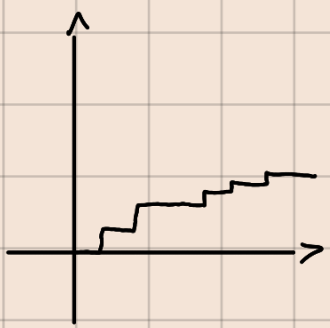
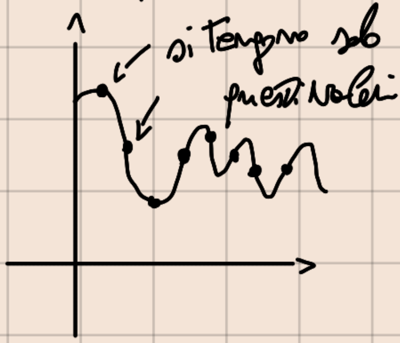
ESERCIZI

Codominio / Dominio	$\mathbb{Z}$	$\mathbb{R}$	$\mathbb{C}$
$\mathbb{Z}$	digitale	campionato	
$\mathbb{R}$	quantizzato	analogico	
$\mathbb{C}$			artificiali

quantizzato

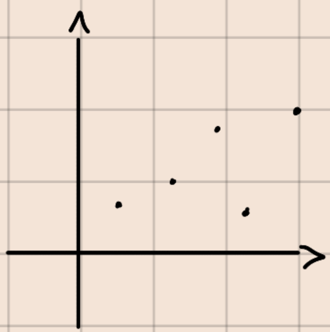


campionato



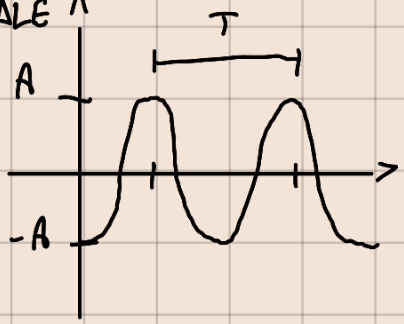
analogico

digitale



SEGNALI RIPASSO

SINUSOIDALE



$$v(t) = A\cos(\omega t + \phi)$$

$$\omega = \frac{2\pi}{T} = 2\pi f$$

$t - T$ segnale in ritardo

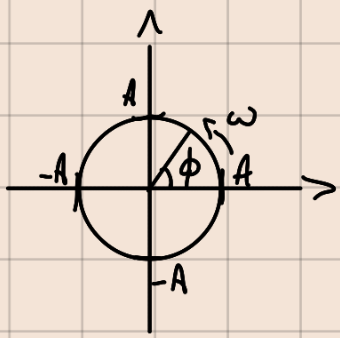
$t + T$ " in anticipo

$$\omega t + \phi \rightarrow \omega\left(t + \frac{\phi}{\omega}\right) \rightarrow$$

$$\rightarrow \omega\left(t - \underbrace{\left(-\frac{\phi}{\omega}\right)}_{t_0}\right)$$

