Computational Physics / PHYS-GA 2000 / Problem Set #3
Due September 24, 2024

You *must* label all axes of all plots, including giving the *units*!!

1. Read Example 4.3 in Newman. Using successively larger matrices (10×10, 30×30, etc.) find empirically and plot how the matrix multiplication computation rises with matrix size. Does it rise as N^3 as predicted? Use both an explicit function (i.e. the one in the example) and use the `dot()` method. How do they differ?

2. Exercise 10.2 in Newman.

3. Exercise 10.4 in Newman.

4. Demonstrate that the central limit theorem works. Do so by generating random variate $y = N^{-1}\sum_{i=0}^{N} x_i$, where x_i is a random variate distributed as $\exp(-x)$ (you can use the `np.random` library to generate the exponentially-distributed variates). First, calculate analytically how you expect the mean (that one should be easy) and variance of y to vary with N. Show visually that for large N the distribution of y tends towards Gaussian. Show as a function of N how the mean, variance, skewness, and kurtosis of the distribution change. Estimate at which N the skewness and kurtosis have reached about 1% of their value for $N = 1$.