CENG 384 - Signals and Systems for Computer Engineers
Spring 2024
Homework 2

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April 2, 2024

Answer 2

a)

$$x[n] = \delta[n] + 2\delta[n-2] - 3\delta[n-4]$$
$$h[n] = 2\delta[n+2] + \delta[n-2]$$

By the distributive property of convolution

$$x[n] * h[n] = \delta[n] * h[n] + 2\delta[n-2] * h[n] - 3\delta[n-4] * h[n]$$

$$\delta[n] * h[n] = 2\delta[n+2] + \delta[n-2]$$
$$\delta[n-2] * h[n] = 2\delta[n] + \delta[n-4]$$
$$\delta[n-4] * h[n] = 2\delta[n-2] + \delta[n-6]$$

$$x[n] * h[n] = 2\delta[n+2] + 4\delta[n] - 5\delta[n-2] + 2\delta[n-4] - 3\delta[n-6]$$

$$y_1[n] = 2\delta[n+2] + 4\delta[n] - 5\delta[n-2] + 2\delta[n-4] - 3\delta[n-6]$$

b)

$$y_2[n] = x[n+2] * h[n]$$

By the time shifting property of LTI systems:

$$y[n] = x[n] * h[n] => x[n+k] * h[n] = y[n+k]$$

$$y_2[n] = x[n+2] * h[n] = y_1[n+2]$$
$$y_2[n] = 2\delta[n+4] + 4\delta[n+2] - 5\delta[n] + 2\delta[n-2] - 3\delta[n-4]$$

c)

$$x[n+2] = \delta[n+2] + 2\delta[n] - 3\delta[n-2]$$
$$h[n-2] = 2\delta[n] + \delta[n-4]$$

Same amount of shifts to opposite sides
for two functions defined on impulse functions:

$$y_3[n] = y_1[n] = 2\delta[n+2] + 4\delta[n] - 5\delta[n-2] + 2\delta[n-4] - 3\delta[n-6]$$