FASORE

$$v(t) = Ae^{j(\omega t + \phi)}$$



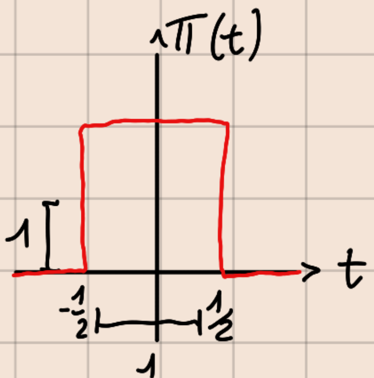
$$v(t) = A\cos(\omega t + \phi)$$

$$= A\left(\frac{e^{j(\omega t + \phi)} + e^{-j(\omega t + \phi)}}{2}\right)$$

$$= \frac{A}{2}e^{j(\omega t + \phi)} + \frac{A}{2}e^{-j(\omega t + \phi)}$$

BOX

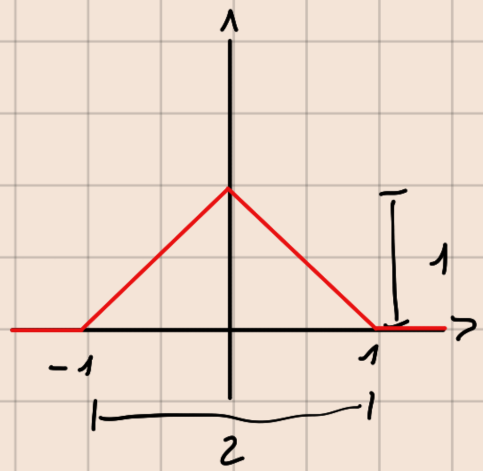
$$\Pi(t) = \begin{cases} 1 & -\frac{1}{2} < t < \frac{1}{2} \\ 0 & \text{altrimenti} \end{cases}$$



BASE 1

TRIANGOLO

$$\Lambda(t) = \begin{cases} 1-|t| & -1 \le t \le 1 \\ 0 & \text{altrimenti} \end{cases}$$

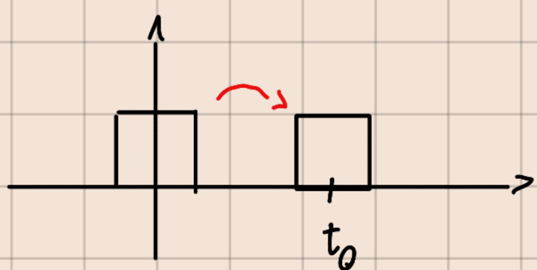


BASE 2

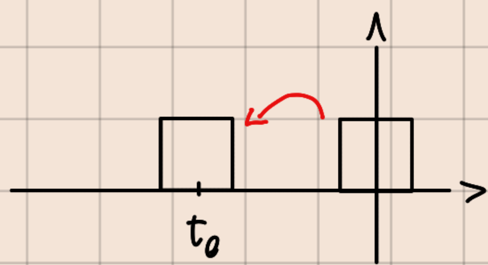
Operazioni con segnali

Time shifting

$\Pi(t-t_0)$

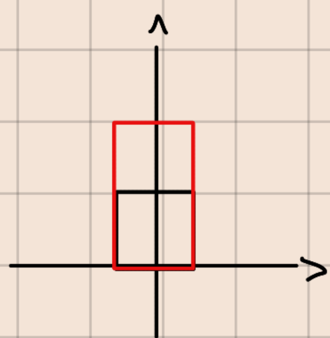


$\Pi(t+t_0)$



Amplificazione stretching rispetto asse y

$A\Pi(t)$

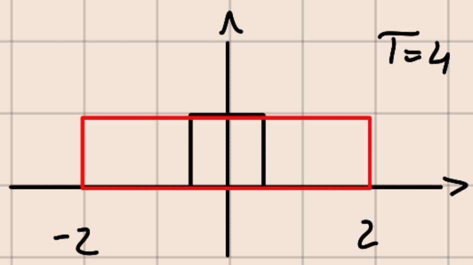


Rescaling

$\Pi\left(\frac{t}{T}\right)$

t/T segnale si allarga

$t \cdot T$ si stringe



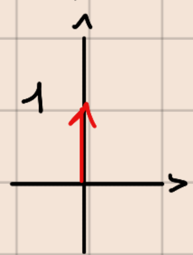
Ribaltamento

$s(t) =$

$s(-t) =$

Segnali polinomiali

Impulso (unitario)



$$\delta_0(t) = \begin{cases} 1 & \text{se } t=0 \\ 0 & \text{altrimenti} \end{cases}$$

ordine di derivata, se integro ottengo un gradino e via di lì

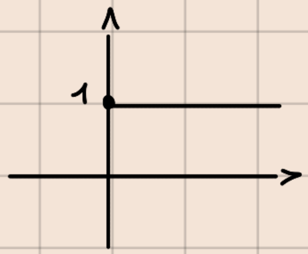
Proprietà

Parità $\delta(-t) = \delta(t)$

Campionamento $v(t)\delta(t-t_0) = v(t_0)$ campioniamo

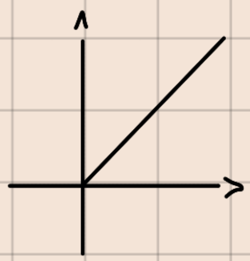
Riproducibilità $v(t) = \int_{-\infty}^{+\infty} v(\tau)\delta(t-\tau)\,d\tau = (v * \delta)(t)$

