Exercise 3: Signal Representation and Modeling

Ramez Koudsieh

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Manara University

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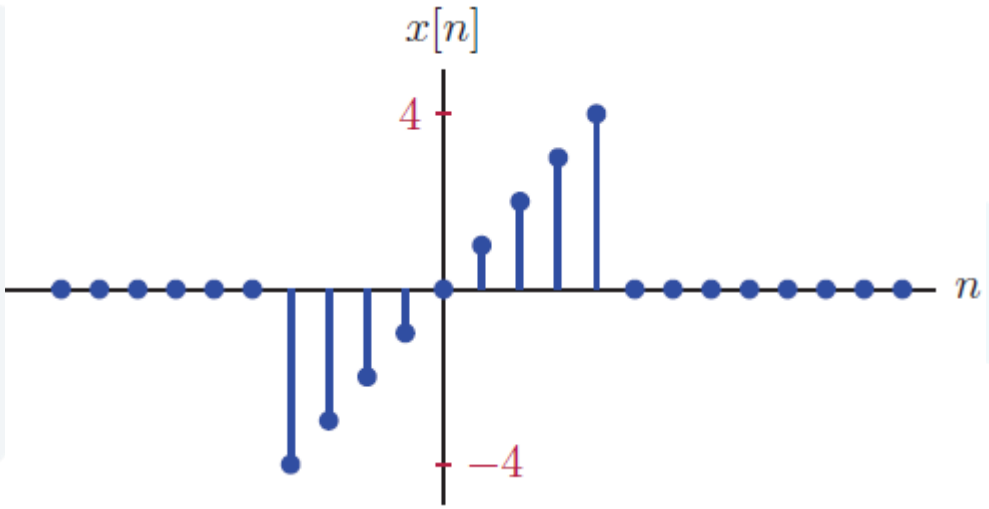
13. For the signal $x[n]$ shown, sketch the following signals:

