Random Graphs and Social Networks: Homework 3

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Exercise 1:

Suppose we have a random variable U that is uniformly distributed on $[0, 1]$. Explain how you can use it to generate:

a.) A discrete random variable X having the following probability mass function:

x	1	2	3	4	5
$P(X = x)$	0.3	0.3	0.2	0.1	0.1

b.) An exponential random variable X with mean 3, i.e., whose distribution function is given by:
$$F(x) = P(X \leq x) = 1 - e^{-x/3}, \qquad x \geq 0.$$

Exercise 2:

Suppose we want to generate an evolving graph where each incoming vertex has exactly one edge, and where vertex k (the kth vertex to arrive) chooses one of the existing vertices $\{1, 2, \ldots, k - 1\}$ with equal probability, i.e.,

$$P(\text{vertex } k \text{ attaches to vertex } i) = \frac{1}{k - 1}, \qquad i = 1, 2, \ldots, k - 1.$$

This graph is called a *uniform attachment graph* or *random recursive tree*. Give an algorithm to simulate it.