Prelab4

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Pre-lab

Read the Lab 4 Background document, then complete the following exercises.

1. In lab 2, assignment 2, you implemented a smoothing system using convolution with a box of length N and height 1/N: $h_1[n] = (u[n] - u[n-N])/N$. Find the coefficients {a, b} of the linear constant coefficient difference equation (LCCDE) describing this system for N=10. Find the coefficients for the system $h_1[n] = 0.8^n u[n]$

$$\sum_{k=0}^{N} a_k y[n-k] = \sum_{k=0}^{M} b_k x[n-k]$$

a) $k = 0$

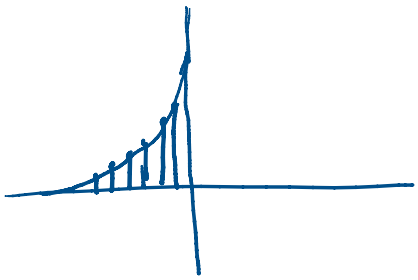
$a_0 = 1$

$$y[n] = \sum_{k=0}^{9} 0.1\, x[n-k]$$

$b_k = 0.1 \quad b_0 = 0.1 \sim b_9 = 0.1$

b) $h_1 = 0.8^n u[n]$

$h[n-k]$:



$$y[n] - 0.8y[n-1] = x[n]$$

$a_0 = 1 \qquad b_0 = 1$

$a_1 = -0.8$

rest is 0

2. Find the normalized frequency (for use in the filter design functions) that corresponds to a DT filter cut-off of $\pi/4$. What normalized frequency corresponds a cut-off of 500Hz if the sampling frequency is 11,025 Hz?

$0 \le \omega \le \pi$

$$N_{freq} = \frac{\pi}{4} \cdot \frac{1}{\pi} = \frac{1}{4}$$

$$N_{freq} = 500 \cdot \frac{1}{0.5 \cdot 11025} = 0.0907$$

3. Provide an equation for converting gain G in dB to a linear scale. For example, a 6dB gain translates to a factor of 2, so y[n]=2x[n] is an allpass filter with a gain G=6dB.

$$G = 20 \log\left(\frac{V_{out}}{V_{in}}\right)$$

$$\frac{G}{20} = \log\left(\frac{V_o}{V_i}\right)$$

$$\frac{V_o}{V_i} = 10^{G/20}$$

$$V_o = V_i \, 10^{G/20} \quad , \; G \text{ in dB}$$