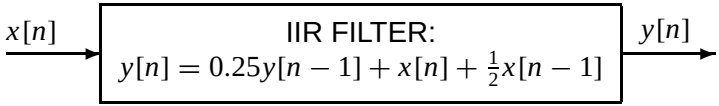
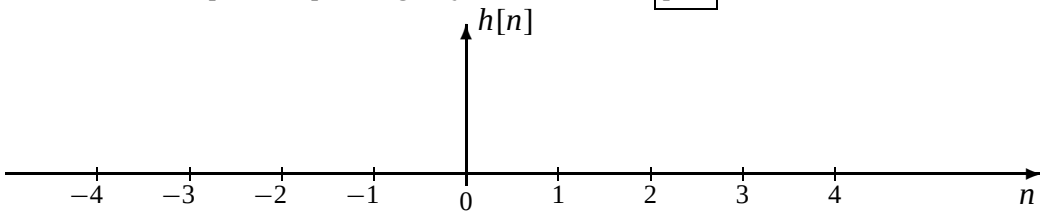
## PROBLEM:

The following IIR filter is specified by a difference equation:




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




Plot zero values also

(b) Determine the system function, $H(z)$

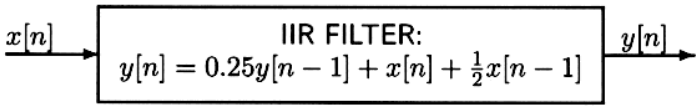
(c) Use the inverse $z$-transform method and partial fractions to determine a simple formula for the output when the input is the unit step signal: $x[n] = u[n]$

$y[n] =$

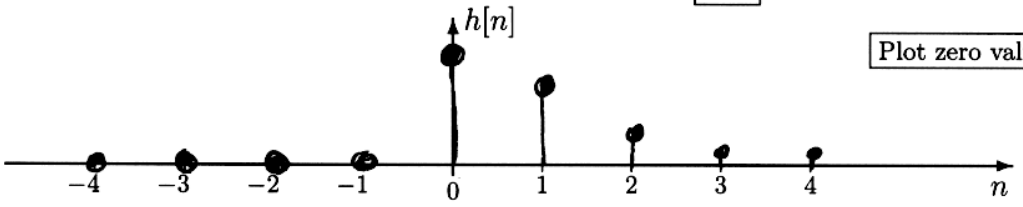
McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458. 

SOLUTION

The following IIR filter is specified by a difference equation:




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




| n | <0 | 0 | 1 | 2 | 3 | 4 | ... |
|---|---|---|---|---|---|---|---|
| x[n] | 0 | 1 | 0 | 0 | 0 | 0 | ... |
| y[n] | 0 | 1 | 3/4 | 3/16 | 3/64 | 3/256 | ... |

(b) Determine the system function, $H(z)$

$$H(z) = \frac{1 + \frac{1}{2}z^{-1}}{1 - \frac{1}{4}z^{-1}}$$

change the sign of the feedback coefficient

(c) Use the inverse $z$-transform method and partial fractions to determine a **simple formula** for the output when the input is the unit step signal: $x[n] = u[n]$

$$y[n] = 2u[n] - \left(\frac{1}{4}\right)^n u[n]$$

$$u[n] \longrightarrow \frac{1}{1 - z^{-1}}$$

$$Y(z) = H(z)X(z) = \frac{1 + \frac{1}{2}z^{-1}}{1 - \frac{1}{4}z^{-1}} \cdot \frac{1}{1 - z^{-1}}$$

$$= \frac{-1}{1 - \frac{1}{4}z^{-1}} + \frac{2}{1 - z^{-1}}$$

$$y[n] = -\left(\frac{1}{4}\right)^n u[n] + 2u[n]$$