The lifetime of a lightbulb is an exponentially distributed random variable T, where T is measured in hours and the expected lifetime is 800 hours. You consider a "dud" to be a bulb that lasts less than 400 hours. You have a box of six bulbs, what is the probability that we have to wait until the 6th bulb to get a dud

In Chapter 2 we dealt a lot with Bernoulli trials. We can easily identify Bernoulli trials by scanning the problem and looking for something that can be modeled by a "loaded coin toss." Even though we are in Chapter 3, we should be able to notice that the "Dud"/"no Dud" classification can be modeled as a loaded coin toss. We are being asked to find the <u>waiting time</u> for a successful outcome of a Bernoulli trial.

So we are looking for $P(X=6)$ for a <u>geometric random variable</u>. The new twist in this problem is that now we have the information we need to compute p (In the past, p was usually given to us)

exponential RV

$$P(\text{lightbulb is a "dud"}) = p = P(0 \le T \le 400) = F(400)$$
$$= 1 - e^{-400/800}$$
$$\boxed{= 0.3935}$$

geometric RV

$$P(X=6) = q^5 p = (0.6065)^5 (0.3935)$$
$$\boxed{= 0.0323}$$

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