EEL2010: Signals and Systems
Programming Assignment Report

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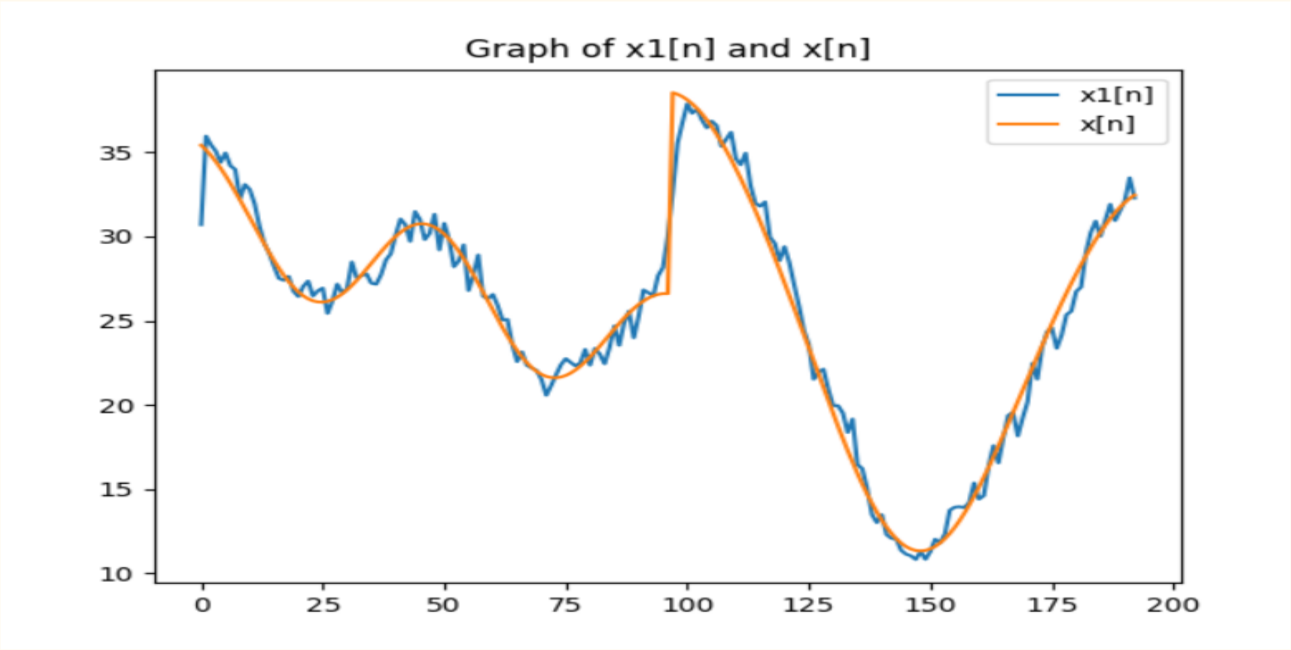
Objective of the assignment :

