UNIFESSPA | Faculdade de Computação e Engenharia Elétrica

# PROCESSAMENTO DIGITAL DE SINAIS

Prof. Claudio Coutinho

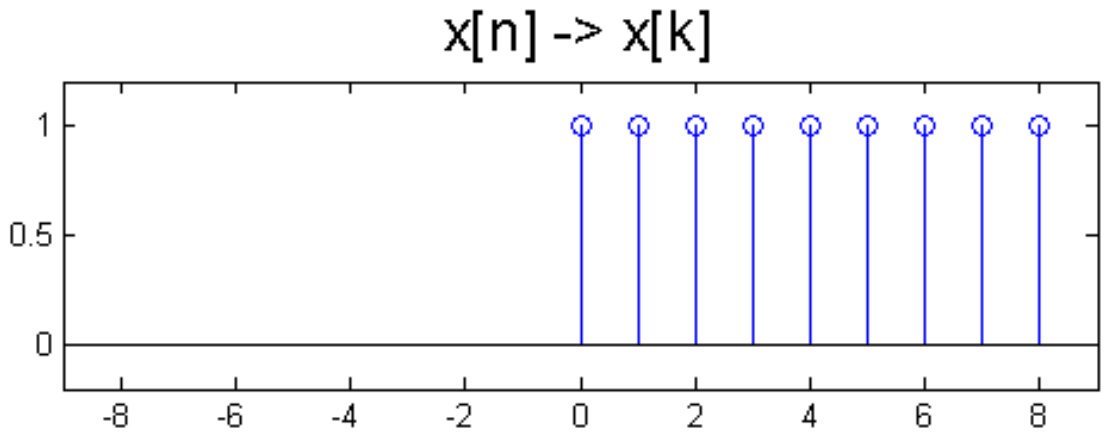
Turma EC
2018

# Aula 05

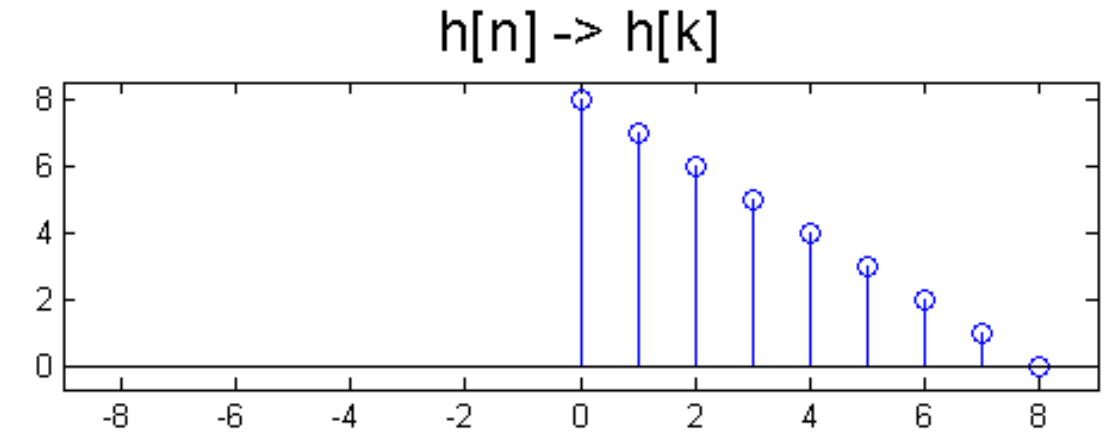
