Assignment1: Convolution and Difference Equation (DE)

1. Create 3 discrete-time one unit amplitude sinusoidal signals with the different linear frequencies, 0.05, 0.1 and 0.2 $sample^{-1}$, called $x_1[n], x_2[n]$ and $x_3[n]$ respectively. These signals can be written by either sin or cosine function and have arbitrary phase. All signals are generated at $n = [0{:}\,100]$.
2. With the given Finite Impulse Response, $h[n], n = [0{:}\,20]$ compute the output signals from discrete-time convolution between $h[n]$ and the three sinusoidal signals in (1) called $y_1[n], y_2[n]$ and $y_3[n]$ respectively.
3. Display three pair of plots between input and output signals, $x_i[n], y_i[n]$ in figure 1-3 respectively. Note that $x_i[n]$ is 101 samples, $n = [0{:}\,100]$ but $y_i[n]$ is 121 samples, $n = [0{:}\,120]$. So they have to be plotted on different windows.
4. Find the Peak-to-Peak amplitude of the steady part (in the middle of the signal) of the output signals, $y_i[n]$. Can you tell that how this FIR respond to the sinusoidal signals at the different frequencies?

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5. From the difference equation below,
$$y[n] = 1.5y[n-1] - 0.85y[n-2] + x[n]$$
compute the output signals from the three sinusoidal signals in (1) and zero initial conditions, $y[-2] = 0, y[-1] = 0$, called , $y_4[n], y_5[n]$ and $y_6[n]$ respectively.
6. Display three pair of plots between input and output signals, $x_i[n], y_i[n]$ in figure 4-6 respectively. Note that $x_i[n]$ is 101 samples, $n = [0:100]$ but $y_i[n]$ is 103 samples, $n = [-2:100]$. So they have to be plotted on different windows.
7. Find the Peak-to-Peak amplitude of the steady part (at the end of the signal) of the output signals, $y_i[n]$. Can you tell that how this difference equation (IIR) respond to the sinusoidal signals at the different frequencies?
8. Can you tell how the two systems (FIR and IIR) operate? Which one is better? Why?