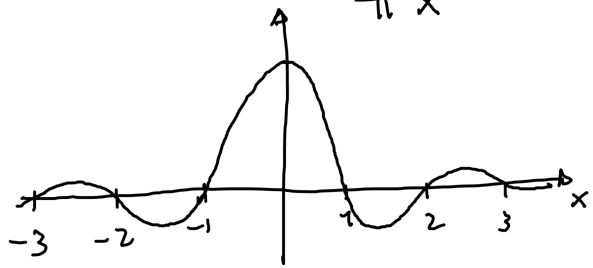
$$R_n = \frac{2AT_0}{(2\pi n)^2 \tau}\left(1 - \cos\frac{2\pi n\tau}{T_0}\right)$$

$$\cos 2\alpha = 1 - 2\sin^2\alpha$$

$$R_n = \frac{\cancel{2}AT_0}{(\cancel{2}\pi n)^2 \tau}\,\cancel{2}\sin^2\frac{\pi n\tau}{T_0}$$

$$\mathrm{sinc}(x) \triangleq \frac{\sin(\pi x)}{\pi x}$$



$$R_n = \frac{A\tau}{T_0}\,\frac{1}{\left(\frac{\pi n\tau}{T_0}\right)^2}\sin^2\left(\frac{\pi n\tau}{T_0}\right) =$$

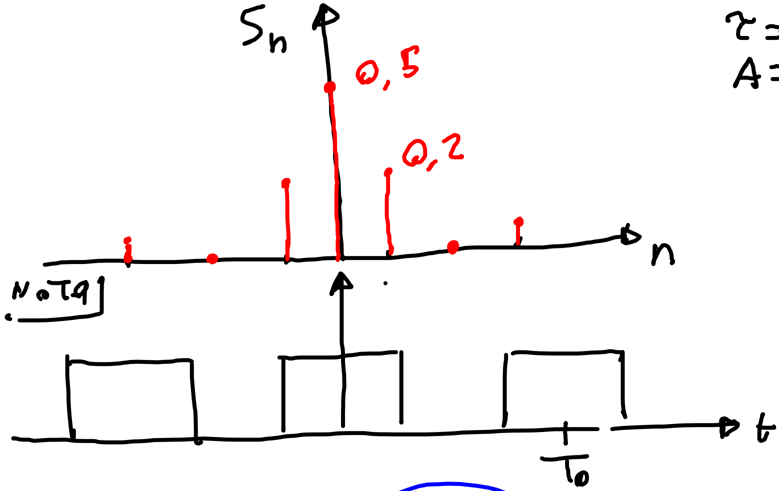
$$= \frac{A\tau}{T_0}\,\mathrm{sinc}^2\left(\frac{n\tau}{T_0}\right) \qquad n \neq 0$$

$$n = 0 \qquad S_n = \frac{2}{T_0}\int_0^{T_0/2} s(t)\cos\frac{2\pi nt}{T_0}\,dt =$$

