EE3025 - Assignment 1

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Download all python codes from

https://github.com/pranayEE11009/EE3025_IDP/tree/main/Assignment_1/codes

and latex-tikz codes from

https://github.com/pranayEE11009/EE3025_IDP/tree/main/Assignment_1

1 Problem

Let

$$x(n) = \left\{ \underset{\uparrow}{1}, 2, 3, 4, 2, 1 \right\} \tag{1.0.1}$$

and

$$y(n) + \frac{1}{2}y(n-1) = x(n) + x(n-2)$$
$$y(n) = 0, n < 0 \tag{1.0.2}$$

Compute

$$X(k) \triangleq \sum_{n=0}^{N-1} x(n)e^{-j2\pi kn/N},$$
$$k = 0, 1, \ldots, N-1 \tag{1.0.3}$$

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

Solution:

Since, We know that the Impulse response of an LTI system is the output of the system when an Unit Impulse signal is given as the input to the system.

Now, from equation (1.0.2) the impulse response of the system can be defined as,

$$h(n) + \frac{1}{2}h(n-1) = \delta(n) + \delta(n-2) \tag{1.0.4}$$

$$\implies h(n) = \delta(n) + \delta(n-2) - \frac{1}{2}h(n-1) \tag{1.0.5}$$

Computing DFT :

The DFT of the Input Signal $x(n)$ is given by :

$$X(k) \triangleq \sum_{n=0}^{N-1} x(n)e^{-j2\pi kn/N}, \quad k = 0, 1, \ldots, N-1 \tag{1.0.6}$$

Similarly, the DFT of the Impulse Response $h(n)$ is given by :

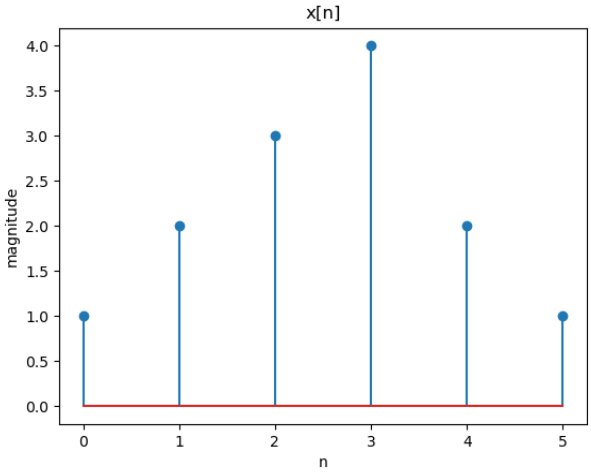
$$H(k) \triangleq \sum_{n=0}^{N-1} h(n)e^{-j2\pi kn/N}, \quad k = 0, 1, \ldots, N-1 \tag{1.0.7}$$

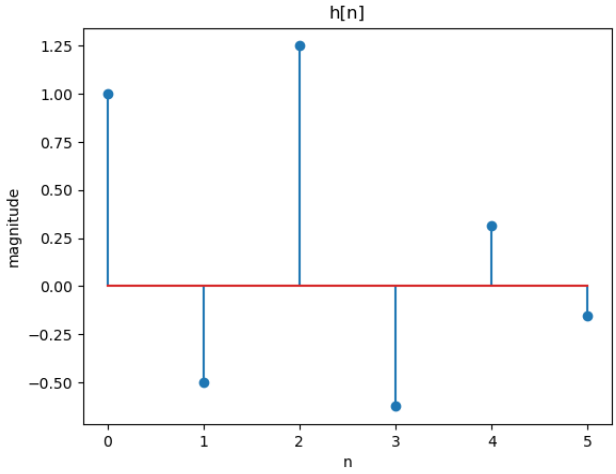
The following python code computes the DFT of $x(n)$ and $h(n)$.