## Convolução (Cont.) e exercícios

# Convolução na prática

$$y[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$$

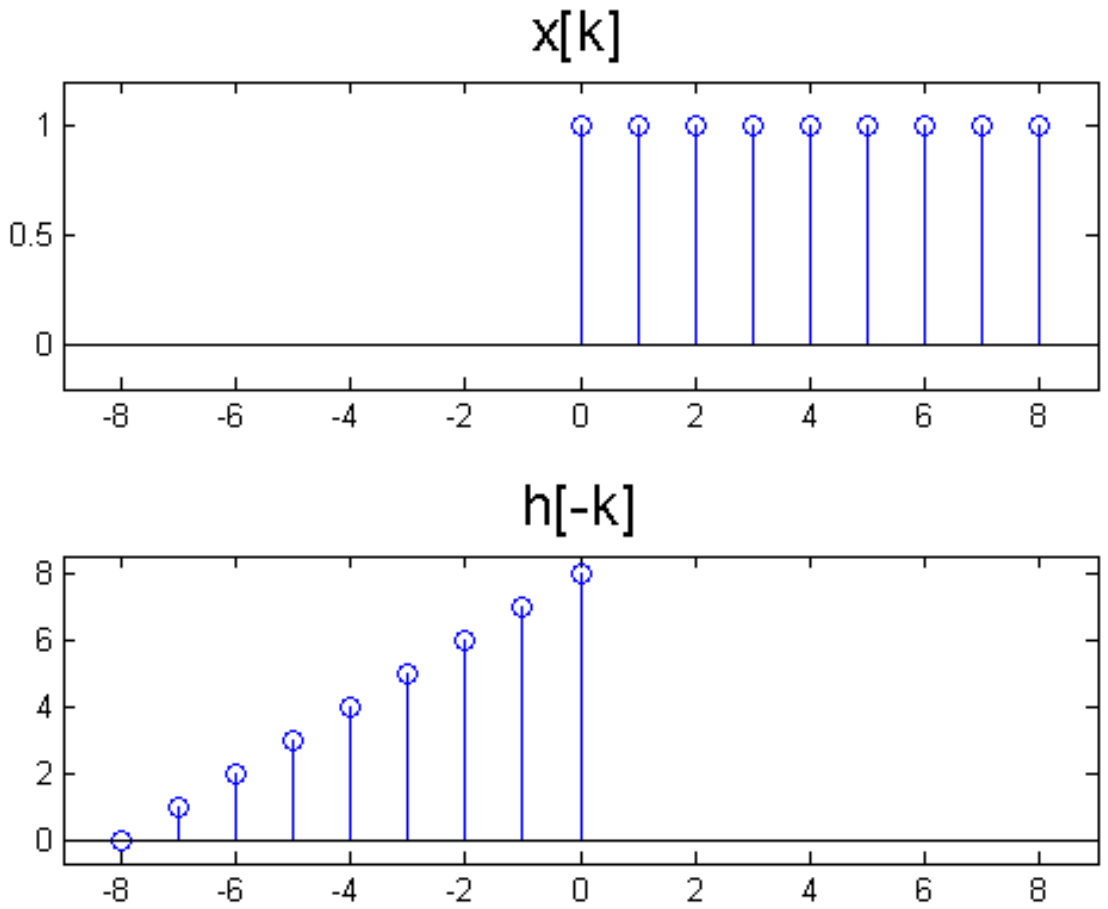



$$x[n] = u[n]$$




$$h[n] = \begin{cases} 8-n, n \geq 0 \\ 0 \quad\quad , n < 0 \end{cases}$$

