University of Massachusetts Lowell ECE
EECE 5430 Theory of Communication
Take Home Exercise 3: Central Limit Theorem in Matlab

The purpose of this exercise is for you to see in action the central limit theorem that is critical to the formation of white Gaussian Noise. You will learn to work with histograms and estimate the probability density function from histograms of real data. You will compare theoretical pdf to your measured estimate of pdf.

Part A.

Step 1. Create an array of 1,000,000 samples of a uniform random variable on the interval (0,1).

Step 2. Create a histogram of the samples with a delta of 0.01. Use the command [x,y]=hist(values,100), where values are the random numbers you have created

Step 3. note that a f(x)dx =P(x<X<=x+dx) so that f(x)= P(x<X<=x+dx)/dx. Normalize the number of points in the histogram by the total and divide by delta x (0.01). This should approximate f(x) and it should look like a uniform RV

Part B.
Step 1: Create an array (30,1,000,000) of uniform random numbers on the interval 0,1. Subtract the mean from sample. Divide by (1/sqrt (12)), the standard deviation of a [0,1] uniform random variable.

Step 2: Now take groups of 30 samples and sum them by doing sum(array). Divide by sqrt(30), so that the variance remains 1.

Step 3: Plot a histogram of the sum and covert to pdf using technique above. On the same plot create a pdf for a N(0,1) Gaussian random variable (use the formula). You will notice that the normalized sum of 30 independent samples of a uniform random variable has a Gaussian distribution. This demonstrates that the probability density function formed from the sum of a large number of independent random events will tend to a Gaussian, and that 30 samples forms a good statistical sample.