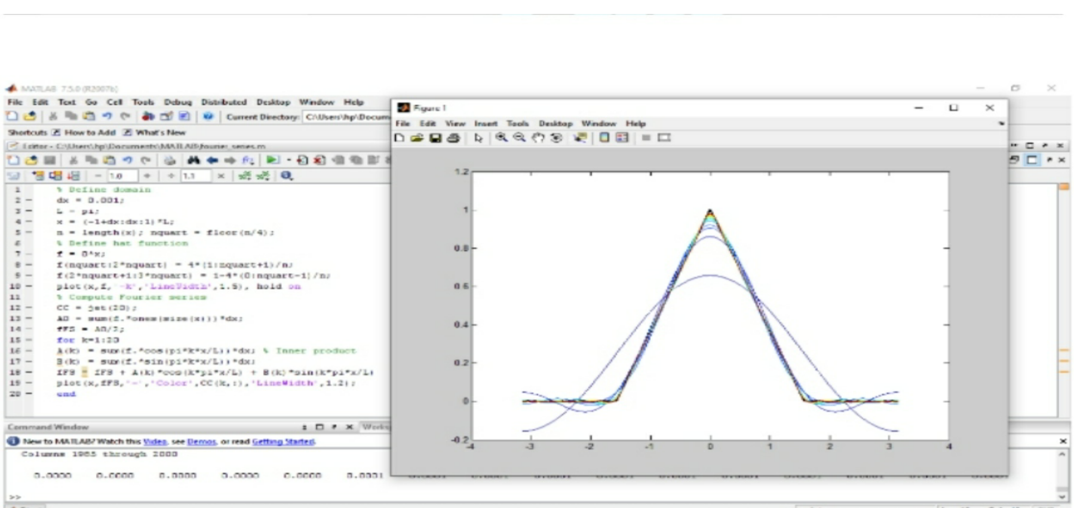
DAILY ASSESSMENT FORMAT

Date:	25/05/2020	Name:	Abhishek
Course:	Digital Signal Processing	USN:	4al17ec001
Topic:	1]Introduction to Fourier Series & Fourier Transform 2]Fourier Series – Part 1 3]Fourier Series – Part 2 4]Inner Product in Hilbert Transform 5]Complex Fourier Series 6]Fourier Series using Matlab 7]Fourier Series using python 8]Fourier Series and Gibbs Phenomena using Matlab	Semester & Section:	6th ‘A’
Github Repository:	Abhishek-online-courses		

FORENOON SESSION DETAILS
Image of session 

Report

Fourier Series

A fundamental result in Fourier analysis is that if f(x) is periodic and piecewise smooth, then it can be written in terms of a Fourier series, which is an infinite sum of cosines and sines of increasing frequency. In particular, if f(x) is 2π periodic, it may be written as:

$$f(x) = \frac{a_0}{2} + \sum_{k=1}^{\infty} \left(a_k \cos(kx) + b_k \sin(kx)\right)$$

The coefficients a_k and b_k are given by,

$$\begin{aligned} a_k &= \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cos(kx) dx \\ b_k &= \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \sin(kx) dx, \end{aligned}$$

Fourier Transform

The Fourier transform integral is essentially the limit of a Fourier series as the length of the domain goes to infinity, which allows us to define a function defined on (-∞,∞) without repeating. We will consider the Fourier series on a domain x belongs to
(-L; L), and then let L → . On this domain, the Fourier series is:

$$f(x) = \frac{a_0}{2} + \sum_{k=1}^{\infty} \left[a_k \cos\left(\frac{k\pi x}{L}\right) + b_k \sin\left(\frac{k\pi x}{L}\right)\right] = \sum_{k=-\infty}^{\infty} c_k e^{ik\pi x/L}$$

With the coefficients given by:

$$c_k = \frac{1}{2L}\langle f(x), \psi_k \rangle = \frac{1}{2L}\int_{-L}^{L} f(x)e^{-ik\pi x/L}\, dx.$$

Using previous results of f(x) in addition, the summation with weight ▲w becomes a integral, resulting in the following:

$$f(x) = \mathcal{F}^{-1}\left(\hat{f}(\omega)\right) = \frac{1}{2\pi}\int_{-\infty}^{\infty} \hat{f}(\omega)e^{i\omega x}\, d\omega$$
$$\hat{f}(\omega) = \mathcal{F}\left(f(x)\right) = \int_{-\infty}^{\infty} f(x)e^{-i\omega x}\, dx.$$

These two integrals are known as the Fourier transform pair.

Complex Fourier Series

The complex Fourier series is presented first with period 2π, then with general period. The expression for complex fourier series is given by,

$$f(t) = d + \sum_{n=1}^{\infty}\left[a_n \cos(nt) + b_n \sin(nt)\right]$$
$$= d + \sum_{n=1}^{\infty}\left[a_n\left(\frac{e^{int} + e^{-int}}{2}\right) + b_n\left(\frac{e^{int} - e^{-int}}{2i}\right)\right]$$
$$= d + \sum_{n=1}^{\infty}\frac{(a_n - ib_n)}{2}e^{int} + \sum_{n=1}^{\infty}\frac{(a_n + ib_n)}{2}e^{-int}$$
$$= \sum_{n=-\infty}^{\infty} c_n e^{int}$$

where,

$$c_n = \begin{cases} d & , n = 0 \\ (a_n - ib_n)/2 & , n = 1, 2, 3, \ldots \\ (a_{-n} + ib_{-n})/2 & , n = -1, -2, -3, \ldots \end{cases}$$

Note that a_{-n} and b_{-n} are only defined when n is negative.

