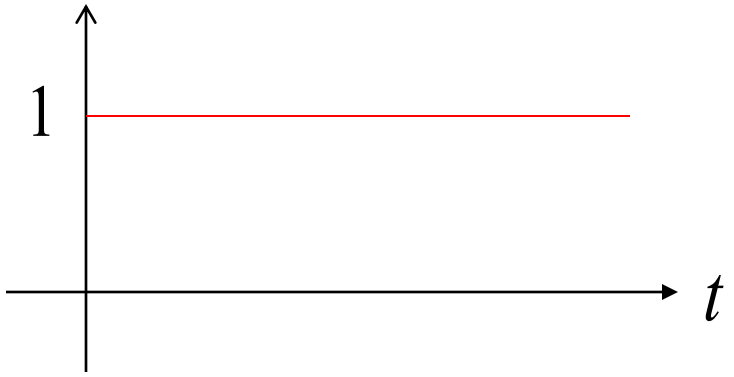
Classification of signals

- Continuous time and discrete-time signals
- Even and odd signals
- Periodic and non periodic signals
- Standard signal

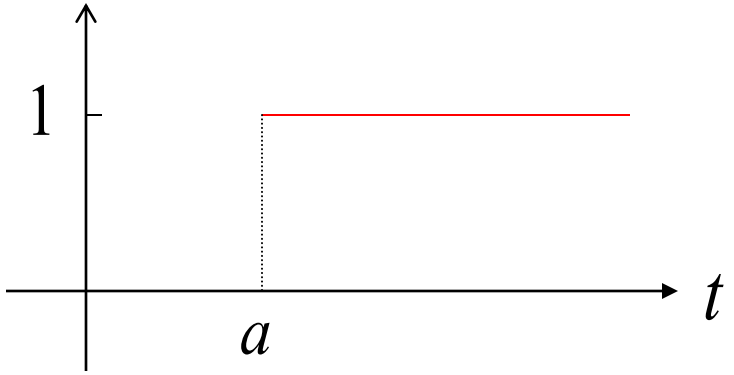
(1) Unit step function

$$u(t)=\begin{cases}1, & t \succ 0\\ 0, & t \prec 0\end{cases}$$



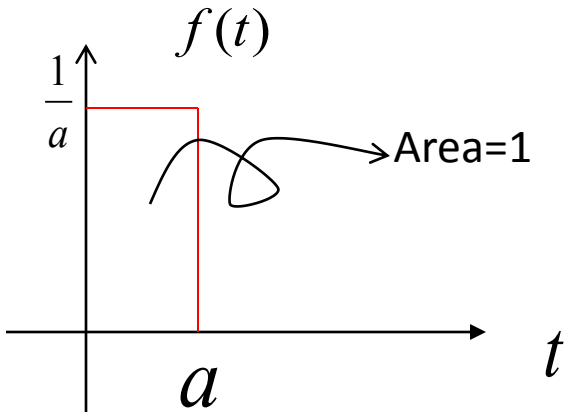
Shift a

$$u(t-a)=\begin{cases}1, & t \succ a\\ 0, & t \prec a\end{cases}$$

