

Lab Number : 12

Due Date : Nov 27, 2020

Student Details :

- Name : AB Satyaprakash
- Roll Number : 180123062
- Department : Mathematics and Computing

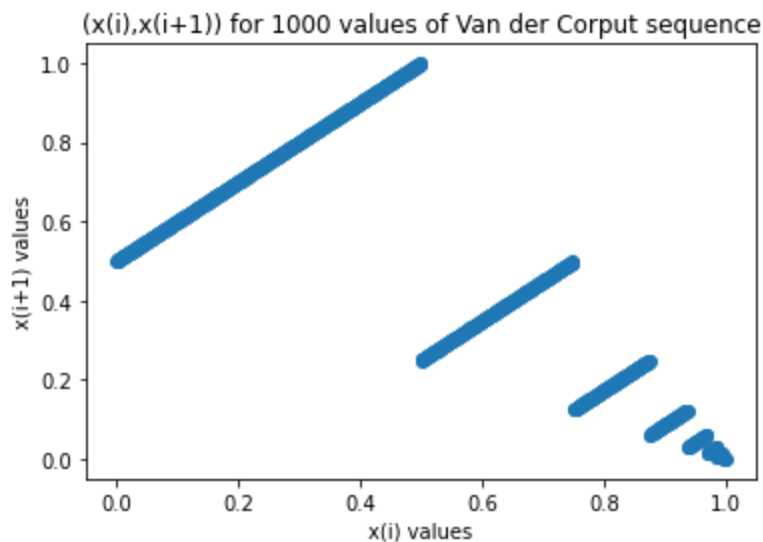
Explanation:

