CS2400 : Assignment 1

Vedant Somani CS14B053
Shyam Prasad Naik CS13B045

Introduction/Problem Description

In this assignment, we generate and sample two sinusoidal signals, and observe their properties in the frequency domain using the DFT. In this process, we study the properties and intricacies associated with the DFT.

The two signals

$X1(t) = 2.0 \sin(900\pi t)$

$X2(t) = 2.3 \sin(1500\pi t)$

Thus

A1 = 2.0

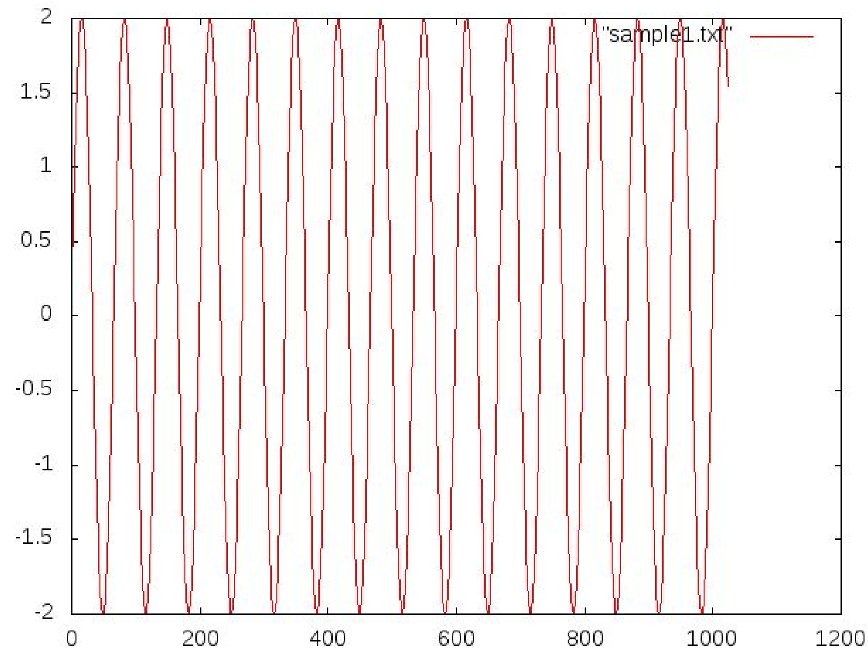
A2 = 2.3

F1 = 450 Hz

F2 = 750 Hz.

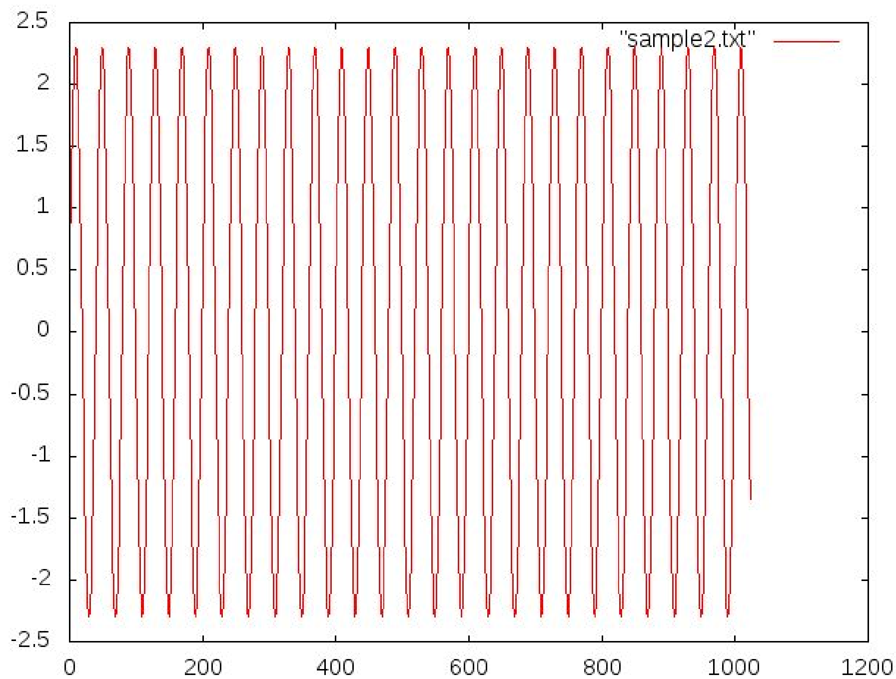
Sampling :

