Monte Carlo Simulation - MA 323

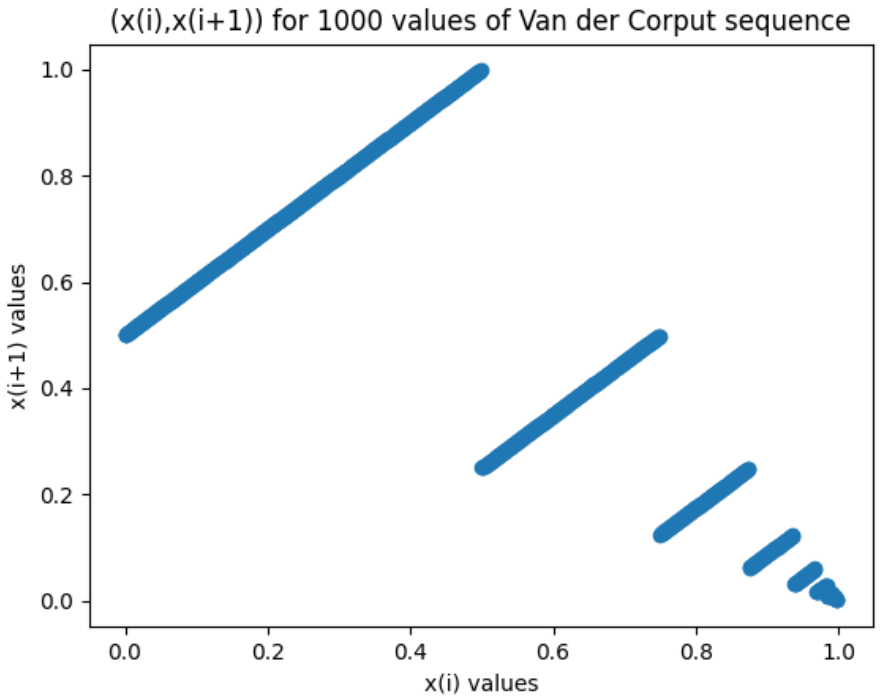
Lab 10 - Report - Lakshya Kohli - 210123077

Answer 1.

The first 25 values of the Van Der Corput Sequence obtained using radical inverse function xi := $\phi_2(i)$, are:

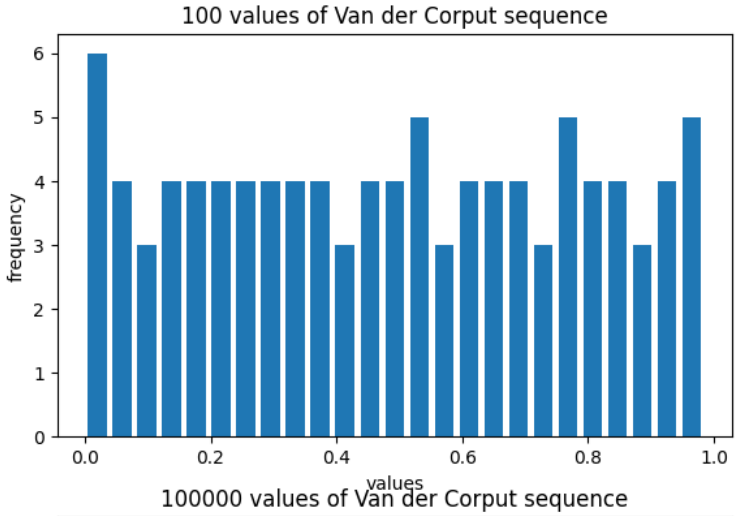
[0, 0.5, 0.25, 0.75, 0.125, 0.625, 0.375, 0.875, 0.0625, 0.5625, 0.3125, 0.8125, 0.1875, 0.6875, 0.4375, 0.9375, 0.03125, 0.53125, 0.28125, 0.78125, 0.15625, 0.65625, 0.40625, 0.90625, 0.09375]

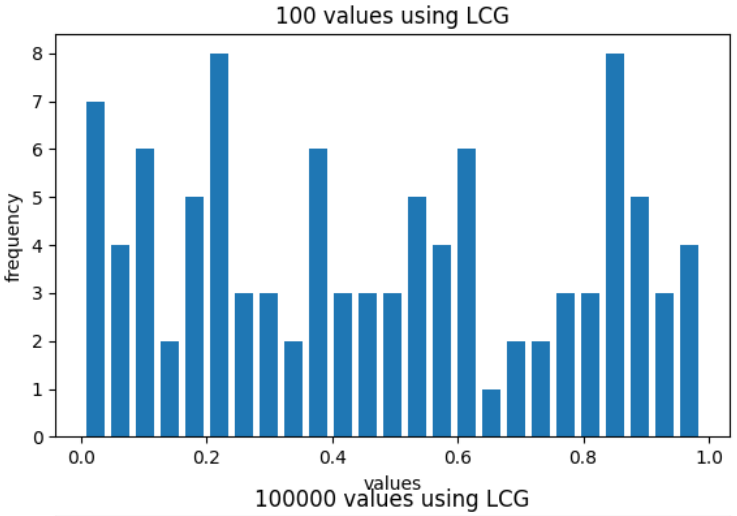
The first 1000 values were generated and the pairs (x_i , x_{i+1}) were plotted as shown below:

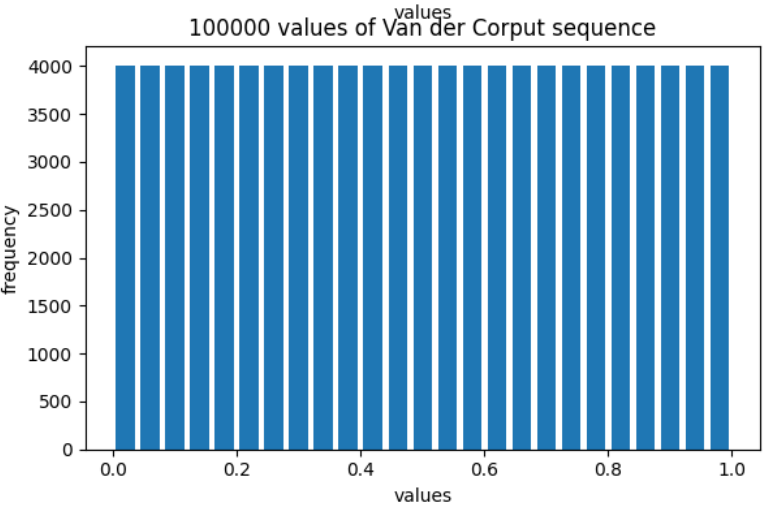


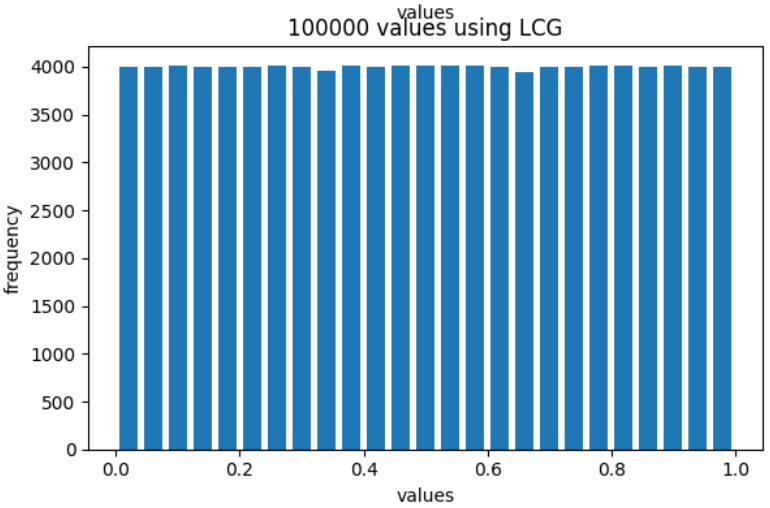
When scatter is used to map the points, we can see that there is a distinct and clear pattern. The above lines are parallel to line y=x as well.

Answer 2.









The first 100 and 100000 values of the Van Der Corput Sequence and a mixed Linear Congruence Generator Sequence are generated. The LCG used is same as Lab01 , that is :

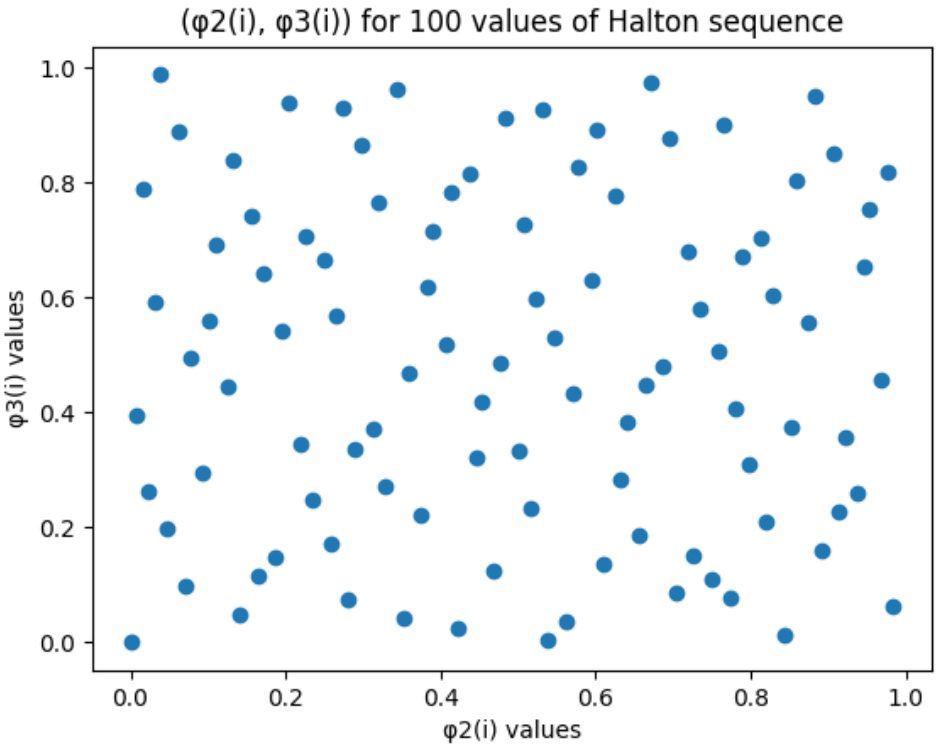
$X_{i+1} = (1229 * X_i + 1) \% 2048$
$U_{i+1} = X_{i+1} / 2048$, where X_0 (seed) = 7

