

# Digital Signal Processing

**share your talent.**  
**move the world.**

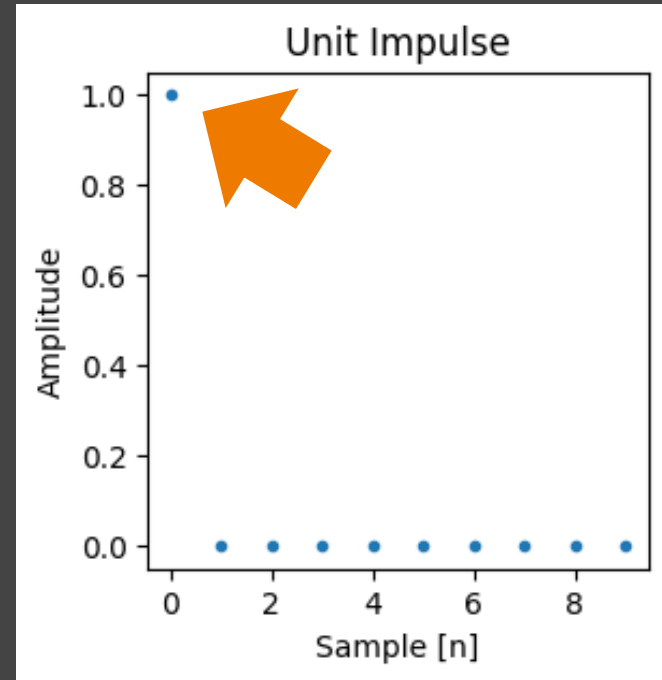
**ewout bergsma.**

# Last Time: LTI Systems

- LTI Systems
  - 3 properties
  - Do you remember them?

# Last Time: Discrete Time Unit Impulse

$$\delta[n] = \begin{cases} 1, & n = 0 \\ 0, & n \neq 0 \end{cases}$$



# Last Time: Discrete Time Impulse Response



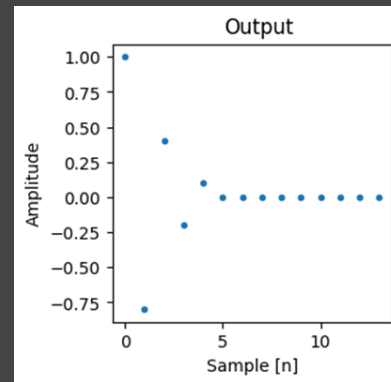
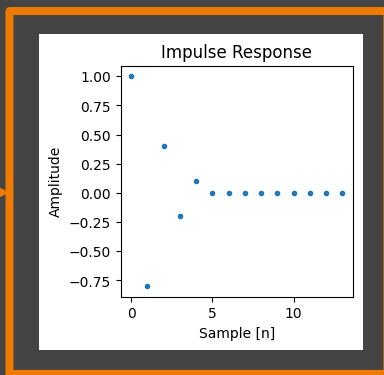
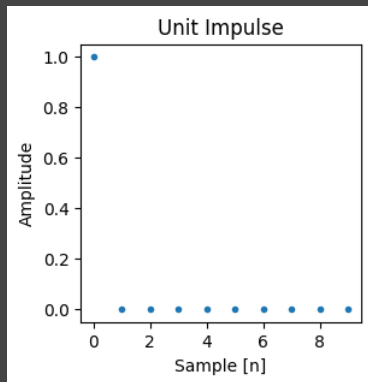
**Questions?**

# Convolution

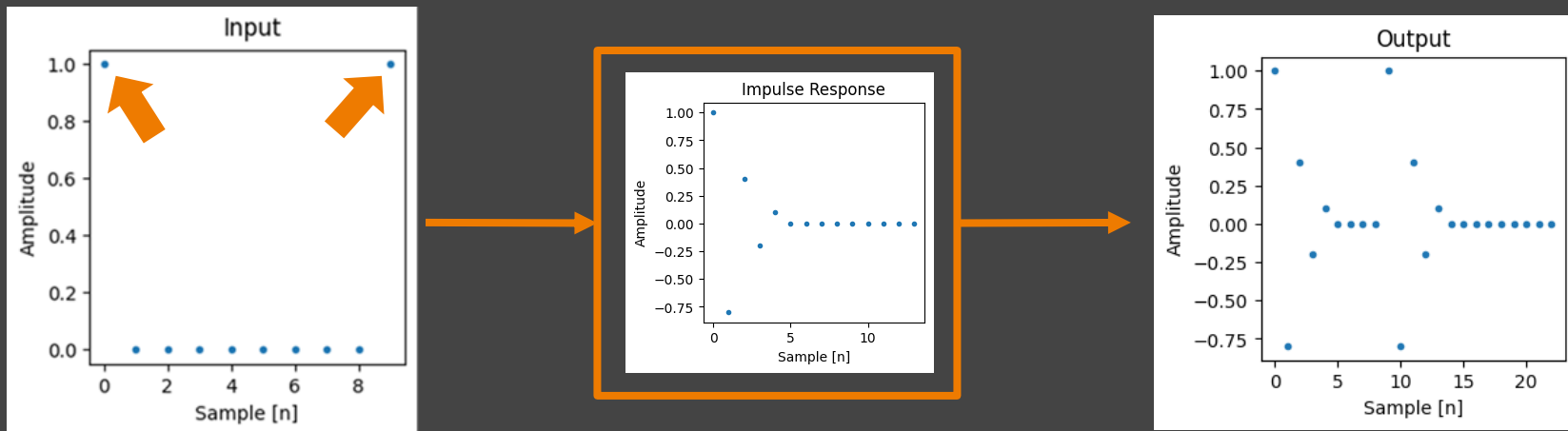
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# Simple!

