Example 10-3: Consider again the LTI system defined by the difference equation (**??**), whose impulse response was shown in Example 10-2 to be $h[n] = 5(0.8)^n u[n]$. For the input of (**??**) and Fig. **??**,

$$x[n] = 2\delta[n] - 3\delta[n-1] + 2\delta[n-3]$$

it is easily seen that

$$\begin{aligned} y[n] &= 2h[n] - 3h[n-1] + 2h[n-3] \\ &= 10(0.8)^n u[n] - 15(0.8)^{n-1} u[n-1] + 10(0.8)^{n-3} u[n-3] \end{aligned}$$

To evaluate this expression for a specific time index, we need to take into account the different regions over which $h[n]$, $h[n-1]$, and $h[n-3]$ are nonzero. Once we do, we obtain

$$y[n] = \begin{cases} 0 & n < 0 \\ 10 & n = 0 \\ 10(0.8) - 15 = -7 & n = 1 \\ 10(0.8)^2 - 15(0.8) = -5.6 & n = 2 \\ 10(0.8)^3 - 15(0.8)^2 + 10 = 5.52 & n = 3 \\ 5.52(0.8)^{n-3} & n > 3 \end{cases}$$

A comparison to the output obtained by iterating the difference equation (see Fig. **??** on p. **??**) shows that we have obtained the same values of the output sequence by superposition of scaled and shifted impulse responses.

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