$$n = 0 \qquad S_0 = \frac{2}{T_0}\int_0^{T_0/2} s(t)\,dt = \frac{A\tau}{T_0}$$

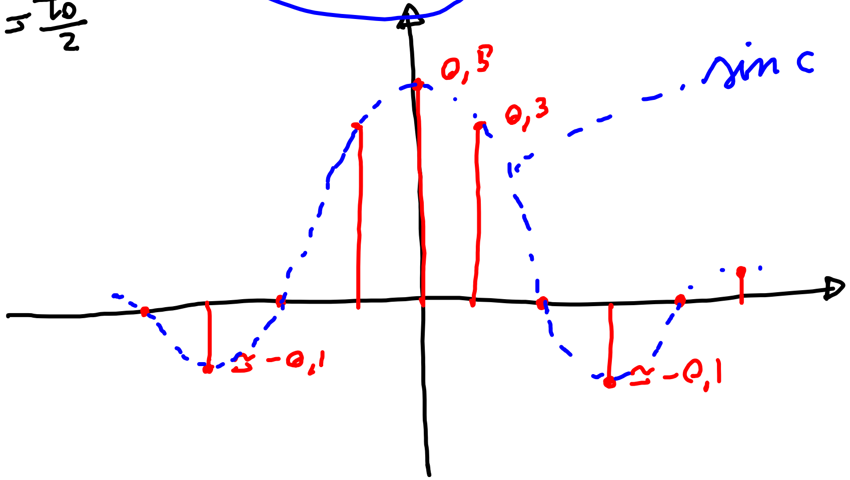
$\tau = T_0/2$

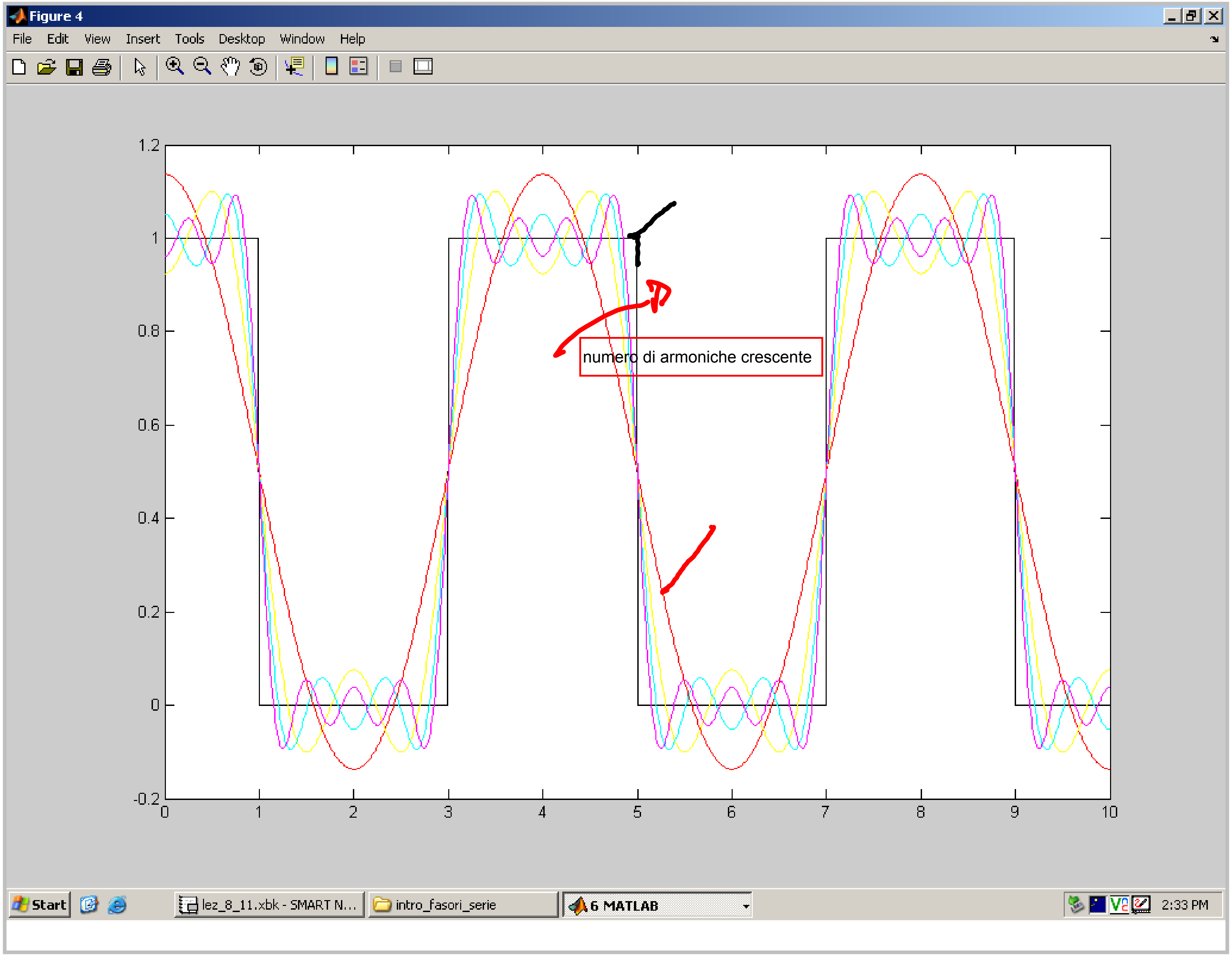
$A = 1$



$$S_n = \frac{A\tau}{T_0}\,\frac{\sin\frac{\pi n \tau}{T_0}}{\pi \frac{n\tau}{T_0}} = \frac{A\tau}{T_0}\,\mathrm{sinc}\left(n\frac{\tau}{T_0}\right)$$