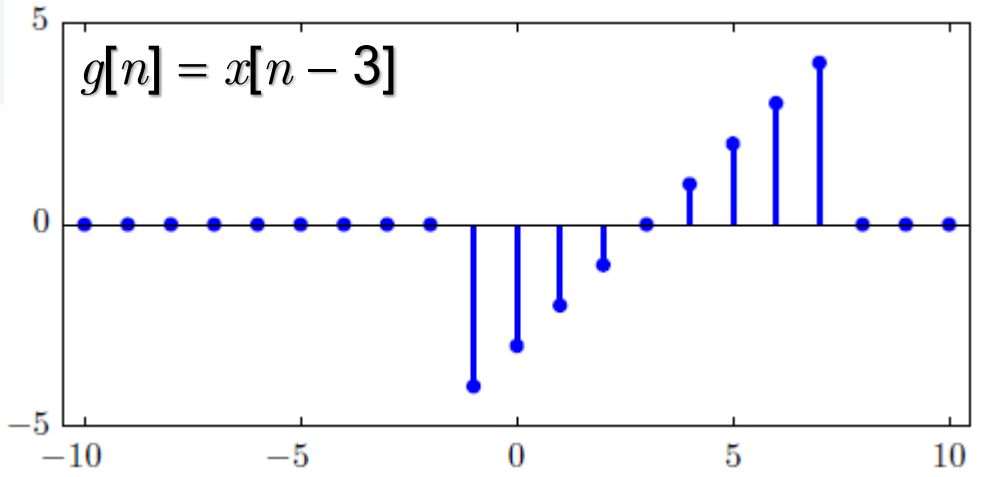
a. $g[n] = x[n - 3]$

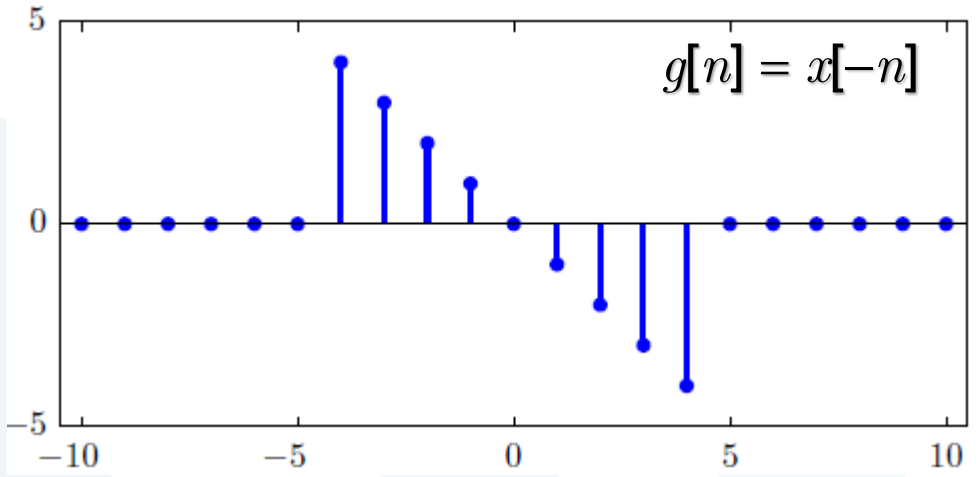
b. $g[n] = x[-n]$

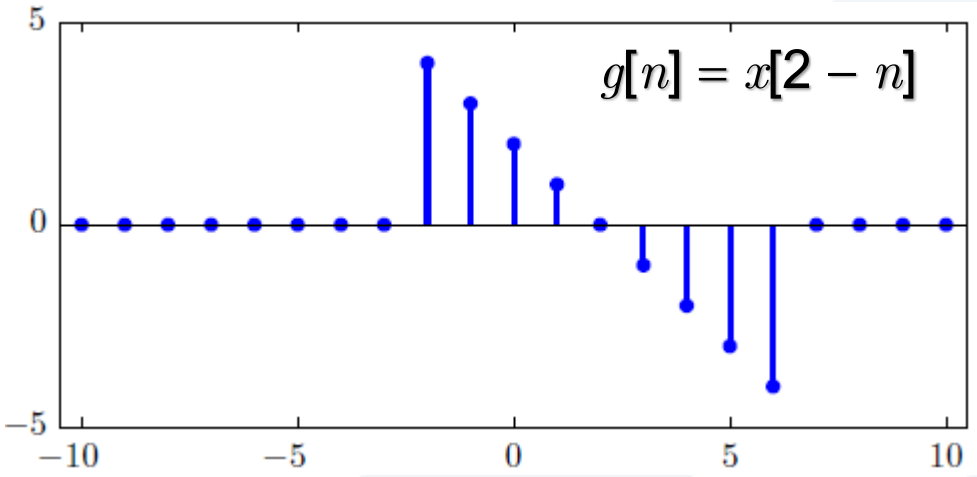
c. $g[n] = x[2 - n]$

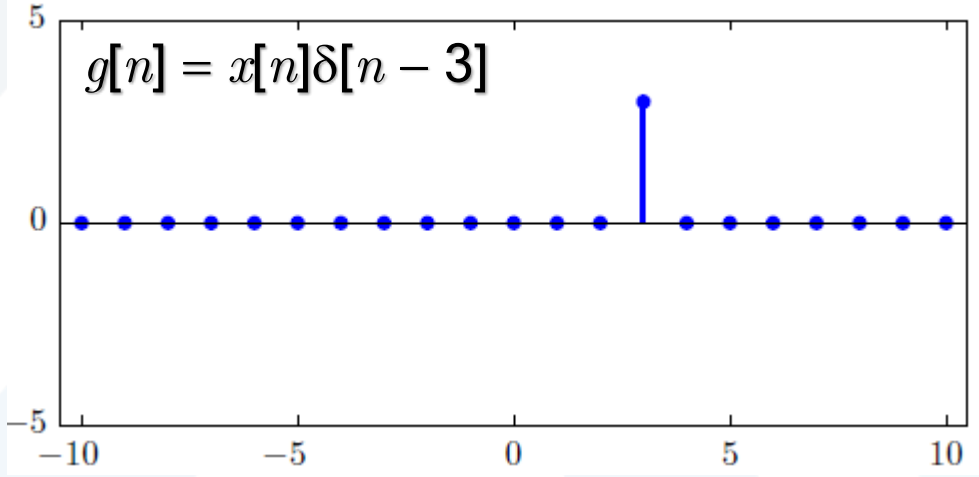
d. $g[n] = x[n]\delta[n - 3]$




$g[n] = x[n-3]$
5
0
−5
−10
−5
0
5
10


$g[n] = x[-n]$
5
0
−5
−10
−5
0
5
10


$g[n] = x[2-n]$
5
0
−5
−10
−5
0
5
10


$g[n] = x[n]\delta[n-3]$
5
0
−5
−10
−5
0
5
10

14. Consider the sinusoidal discrete-time signal:

$$x[n] = 5\cos\left(\frac{3\pi}{23}n + \frac{\pi}{4}\right)$$

Is the signal periodic? If yes, determine the fundamental period

$2\pi F_0 = 3\pi/23 \Rightarrow F_0 = 3/46$

$N = k/F_0 = 46k/3$