GRADINO serve a troncare i segnali



$$\delta_{-1}(t) = \begin{cases} 1 & t \geq 0 \\ 0 & \text{altrimenti} \end{cases}$$

RAMPA



$$\delta_{-2} = \begin{cases} t & \text{se } t \geq 0 \\ 0 & \text{altrimenti} \end{cases}$$

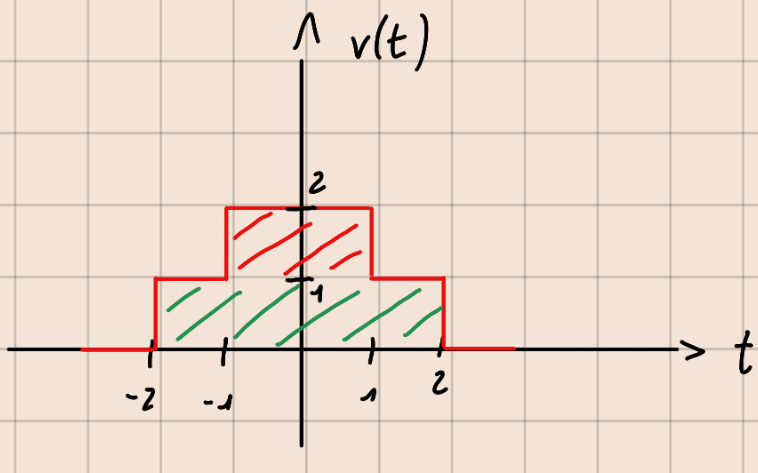
S. POLINOMIALE def. generica

$$\delta_{-n}(t) = \begin{cases} \dfrac{t^{n-1}}{(n-1)!} & \text{se } t \geq 0 \\ 0 & \text{altrimenti} \end{cases}$$

