PROBLEM:

A *unit impulse sequence* is defined as

$$\delta[n] = \begin{cases} 1 & n = 0 \\ 0 & n \neq 0 \end{cases}$$

Suppose that a LTI system has system function equal to

$$H(z) = 1 + z^{-1} - z^{-3} + 2z^{-4} - 2z^{-5}$$

(a) Determine the difference equation that relates the output $y[n]$ of the system to the input $x[n]$.

(b) Determine and plot the *impulse response*: i.e., the output sequence $y[n]$ when the input is $x[n] = \delta[n]$. How is the output due to an impulse related to $H(z)$?

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.

SOLUTION

(a) $H(z) = 1 + z^{-1} - z^{-3} + 2z^{-4} - 2z^{-5}$

By comparison to FIR Filter's $H(z)$

$$H(z) = \sum_{k=0}^{L-1} b_k z^{-k}$$

We can read off the b_k from $H(z)$ by taking the coeffs of different powers of z^{-1}

$b_0 = 1$ $\qquad$ $b_3 = -1$ because we have $-z^{-3}$

$b_1 = 1$ $\qquad$ $b_4 = 2$ ← $2z^{-4}$

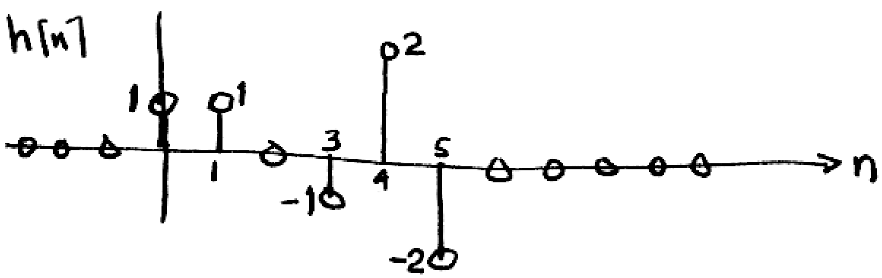
$b_2 = 0$ (no z^{-2} term) $\qquad$ $b_5 = -2$ ← due to $-2z^{-5}$

Now we can write the difference Equation:

$$y[n] = x[n] + x[n-1] - x[n-3] + 2x[n-4] - 2x[n-5]$$

(b) The impulse response for FIR is just the filter coeffs:

n	<0	0	1	2	3	4	5	n>5
h[n]	0	1	1	0	-1	2	-2	0



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