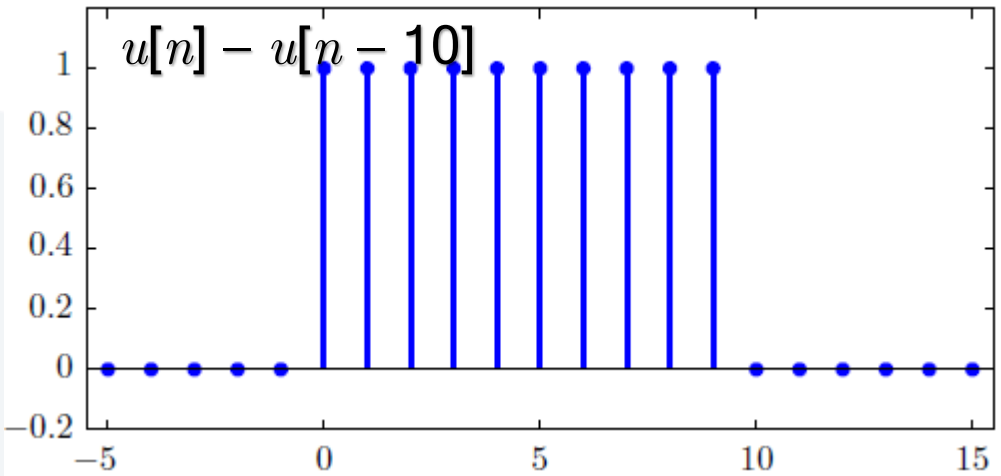
For $k = 3$ we get $N = 46$.

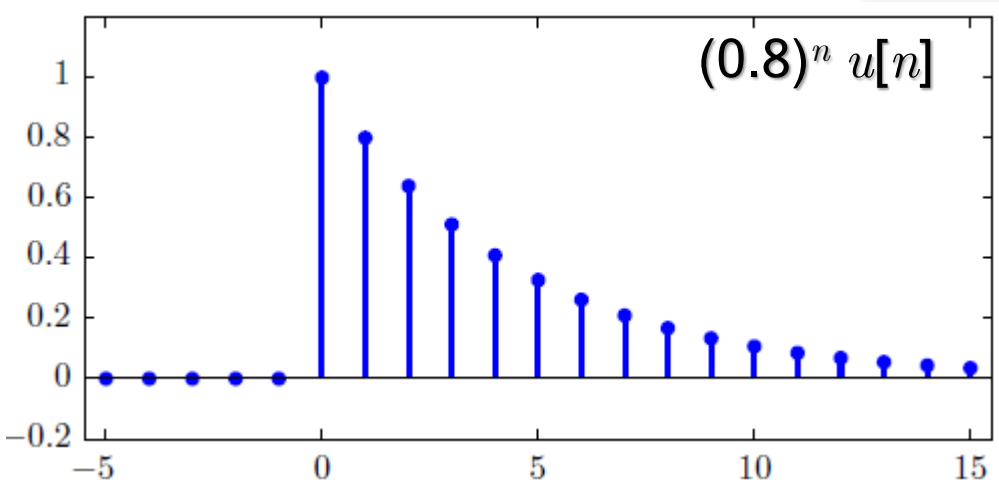
15. sketch each signal described below:

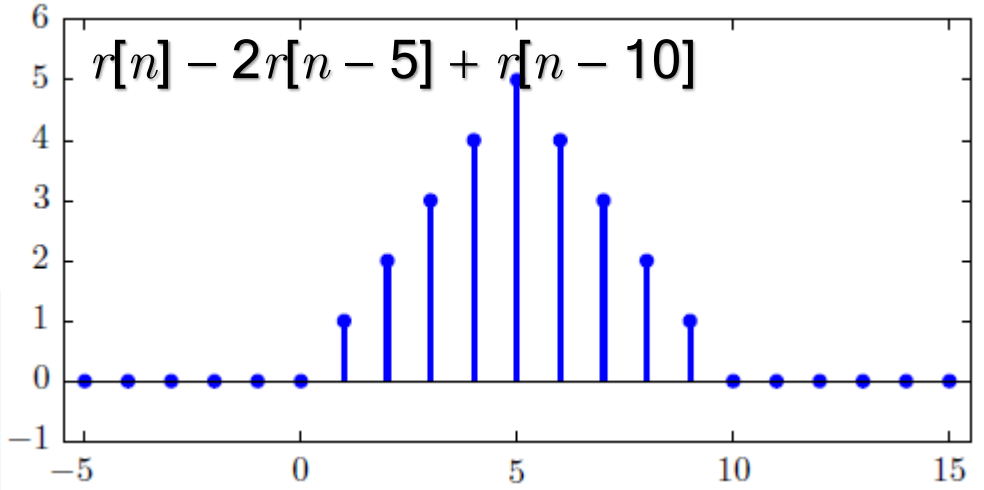
a. $x[n] = (0.8)^n\, u[n]$

b. $x[n] = u[n] - u[n-10]$

c. $x[n] = r[n] - 2r[n-5] + r[n-10]$







16. Determine the normalized energy of each signal described in Ex.3

$$a.\ E_x = \sum_{n=0}^{\infty} (0.8)^{2n} = \sum_{n=0}^{\infty} (0.64)^n = \frac{1}{1-0.64} \approx 2.771$$

$$b.\ E_x = \sum_{n=0}^{9} (1)^2 = 10$$

$$c.\ E_x = \sum_{n=0}^{5} n^2 + \sum_{n=6}^{10} (10-n)^2 \qquad m = 10 - n$$

$$= \sum_{n=0}^{5} n^2 + \sum_{m=4}^{0} m^2 = 5^2 + 2\sum_{n=0}^{4} n^2 = 85$$