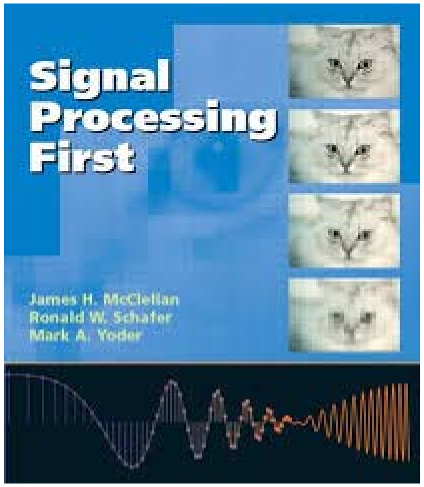
Lecture 2: Thu Aug 20, 2020

Lecture

- Dirac impulse "function"
- Calculus for $\delta(t)$

Reading Assignment



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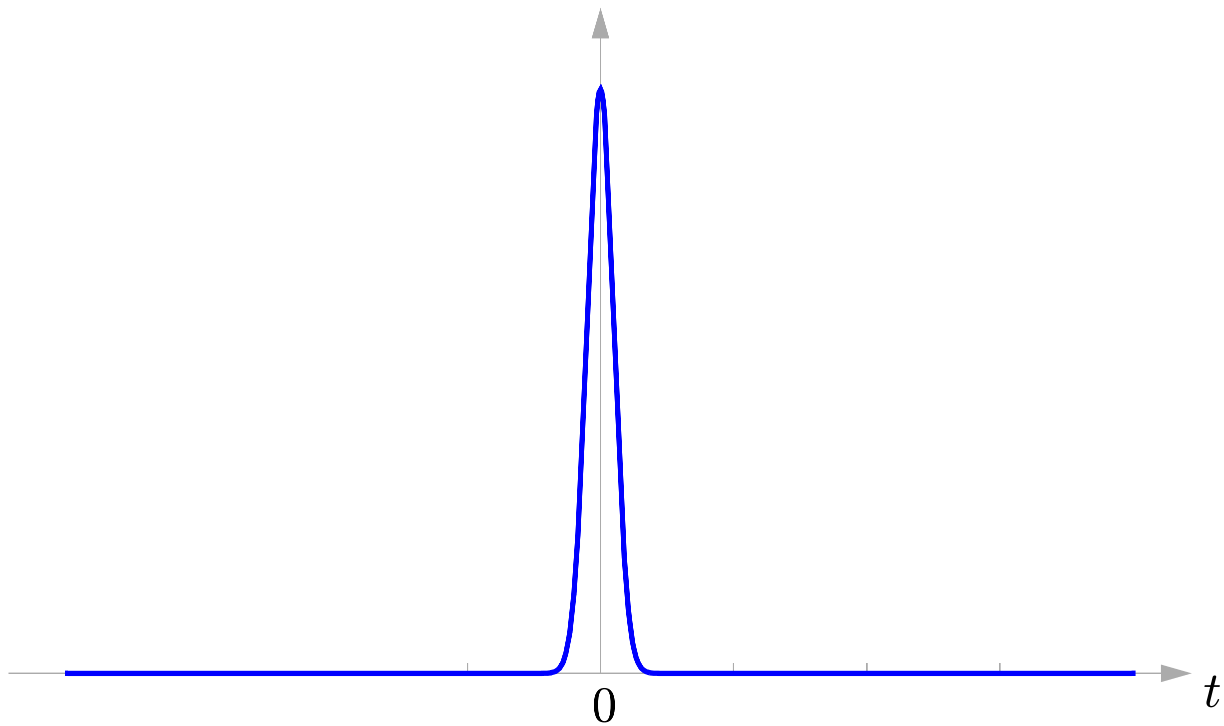
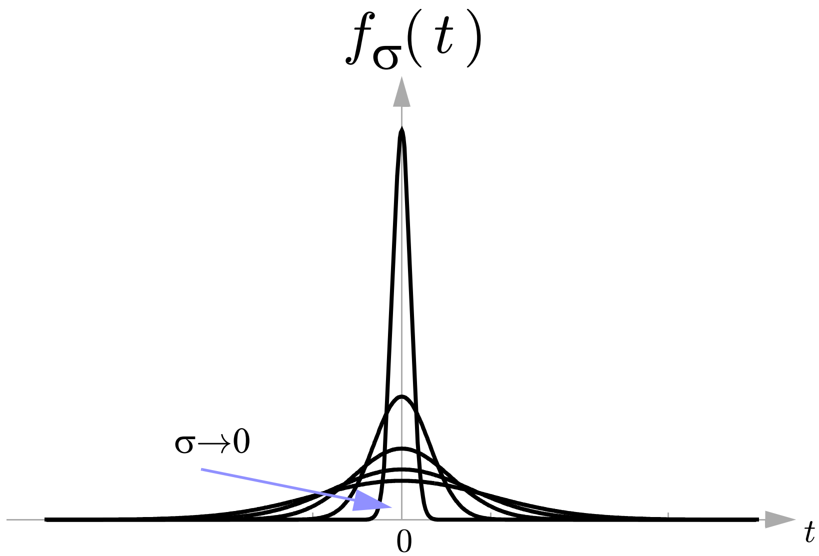
A Short-Duration Signal at Time Zero

