CE412 – PROJECT 4
"SIMULATION OF A BANK ATM with Discrete Event Simulation"

In this project, you will write a program which simulates a bank ATM by using Discrete Event Simulation (DES). Suppose that customers arrive at a bank ATM in accordance with a Poisson process having rate λ. That is, the times between successive arrivals are independent exponential random variables, with a mean value of 1/ λ. Each customer upon arrival, goes directly into service if the ATM is free and, if not, the customers join the queue. When the ATM finishes serving a customer, the customer leaves the system, and the next customer in line, if there is any, enters service. The successive service times are assumed to be independent exponential random variables having mean 1/ μ.

Please note that the pdf and mean for an exponential random variable with parameter a is as follows:

$$f(x) = \begin{cases} ae^{-ax} & x \geq 0 \\ 0 & x < 0 \end{cases}$$

$$E[X] = \frac{1}{a}$$

Your simulation should ask the user to input the following parameters:

- The average arrival rate λ (customers/min)
- The average service rate μ (customers/min)
- The capacity of the system N (two choices)
    - The system will have an infinite capacity: all arriving customers can enter the system
    - The system will have a finite capacity of N: if a customer arrives and sees that there are N customers in the system, the customer leaves the system.

      N = (# of customers in queue) + (# of customers in service)

Your simulation should produce the following outputs:

- the average waiting time in the system
- the average number of customers in the system (queue + system)
- the average waiting time in the queue
- the average number of customers in the queue
- the percentage of customers who cannot enter the ATM

Please note that your simulation must be written based **on Discrete Event Simulation**. In the project report, show the system states, entities, attributes, sets, statistics. Draw the flowcharts for the events that you consider for the DES. Describe how you have implemented the FEL. Explain DES and print out sample outputs and the first 5 snapshots for the following input parameters:

- λ = 10, μ=12, N=infinity
- λ = 10, μ=12, N=5
- λ = 11, μ=12, N=infinity
- λ = 11, μ=12, N=5

Project 4 Submission:
Name your program as *yournamePrj4.X* and submit your program and project report to LEARN by April 20th, 2020. You will make a 5 minute demo explaining how you wrote the code and show sample outputs.