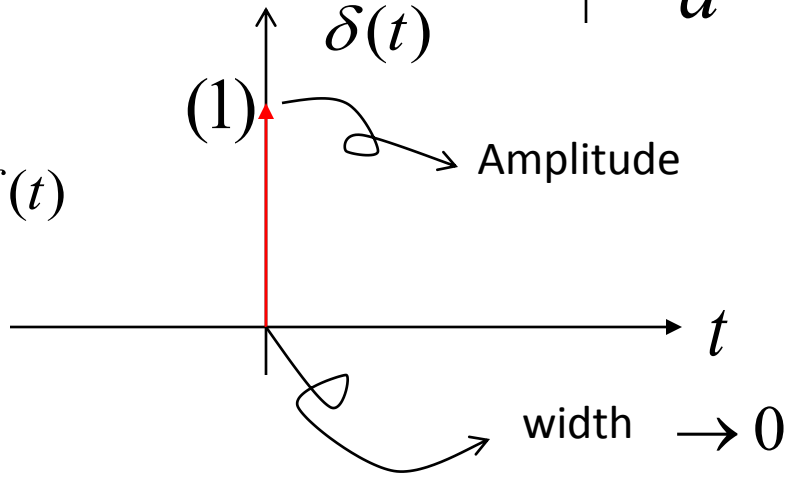


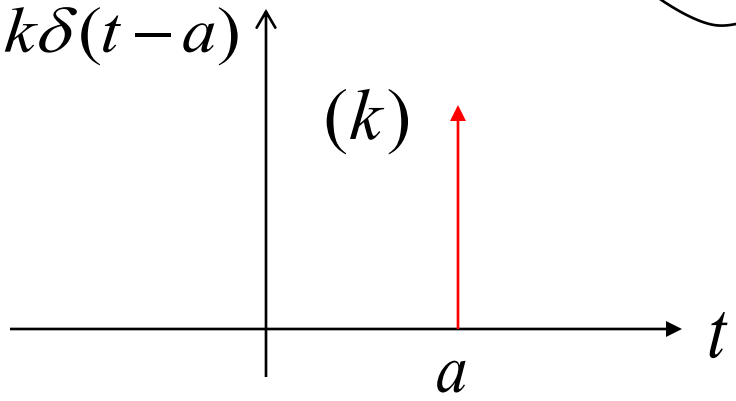
(2) Unit impulse function

$$\delta(t) = \lim_{a \to 0} \frac{1}{a}[u(t) - u(t-a)]$$

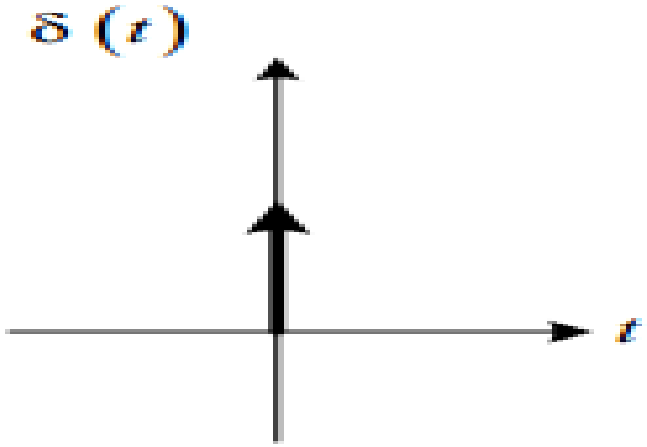


$$\delta(t) = \frac{d}{dt} f(t)$$





SINGULARITY FUNCTIONS -IMPULSE

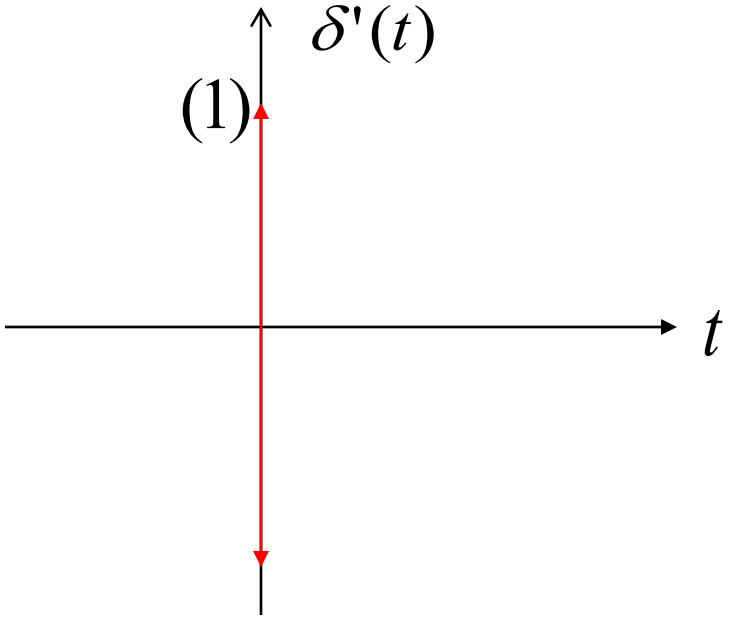


The unit Impulse function (Dirac distribution or delta function)

