MP468C — Computational Physics 2 — Lab 01

1. Plot the normalized distribution function of the quantity

$$y = -x^3 \ln x$$

where x is a uniformly distributed random number between 0 and 1. Use at least 100 bins in your plot (histogram), and find how many random numbers you need to get a smooth curve.

Plotting questions:

(a) How do you control the number of bins when using matplotlib to plot histograms?

(b) Matplotlib has an option of normalizing histograms. This option multiplies the histogram counts by some factor. What factor? Should the bar heights add to 1 when you normalize, or should the areas of the bars add to 1? Explain.

(c) Is there any advantage to using the seaborn package for plotting histograms?

More important question:

Can you derive the functional form of the probability distribution (pdf) that you obtain? If so, don't we want this function plotted on top of the normalized histogram?

2. Generate pairs of random numbers (x, y), each uniformly distributed random number between 0 and 1. Compute $R = \sqrt{x^2 + y^2}$. Using at least 10^7 pairs, find the proportion p of pairs satisfying $R < 1$, and print $4p$. What do you get?

Explain geometrically the value of $4p$.