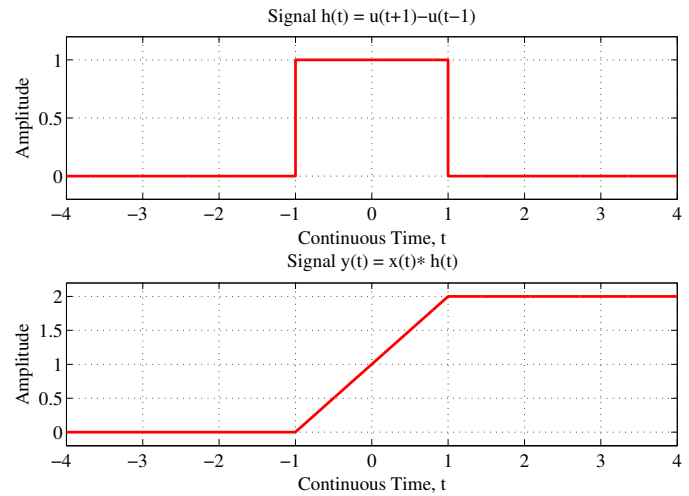
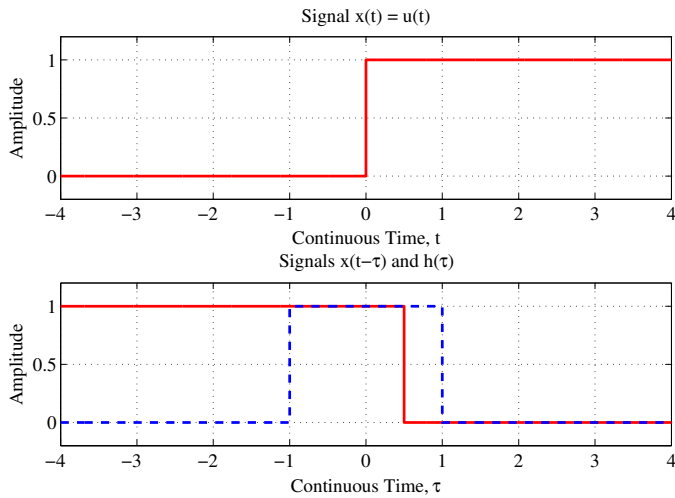


**Quiz 2: \_\_\_\_/10****ELEC 309 – Signals & Systems**

A continuous-time system has impulse response  $h(t) = u(t+1) - u(t-1)$  and input signal  $x(t) = u(t)$ . Using convolution, determine the output signal  $y(t)$ .



In determining  $h(t) * x(t)$ , we need to consider three ranges of time  $t$ :  $t < -1$ ,  $-1 \leq t < 1$ , and  $t \geq 1$ .

For  $t < -1$ ,  $h(\tau)x(t-\tau) = 0$  for all  $\tau$ . Therefore,

$$h(t) * x(t) = \int_{-\infty}^{\infty} h(\tau)x(t-\tau)d\tau = 0.$$

For  $-1 \leq t < 1$ ,  $h(\tau)x(t-\tau) = 1$  for  $-1 \leq \tau \leq t$ . Therefore,

$$h(t) * x(t) = \int_{-\infty}^{\infty} h(\tau)x(t-\tau)d\tau = \int_{-1}^t d\tau = t + 1.$$

For  $t \geq 1$ ,  $h(\tau)x(t-\tau) = 1$  for  $-1 \leq \tau \leq 1$ . Therefore,

$$h(t) * x(t) = \int_{-\infty}^{\infty} h(\tau)x(t-\tau)d\tau = \int_{-1}^1 d\tau = 2.$$

Therefore,

$$h(t) * x(t) = \begin{cases} 0 & t < -1 \\ t + 1 & -1 \leq t < 1 \\ 2 & t \geq 1 \end{cases}$$

$$= (t + 1)[u(t + 1) - u(t - 1)] + 2u(t - 1) = (t + 1)u(t + 1) - (t - 1)u(t - 1)$$