$$\delta(t) = \begin{cases} 1 & t = 0 \\ 0 & t \neq 0 \end{cases}$$

Laplace of δ(t) = 1

(3) Unit doublet function $\delta'(t)$



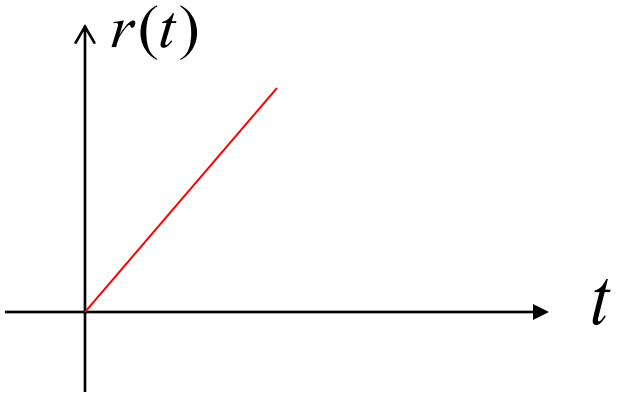
Laplace of unit doublet function = s

(4) sign function

$$\operatorname{sgn}(t)=\begin{cases}1, & t\succ 0\\ 0, & t=0\\ -1, & t\prec 0\end{cases}$$

(5) Unit ramp signal

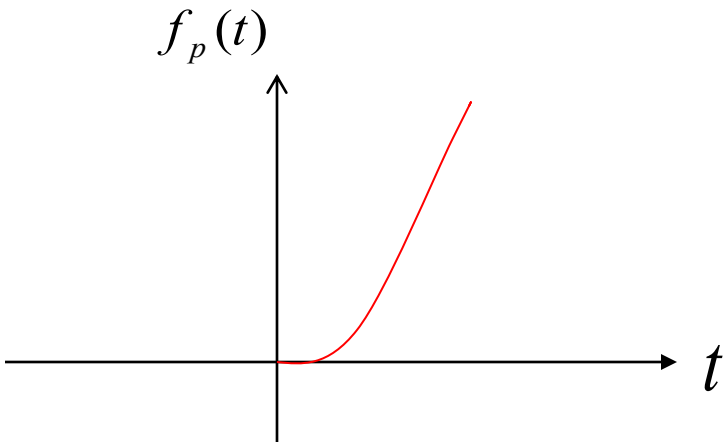
$$r(t)=\begin{cases}t, & t\geq 0\\ 0, & t\prec 0\end{cases}$$



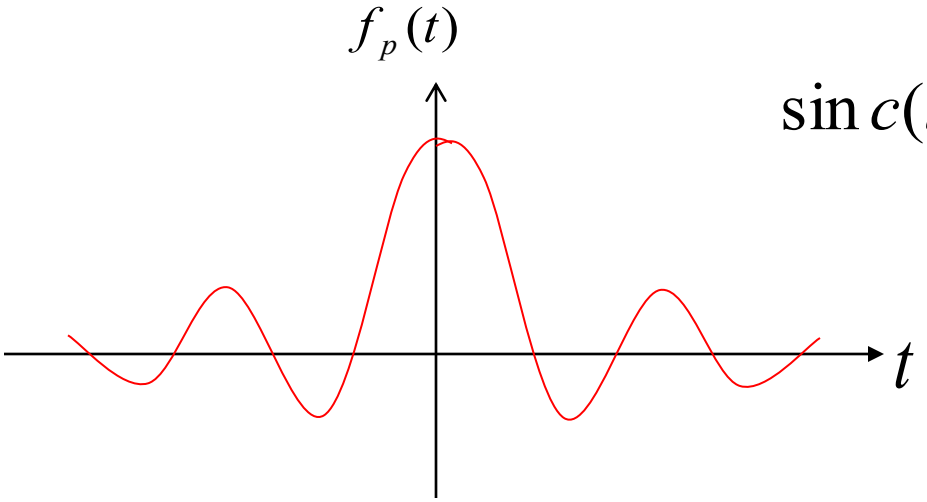
$$u(t)=\frac{dr(t)}{dt}\qquad or\qquad r(t)=\int_{-\infty}^{t}u(\tau)d\tau$$

