Discrete-Time Linear Time-Invariant Systems
  - The convolution sum

Continuous-Time Linear Time-Invariant Systems
  - The convolution integral

Properties of Linear Time-Invariant Systems

Causal Linear Time-Invariant Systems
  Described by Differential & Difference Equations

Singularity Functions

\[ x[n] \rightarrow h[n] \rightarrow y[n] \quad x(t) \rightarrow h(t) \rightarrow y(t) \]

Problem 2.8 (p.139) – Convolution Integral [SS2:37]

2.8. Determine and sketch the convolution of the following two signals:

\[ x(t) = \begin{cases} 
  t + 1, & 0 \leq t \leq 1 \\
  2 - t, & 1 < t \leq 2 \\
  0, & \text{elsewhere} 
\end{cases} \]

\[ h(t) = \delta(t + 2) + 2\delta(t + 1). \]
Problem 2.22 (p.141) – Convolution Integral [SS2:37]

2.22. For each of the following pairs of waveforms, use the convolution integral to find the response \( y(t) \) of the LTI system with impulse response \( h(t) \) to the input \( x(t) \). Sketch your results.

(a) \[ x(t) = e^{-\alpha t}u(t) \quad h(t) = e^{-\beta t}u(t) \] (Do this both when \( \alpha \neq \beta \) and when \( \alpha = \beta \).)

(b) \[ x(t) = u(t) - 2u(t - 2) + u(t - 5) \]
\[ h(t) = e^{2t}u(1 - t) \]

(c) \( x(t) \) and \( h(t) \) are as in Figure P2.22(a).

(d) \( x(t) \) and \( h(t) \) are as in Figure P2.22(b).

(e) \( x(t) \) and \( h(t) \) are as in Figure P2.22(c).

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3. [10] Suppose that the impulse response \( h(t) \) of an LTI system is given by the following function:

\[ h(t) = \begin{cases} 
  t + 1, & 0 < t \leq 1 \\
  2 - t, & 1 < t \leq 2 \\
  0, & \text{otherwise} 
\end{cases} \]

If the following function is the input signal into the LTI system:

\[ x(t) = \begin{cases} 
  1, & 0 < t \leq 1 \\
  0, & \text{otherwise} 
\end{cases} \]

Find the output of the system.