$\tau = \frac{T_0}{2}$





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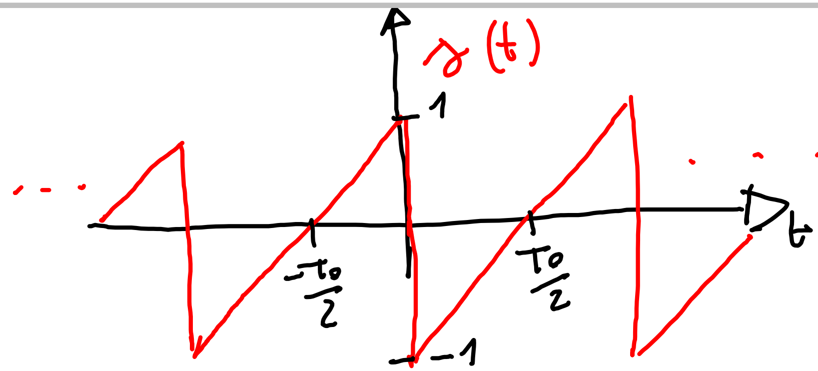


$$s(t) = -s(-t)$$

$$S_n = -S_{-n}$$ se è anche reale $(S_n = S_{-n}^*)$

$$R_n = 0 \quad \forall n$$

$$I_n = -\frac{1}{T_0}\int_{t_0}^{t_0+T_0} s(t) \sin\frac{2\pi n t}{T_0}\, dt =$$

$$= -\frac{1}{T_0}\int_{-T_0/2}^{T_0/2} s(t) \sin\frac{2\pi n t}{T_0}\, dt =$$

$$= -\frac{2}{T_0}\int_{0}^{T_0/2} s(t) \sin\frac{2\pi n t}{T_0}\, dt$$

$$I_0 = 0$$

$s(t) \quad t \in [0, T_0/_2] \quad s(t) = a + b\,t$

$$\begin{cases} s(0) = -1 = a \\ s\left(\frac{T_0}{2}\right) = 0 = a + b\,T_0/_2 \end{cases} \qquad a = -1 \quad b = \frac{2}{T_0}$$

$$s(t),\ t \in [0, T_0/_2] = \frac{2}{T_0}t - 1$$

$$s(t) = -\frac{2}{T_0}\int_0^{T_0/2}\left(\frac{2t}{T_0} - 1\right)\sin\left(2\pi\frac{nt}{T_0}\right)dt =$$

$$= -\frac{2}{T_0}\int_0^{T_0/2}\frac{2t}{T_0}\sin\left(\frac{2\pi nt}{T_0}\right)dt + \frac{2}{T_0}\int_0^{T_0/2}\sin\frac{2\pi nt}{T_0}\,dt =$$

$$= -\frac{2}{T_0}\int_0^{T_0/2}\frac{2t}{T_0}\left(\frac{-1}{\frac{2\pi n}{T_0}}D\left(\cos\frac{2\pi nt}{T_0}\right)\right)dt +$$

$$+\frac{\cancel{2}}{\cancel{T_0}}\,\frac{\cancel{T_0}}{\cancel{2}\pi n}\left(-\cos\frac{2\pi nt}{T_0}\right)\Bigg|_0^{T_0/2} =$$

$$= -\frac{2}{T_0}\left[\frac{2t}{T_0}\left(-\frac{T_0}{2\pi n}\right)\cos\frac{2\pi nt}{T_0}\Bigg|_0^{T_0/2} + \right.$$

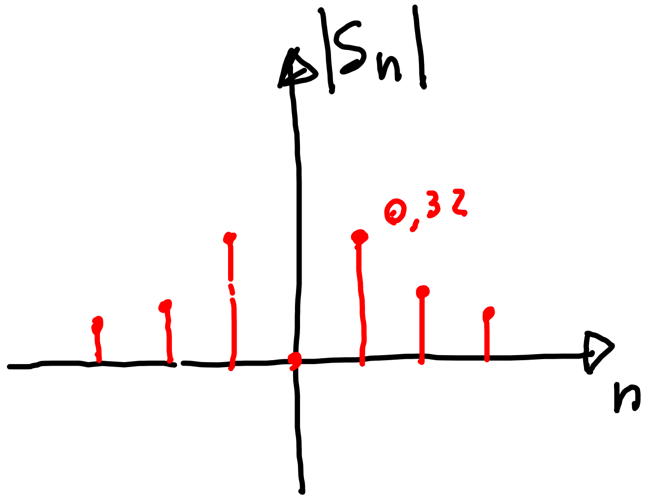
$$\left.\frac{T_0}{2\pi n}\int_0^{T_0/2}\frac{2}{T_0}\cos\frac{2\pi nt}{T_0}\,dt\right] + \frac{1}{\pi n}(1 - \cos\pi n) =$$

