Assignment 1

G Yashwanth Naik - EE18BTECH11017

Download all python codes from

https://github.com/yashwanthguguloth24/EE3025-DSP-lab/tree/main/Assignment1/codes

and latex-tikz codes from

https://github.com/yashwanthguguloth24/EE3025-DSP-lab/tree/main/Assignment1

1 Problem

1.1. Let

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

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

1.2. Compute

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

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

1.3. Compute

$$Y(k) = X(k)H(k) \quad (1.3.1)$$

2 Solution

2.1. We know that,the Impulse Response of the LTI system is the output of the system when Unit Impulse Signal is given as input to the system.

So, using Eq (1.1.2) the Impulse Response of the System can be found as,

$$h(n) + \frac{1}{2} h(n-1) = \delta(n) + \delta(n-2) \quad (2.1.1)$$

where $h(n)$ is an IIR Filter.

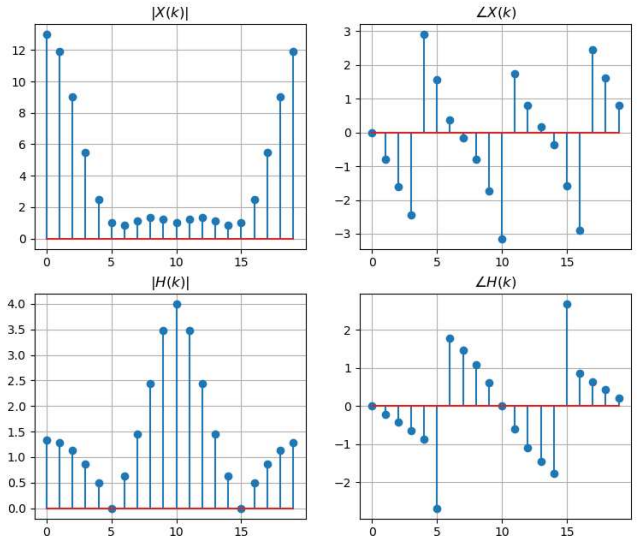
2.2. DFT of a Input Signal $x(n)$ is

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

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

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

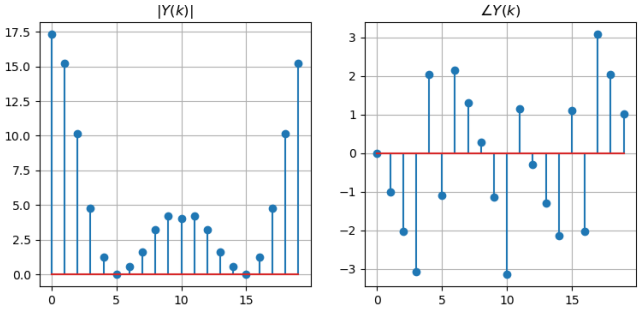
2.4. The magnitude and phase plots of $X(k)$ and $H(k)$



2.5. We can now compute $Y(k)$ using Eq (2.5.1)

$$Y(k) = X(k)H(k) \quad (2.5.1)$$

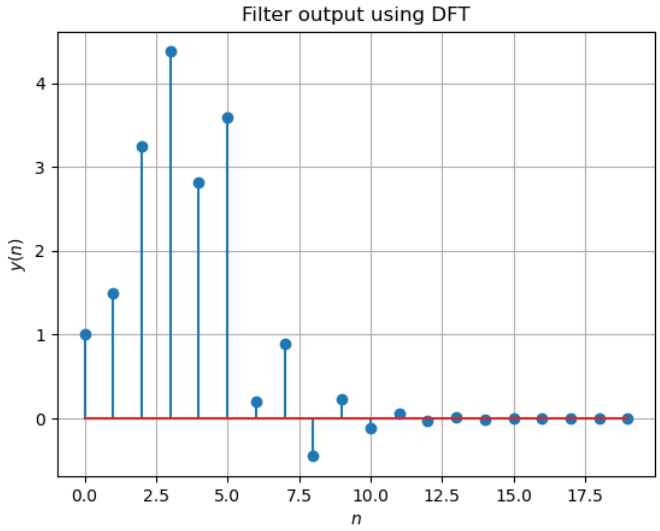
The magnitude and phase plots of $Y(k)$ are



2.6. We can also find $y(n)$ from $Y(k)$ using IDFT formula Eq (2.6.1)

$$y(n) \triangleq \frac{1}{N}\sum_{k=0}^{N-1} Y(k)\cdot e^{j2\pi kn/N}, \quad n = 0,1,\ldots,N-1 \tag{2.6.1}$$

2.7. The Plot of $y(n)$ using above Eq (2.6.1) is



2.8. The following code plots all the above figures.

https://github.com/yashwanthguguloth24/EE3025-DSP-lab/tree/main/Assignment1/codes/ee18btech11017.py