# Convolução na prática



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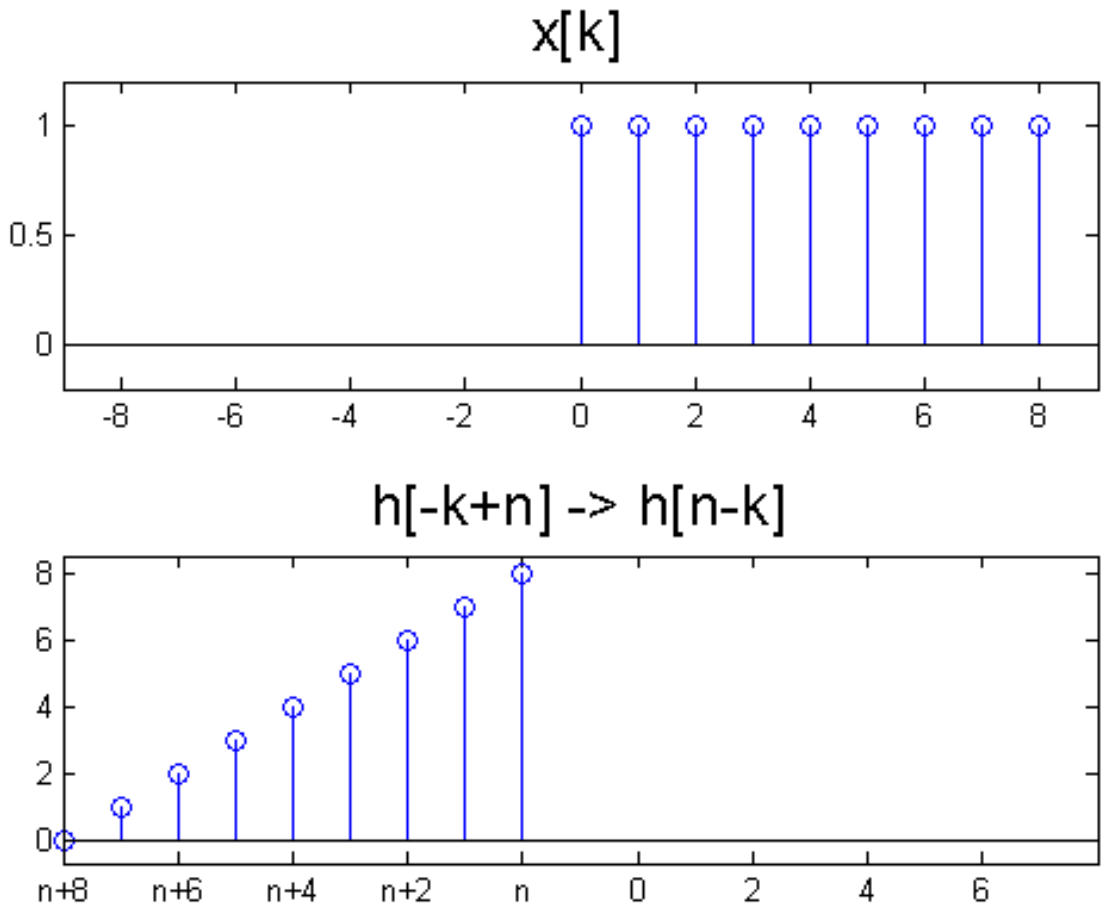
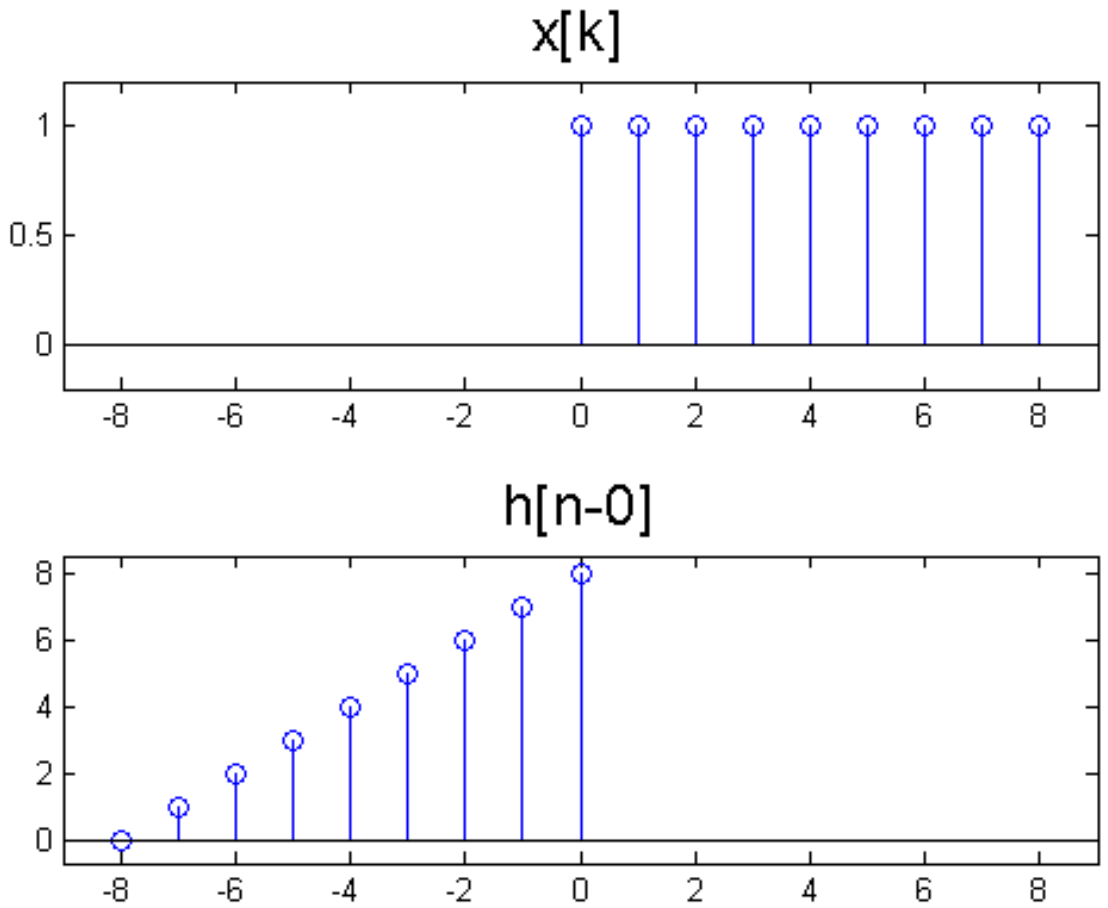
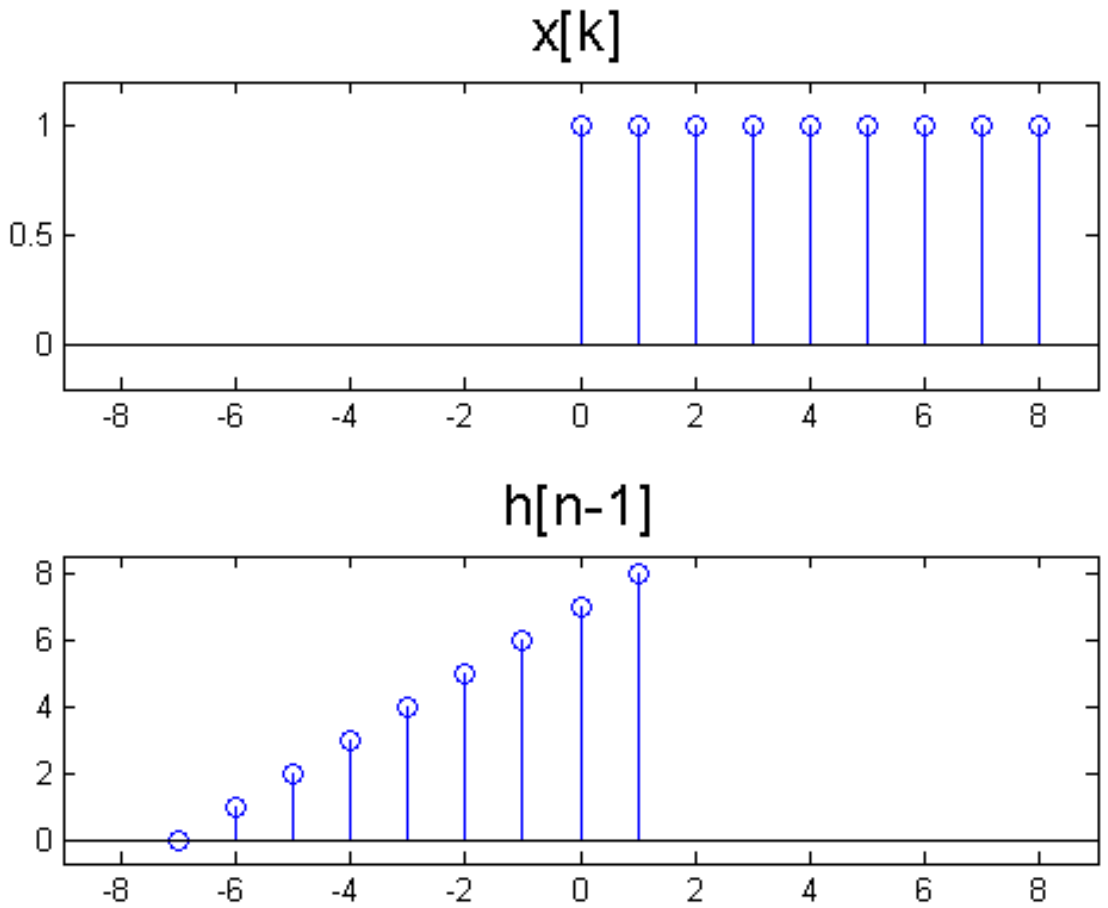


