CARLETON UNIVERSITY

SCHOOL OF COMPUTER SCIENCE

Winter 2021

COMP 5005 **Final Project** **Due: April 13, 2021**

The project consists of using LA to solve the Elevator Problem. A building has an elevator that stops at k floors. People can request the elevator from floor i, and get off the elevator on floor j, where $i = 1, \dots k,\ i \neq j$. At any time instant, the probability that the elevator is requested from a floor and the probability that the person gets off the elevator on another floor, are given by the following matrices E and L respectively (where their components e_i and l_i are the probabilities of a person entering and leaving at floor i respectively):

$$\begin{array}{c} \\ 1 \\ 2 \\ \vdots \\ k \end{array} \quad E = \begin{array}{c} \text{Request} \\ \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_k \end{bmatrix} \end{array}, \text{and} \quad L = \begin{array}{c} \text{Get off} \\ \begin{bmatrix} l_1 \\ l_2 \\ \vdots \\ l_k \end{bmatrix} \end{array}. \tag{1}$$

The main goal of the problem is to minimize the *Overall Time,* T, where $T = T_1 + \frac{T_2}{2}$, and:

1. T_1 is the time that people wait when they request the elevator. If someone requests the elevator from floor i and wants to go to floor j, the elevator should have been waiting at floor i or quite close to it. If it is waiting at floor m, T_1 is the absolute distance between i and m.

2. T_2 is the time taken for the elevator to go from the floor where the person got off (i.e., j in the above case), to the place where it is waiting for the next person. Thus, when this person gets off on floor j, and the elevator chooses to go to a floor n, T_2 is the absolute distance between j and n.

In real life, the probabilities given in Eq. (1) change with time. This means, for example, that the probability that the elevator is requested from floor 1 could be 0.6 at 8:30AM, and 0.2 at 4:30PM. In our case, we assume that these probabilities do **not** change with time.

The inputs for this problem consist of the probability distributions for each floor, as given in Eq. (1). At each time instant t, the system receives an event that consist of the following. A person requests the elevator from floor i and gets off the elevator on floor j. These events must be simulated using the probabilities given in Eq. (1), considering that the floor in which the elevator is requested is different from the floor at which the person gets off. At each time t, the system must generate an event, process it, and decide at which floor the elevator must wait for the next event (where the next person will be requesting the elevator) so that the *Overall Time*, T, is minimized.

You can also assume that the elevator picks up a passenger, moves to the requested floor, and then moves to another floor to wait *before* the next passenger arrives.

Devise various LA schemes to schedule the elevator and see if you can get a strategy that is expedient, i.e., better than doing nothing at all. Note that the probability vectors are assumed to be unknown to the LA.

You are not required to obtain an optimal solution, but what we want is to get a *few* LA-based solutions (FSSA and/or VSSA and/or Discretized and/or Pursuit) for this problem.

You must submit a brief report (at most 5 pages) with a description of what you have done, the LA you have employed, and the comparative results you have obtained. Try to also graphically describe, over an ensemble of experiments, how quickly the machines converge.

BONUS: Can you solve the problem for two elevators???