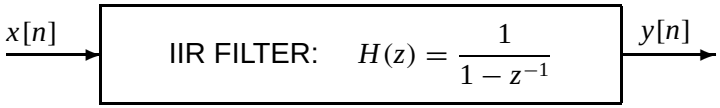
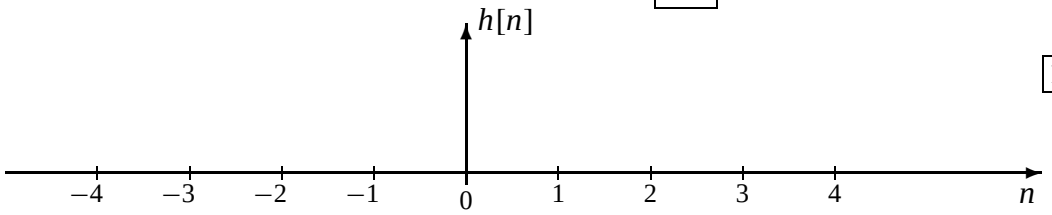
PROBLEM:

The following IIR filter is specified by its system function:

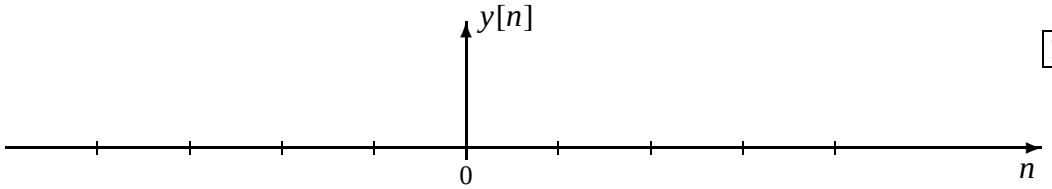


(a) Determine the impulse response: give your answer as a plot of $h[n]$ vs. n.



Plot zero values also

(b) Use the z-transform method to determine a simple formula for the output when the input is $x[n] = -2\delta[n] + (\frac{1}{2})^n u[n]$. Make a plot of $y[n]$ versus n for the range $-1 \leq n \leq 4$.

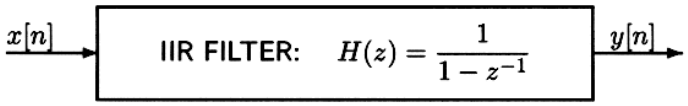


Plot zero values also

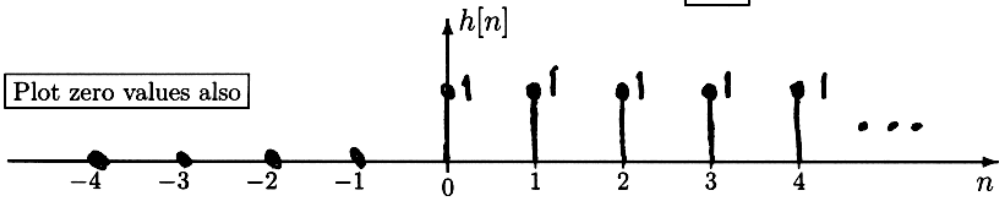
McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION

The following IIR filter is specified by its system function:



(a) Determine the impulse response: give your answer as a **plot** of $h[n]$ vs. n.



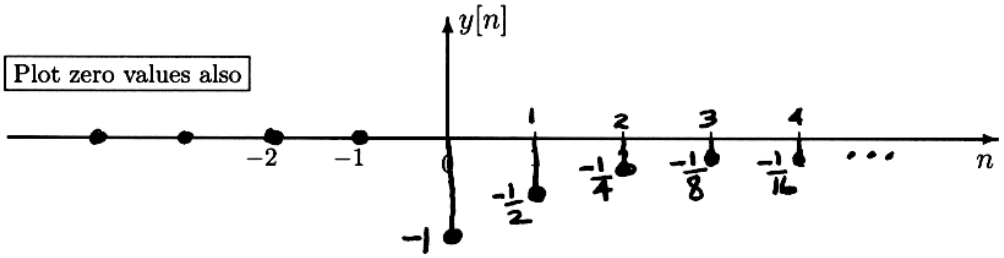
$y[n] = y[n-1] + x[n]$

n	<0	0	1	2	3 ...
x[n]	0	1	0	0	0 ...
y[n]	0	1	1	1	1 ...

$y[n] = 1$ for $n \geq 0$

or $y[n] = u[n]$

(b) Use the z-transform method[1] to determine a **simple formula** for the output when the input is $x[n] = -2\delta[n] + (\frac{1}{2})^n u[n]$. Make a plot of $y[n]$ versus n for the range $-1 \leq n \leq 4$.



$$X(z) = -2 + \frac{1}{1 - \frac{1}{2}z^{-1}} = \frac{-2 + z^{-1} + 1}{1 - \frac{1}{2}z^{-1}} = \frac{-1 + z^{-1}}{1 - \frac{1}{2}z^{-1}} = \frac{(-1)(1 - z^{-1})}{1 - \frac{1}{2}z^{-1}}$$

$$Y(z) = H(z)X(z) = \frac{1}{1 - z^{-1}} \cdot \frac{(-1)(1 - z^{-1})}{1 - \frac{1}{2}z^{-1}} = \frac{-1}{1 - \frac{1}{2}z^{-1}}$$

Use $a^n u[n] \leftrightarrow \frac{1}{1 - az^{-1}}$

$$y[n] = -\left(\frac{1}{2}\right)^n u[n]$$