Inversion, Shifting and Scaling of signals

Operations of CT Signals

1. Time Reversal $y(t) = x(-t)$
2. Time Shifting $y(t) = x(t-td)$
3. Amplitude Scaling $y(t) = Bx(t)$
4. Addition $y(t) = x1(t) + x2(t)$
5. Multiplication $y(t) = x1(t)x2(t)$
6. Time Scaling $y(t) = x(at)$

1. Time Reversal

Flips the signal about the y axis

$y(t) = x(-t)$

ex. Let $x(t) = u(t)$, and perform time reversal

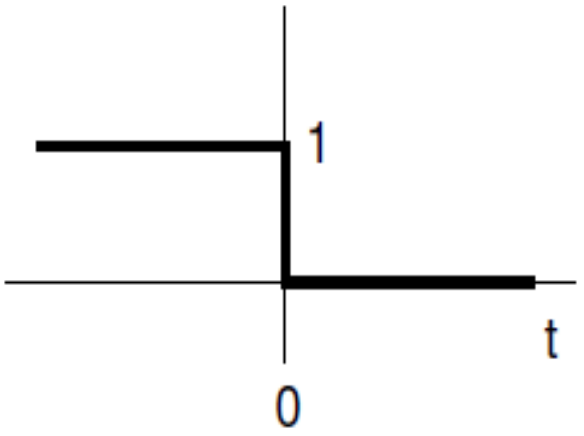
Solution: Find $y(t) = u(-t)$

Let "a" be the argument of the step function u(a)

$$u(a) = \begin{cases} 1 & a \geq 0 \\ 0 & a < 0 \end{cases}$$

Let a = -t, and plug in this value of "a"

$$u(-t) = \begin{cases} 1 & t \leq 0 \\ 0 & t > 0 \end{cases}$$



2. Time Shifting / Delay

$y(t) = x(t - td)$

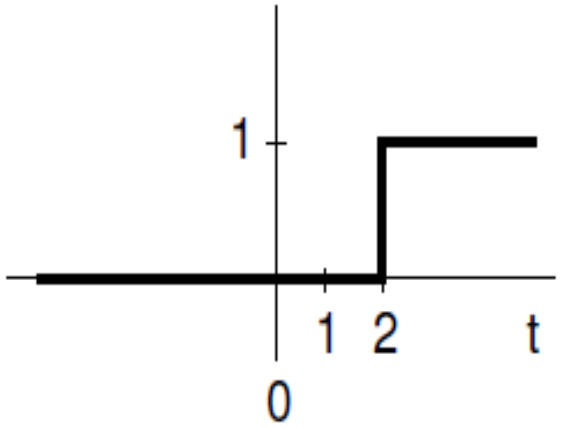
- Shifts the signal left or right
- Shifts the origin of the signal to t_d
- Rule -Set $(t - td) = 0$ (set the argument equal to zero)
- Then move the origin of x(t) to td
- Effectively, y(t) equals what x(t) was td seconds ago

ex. Sketch y(t) = u(t – 2)

Method 1

Let "a" be the argument of "u"

$$y(a)=\begin{cases}1 & a\geq 0\\ 0 & a<0\end{cases}=\begin{cases}1 & t-2\geq 0\\ 0 & t-2<0\end{cases}=\begin{cases}1 & t\geq 2\\ 0 & t<2\end{cases}$$



Method 2 (by inspection)

Simply shift the origin to $t_d = 2$