(6) parabolic signal

$$f_p(t) = \begin{cases} t^2, & t \geq 0 \\ 0, & t \prec 0 \end{cases}$$

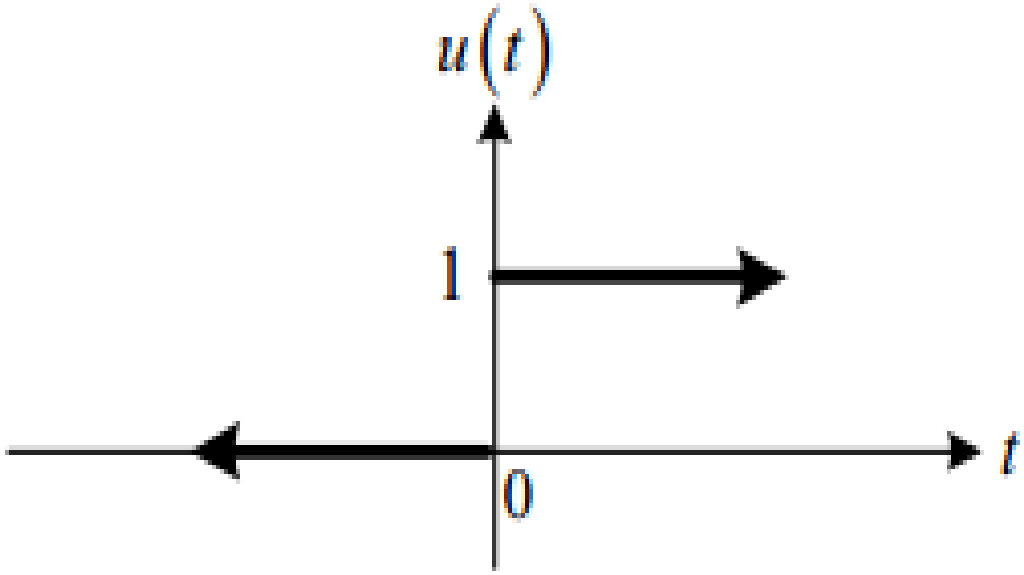


(7) sinc signal

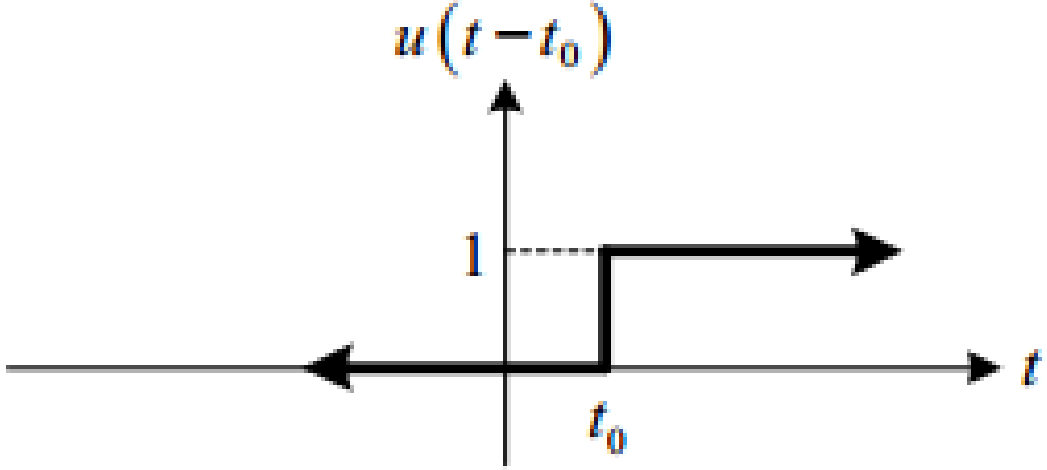


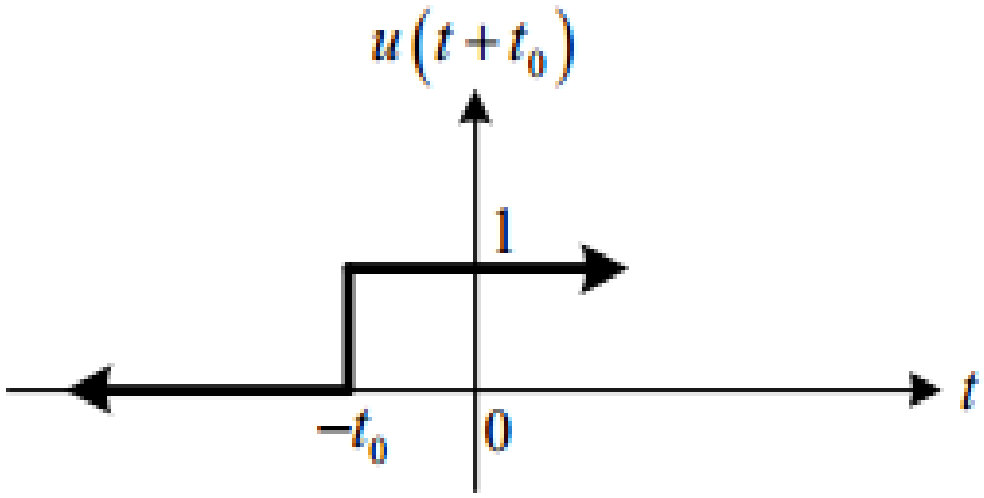
$$\sin c(t) = \frac{\sin \pi t}{\pi t}$$