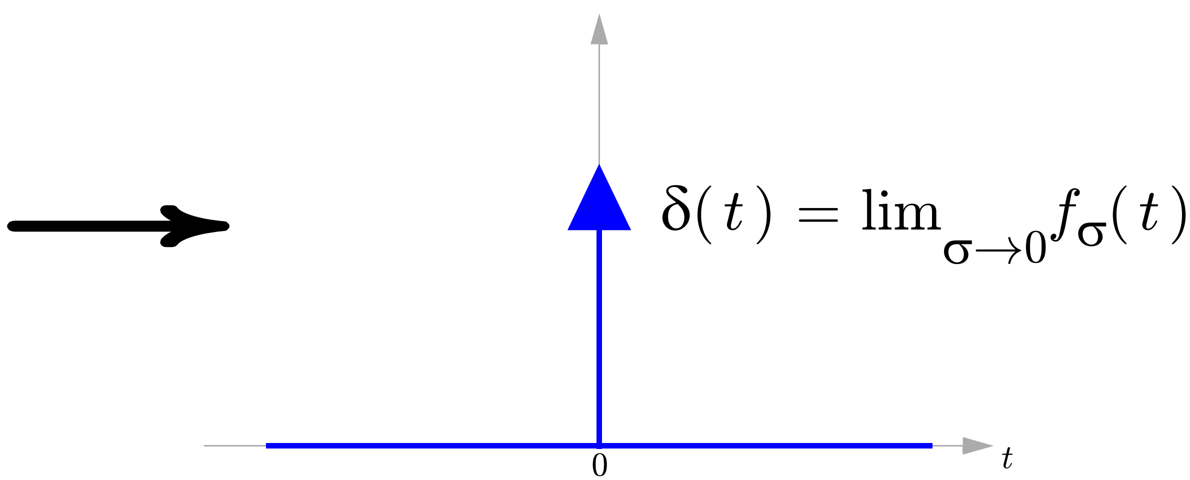


How to model mathematically?

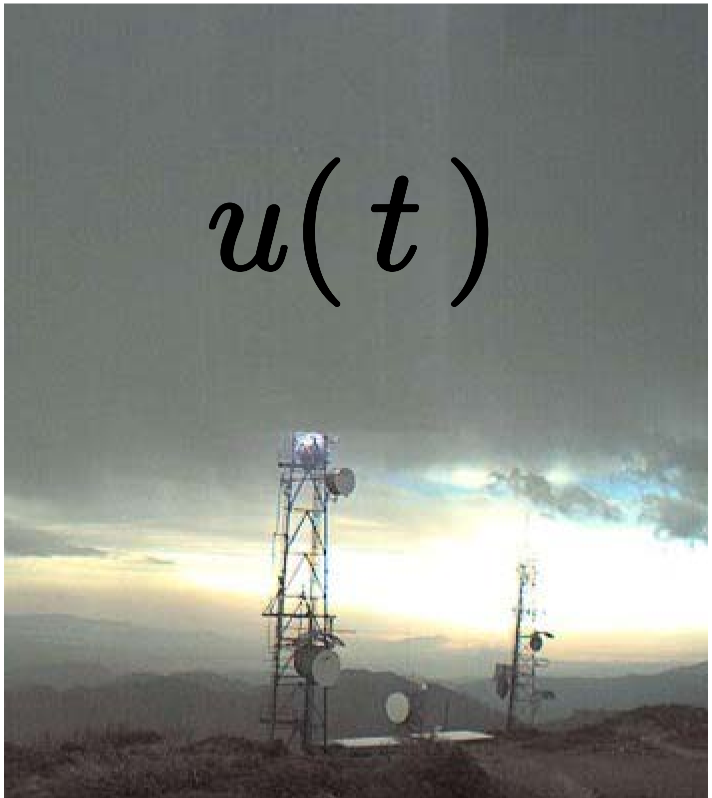
Dirac Impulse "Function"

