Software Testing & Risk Assessment
Assignment 3

Problem 1: You are waiting for a package to arrive from the webshop Wish. People have figured out that, for this webshop, the delivery time X is exponentially distributed with parameter $\lambda=1/15$ days.

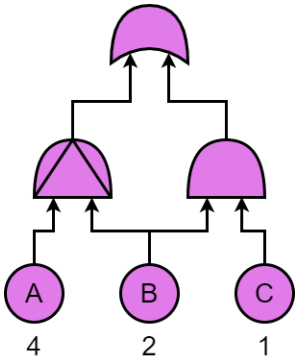
Questions

1. What is the expected amount you have to wait?
2. What is the probability that you wait
   A. less than 5 days?
   B. more than 10 days?
   C. exactly 10 days?
   D. between 10 and 25 days?
3. So far, you have been waiting for 15 days.
   A. What is the probability that you have to wait less than 5 more days?
   B. What is the probability that you have to wait more than 10 more days?
   C. exactly 10 more days?
   D. between 10 and 25 more days?

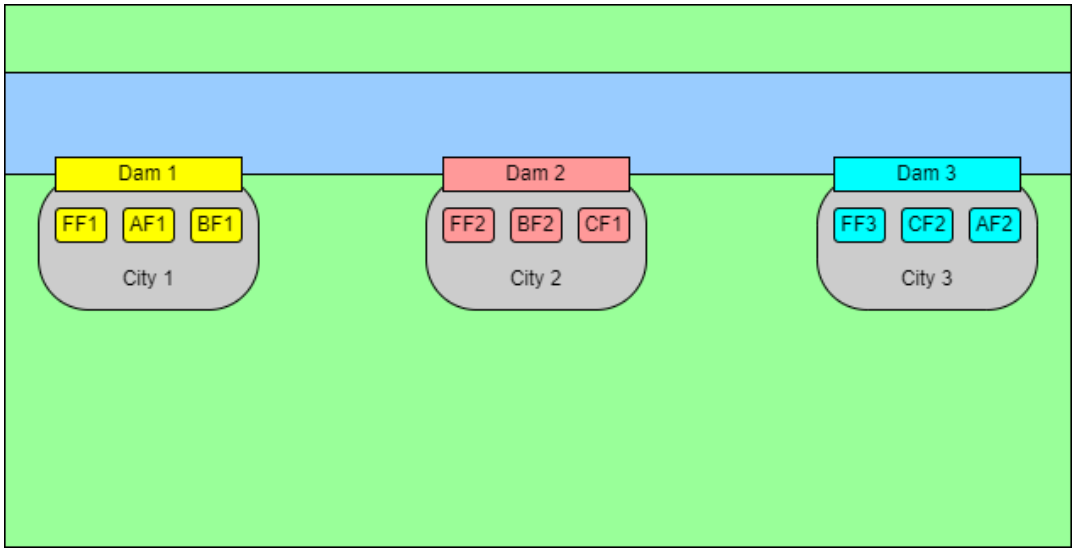
Hint: use that the exponential distribution is memoryless, i.e., $\mathbf{P}[X > t+t' \mid X > t'] = \mathbf{P}[X > t]$.

Problem 2 (homework):
Consider the dynamic fault tree to the right.

1. Represent this DFT as a Markov chain with 5 states.
2. Give the transition matrix of this Markov chain.
3. Calculate probability that this DFT fails before $t = 0.4$.



Problem 3 Consider the marvel of modern art below.



- Three types of components (A,B,C) are being produced in three cities: A in A Factory 1 (AF1) and AF2 in Cities 1 and 3, B in BF1 and BF2 in Cities 1 and 2, and C in CF1 and CF2 in Cities 2 and 3.

- At least one factory of each component must be operational.
- All factories are operational from the start.
- Each city contains a factory factory (FF1-3): as long as the factory factory a city is operational, each factory that fails in that town is immediately repaired.
- A factory repaired by a factory factory can never fail again.
- Factory factories cannot repair factories in other cities.
- Each city is protected from the river by a dam. If a dam fails, all factories in that city (including the factory factory) are immediately destroyed.

Create a DFT for this scenario.

Problem 4:
In the DFT of problem 2, suppose that B has failed (and no other basic event). What is the probability that the DFT fails within t = 0.5 time units?

Problem 5:
1. In the lecture, you have been told that the exponential probability distribution is memoryless, i.e., that $\mathbf{P}[X > t+t' \mid X > t'] = \mathbf{P}[X > t]$. Prove this. *Hint*: recall that the conditional probability of an event A given an event B is given by $\mathbf{P}[A|B] = \mathbf{P}[A \wedge B]/\mathbf{P}[B]$.
2. **For those of you with a background in calculus:* In the lecture, you have been told that the expected value of an exponentially distributed random variable with parameter λ is equal to 1/λ. Prove this. *Hint*: recall that the expected value of a continuous random variable with cumulative density function P is equal to $\int_0^\infty P'(x)x \, \mathrm{d}x$, where P' is the derivative of P.