# Statistical Signal Processing
# Assignment 1

Submission deadline: 17th, November, 2015

## Basic Programming (Submit only the results and plots)

1. Generate a time vector $t$ from 0 seconds to 10 seconds with a sampling interval of 0.1 second. Generate the function $f(t) = cos(\pi t)$. Plot this function. Now replace all values in $f(t)$ that are above 0.5 with 1. Plot the modified array.

2. Write a program to generate the first 30 Fibonacci numbers, and calculate how many of them are prime.

3. Probability Density Function (PDF) of a joint distribution of random variables $\mathbf{X}$ and $\mathbf{Y}$ is given by $f(x, y) = \frac{1}{32\pi}(xy)^2 e^{-(x^2+y^2)/8}$ for $0 \leq x, y \leq 10$. (i) Plot the PDF. (ii) Calculate and plot PDF $f(x)$ and Cumulative Distribution Function (CDF) $F(x)$ of random variable $\mathbf{X}$. (iii) Also calculate expectation $E(\mathbf{X})$ and Variance $Var(\mathbf{X})$ of $\mathbf{X}$.

## Random Numbers (Submit only the results and plots)

1. Generate 10000 Gaussian random numbers with $\mu = 4$ and $\sigma^2 = 2$. Plot the histogram of these numbers. Check whether the histogram of the distribution is same as the PDF of the distribution by plotting the PDF along with the histogram.

2. Assume $\mathbf{X}$ and $\mathbf{Y}$ are two random variables drawn from independent yet identical distributions (normal distribution $\mathcal{N}(\mu = 0, \sigma^2 = 1)$ ). Numerically evaluate and plot the PDFs of $x$, $\text{Arg}(x + iy)$,$|x + iy|$, and $|x + iy|^2$.

## Iteration (Submit the code as well as results)

1. Generate a $100 \times 100$ matrix A whose diagonal elements are unity, and element $i, j$ for $i \neq j$ are given by $1/|i - j|$. Plot this matrix as an image.

2. A person starts walking at $x = 0$ accoding to the following rule. Every second, he rolls a die. If the outcome is more than 2, he takes a step in the positive $x$ direction, else, he takes a step in the negative $x$ direction. Numerically simulate the $x$ co-ordinate of the person as a function of time and plot the result for 100 steps. Modify the above program to stop when the person reaches $x = 15$. How many times did he roll the die to reach this position. Repeat the simulation 1000 times to find the PDF for the number of die rolls it takes to reach $x = 15$.