# Convolution Animation

Ranga Rodrigo
ranga@uom.lk

Department of Electronic and Telecommunication Engineering, The University of Moratuwa, Sri Lanka

May 20, 2023

# Convolution Integral and Sum

The convolution of the signal $x(t)$ and $h(t)$ is given by

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

which is referred to as the convolution integral or the superposition integral. This corresponds to the representation of a continuous-time LTI system in terms of its response to a unit impulse.

$$y(t) = x(t) * h(t).$$

The convolution of the sequence $x[n]$ and $h[n]$ is given by

$$y[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k], \tag{1}$$

which is referred to as the convolution sum or superposition sum. This corresponds to the representation of a discrete-time LTI system in terms of its response to a unit impulse (sample), which we represent symbolically as

$$y[n] = x[n] * h[n]. \tag{2}$$

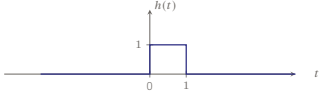
The characteristics of an LTI system are completely determined by its impulse response.

# Examples for the Animation

1. $y(t) = x(t) * \delta(t)$
2. $y(t) = x(t) * \delta(t-2)$
3. $y(t) = x(t) * [\delta(t) + \delta(t-2)]$
4. $y(t) = x(t) * [u(t) - u(t-1)]$

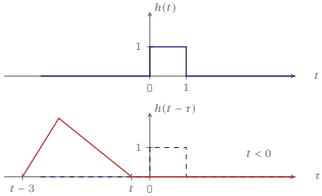
# Example 4

1. $y(t) = x(t) * \delta(t)$
2. $y(t) = x(t) * \delta(t-2)$
3. $y(t) = x(t) * [\delta(t) + \delta(t-2)]$
4. $y(t) = x(t) * [u(t) - u(t-1)]$



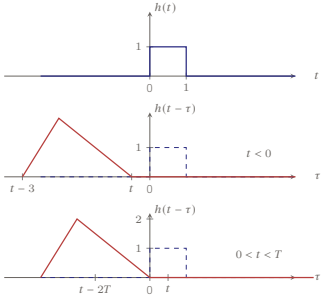
# Example 4

1. $y(t) = x(t) * \delta(t)$
2. $y(t) = x(t) * \delta(t-2)$
3. $y(t) = x(t) * [\delta(t) + \delta(t-2)]$
4. $y(t) = x(t) * [u(t) - u(t-1)]$



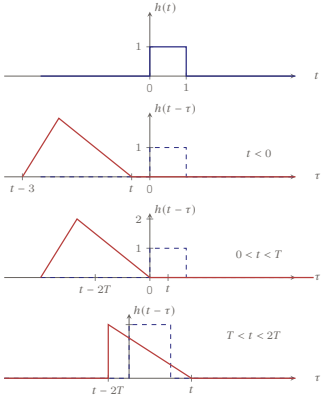
# Example 4

1. $y(t) = x(t) * \delta(t)$
2. $y(t) = x(t) * \delta(t-2)$
3. $y(t) = x(t) * [\delta(t) + \delta(t-2)]$
4. $y(t) = x(t) * [u(t) - u(t-1)]$



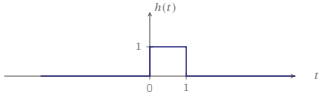
# Example 4

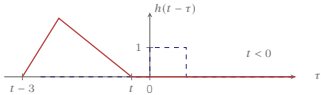
1. $y(t) = x(t) * \delta(t)$
2. $y(t) = x(t) * \delta(t-2)$
3. $y(t) = x(t) * [\delta(t) + \delta(t-2)]$
4. $y(t) = x(t) * [u(t) - u(t-1)]$

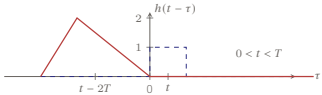


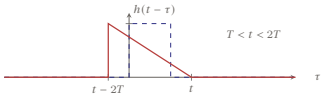
# Example 4

1. $y(t) = x(t) * \delta(t)$
2. $y(t) = x(t) * \delta(t-2)$
3. $y(t) = x(t) * [\delta(t) + \delta(t-2)]$
4. $y(t) = x(t) * [u(t) - u(t-1)]$




# Example 4

1. $y(t) = x(t) * \delta(t)$
2. $y(t) = x(t) * \delta(t-2)$
3. $y(t) = x(t) * [\delta(t) + \delta(t-2)]$
4. $y(t) = x(t) * [u(t) - u(t-1)]$