# Convolução na prática



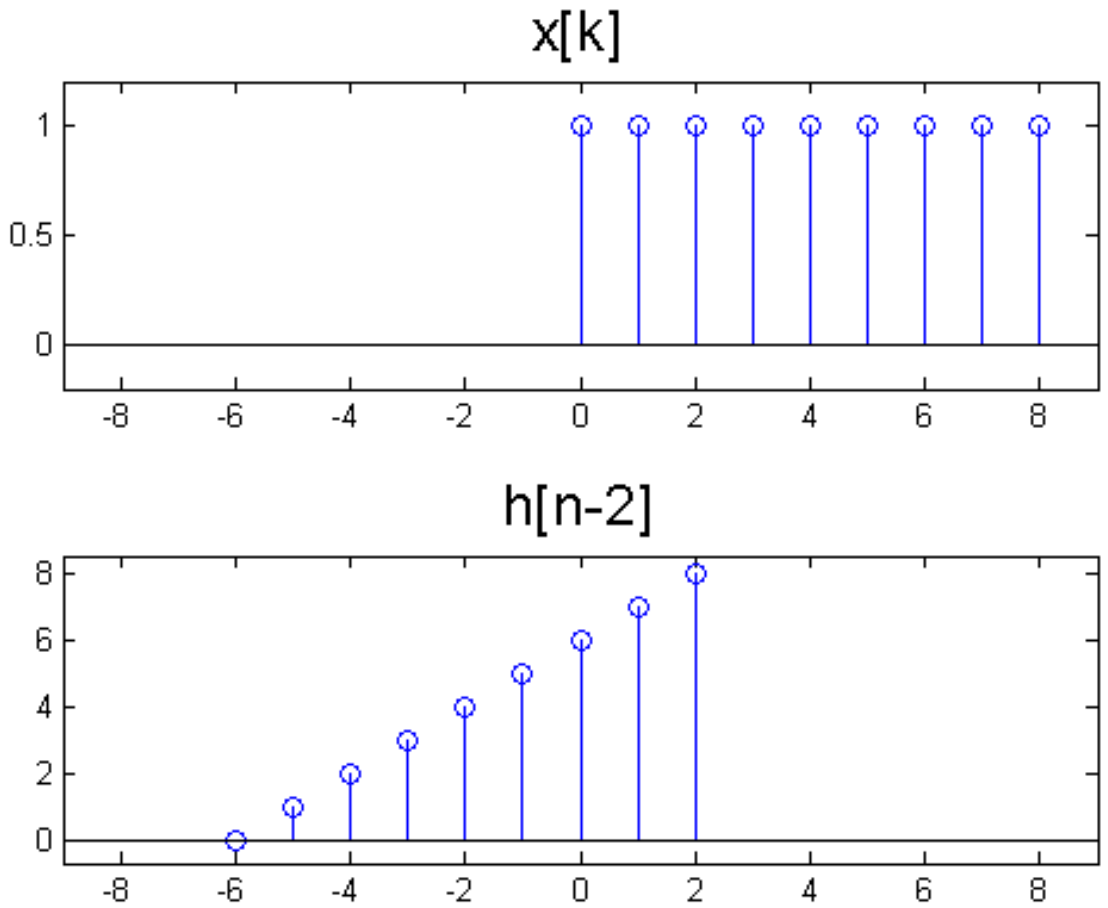

$$y[0] = x[0] \times h[0]$$
$$y[0] = 1 \times 8 = 8$$

# Convolução na prática



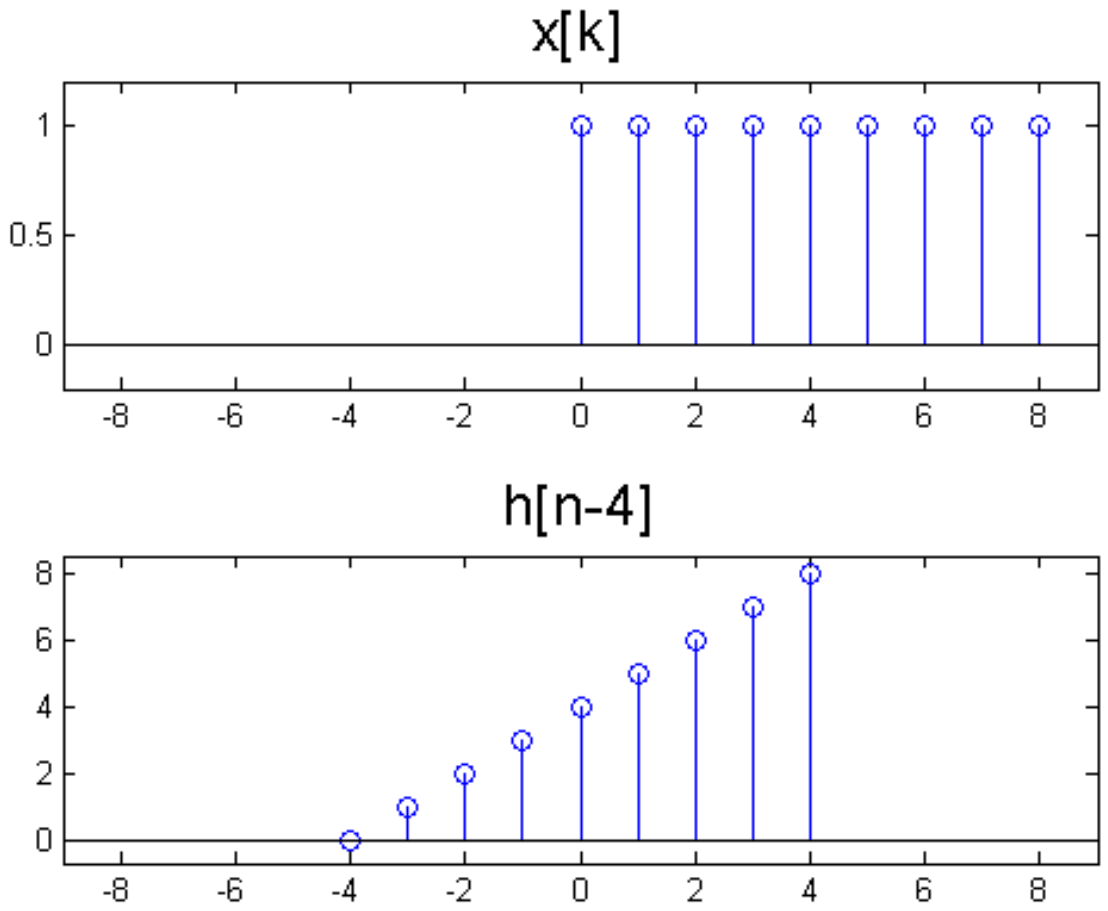

$$y[1] = x[0] \times h[1] +$$
$$= x[1] \times h[0]$$
$$= 1 \times 7 + 1 \times 8$$
$$= 15$$