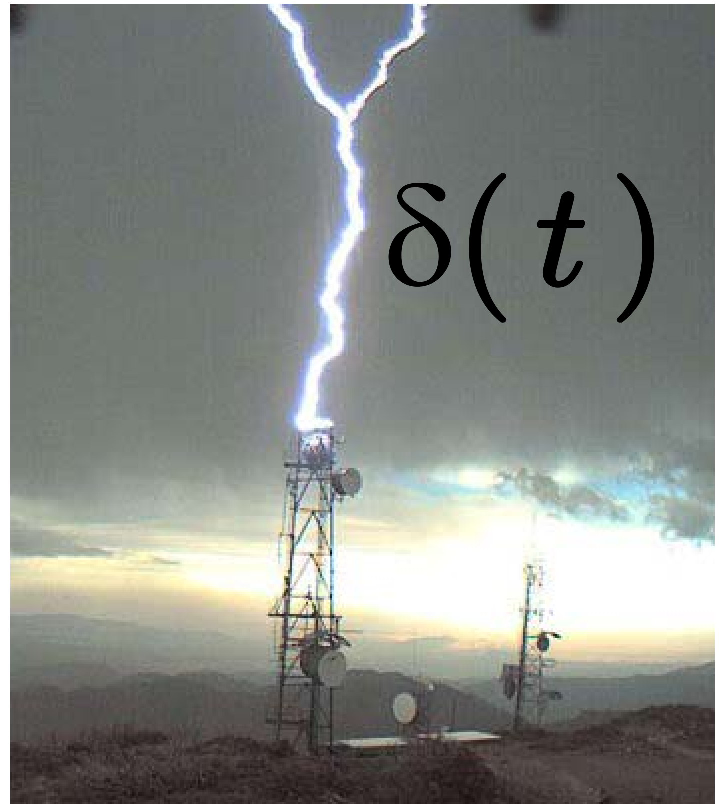
An idealization of a incredibly short pulse that integrates to one:



