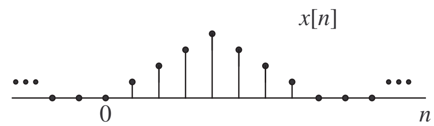
ENEE 222: 11/26 Class

Material: Lecture videos **23.1**, **23.2**

1 The FIR filter described by

$$y[n] \;=\; b_0x[n] \;+\; b_1x[n-1] + b_2x[n-2] + b_3x[n-3] + b_4x[n-4] + b_5x[n-5]$$

(where b_0 and b_5 are both nonzero) accepts the finite-duration input $x[\,\cdot\,]$ depicted below.



If n_1 and n_2 are, respectively, the time indices of the first and last nontrivial (nonzero) samples in the output sequence, then (n_1, n_2) equals

A. (0, 12) B. (0, 13) C. (1, 12) D. (1, 13)

2 The convolution table shown below computes the response of a FIR filter to a finite-duration input sequence.

		-1	4	0	-4	1			
3	5	1							y_0
	3	5	1						y_1
		3	5	1					y_2
			3	5	1				y_3
				3	5	1			y_4
					3	5	1		y_5
						3	5	1	y_6

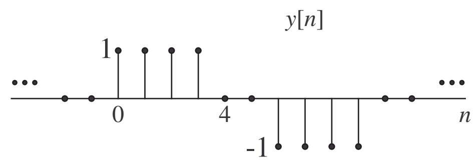
The value of y_3 is

A. 8 B. -2 C. 4 D. -3

3 Consider the FIR filter with input-output relationship

$$y[n] \;=\; x[n] \;-\; x[n-4]$$

If the filter produced the output $y[\,\cdot\,]$ shown below, what was the filter input $x[\,\cdot\,]$?



A. $x[0:5] \;=\; [1\;\;1\;\;1\;\;1\;\;1\;\;1]^T;$ $x[n] \;=\; 0$ for all other n

B. $x[0:3] \;=\; [1\;\;1\;\;1\;\;1]^T;$ $x[n] \;=\; 0$ for all other n

C. $x[0:4] \;=\; [1\;\;1\;\;1\;\;1\;\;1]^T;$ $x[n] \;=\; 0$ for all other n

D. $x[0:5] \;=\; [1\;\;1\;\;1\;\;1\;-1\;-1]^T;$ $x[n] \;=\; 0$ for all other n

4 When the input

$$x[0:4] \;=\; [\;1 \quad -3 \quad 4 \quad -1 \quad 2\;]^T\;; \qquad x[n] \;=\; 0 \;\text{ for all other } n$$

is applied to a FIR filter, the output is given by

$$y[0:7] \;=\; \mathbf{c}\;; \qquad y[n] \;=\; 0 \;\text{ for all other } n$$

If the input

$$\tilde{x}[0:8] \;=\; [\;1 \quad -3 \quad 4 \quad -1 \quad 0 \quad 6 \quad -8 \quad 2 \quad -4\;]^T\;; \qquad \tilde{x}[n] \;=\; 0 \;\text{ for all other } n$$

is applied to the same filter, then the output will be given by ($\mathbf{0}_i$ denotes a vector of i zeros)

A. $\tilde{y}[0:10] \;=\; [\mathbf{c}\,;\,\mathbf{0}_3] \;-\; [\mathbf{0}_3\,;\,2\mathbf{c}]\;; \qquad y[n] \;=\; 0 \;\text{ for all other } n$

B. $\tilde{y}[0:11] \;=\; [\mathbf{c}\,;\,\mathbf{0}_4] \;-\; [\mathbf{0}_4\,;\,2\mathbf{c}]\;; \qquad y[n] \;=\; 0 \;\text{ for all other } n$

C. $\tilde{y}[0:12] \;=\; [\mathbf{c}\,;\,\mathbf{0}_5] \;-\; [\mathbf{0}_5\,;\,2\mathbf{c}]\;; \qquad y[n] \;=\; 0 \;\text{ for all other } n$

D. None of the above.

5 Let $\mathbf{b}$ and $\mathbf{s}$ be arbitrary vectors of length 6 and 9, respectively. If $\mathbf{0}_i$ denotes a vector of i zeros, which of the following circular convolutions produces the vector

$$[\mathbf{b} * \mathbf{s}\,;\,\mathbf{0}_2]\ ?$$

A. $[\mathbf{b}\,;\,\mathbf{0}_8] \circledast [\mathbf{s}\,;\,\mathbf{0}_5]$

B. $[\mathbf{b}\,;\,\mathbf{0}_9] \circledast [\mathbf{s}\,;\,\mathbf{0}_6]$

C. $[\mathbf{b}\,;\,\mathbf{0}_{10}] \circledast [\mathbf{s}\,;\,\mathbf{0}_7]$

D. $[\mathbf{b}\,;\,\mathbf{0}_{11}] \circledast [\mathbf{s}\,;\,\mathbf{0}_8]$

6 Which (one or more) of the following signal sequences can be determined by *circularly* convolving two vectors of the same (finite) length?

A. The response of a FIR filter to any input sequence of finite duration.

B. The response of a FIR filter to any input sequence of infinite duration.

C. The response of a FIR filter to any periodic input sequence.

D. The impulse response of the cascade connection of any two FIR filters.