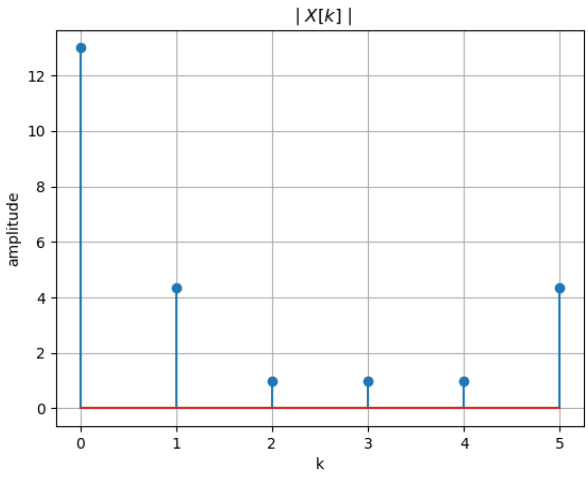
https://github.com/pranayEE11009/EE3025_IDP/tree/main/Assignment_1/codes

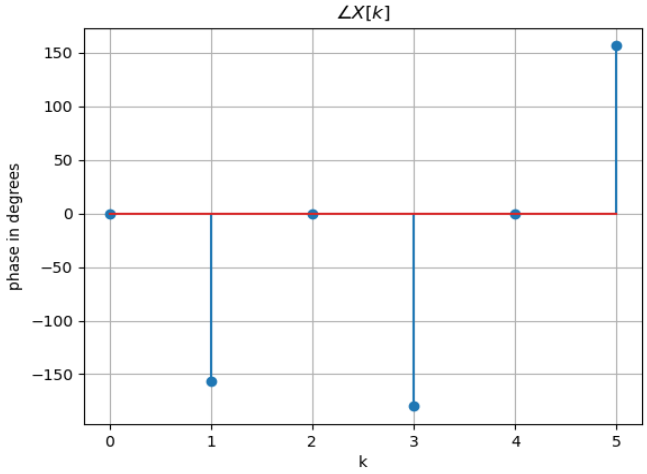
The plots are in

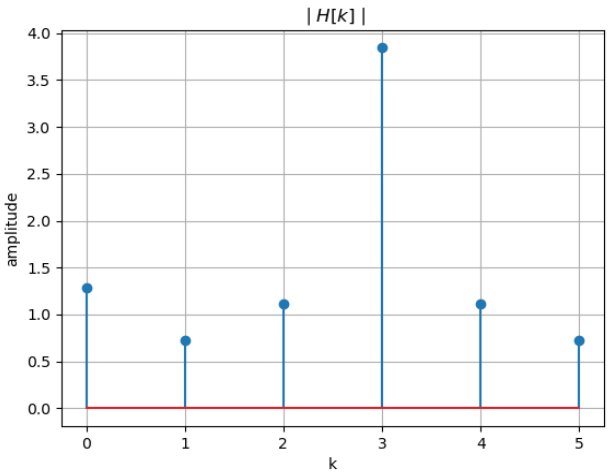
https://github.com/pranayEE11009/EE3025_IDP/tree/main/Assignment_1/figs

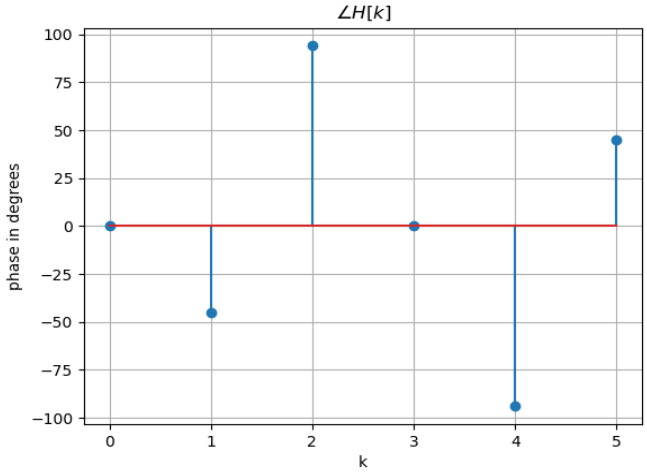

x[n]
magnitude
n


h[n]
magnitude
n


| X[k] |
amplitude
k


∠X[k]
phase in degrees
k


| H[k] |
amplitude
k


∠H[k]
phase in degrees
k