Question 1

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

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

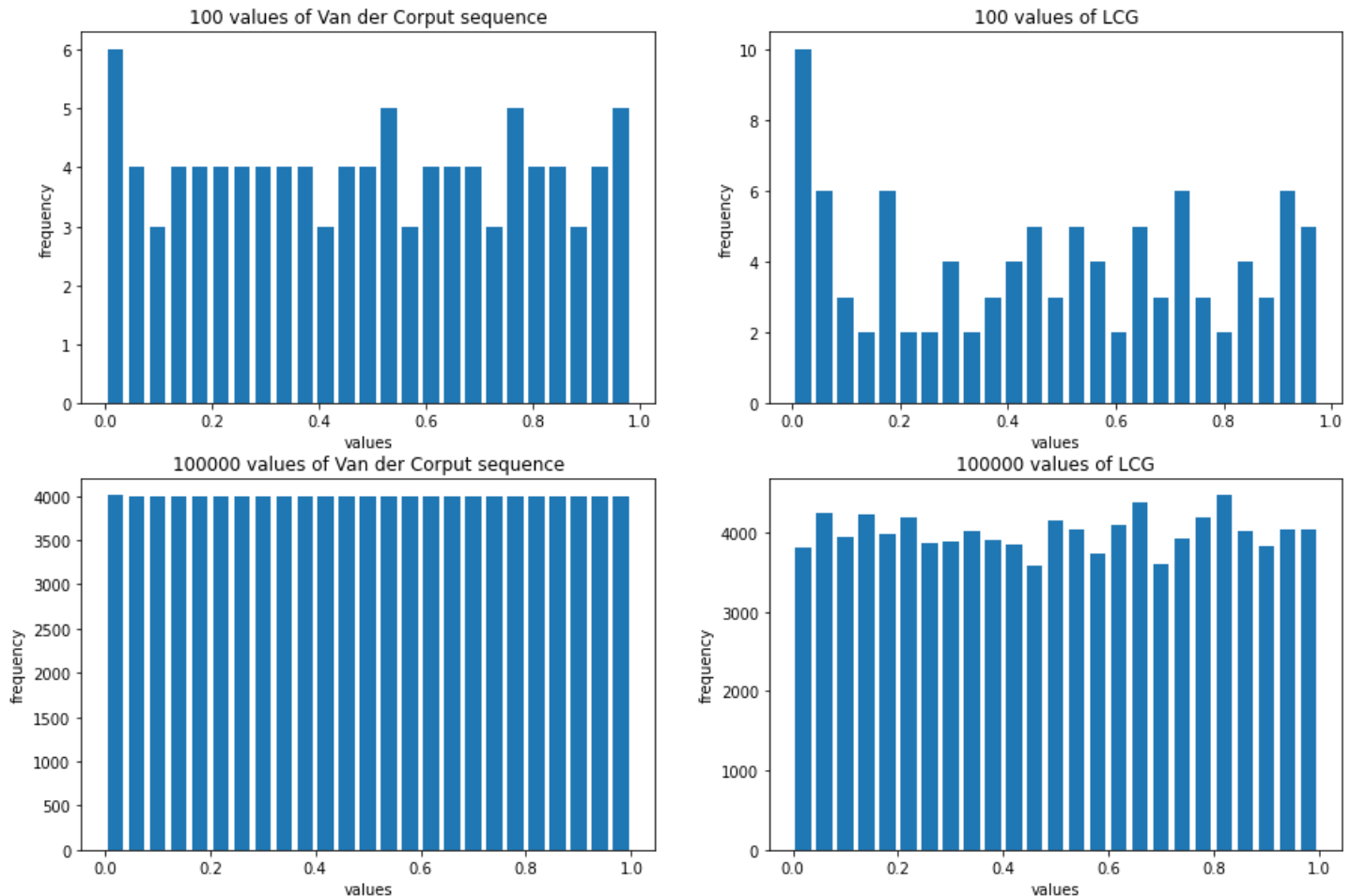


As we can see, there is a clear pattern when scatter is used to plot the points

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 lab 11, that is :

```
x(i + 1 ) = (1229x(i) + 11)%2048
u(i + 1 ) = x(i + 1 )/2048
x0 (seed) = 111
```

The **histograms** are drawn side by side as follows:

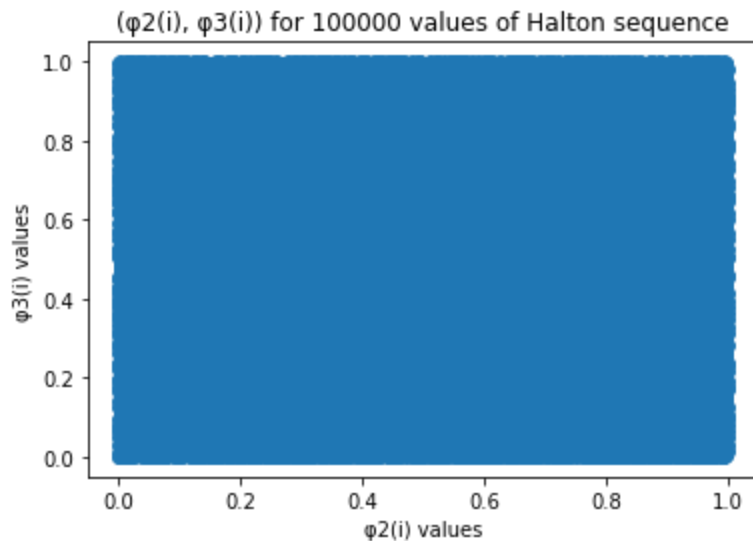
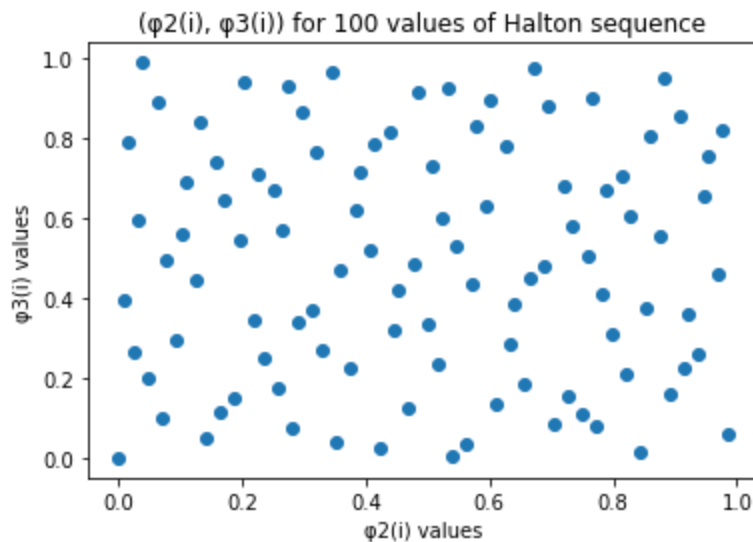


It can be seen that for just $n = 100$ values of the sequence, Both Van der Corput and Linear Congruence Generator **weakly mimic the actual Uniform Distribution**. However, for $n = 100000$, **Van der Corput mimics the uniform distribution better than the LCG does**.

Question 2

The **Halton** sequence $x_i := (\phi_2(i), \phi_3(i))$ (as points in R^2) is generated for **100** and **100000** values from the radical inverse functions for base 2 and 3.

For $n=100$, the plot is less dense and does not show any clear pattern, but for the case of $n=100000$, the points cover the whole of **hyper-cube** which in R^2 is a square! The density of the points is uniform for both cases, thus proving that the Halton sequence mimics the uniform distribution.



Output:

The lab needs **matplotlib**, which can be easily installed by using the following.
One can use only pip, if one doesn't use python3.

```
pip install matplotlib
```

The output in the terminal is as below.

```
lord:Lab 12 imperial_lord$ python3 AB_180123062.py  
[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]  
LCG used:  $x(i+1)=(1229*x(i)+11)\%2048$  with  $x(0)=111$ 
```