Monte Carlo – Uniform distributions

- Write a small code to generate random numbers using the RANDU algorithm:

$$X_{n+1} = (aX_n + c) \mod m$$

With $m = 2^{31}$, a=65539, X_0=1, c=0

- Show that it has (hyper)planes in 3-dimentional space.
- Run the
  - test on equal distributions,
  - gap test,
  - random walk test.

Monte Carlo – MC Generation

- Use the Transform method to generate random numbers according to $f(x) = e^{-x}$ with $x>0$.
  - Do the same thing using the rejection method.
  - Compare with the ouput of the random generator of ROOT.

Monte Carlo – Integration

- In a Compton scattering experiment, a cylindrical aluminium target is put in front of a punctual source of gamma rays, and the detector is put on the other side. In order to normalize the results, one needs the effective volume, defined by the intersection between the cylinder and the cone defined by the source and the detector. Compute that volume by MC means, in the following two configurations:
  - the cylinder is 10cm high, r=2cm. It is standing vertically at equal distance of the source and of the detector, such that the gamma rays enters on the curved side. The detector window is a circle of r=2cm put at 4m away from the source.
  - The distance between source and detector is reduced to 10cm and the cylinder is replaced by a smaller one, of radius equal to 1cm.

Event classification

- Starting from the small code provided, reproduce the example shown in the lecture.
  - Show what happens if the training dataset is too small.
  - Find a proper structure „that works well”.
- Build the efficiency vs rejection plot and find the best cut on the NN output
  - To make a discovery
  - To measure the signal
    - We will assume that S/N=1, in total.