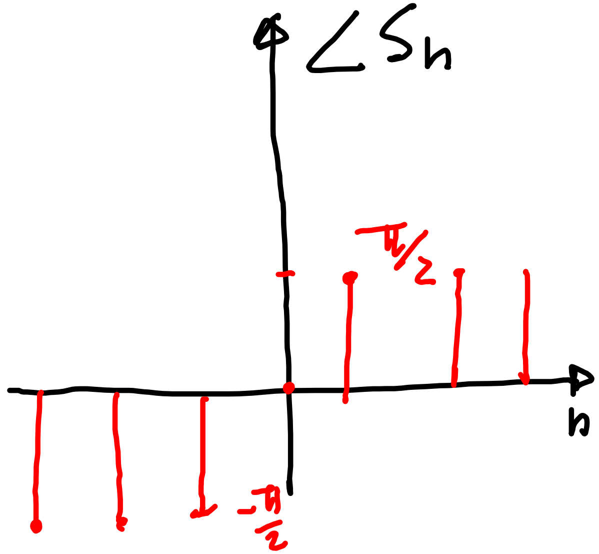
$$= -\frac{\cancel{2}}{\cancel{T_0}}\left[-\frac{\cancel{T_0}}{\cancel{2}\pi n}\cos\pi n + \cancel{\frac{T_0}{2\pi n}\frac{2}{T_0}\frac{T_0}{2\pi n}\sin\pi n}\right]+$$

$$+\frac{1}{\pi n}(1-\cos\pi n) =$$

$$= \cancel{\frac{1}{\pi n}\cos\pi n} + \frac{1}{\pi n} - \cancel{\frac{1}{\pi n}\cos\pi n}$$

$$I_n = \frac{1}{\pi n} \Rightarrow S_n = j\frac{1}{\pi n}$$





$\delta(t)$ delta di Dirac

$$\int_{-\infty}^{\infty} f(t)\,\delta(t-t_0)\,dt = f(t_0)$$

"funzione campionatrice"

$$\int_{-\infty}^{\infty} f(t)\,\delta(t_0-t)\,dt = f(t_0)$$

<u>es.</u> $f(t) = A\,\mathrm{rect}\left(\frac{t-t_0}{2\varepsilon}\right)$

$$\int_{-\infty}^{\infty} A\,\mathrm{rect}\left(\frac{t-t_0}{2\varepsilon}\right)\delta(t-t_0)\,dt = A$$

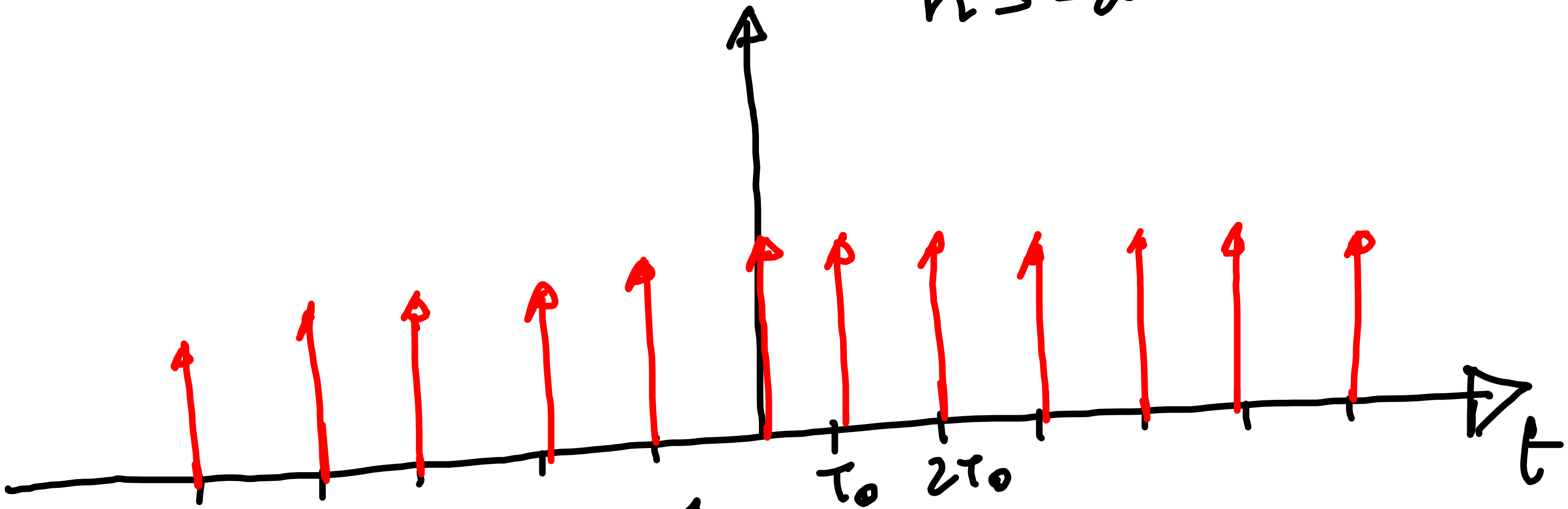
$$\int_{-\infty}^{t} \delta(\tau)\,d\tau = \begin{cases} t<\tau = 0 \\ t \geq \tau = 1 \end{cases} \Rightarrow u(t)$$