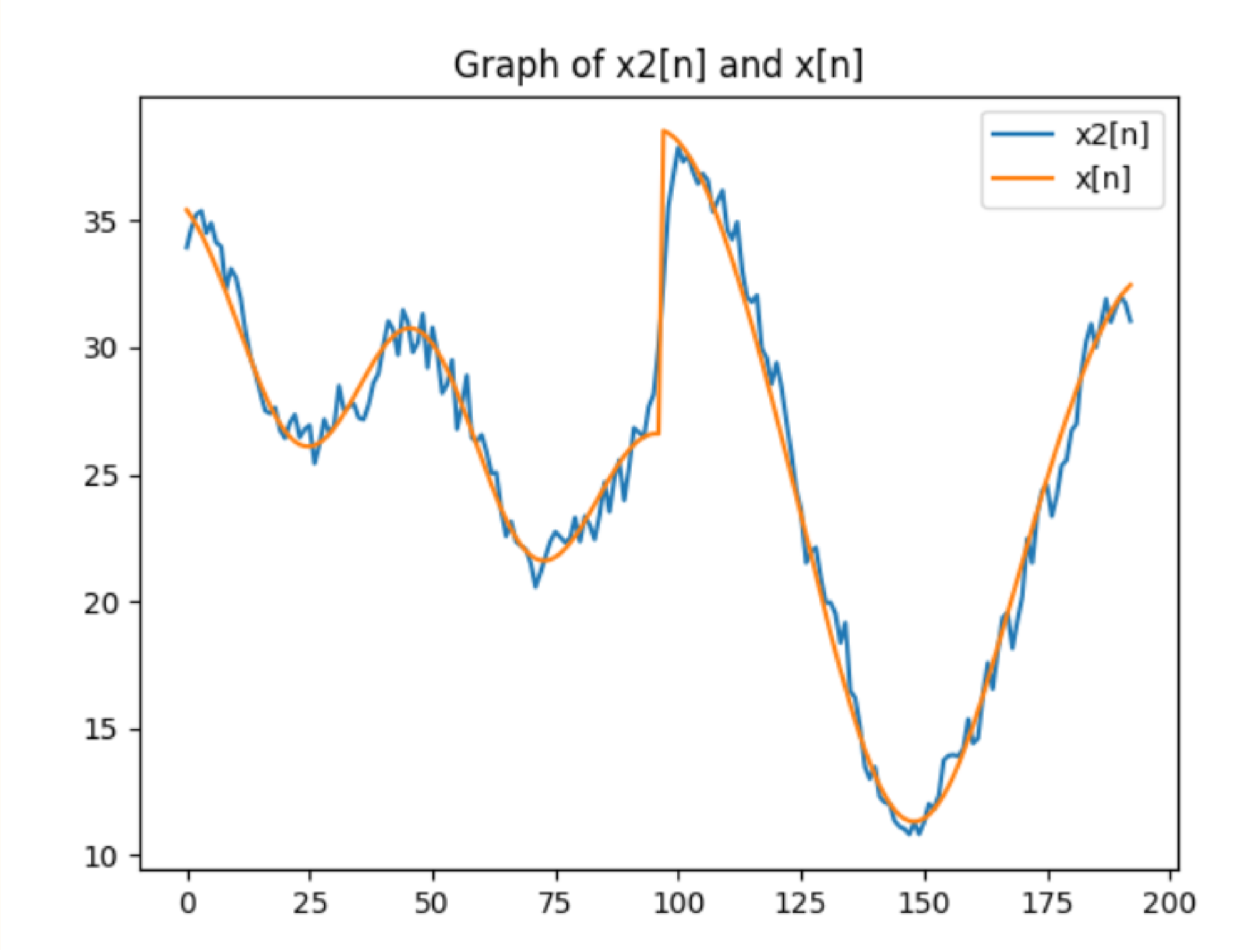
To apply our course knowledge to real-world problems, and in this assignment, we are given temperature measurements in an area, and during transmission of stored values to the base unit, the received signal y[n] at the base unit suffers from distortions and noise, so we need to recover the original signal from it using two approaches: first, removing the noise, and then deblurring the signal and second deblurring and then remove noise from the signal.

Results :

1. The signal x1[n] is obtained by First removing noise and then sharpening (deblurring) the signal :



2.The signal x2[n] is obtained by first sharpening (deblurring) and then removing the noise:



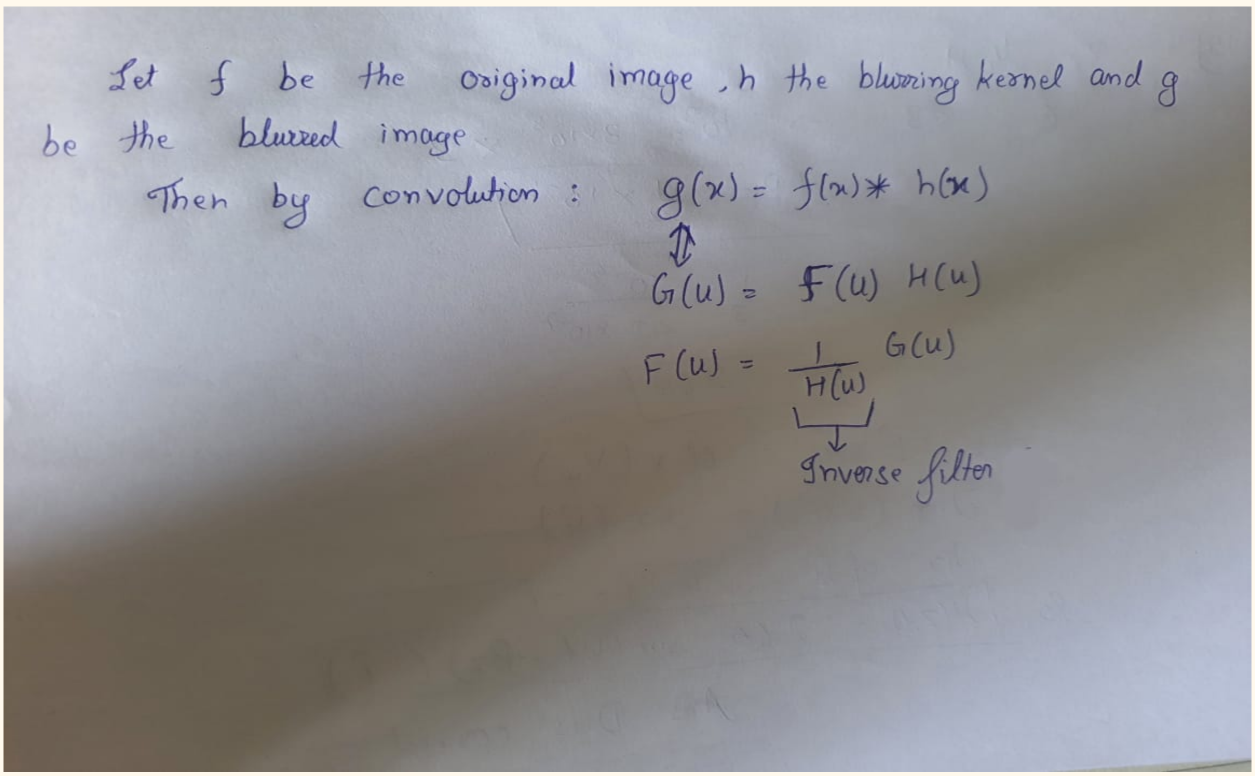
Theoretical explanations :

For denoising the signal:

In order to denoising the signal we have passed our noisy signal through a low pass filter, the main strategy here for removing noise is to average some nearby signals now since neighboring signals generally have similar values therefore we can replace a signal value by the average of its neighbors.

De-blurring/Sharpening the signal:

To deblur our signal, we used direct inverse filtering, and our question is provided with the information of h(n) (blurring kernel), which is our characterized impulse response to how the image is deblurred, so from the convolution theorem, the DFT of the blurred image is the product of the DFT of the original image and the DFT of the blurring kernel. We can recover the original image by dividing the DFT of the blurred image by the DFT of the kernel.



<u>Deblurring of the signal</u>

<u>Formula for Fourier transform -:</u>

$X(K) = \Sigma\, X_n\, e^{(-jwn)}$

The limit of summation goes from n=0 to n=N-1 and w= 2πk/N

Formula for Inverse Fourier transform -:

$x(n)=(1/N)\Sigma X\_n e^{(-jwn)}$

The limit of summation goes from n=0 to n=N-1 and w= 2πk/N

Conclusions :

1. Choosing an appropriate kernel gives the optimum output. While denoising the signal y[n].

2.We can conclude from the results that most values of x1[n] and x2[n] are the same but x2[n] values are more accurate than x1[n]. Because According to the mean square value of
x1=1.1675870161752986
x2=1.0647350357303536
x2<x1. Less the value of the mean square, the more accurate the signal.

3.Also theoretically, in the case of x1[n] denoising applied before the deblurring thus slightly blurred noise that has been present in the output signal was only partially removed.

4.But in the case of x2[x] first the signal gets sharpened (deblur) and then the noise is removed from the signal.

Contributions:

I.Shivank Maurya B20CH040:

i) Made the functions of denoising the signal,denoising then deblur and deblur then denoise.
ii)Readme file.

II.Shubh Soni B20BB039:

i) Made the functions of discrete Fourier transform of the output signal, discrete Fourier transform of the impulse response, and inverse Fourier transform of the signal.
ii) Report Writing

At last, both help each other in debugging the code.