Singularity functions-Unit Step



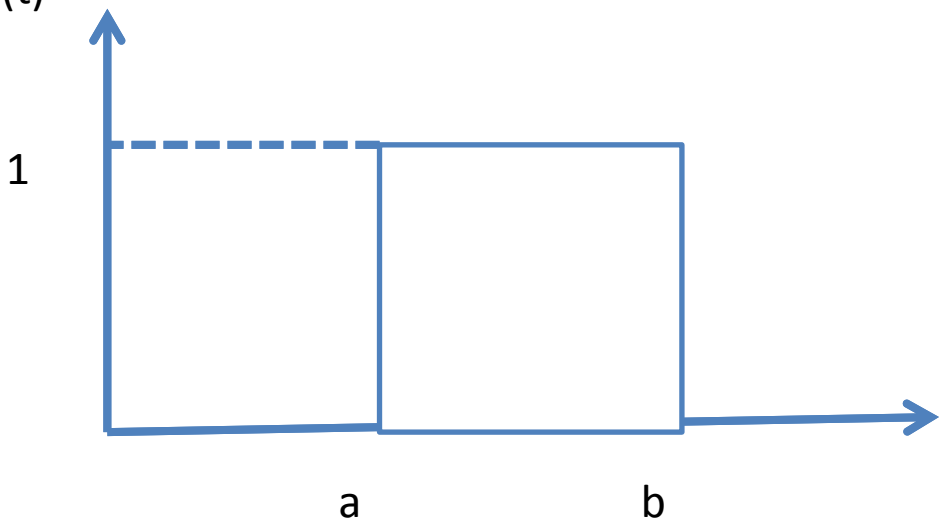
$$u(t) = \begin{cases} 0, & \text{for } t < 0 \\ 1, & \text{for } t \geq 0 \end{cases}$$