Hilbert Transform

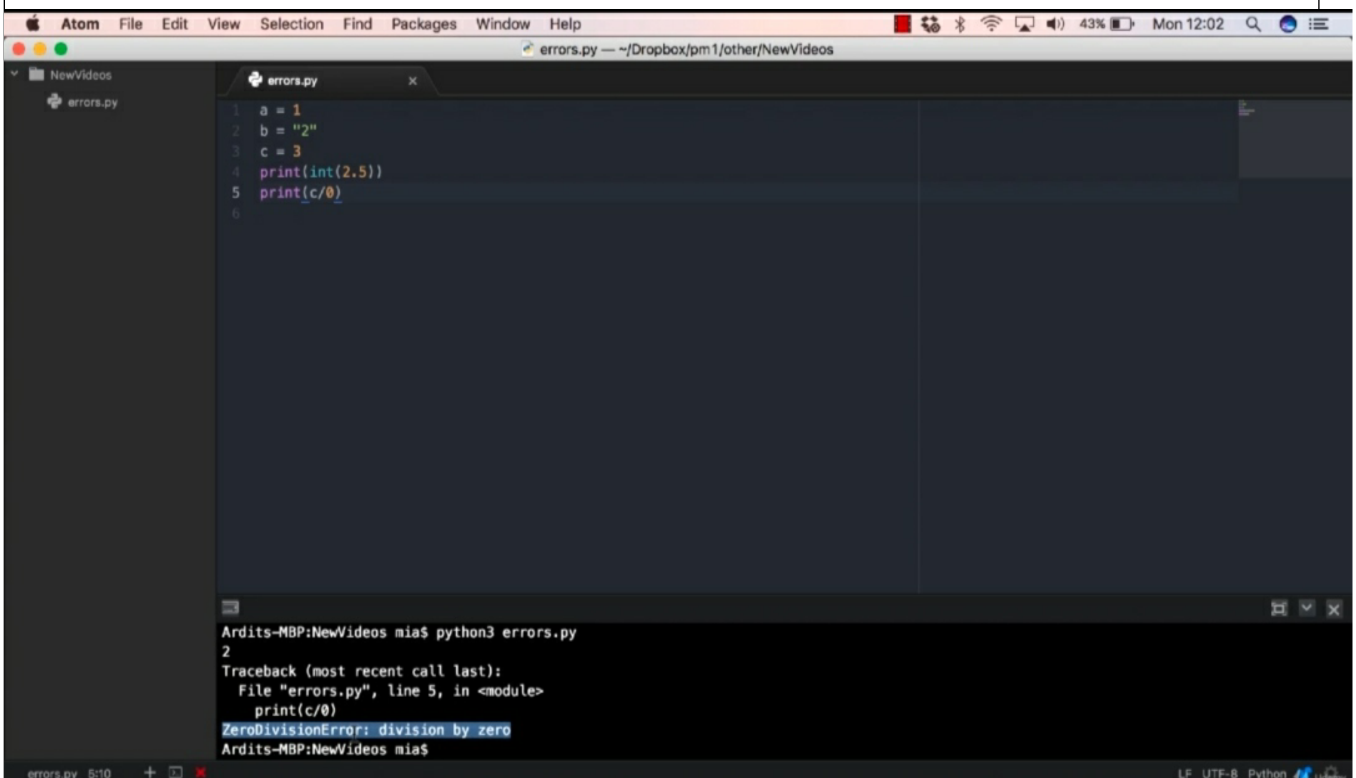
In mathematics and in signal processing, the Hilbert transform is a specific linear operator that takes a function, *u*(*t*) of a real variable and produces another function of a real variable *H*(*u*)(*t*). This linear operator is given by convolution with the function $1/(\pi t)$:

$$H(u)(t) = \frac{1}{\pi} \int_{-\infty}^{\infty} \frac{u(\tau)}{t - \tau}\, d\tau$$

- The Gibbs phenomenon is an overshoot (or "ringing") of Fourier series and other eigen function series occurring at simple discontinuities.
- It can be reduced with the Lanczos sigma factor. The phenomenon is illustrated above in the Fourier series of a square wave.

Date:	25/05/2020	Name:	Abhishek
Course:	The Python Mega Course: Build 10 Real World Applications	USN:	4al17ec001
Topic:	1] Fixing Programming Errors	Semester & Section:	6th 'A'

AFTERNOON SESSION DETAILS
Image session



Report

Fixing Programming Errors

- Basically, there are two types of errors in python – Syntax and exceptional errors.
- Syntax errors can be found in the line mentioned by the terminal or in the previous lines in the code.
- To fix the difficult errors, the error details can be copied from the terminal and paste it on the google search bar to get the solutions (recommended website is stack overflow).