# Convolução na prática



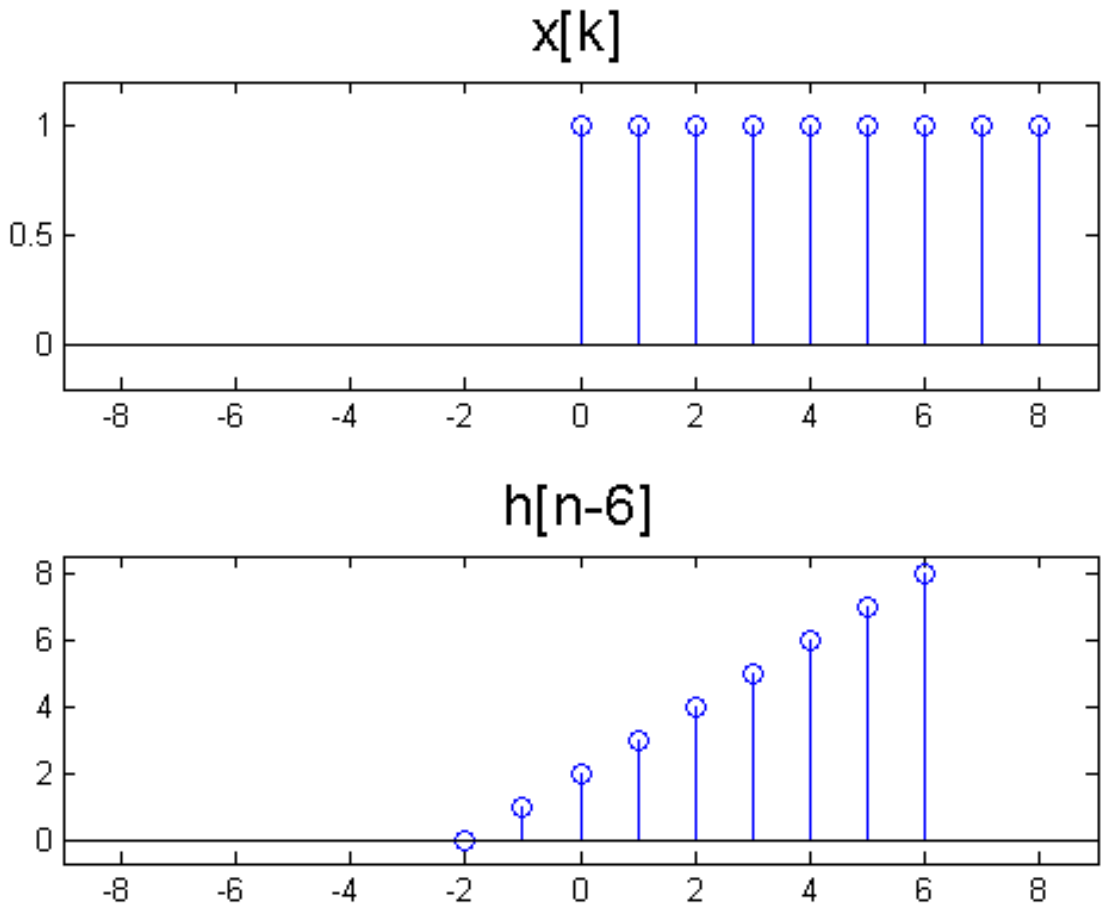

$$
\begin{aligned}
y[2] &= x[0] \times h[2] + \\
&= x[1] \times h[1] + \\
&= x[2] \times h[0] \\
&= 6 + 7 + 8 \\
&= 21
\end{aligned}
$$

# Convolução na prática




$$
\begin{aligned}
y[4] &= x[0] \times h[4] + \\
&= x[1] \times h[3] + \\
&= x[2] \times h[2] + \\
&= x[3] \times h[1] + \\
&= x[4] \times h[0] \\
&= 4 + 5 + 6 + 7 \\
&+8 \\
&= 30
\end{aligned}
$$