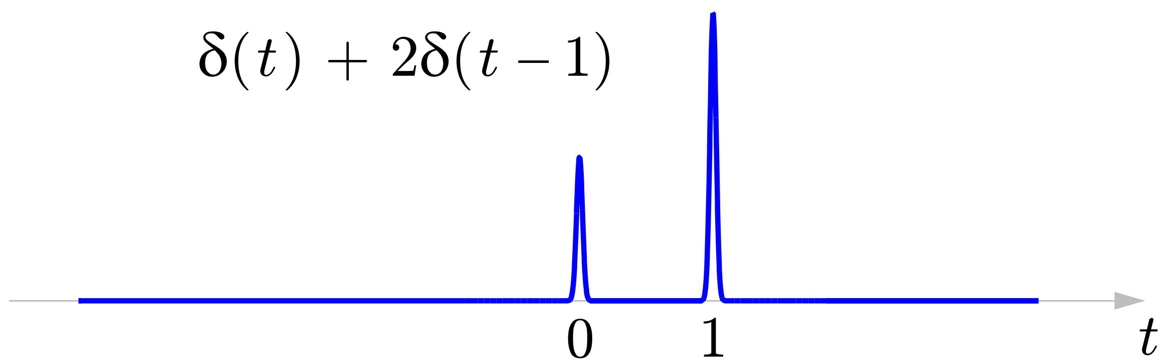


The Difference Between the Unit Step and the Dirac Impulse

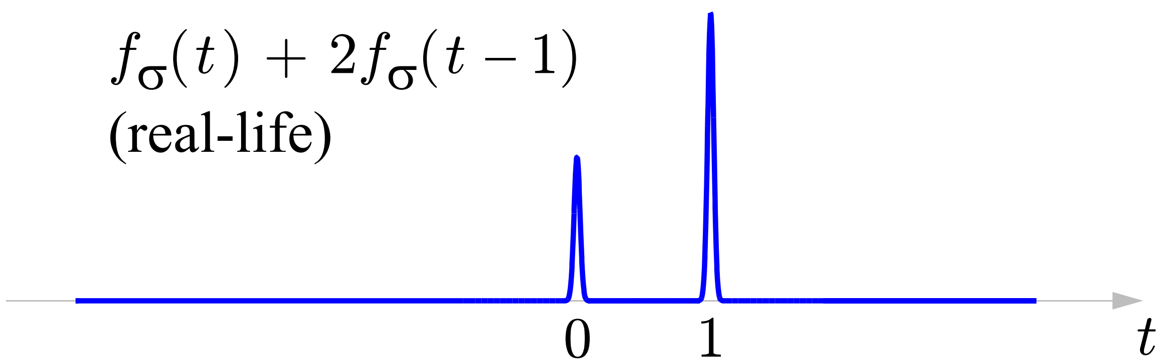




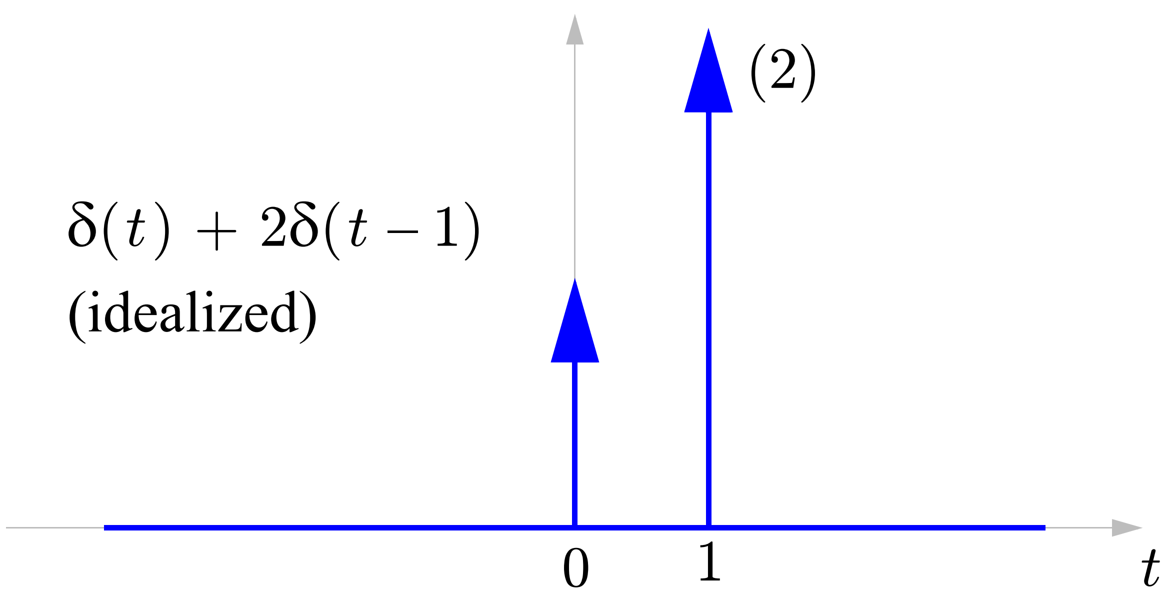
How to Plot



How to Plot