Both the signals have been sampled at a rate of 30,000 samples per second. The discrete values thus obtained are plotted and we observe the following plots



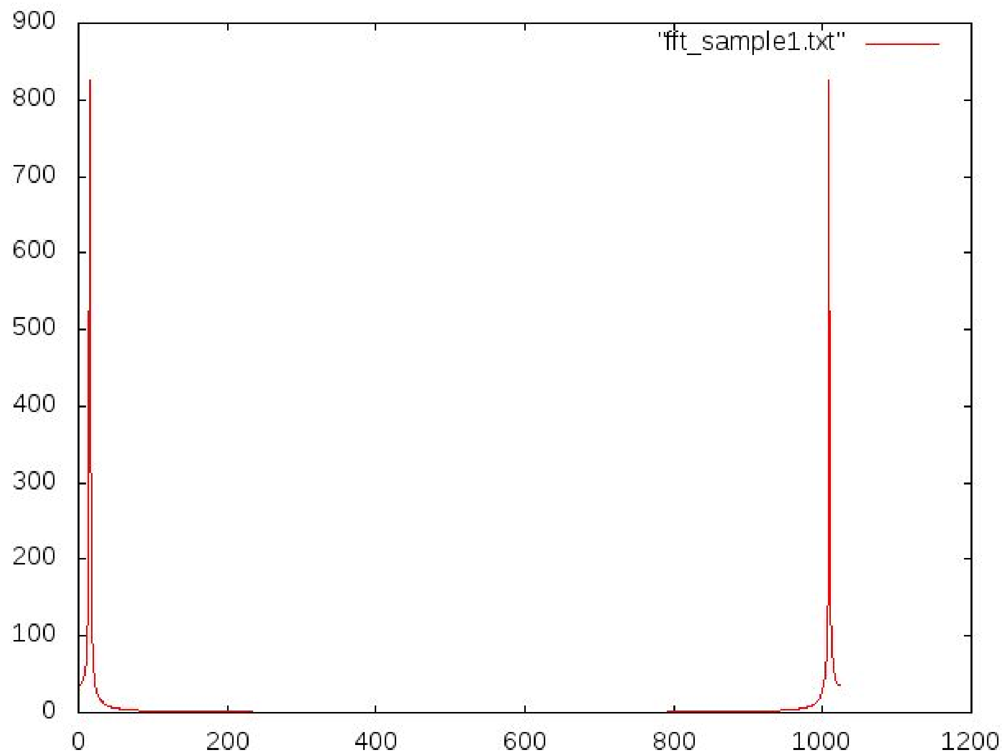
.