# Convolução na prática



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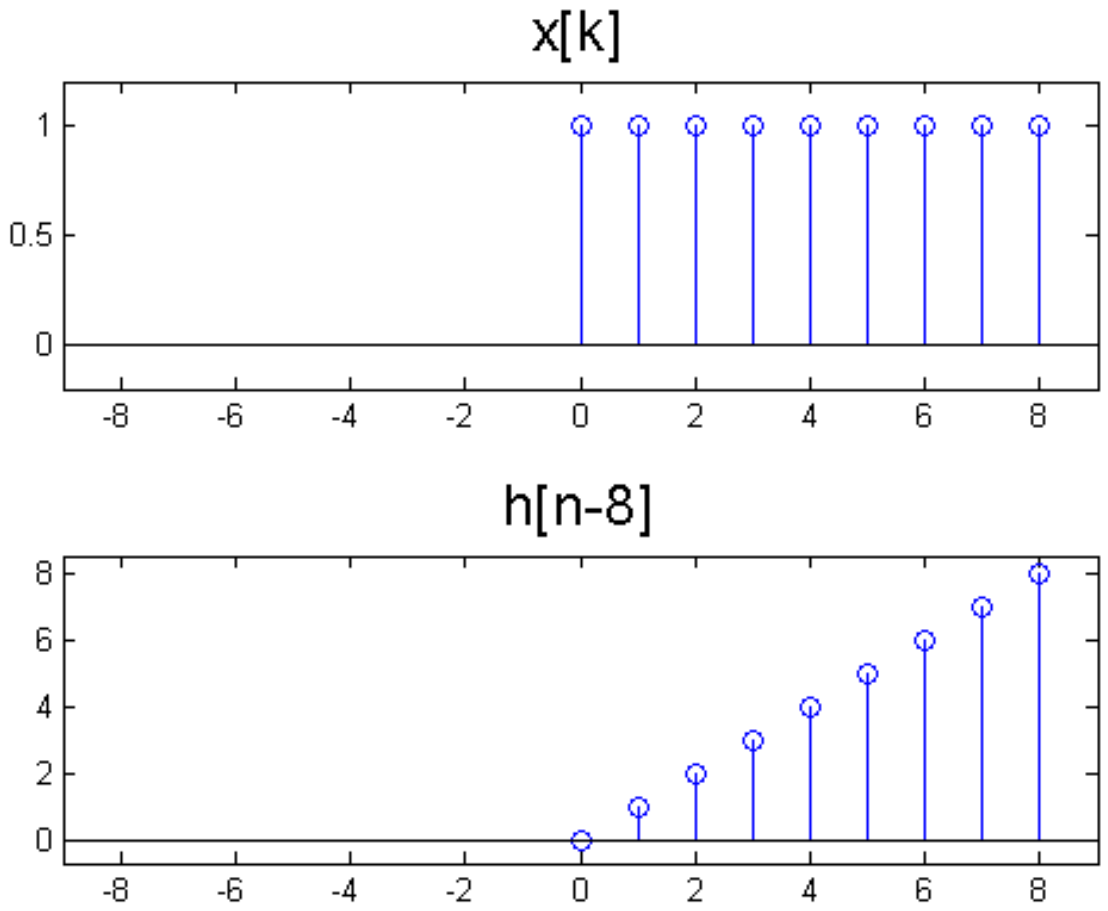

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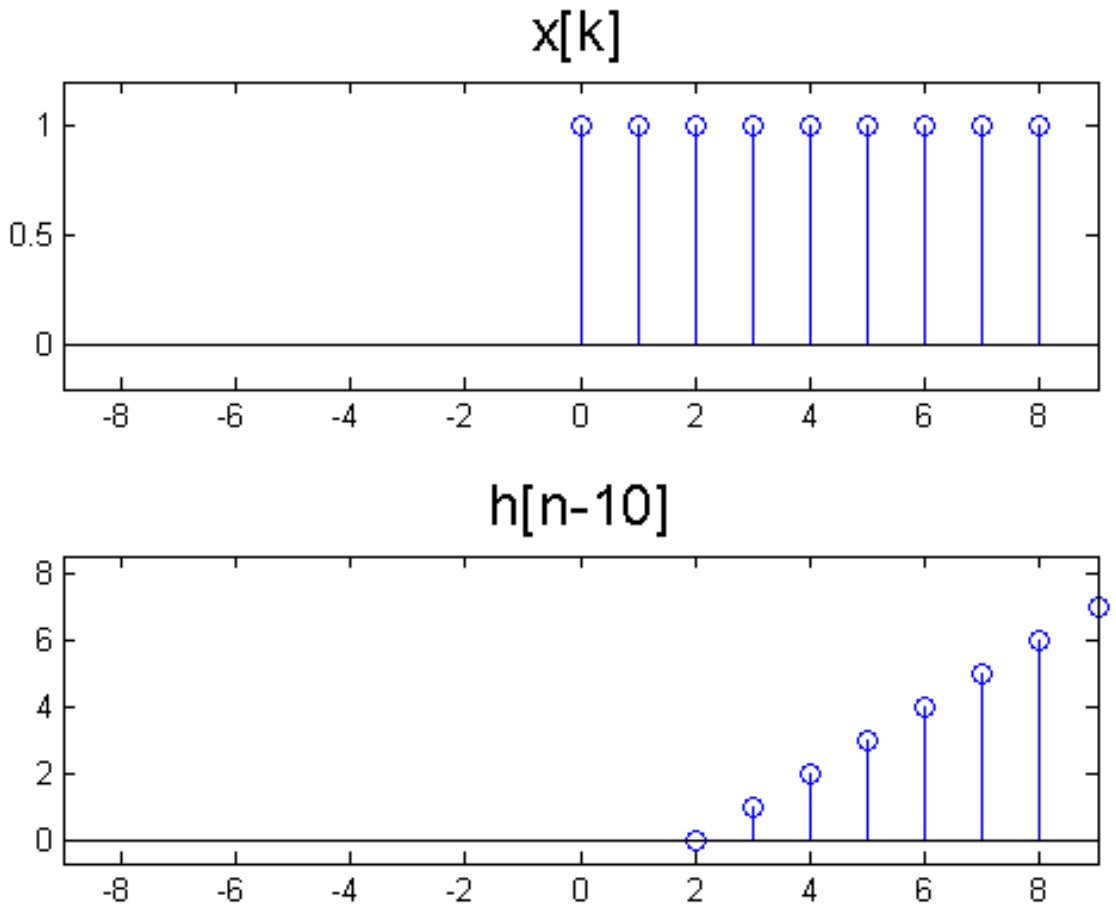