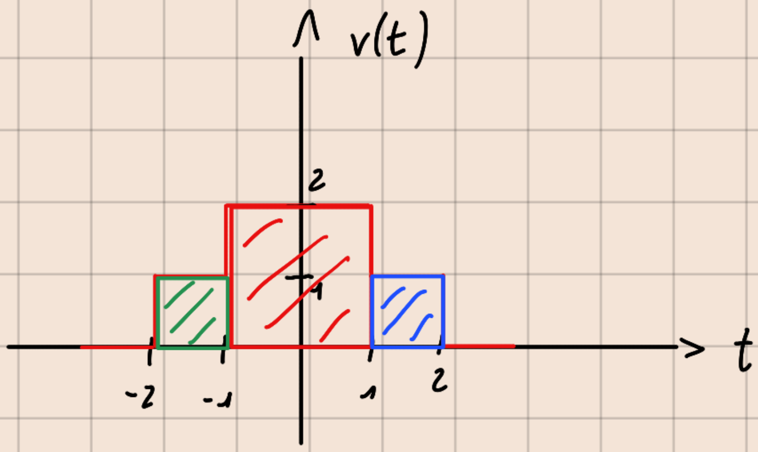
MANIPOLAZIONE DEI SEGNALI

1 Disegnarlo e poi descriverlo con le funzioni base

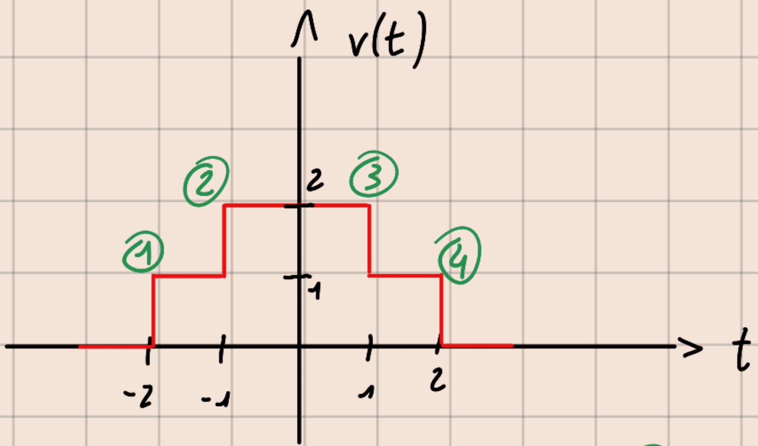
$$v(t) = \begin{cases} 1 & \text{se } -2 \leq t < -1 \\ 2 & \text{se } -1 \leq t < 1 \\ 1 & \text{se } 1 \leq t \leq 2 \\ 0 & \text{altrimenti} \end{cases}$$



$$v(t) = \Pi\left(\frac{t}{4}\right) + \Pi\left(\frac{t}{2}\right)$$



$$v(t) = \Pi\left(t+\frac{3}{2}\right) + 2\Pi\left(\frac{t}{2}\right) + \Pi\left(t-\frac{3}{2}\right)$$



$$v(t) = \overset{1}{\delta_{-1}(t+2)} + \overset{2}{\delta_{-1}(t+1)} - \overset{3}{\delta_{-1}(t-1)} - \overset{4}{\delta_{-1}(t-2)}$$

2

$$v(t) = \begin{cases} |t| & \text{se } -1 \le t \le 1 \\ 0 & \text{altrimenti} \end{cases}$$

$$v(t) = \Pi\left(\tfrac{t}{2}\right) - \Lambda(t)$$

CONVOLUZIONE

Propr. commutativa

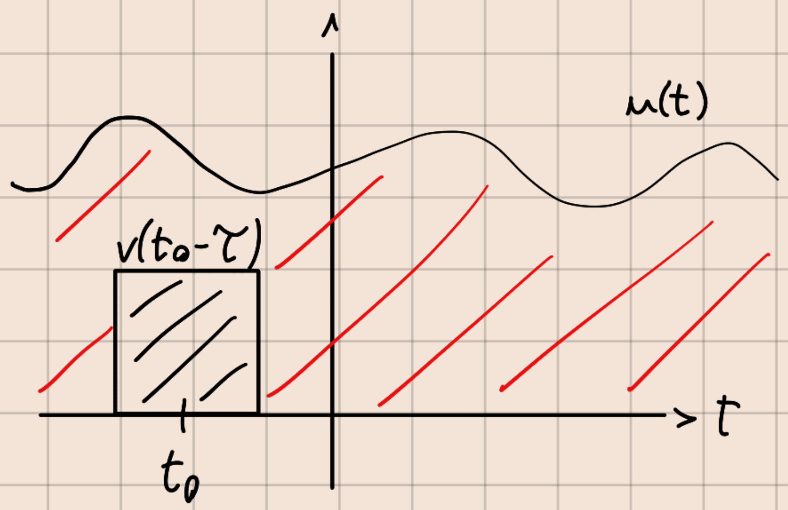
$$(u(t) * v(t))(t) = \int_{-\infty}^{+\infty} u(\tau)\, v(t-\tau)\, d\tau = \int_{-\infty}^{+\infty} v(\tau)\, u(t-\tau) = (v * u)(t)$$

Associativa $\quad f * (g * h) = (f * g) * h$

distributiva $\quad f * (g + h) = f * g + f * h$

lineare $\quad \alpha (f * g) = (\alpha f * g) = (f * \alpha g)$

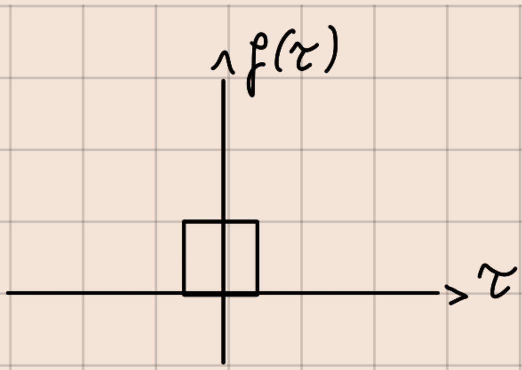
differenziazione $\quad \frac{d}{dt}(f * g) = \left(\frac{df}{dt} * g\right) = \left(f * \frac{dg}{dt}\right)$