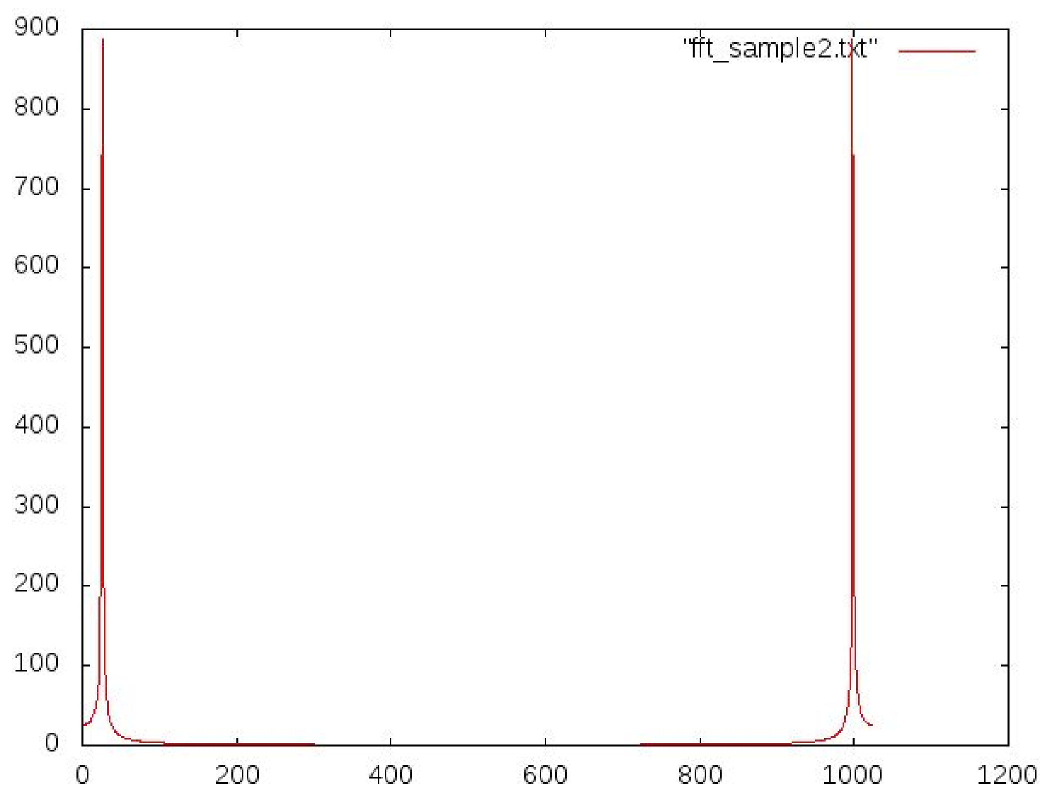
Sample 1 : A = 2.0, f=450Hz R=30,000



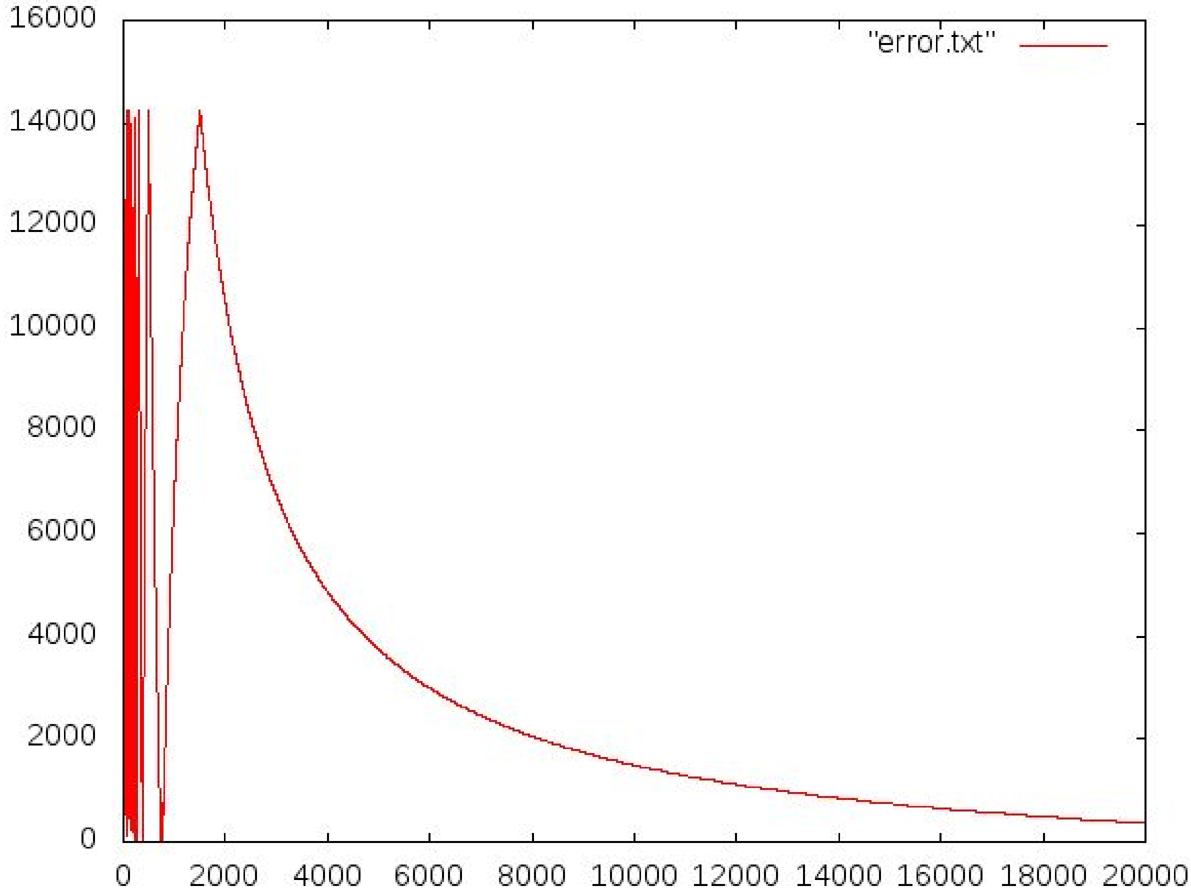
Sample 2 : A=2.3, f=900Hz R=30,000

The fourier transforms of the both the plots

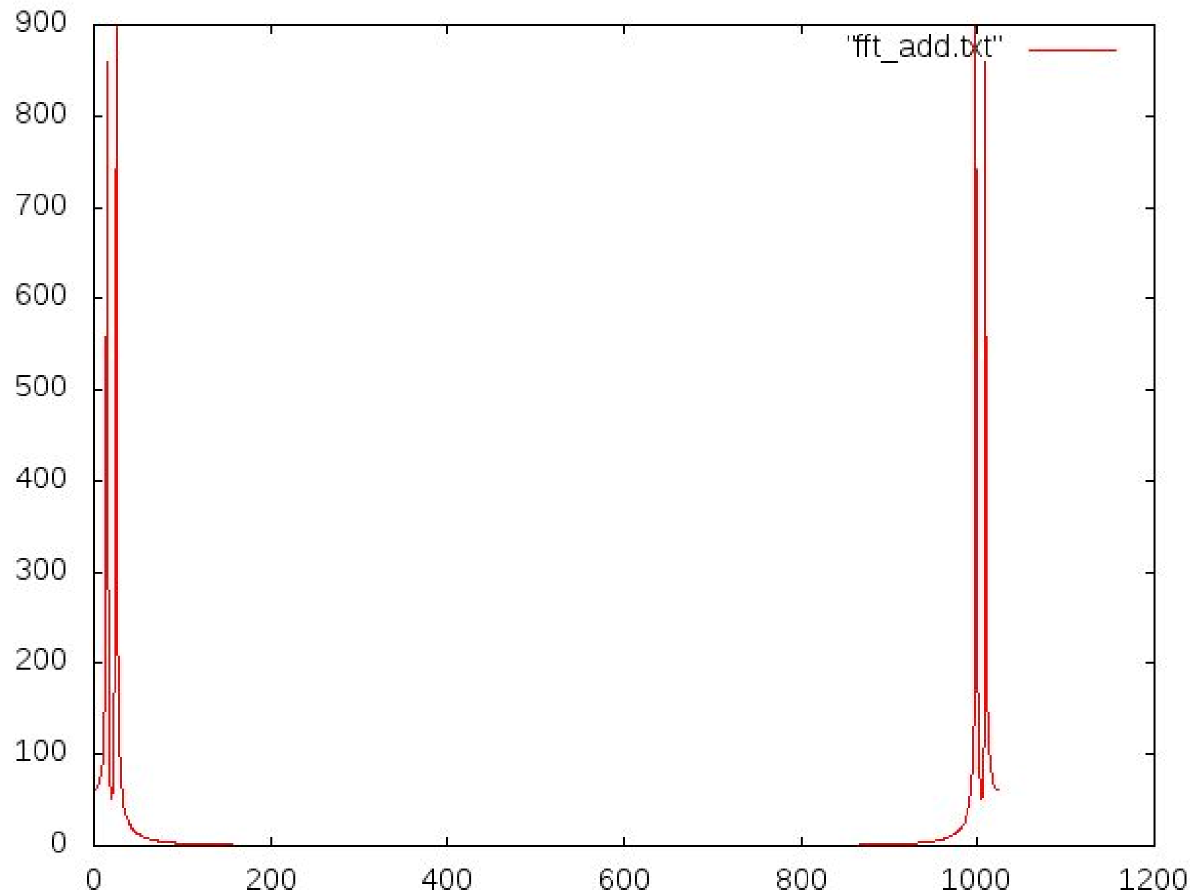




From the sampled signal, we can find out the frequency of the signal. The process is as follows.
For every cycle, there exists two zero crossings. A zero crossing is a place where the signal value becomes zero. Thus the total number of zero crossings / 2 will give us the number of cycles.
We know the that frequency is equal to the (zero_crossings * R) / 2*N.
The frequencies are thus calculated by varying R and the errors are plotted in the following graph.



Adding two signals and taking a fourier transform is equivalent to adding the fourier transform of both the signals, the same can be observed through the following plot of the fourier transform of the addition of the sampled signals



Convolution of two signals in the time domain leads to the multiplication in frequency domain. The property can be observed in the following plot where the fourier transform of the convolution of both the sampled signals is depicted. It clearly is the multiplication of the fourier transforms of individual signals.