$u(t-t_0)$
1
t
t_0

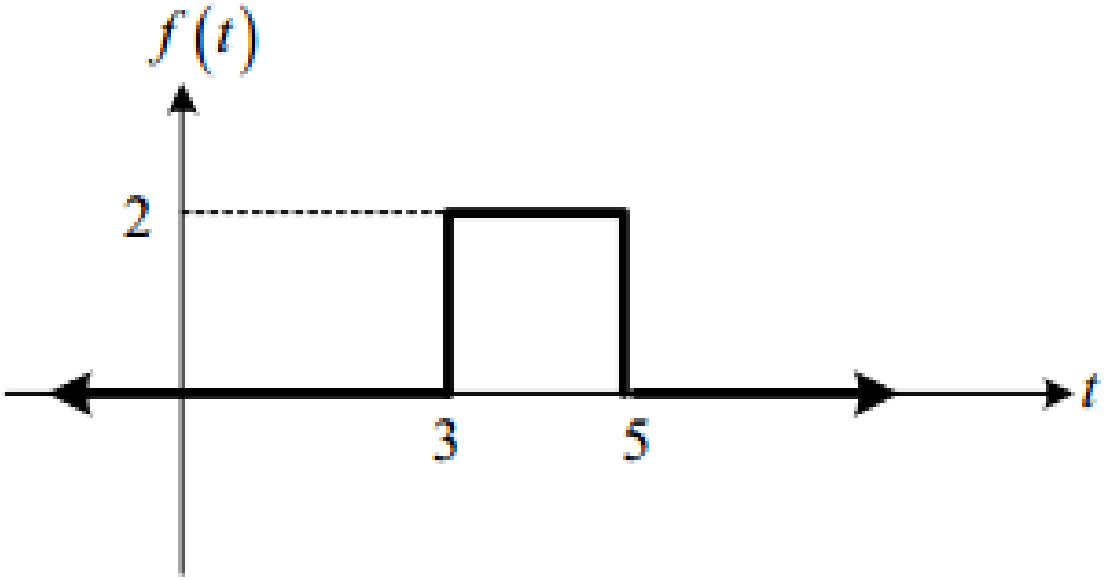

$u(t+t_0)$
1
t
$-t_0$
0

Gate Signal

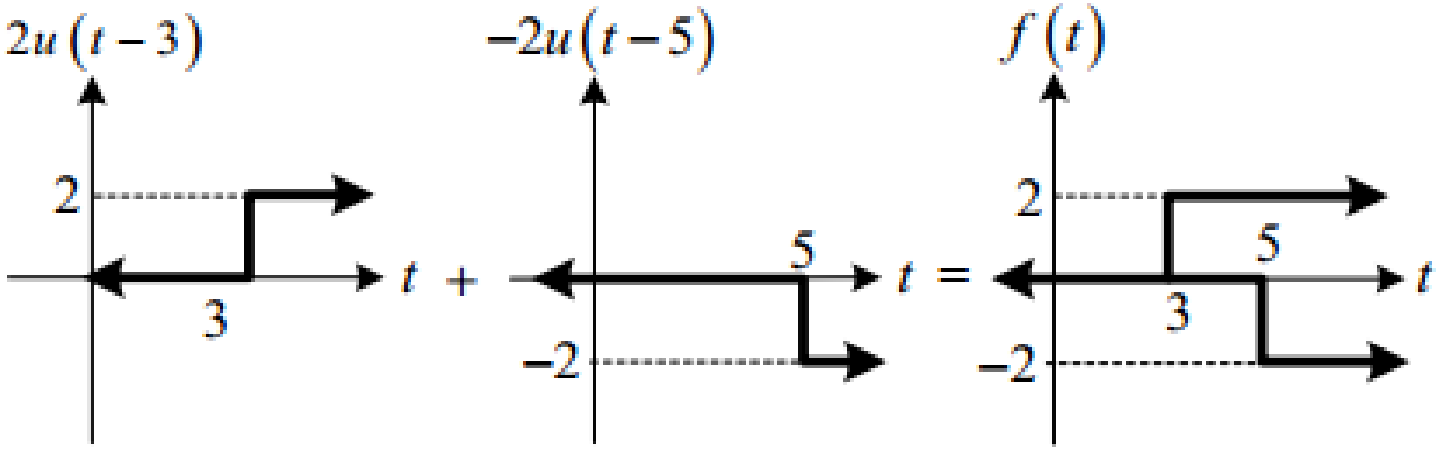
- A rectangular pulse of unit height starting at t-0 and ending at t=b
- $G_{a,b}(t) = U(t-a)-U(t-b)$

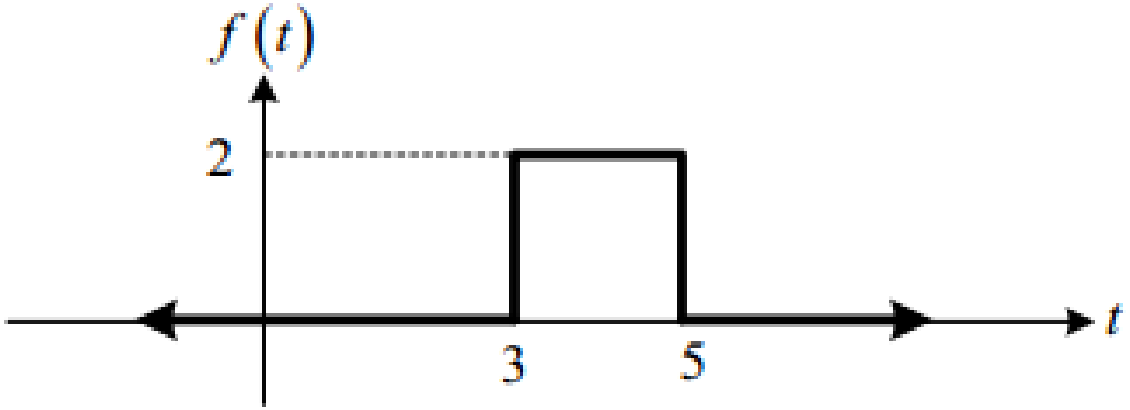


Write an analytical expression to describe the waveform shown in Figure



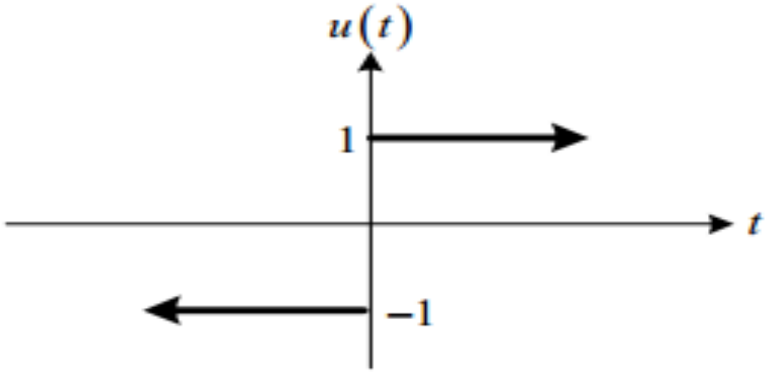
$$f(t) = 2\left[u(t-3) - u(t-5)\right]$$