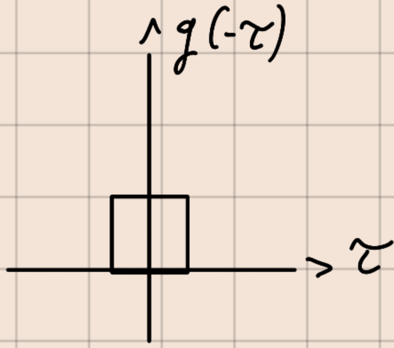


$v_f(t) = (h * u)(t)$

Come calcolare

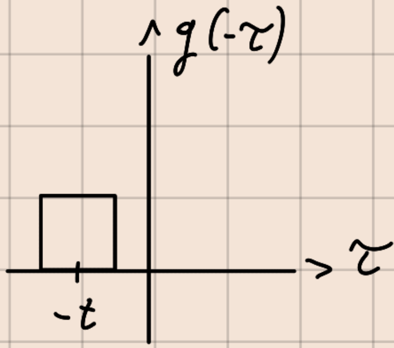
1. Scegli segnale più "semplice"
2. specchiamo il segnale $\quad v(\tau) \Rightarrow v(-\tau)$
3. shiftiamo il segnale
4. scorriamo $\forall t$

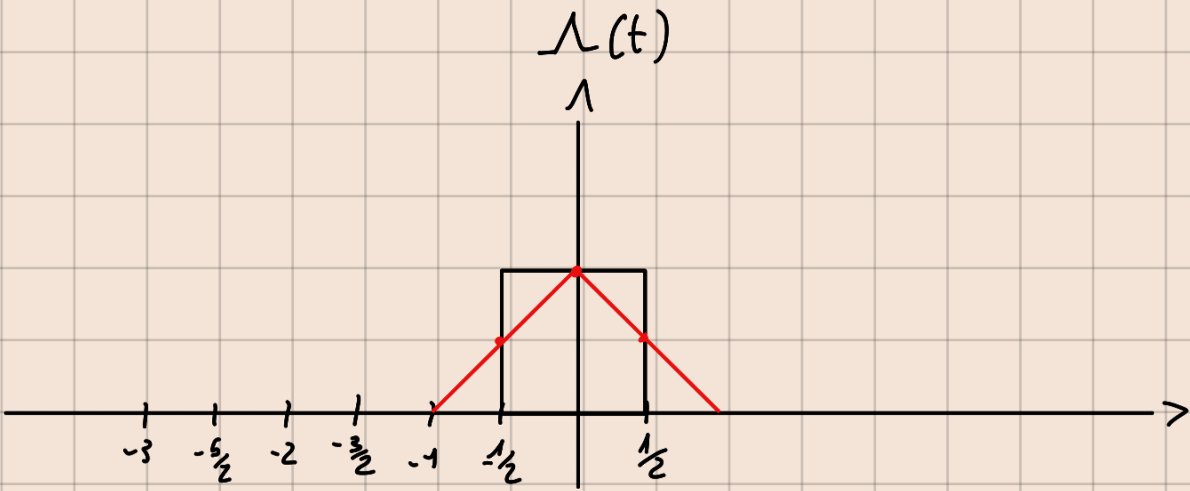




$$v(t) = (\Pi * \Pi)(t) = \int_{-\infty}^{+\infty} \Pi(\tau)\,\Pi(t-\tau)\,d\tau$$

②





④ $v(t=-2) = 0$

$v(t=-1) = 0$

- $v(t=-\frac{1}{2}) = \frac{1}{2}$
- $v(t=0) = 1$
- $v(t=\frac{1}{2}) = \frac{1}{2}$