the data file. You should output the coordinates of the most likely trajectory of the robot for *11* time-steps. The Viterbi algorithm is the recommended algorithm to use.

You can write your program in any programming language. However, you will have to implement the algorithms yourself instead of using library functions. In your report, please provide a description of the data structures you use, any code-level optimizations you perform, any challenges you face, and of course, the requested outputs.

Part 2: Software Familiarization [2 points]

Do your own research and find out about library functions relevant to Hidden Markov Models. Learn how to use them. Compare them against your implementations and suggest some ideas for how you can improve your code. Describe all this in your report.

Part 3: Applications [1 point]

Do your own research and describe some interesting applications of Hidden Markov Models.

Submission Guidelines

In your report, please include the names of all group members and mention their individual contributions. The report should be in PDF format. Your submission should include the code as well as the report. It is due before **5/5, 11:59pm** in an archive in zip, tar.gz or tar.xz format. Only one submission is required for each group by one of the group members. Please submit your homework on **BlackBoard** (do NOT email the homework to the instructor or the TA).