The continuous-time pulse function time shifted to the right

$$f(t) = 2\left[u(t-3) - u(t-5)\right]$$

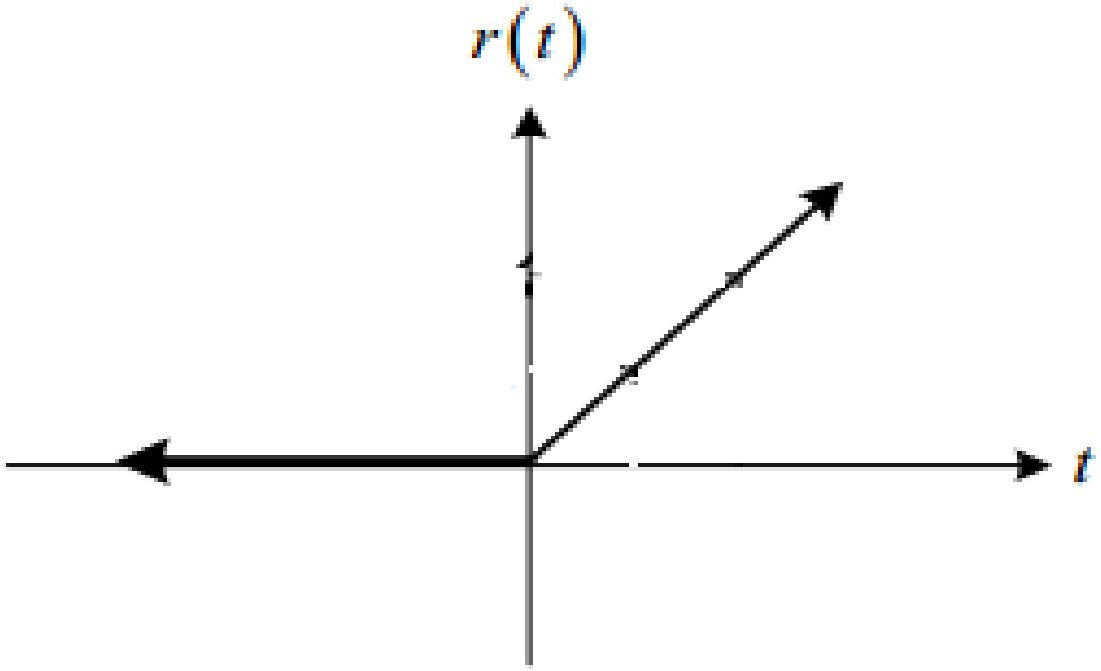


$$\operatorname{sgn}(t) = \begin{cases} 1 & t > 0 \\ 0 & t = 0 \\ -1 & t < 0 \end{cases}$$