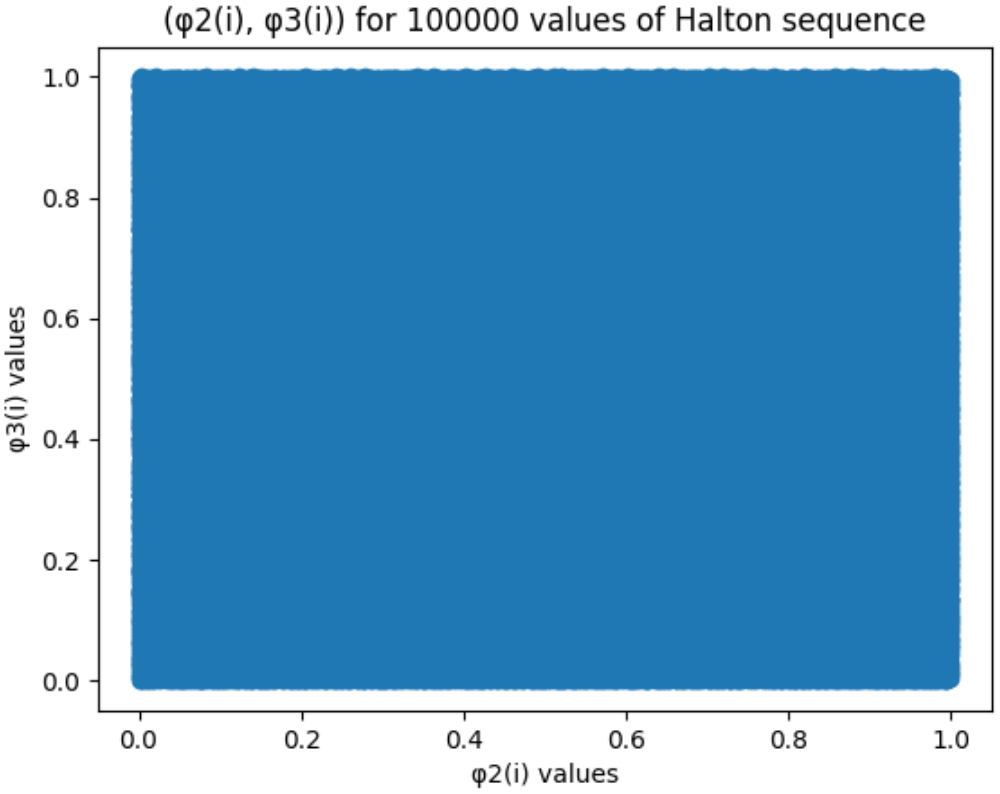
1. One can observe that when n equals 100, which corresponds to smaller n values, both the VanderCorput sequence and the Linear Congruence Generator display a mild resemblance to the true Uniform Distribution. Nevertheless, as n increases to 100,000, or larger n values, the Van der Corput sequence exhibits a closer resemblance to the uniform distribution compared to the LCG.

2.We can observe that the plot for the Van der Corput sequence is more uniformly distributed, than the LCG used – General Linear Congruence Generator.

3. Van der Corput sequence plots exhibit the characteristic that the count of points within a specific interval is nearly directly related to the interval's length. This quality is crucial for the generation of evenly distributed random numbers. However, the Linear Congruential Generator (LCG) does not fully meet this criterion and only approximates it when the sequence length is significantly increased.

Answer 3.


(φ2(i), φ3(i)) for 100 values of Halton sequence
φ3(i) values
φ2(i) values
0.0
0.2
0.4
0.6
0.8
1.0


(φ2(i), φ3(i)) for 100000 values of Halton sequence
φ3(i) values
φ2(i) values
0.0
0.2
0.4
0.6
0.8
1.0

Observations:

1. We can observe that the points are uniformly located in the R^2 plane. They completely cover the whole region and do not form any clusters.

2. The point density resembles a uniform distribution, which becomes more evident when considering a larger sample size of n = 100,000, as the pattern is less discernible with a smaller sample (n = 100).