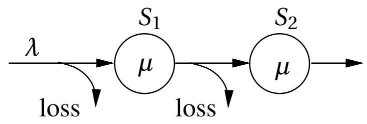
Problem 21.1

Consider the 2 servers in tandem of the figure. Arrivals are Poisson with rate $\lambda = 1/2$ packets/time unit. Service is exponentially distributed with rate $\mu = 1$ packet/time unit. Queue size in each server is 0, i.e. if a packet arrives to a busy server, the packet is lost.



- 21.1.A Build a CTMC that describes the process.
- 21.1.B Compute the stationary distribution.
- 21.1.C Compute the throughput in packets/time unit (packets transmitted by S_2).
- 21.1.D Compute the loss probability of the system (proportion of arrivals that are lost in any stage).
- 21.1.E Compute the distribution of the time in the system of successful packets (transmitted by S_2), and the expected value, T.
- 21.1.F Compute the expected number of packets in the system, N.
- 21.1.G Reason why Little theorem cannot be applied using the expected values T and N computed in the previous items. Check it using the throughput obtained before.
- 21.1.H Use Little theorem to the queue of each stage. Use the result to compute loss probability in each stage.
- 21.1.I Reason why Burke theorem does not apply. Assume that both queues are reversible (even if they aren't) and apply Burke theorem. Check that the stationary distribution obtained with this assumption is different than the one obtained before.

Problem 21.2

Consider the 2 servers in tandem of the figure, but assume now that the first queue has infinite capacity (the second one has size 0).

- 21.2.A Does Burke theorem apply?
- 21.2.B Build the CTMC of the process.
- 21.2.C Assume that Burke theorem applies and check whether the solution satisfies the global balance equations.

Problem 21.3

Consider the 2 servers in tandem of the figure, but assume now that the second queue has infinite capacity (the first one has size 0).

- 21.3.A Does Burke theorem apply?
- 21.3.B Build the CTMC of the process.
- 21.3.C Assume that Burke theorem applies and check whether the solution satisfies the global balance equations.