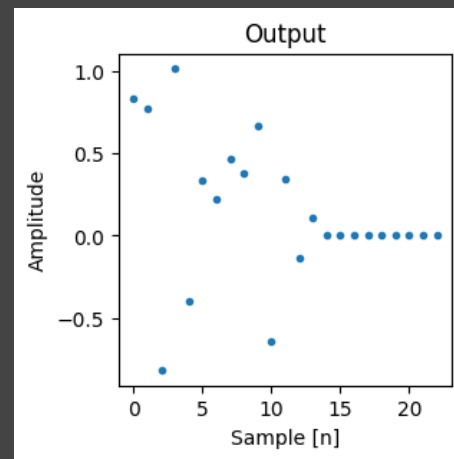
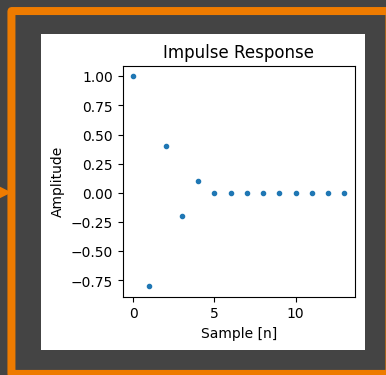
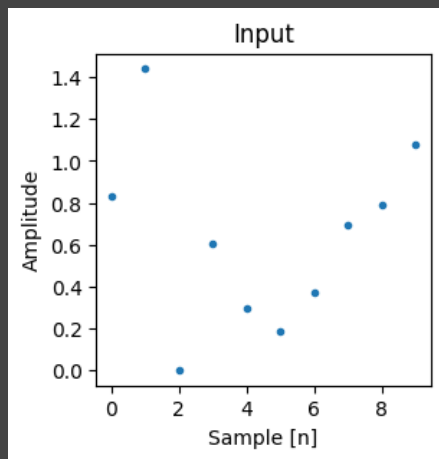


# ... Steady ...

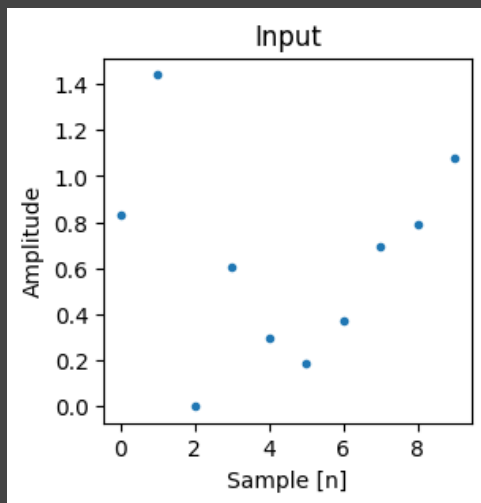




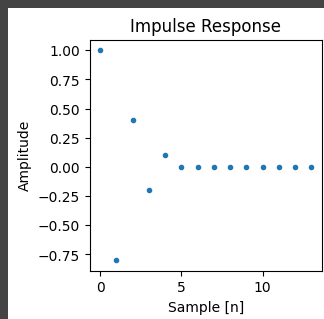
# Excuse me?!



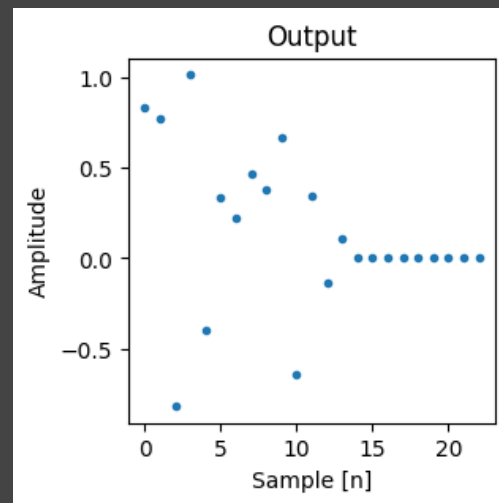
# Convolution!



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=




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



**Convolution?**

# Convolution


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

Snippets of video have been removed due to copyright.  
Please refer to the link below, it has everything and more than what was in the  
slides during class.

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



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


The image shows the convolution equation  $x[n] * h[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$  centered on a white rectangular background. Above the equation, an orange arrow points downwards towards the summation symbol. Below the equation, another orange arrow points upwards towards the same summation symbol. The entire scene is set against a dark gray background, with a solid orange bar at the very top of the frame.

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# Continuous Time Convolution

$$x(t) * h(t) = \int_{-\infty}^{\infty} x(\tau)h(x - \tau) d\tau$$

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

# Exercises!