Assignment 1

CS232/NetSys201/EECS248 Fall 2024

October 9, 2024

Deadline: October 18th @11:59PM on **Gradescope** (upload your answers in PDF under Assignment 1 and please mark each problem accordingly).

Turn in: A pdf file of your answers to each question.

Note: You must fully compute fractions/equations in your answers to the final numbers when possible. Also **show all steps taken to reach the final answer.**

1 Problem 1:

Consider two Exponentially distributed random variables X_1 and X_2, with rate $\lambda_1 = 6$ and $\lambda_2 = 3$, respectively.

a) Compute the probability $P(X_2 > 4)$

b) Compute the probability $P(X_1 <= 3)$

c) Compute the probability $P(min(X_1, X_2) <= 5)$

d) Compute the probability that X_2 is smaller than X_1

2 Problem 2:

A router sends out 45 packets every 3 seconds on average. Suppose that the time in between two packets sent out can be modeled as an exponential r.v. with the corresponding parameter.

a) What is the probability that a packet will be sent out in less than 3 seconds?

b) Suppose that at time $t = 0$ a packet was sent out, what is the probability that at time $t = 3$ no further packets were sent out?

c) Assume now 72 packets every 3 seconds are sent out on average. Is the probability of part (a) larger, smaller, or equal now?

3 Problem 3:

A router is receiving packets from two different clients. Assume the time between the generation of two consecutive packets at each client is exponentially distributed with parameters $\lambda 1 = 2$ packets/second for node 1, and at $\lambda 2 = 3$ packets/second for node 2.

a) What is the probability that the next packet will come from node 2?
b) What is the probability that the router will not receive any packet in the next 3 seconds?
c) Imagine that after the three seconds mentioned in part (b) elapsed, a third client enters the system and is now sending packets through the same router. Assume the time between the generation of two consecutive packets at each client is exponentially distributed as before for nodes 1 and 2, but with parameter $\lambda 3 = 4$ packets/second for node 3. What is the probability that the next packet will arrive from node 3?

4 Problem 4:

Consider a router with service rate μ pkt/s, and arrival rate λ pkt/s. At time $t = 0$ a packet (packet A) is being served. The next packet (packet B) arrives at the router buffer according to the exponential distribution.

a) What is the probability that Packet B is arriving at the buffer while Packet A is still being served?
b) What is the average time packet B spends in the buffer?
c) What is the average time packet B spends in the system? Hint: divide the total time into two parts: T1 and R.