

## Assignment2

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### Problem 2.25a

Let the signal

$$y[n] = x[n] * h[n]$$

where

$$x[n] = 3^n u[-n - 1] + \left(\frac{1}{3}\right)^n u[n]$$

and

$$h[n] = \left(\frac{1}{4}\right)^n u[n + 3]$$

Determine  $y[n]$  without using the distributive property of convolution.

**Solution:**

$u[-n - 1]$  will only be non-zero for  $n \leq -1$

$$\therefore x[n] = \left(\frac{1}{3}\right)^{|n|}$$

$$\begin{aligned} y[n] &= \sum_{k=-\infty}^{\infty} x[k] h[n - k] \\ &= \sum_{k=-\infty}^{\infty} \left(\frac{1}{3}\right)^{|k|} \left(\frac{1}{4}\right)^{n-k} u[n - k + 3] \\ &= \sum_{k=0}^{\infty} \left(\frac{1}{3}\right)^k \left(\frac{1}{4}\right)^{n-k} u[n - k + 3] + \sum_{k=-\infty}^{-1} \left(\frac{1}{3}\right)^{-k} \left(\frac{1}{4}\right)^{n-k} u[n - k + 3] \\ &= \sum_{k=0}^{\infty} \left(\frac{1}{3}\right)^k \left(\frac{1}{4}\right)^{n-k} u[n - k + 3] + \frac{1}{12} \sum_{k=0}^{\infty} \left(\frac{1}{3}\right)^k \left(\frac{1}{4}\right)^{n+k} u[n + k + 4] \end{aligned}$$

using summation of geometric progression formulae we can say that,

$$\Rightarrow y(n) = \begin{cases} \frac{4^4}{3^{n-1}} - \frac{32}{4^n \cdot 11} & n \geq -3 \\ \frac{4^4}{11} & n = -4 \\ \frac{12^4 \cdot 3^n}{11} & n < -4 \end{cases}$$