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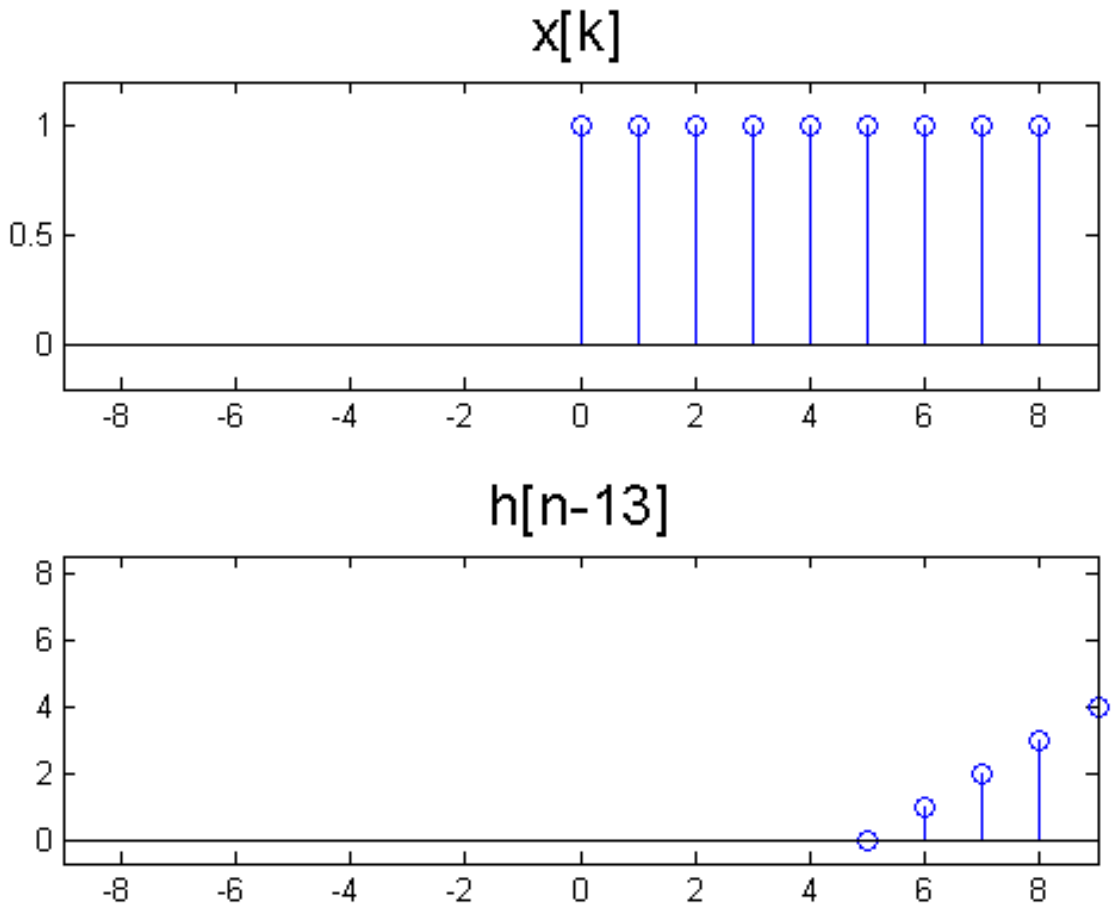

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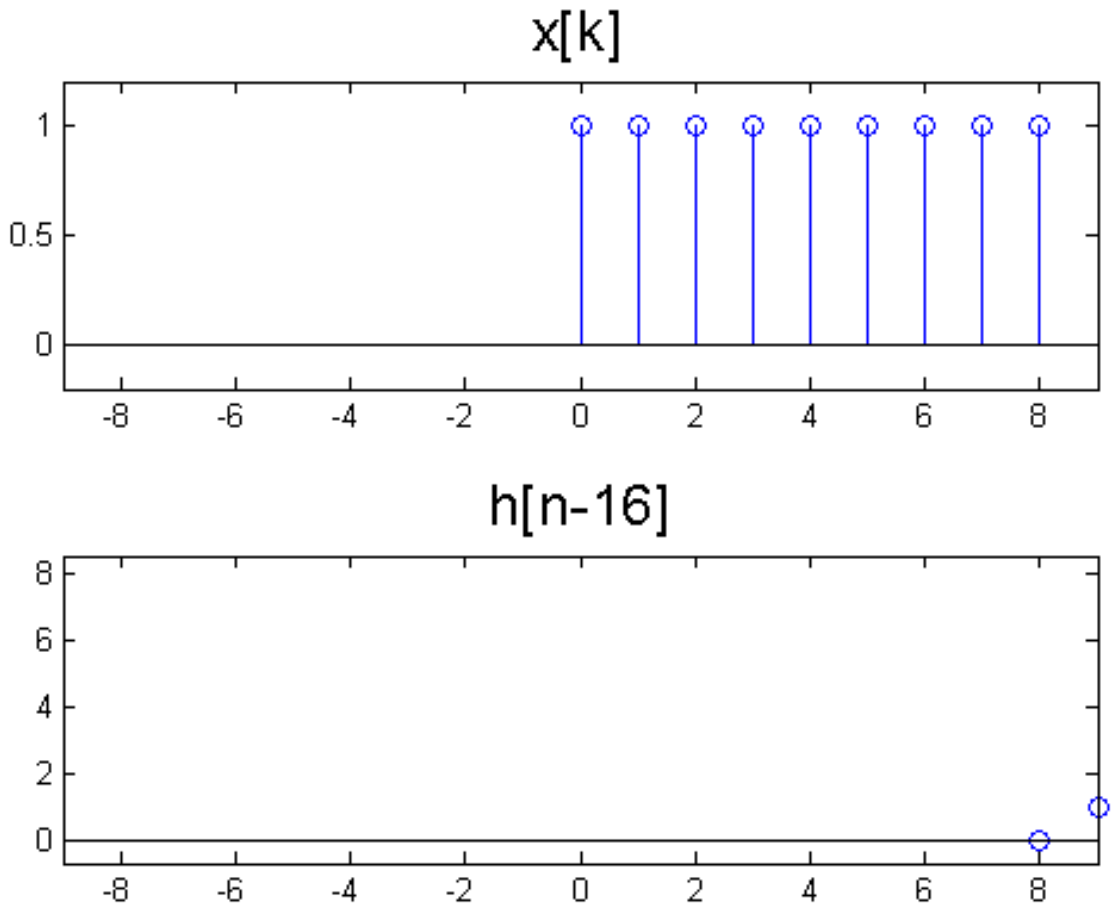

