EE3025 Assignment-1

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Download all python codes from

https://github.com/dks2000dks/IIT-Hyderabad-Semester-Courses/tree/master/EE3015-EE3025/Assignment-1/Part-1/Report/codes

and latex-tikz codes from

https://github.com/dks2000dks/IIT-Hyderabad-Semester-Courses/tree/master/EE3015-EE3025/Assignment-1/Part-1/Report

1 Problem

1.1. Let

$$x(n) = \left\{\underset{\uparrow}{1}, 2, 3, 4, 2, 1\right\} \tag{1.1.1}$$

$$y(n) + \frac{1}{2}y(n-1) = x(n) + x(n-2) \tag{1.1.2}$$

1.2. Compute

$$X(k) \triangleq \sum_{n=0}^{N-1} x(n)e^{-j2\pi kn/N}, \quad k = 0, 1, \dots, N-1 \tag{1.2.1}$$

and $H(k)$ using h(n).

2 Solution

2.1.

$$x(n) = \left\{\underset{\uparrow}{1}, 2, 3, 4, 2, 1\right\} \tag{2.1.1}$$

$$y(n) + \frac{1}{2}y(n-1) = x(n) + x(n-2) \tag{2.1.2}$$

Impulse Response of the LTI system is the output of the system when Unit Impulse Signal is given as input to the system.

So, Impulse Response of the System is

$$h(n) + \frac{1}{2}h(n-1) = \delta(n) + \delta(n-2) \tag{2.1.3}$$

$h(n)$ is an IIR Filter.

2.2. DFT of a Input Signal $x(n)$ is

$$X(k) \triangleq \sum_{n=0}^{N-1} x(n)e^{-j2\pi kn/N}, \quad k = 0, 1, \dots, N-1 \tag{2.2.1}$$

2.3. DFT of a Impulse Response $h(n)$ is

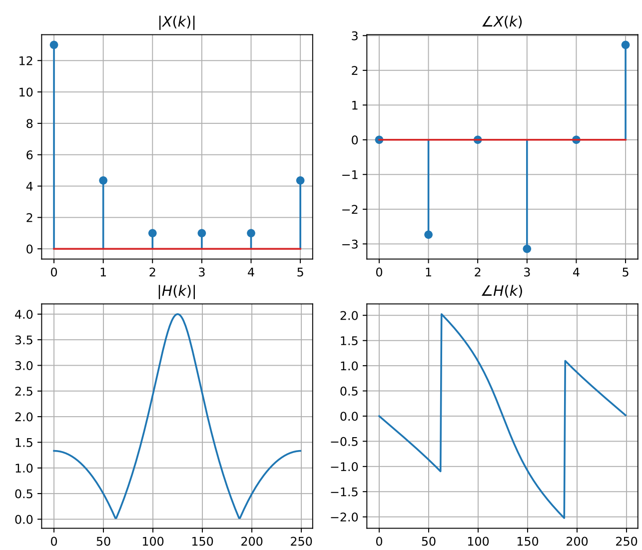
$$H(k) \triangleq \sum_{n=0}^{N-1} h(n)e^{-j2\pi kn/N}, \quad k = 0, 1, \dots, N-1 \tag{2.3.1}$$

2.4. Code for Computing DFT of $x(n)$ and $h(n)$
Solution:
Assuming length of $h(n)$ is 250 for better plotting of Frequency Components.

Code is in

codes/ee18btech11014_1.py

Magnitude and Phase Plots of $X(k)$ and $H(k)$



2.5. Radix-2 Fast Fourier Transform Algorithm in C.
Solution: If Input Signal length is not in the

form of 2^n, 0's are padded at the end of Input Signal and FFT is Computed. Note that FFT is computed for Padded Input Signal. Computed Fourier Transform is stored in ".dat" file.

Code is in

```
codes/ee18btech11014_fft.c
```

Run the code using command

```
gcc ee18btec
h11014_fft.c -lm && ./a.out
```

The above is written for

$$x(n) = \left\{ \underset{\uparrow}{1}, 2, 3, 4, 2, 1 \right\} \tag{2.5.1}$$

$$h(n) + \frac{1}{2}h(n-1) = \delta(n) + \delta(n-2) \tag{2.5.2}$$

2.6. Verification of Radix-2 FFT Algorithm in C using Python.
Solution: For, the Input Signal and Impulse Response

$$x(n) = \left\{ \underset{\uparrow}{1}, 2, 3, 4, 2, 1 \right\} \tag{2.6.1}$$

$$h(n) + \frac{1}{2}h(n-1) = \delta(n) + \delta(n-2) \tag{2.6.2}$$

Similar to C Program both $x[n]$ and $h[n]$ are padded with 0's at the end to have their lengths in 2^n format and FFT is computed using NumPy library. ".dat" Files generated by C Program are read and these values are verified by comparing them with Python results.

Code is in

```
codes/ee18btech11014_2.py
```