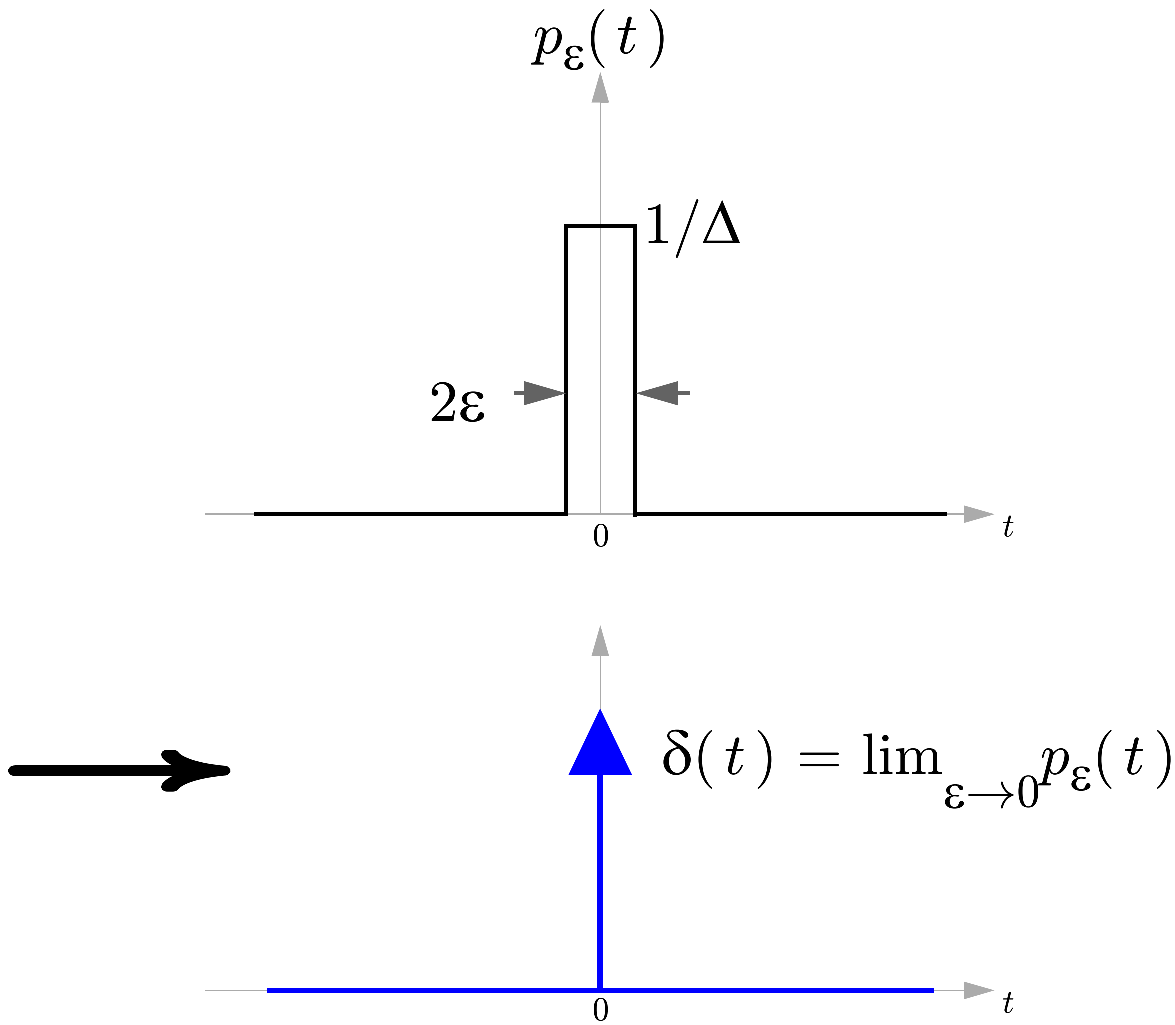
$f_\sigma(t) + 2f_\sigma(t-1)$
(real-life)
0
1
t



(2)
$\delta(t) + 2\delta(t-1)$
(idealized)
0
1
t

Another Limiting Functions

An idealization of a incredibly short rectanguar pulse that integrates to one:

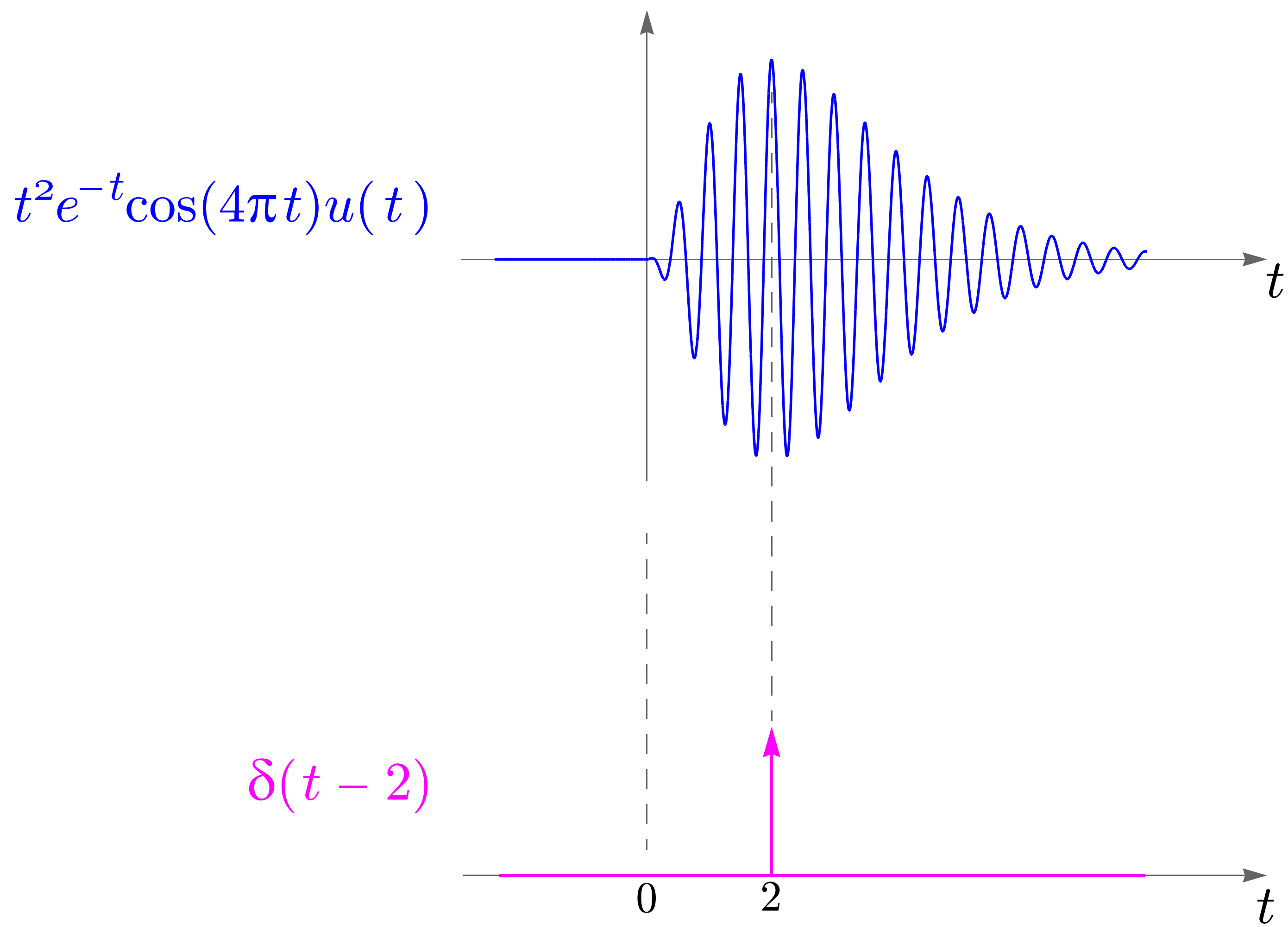


Properties of Dirac Delta "Function"

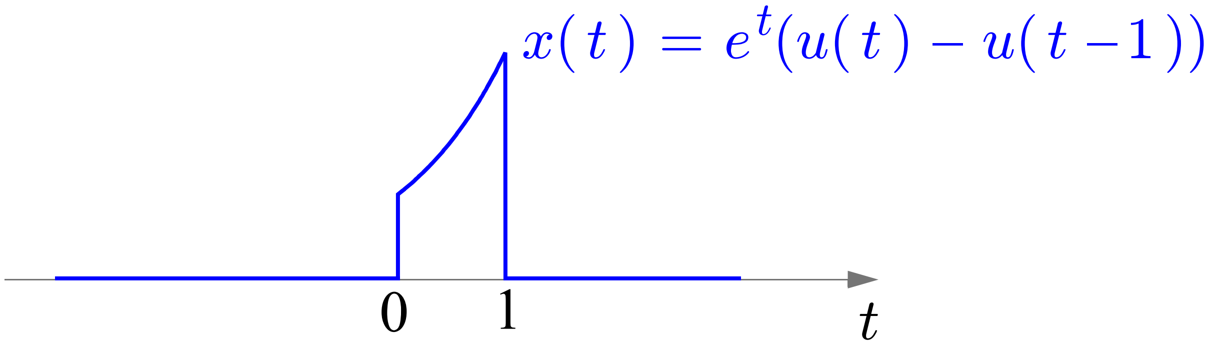
- zero for all $t \neq 0$, yet integrates to one: $\int_{-\infty}^{\infty} \delta(t)\mathrm{d}t = 1$
- Integrates to unit step: $$u(t) = \int_{-\infty}^{t} \delta(\tau)\mathrm{d}\tau$$
- derivative of unit step: $$\delta(t) = \frac{d}{dt}u(t)$$
- **Sampling** property:
  Multiplying *anything* by a delta function yields a *scaled* delta function:
  $$x(t)\delta(t - t_0) = x(t_0)\delta(t - t_0)$$
- **Sifting** property:
  $$\int_{-\infty}^{\infty} x(t)\delta(t - t_0)\mathrm{d}t = x(t_0)$$

Pop Quiz 1

Simplify the product $x(t) = t^2 e^{-t} \cos(4\pi t) u(t) \delta(t-2)$:



Pop Quiz 2



Find derivative $\frac{d}{dt}x(t) =$