Homework #2

- (5pt) Problem 3.1
- (10pt) Problem 3.5
- (15pt total) Problem 3.8
  - 5pt in 3.8(a) and 10pt in 3.8(b)
  - Hint: 3.8(b) uses M/M/∞ queues, solved in 3.4.2.
  - Hint: 3.8(b) will also use the following property: Let X1 and X2 be two exp variables with rates λ_1 and λ_2. $P\{X1<X2\}= \lambda_1/(\lambda_1 + \lambda_2)$.

- A router X is equipped with three ports, 0, 1, and 2 with capacities 10Mbps, 6Mbps, and 8Mbps, respectively. Packets arrive at port 0 at rate 4000 packets per second with exponentially distributed interarrival times. Among these packets, 30% go to port 1 and the rest to port 2. Packets arrive at port 1 at rate 1000 packets per second with exponentially distributed interarrival times. Among these packets, 80% go to port 0 and the rest to port 2. Packets arrive at port 2 at rate 2000 packets per second with exponentially distributed interarrival times. Among these packets, 60% go to port 0 and the rest to port 1. Packet lengths are exponentially distributed with the average of 2000 bits. Each of the three ports has a dedicated queue of infinite capacity. Answer the following questions.

- (3pt) Give the service rates μ_0, μ_1, and μ_2 at the three ports.
- (3pt) Give the packet arrival rates λ_0, λ_1 , and λ_2 at the queues of the three ports.
- (5pt) Compute the average number of packets on the entire router (including the one currently being transmitted).
- (5pt) Compute the average time packets stay on the router (including the times of transmission)

- (10pt) Show the state transition diagram of a G/M/1/4 queueing system (the whole system contains at most 4 customers, 3 in waiting and 1 in service).
- (10pt) Show the state transition diagram of a M/M/2/3 queueing system, where the queue size is 3 (the system can have a maximum of 5 customers).
- (10pt) Consider an M/G/1 system with arrival rate 0.1 and uniformly distributed service times from 0 to 10. Compute the average time T a customer stays in the system.