15-857/47-774 Homework 3: More Operational Laws

Instructions:

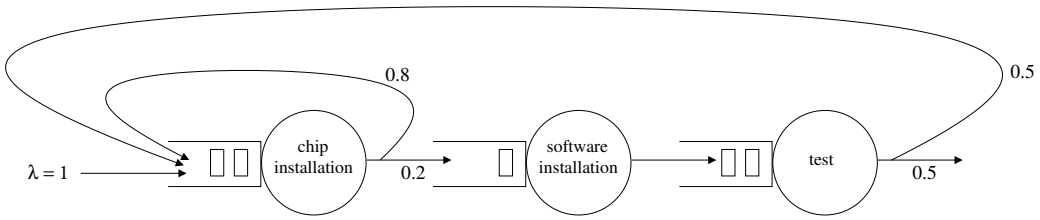
Homework is due at the *start* of Friday's class. You have a full week. We grade your homework right away, so please don't be late. If you're having problems, please go to office hours. Feel free to collaborate with other students, but you should write up your own solutions. It is good form to list the names of people with whom you collaborate.

These problems are from your textbook, *Performance Modeling and Design of Computer Systems*. Starred problems are either *not* in your textbook or are modified from what's in your textbook. These starred problems are given below. Problems 8.4 and 10.3* should be doable after the Sept 15 lecture.

Exercises: 6.4 ; pick one of 6.5 or 6.9* ; 7.2 ; 7.3 ; 7.4* ; 7.5 ; 8.4 ; 10.3*

Some Notes:

Exercise 6.9: [Cellphone Assembly]
At a cellphone assembly line, casings arrive at a rate of $\lambda = 1$ per minute and each casing goes through three stations: a chip installation station, a software installation station, and a test station, as shown below. The chip installation does not always succeed. Each arriving casing undergoes an installation attempt, but with probability 0.8, the installation attempt fails and the casing needs to go through the chip installation station again. The software installation always succeeds. After the chip and the software are installed, the testing station tests each cellphone to see if it works. With probability 0.5, the cellphone does not work. In this case, the cellphone needs to be stripped down to the casing and goes through the whole process again. Suppose you observe this system and see that the expected number of casings is $\mathbf{E}[N_1] = 20$ at the chip installation station and $\mathbf{E}[N_2] = 1$ at the software installation station.



(a) How long does each chip installation attempt take on average? This time includes both the time in the queue and the time for the actual installation.

(b) How long does each software installation take? Again, this time includes both the time in the queue and the time for the actual installation.

(c) What are the expected numbers of visits to the chip installation station and to the software installation station per cellphone, respectively?

Exercise 7.4: This is the exercise in your book. However please make the following modifications to reduce your work:
– Don't bother making graphs (too time-consuming!).
– Limit your discussion to the case where N: large.
– Ignore the line: Observation interval = 17 minutes. It's unnecessary.

Exercise 10.3: Please do the problem in the book. However *additionally* derive $\widehat{T_{1,0}}(z)$, i.e.,the z-transform of $T_{1,0}$.