Consider throwing n balls into n bins uniformly at random. Let X be the number of balls in the first bin.

a) What is the expected value of X?

b) What is the variance of X?

What is the covariance of X and X^3 where X is a uniformly distributed variable on the interval $[0, 1]$? (i.e. $X \sim U[0, 1]$)

1 Halting Problem

Basically problem comes down to reducing any given problem to the halting problem. We can do this by describing a program that halts if we reach the desired input, and not otherwise. Generally, things where we need to determine something about *how* a program executes (for instance, executing a specific line) is uncomputable, and things that can be tracked (like how much memory a program uses) can be computable.