Simulation of a Single-Server Queue System

Objective

The goal of this assignment is to analyze the behavior of a single-server queue system with geometrically distributed packet inter-arrival and service times. You will explore the impact of varying arrival rates on the expected queueing delay within the system.

Background

In our discussions, we have covered queueing theory and its applications to computer networks, particularly focusing on single-server queue models. For this assignment, you will apply those concepts to a queue with geometrically distributed inter-arrival and service times, where the service rate is given as $\mu = 0.75$.

Tasks

1. Simulation Setup

- Choose one programming language to do the simulation from C/C++, Matlab, Python, and Java.
- Implement a simulation of a single-server queue system.
- Ensure that both packet inter-arrival times and service times follow a geometric distribution.
- The service rate (μ) of the system is fixed at 0.75.

2. Parameter Variation

- Conduct simulations for various packet arrival rates (λ). Specifically, use the following λ values: 0.2, 0.4, 0.5, 0.6, 0.65, 0.7, 0.72, 0.74, and 0.745.

3. Data Collection

- For each value of λ, run the simulation for at least 10^6 time slots.
- For each value of λ, keep track of the queue length, compute the average queue length, and obtain the average queueing delay by using Little's law formula.

4. Analysis and Theoretical Comparison

- Plot the expected queueing delay against the arrival rate (λ) based on your simulation results.
- Using the formula derived from the single-server queue analysis, plot the theoretical curve of expected queueing delay as a function of arrival rate (λ).
- Overlay this theoretical curve with your empirical plot to compare the simulation results with theoretical expectations.

5. Report and Submission

- Report should include the plot, simulation code and annotations.
- Submit one single PDF file to the assignment submission folder on onQ.