Assignment 2

CS232/NetSys201/EECS248 Fall 2024

October 23, 2024

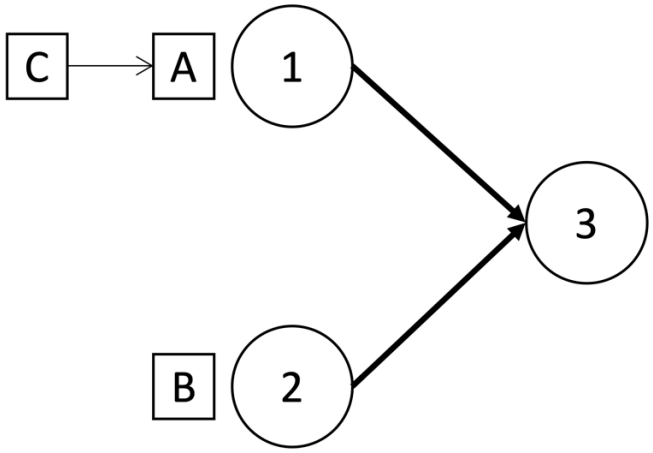
Deadline: November 2nd @11:59PM on Gradescope (upload your answers in PDF under Assignment 2 and please mark each problem accordingly).

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 the queuing system in the figure, where packets whose service is completed by Servers 1 and 2 go to Server 3. The service time of Server 1, 2, and 3 is exponential with rate $\mu_1 = 1$ pks/s, $\mu_2 = 3$ pkt/s and $\mu_3 = 4$ pkt/s, respectively. At time t = 0, packet C arrives in the buffer of Server 1. When C arrived, Server 1 has packet A in service while Server 2 has packet B in service.



a) Compute the probability that A exits the system before any other packets move to server 3.

b) Compute the probability that B exits the system before any other packets move to server 3.

c) Compute the expected time T needed by Packet A to exit the system.

2 Problem 2:

Consider a router receiving packets according to a Poisson process $\{N(t), t \geq 0\}$ with rate $\lambda = 3$ packets/second.

a) Compute the probability that the router will receive 2 packets in the next second.

b) Compute the expected total number of packets the router would receive after 2 seconds.

c) Imagine that 2 packets arrived in the time interval from 0 to the end of 3s, compute the probability that between the start time of $t = 4$ and at the end of time $t = 6$ exactly 3 packets arrive at the router (Hint: Consider the expression $P(N(6) - N(4) = 3)$).

3 Problem 3:

A router sends out 20 packets every 10 seconds on average. Suppose that the time in between two packets sent out can be modeled as an exponential random variable.

a) What is the probability that the next packet will be sent out after 5 seconds?

b) What is the probability that exactly 5 packets will leave in the next second?

c) What is the probability that exactly 3 packets will leave in the next 2 seconds?

d) What is the probability that more than 2 packets, but less than 5 packets will leave in the next 2 seconds?

4 Problem 4:

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 2 packets/second for client 1, and at $\lambda_2 = 3$ packets/second for client 2.

a) What is the probability that the next packet will come from node 1?

b) What is the probability that the router will receive exactly 2 packets in the next 3 seconds?

c) Imagine that at time t = 3, two packets have arrived at the router. At $t = 5$, what is the probability that at least 1 more packet will arrive?