Assignment 3

CS232/NetSys201/EECS248 Fall 2021

December 2, 2021

Deadline: December 7th on Canvas (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 when possible. Also show all steps taken to reach the final answer.

1 Problem 1 (20 pts):

Consider an $M/M/1/5$ system with arrival rate $\lambda = 4$ pkt/s and service rate $\mu = 8$ pkt/s.

(a) Compute the probability that the next packet is dropped.

(b) Compute the expected time a packet needs to go through the system.

2 Problem 2 (20 pts):

Consider an $M/M/1/\infty$ system with arrival rate $\lambda = 4$ pkt/s and service rate $\mu = 5$ pkt/s.

(a) Compute the expected time a packet spends in the system.

(b) Compute the time a packet is expected to wait in the buffer before getting serviced.

3 Problem 3 (20 pts):

Consider a large system that is composed of five separate $M/M/1/\infty$ servers serving five different applications, each application has $\lambda = 2$ pkt/s in packet generation rate and each server has $\mu = 4$ pkt/s in service rate.

(a) Which is better, having a dedicated server for each application with $\mu = 4$ per server or having a single powerful server with 5μ service rate serving all of the five applications simultaneously? Compute a proof for your answer (Hint: compute the packet delay E[T] for both variants and compare them).

(b) Assume that the separate five servers have been combined into a single powerful server with service rate 5μ. Compute the probability that there are two packets in the system.

4 Problem 4 (20 pts):

Consider a landline switch for phone calls modeled as $M/M/2/2$ with arrival rate $\lambda = 1/2$ call/s and service rate $\mu = 2$ call/s.

(a) Compute the probability that the next phone call is dropped.

(b) Assume that there is one active phone call connection going through the switch, compute the probability a second phone call is received before the first one terminates.

5 Problem 5 (20 pts):

Consider a M/M/1/1 system with arrival rate of 5 pkts/s and service rate $\mu = 10$ pkts/s.

(a) Calculate the probability of a packet being dropped upon arrival (P_b), the traffic load and the carried load.

(b) Assume that the system has a buffer. Calculate the average number of packets in the buffer when the average waiting time in the queue is 2.5 seconds. Remember to consider the Probability of packets blocked in the answer.