### **2.**

Uncorrelated random variables are defined as random variables which have zero correlation. If for two random variables, the conditional distribution of one on the other equals the distribution of itself, these two random variables are independent with each other. Obviously, independence is stronger statement.

Example of random variables that are uncorrelated but not independent:

Assume random variable X satisfies f(X) = f(-X), set Y= |X|. We have Cor(X, Y) = E(X)E(Y) - E(XY) = 0 - 0 = 0. Then X and Y are uncorrelated. But obviously, X and Y are not independent.

### **13.**

There are several ways to generate random numbers. One of the most common PRNG is the [linear congruential generator](https://en.wikipedia.org/wiki/Linear_congruential_generator), which uses the recurrence

X_{n+1} = (a X_n + b)\, \textrm{mod}\, m

to generate numbers, where *a*, *b* and *m* are large integers, and X_{n+1} is the next in *X* as a series of pseudo-random numbers.

**Testing**

Assume that f is a function taking any finite sequence of zeros and ones, and returning a non-negative real value. Then, given a sequence of independent and uniformly distributed random variables Xn, applying f to the finite sequence of random variables (X1,…,Xn) yields a new random variable, Yn. This new variable has a certain cumulative probability distribution Fn(x)=ℙ(Yn≤x), which in some cases approaches a function F as ngrows large. This limit function F can be seen as the cumulative probability distribution of a new random variable, Y, and in these cases Yn is said to converge in distribution to Y.

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### **15.**

Exclusive or operation is a [logical operation](https://en.wikipedia.org/wiki/Logical_connective) that outputs true only when both inputs differ. In this problem we could sum all elements in the array using exclusive or operation. All elements that appear twice would sum to zero and the final result would be the element that appears only once.