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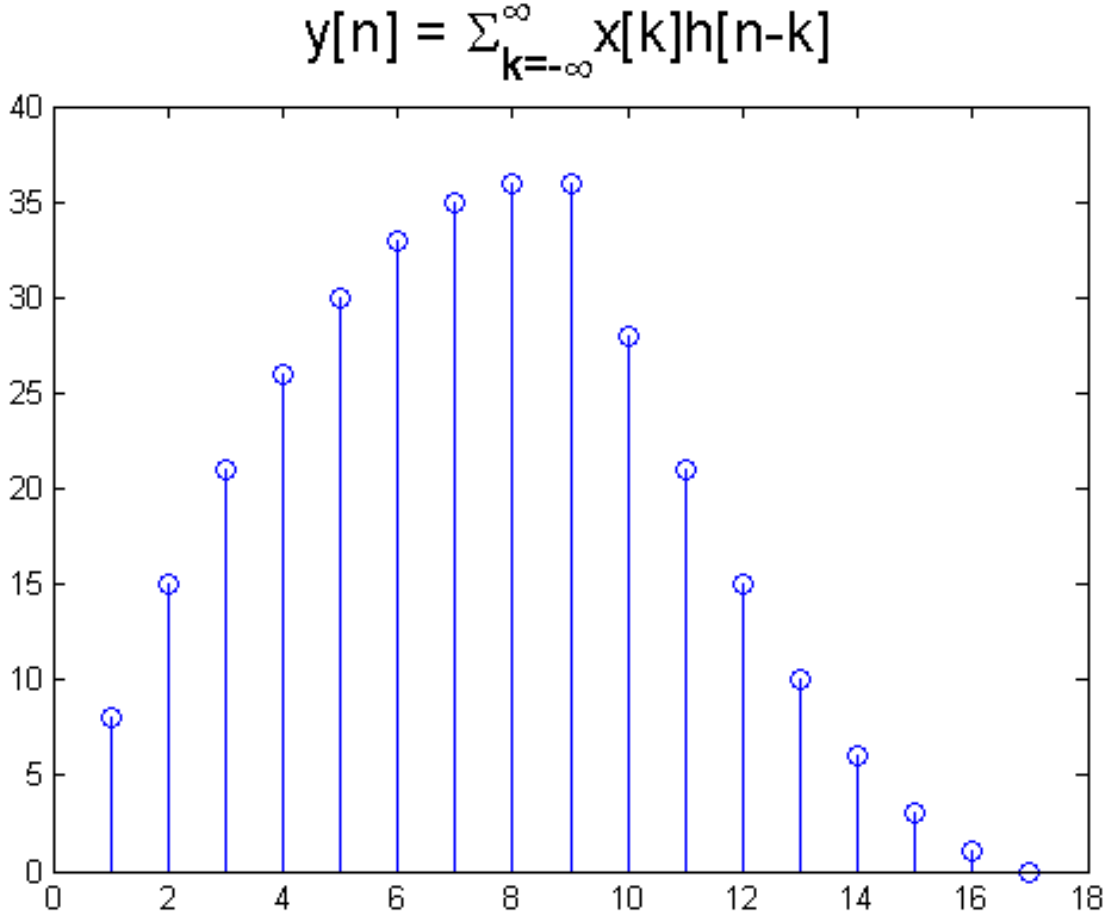


# Exercício

- A resposta ao impulo de um sistema LIT é:

$$h[n] = u[n] - u[n-5]$$

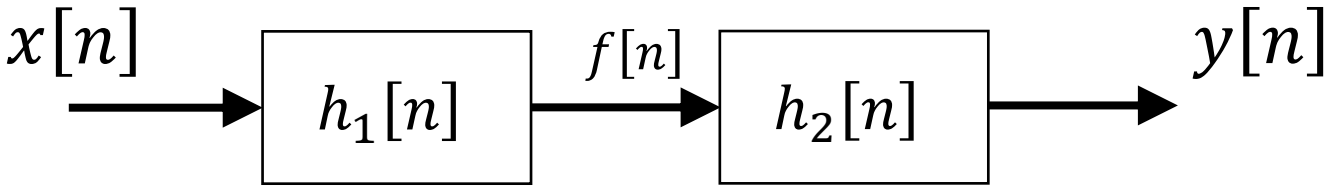
- Ao se aplicar a esse sistema o sinal de entrada:

$$x[n] = n; 0 \leq n \leq 5$$

- Calcule a saída $y[n]$ do sistema

# Exercício

- Um determinado sistema é formado por dois subsistemas. Cada um possui sua própria resposta ao impulso ($h_1[n]$ e $h_2[n]$)




- Passar o sinal de entrada pelos dois subsistemas é o mesmo que convolui-lo com a convolução das duas respostas ao impulso, ou seja:

$$y[n] = \sum_{k=-\infty}^{\infty} x[k]\big[h_1[n-k] * h_2[n-k]\big]$$

- Sendo $h_1[n] = -2\delta[n] + \delta[n-1] + 2\delta[n-2]$ e $h_2[n] = {}^{n}/_{2}\,, 0 \leq \mathrm{n} \leq 4$, encontre a resposta ao impulso do sistema completo e convolua o sinal $x[n] = u[n] - u[n-3]$