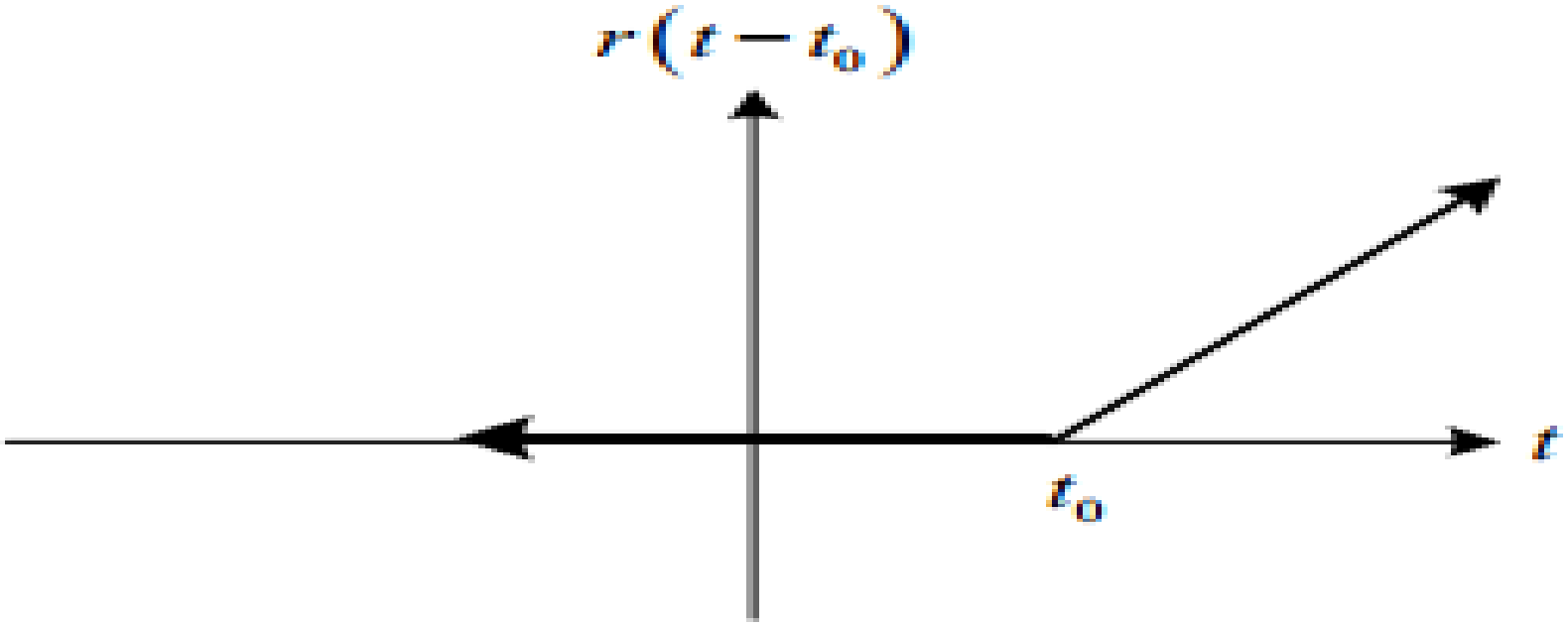
$$\operatorname{sgn}(t) = u(t) - u(-t)$$

The signum or sign function

Ramp Signal

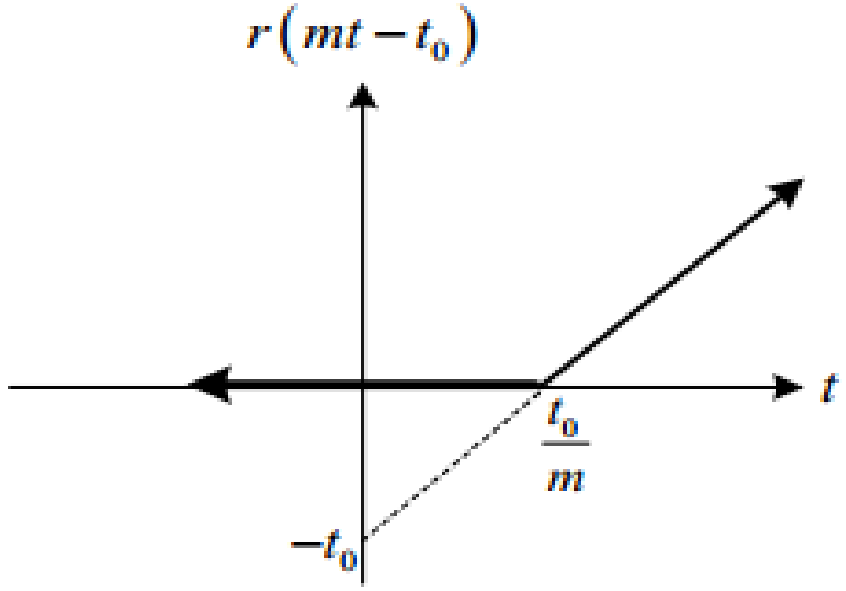


The continuous-time ramp function time shifted to the right by t_0



The time-shifted ramp function having slope of m is denoted by $r(mt-t_0)$, and mathematically defined by:

$$r(mt-t_0)=\begin{cases} mt-t_0 & for\ t \geq \dfrac{t_0}{m} \\ 0 & for\ t < \dfrac{t_0}{m} \end{cases}$$



Ramp function with slope of m and time-shifted by t_0.

$$y = mt - t_0$$

$$t = 0 \qquad y = -t_0$$

$$y = 0 \qquad t = \frac{t_0}{m}$$