$$\delta(t) = \frac{d\,u(t)}{dt} \quad !$$

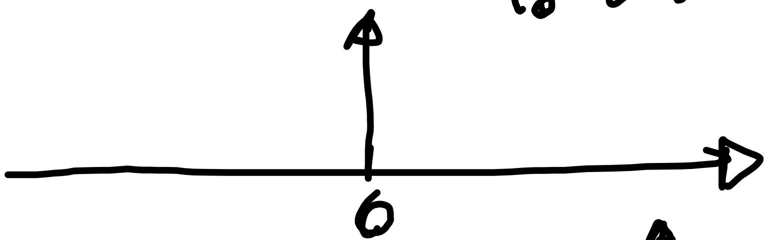
è vero nel limite del gradino reale

$\Rightarrow$ gradino ideale

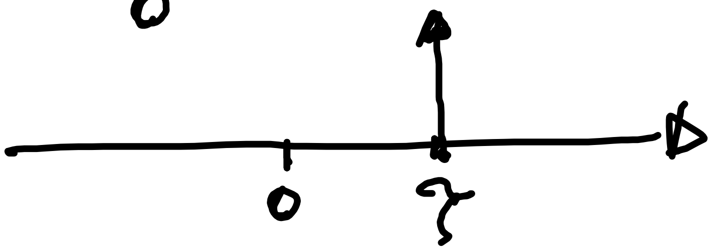
$$x(t) = rep_{T_0}\,\delta(t) = \sum_{n=-\infty}^{+\infty} \delta(t - nT_0)$$

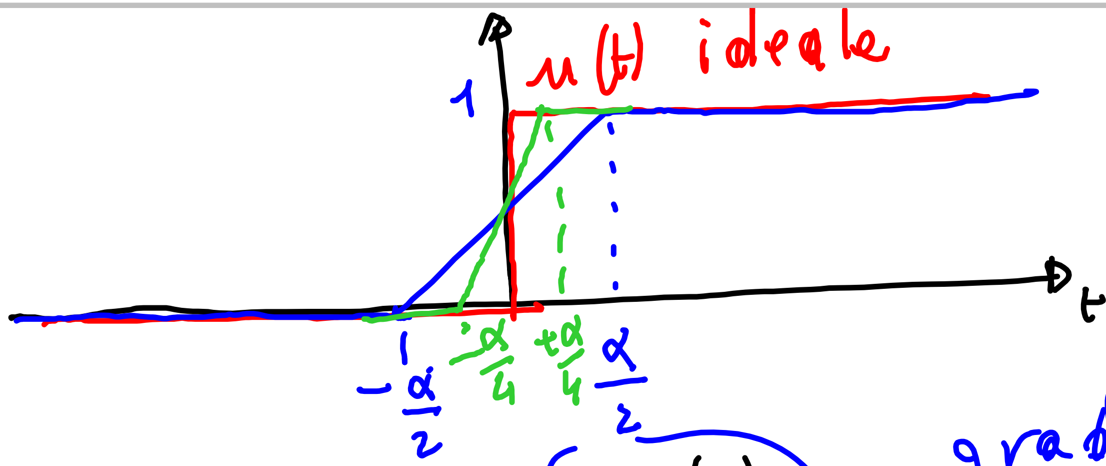


$\rightarrow \delta(t)$



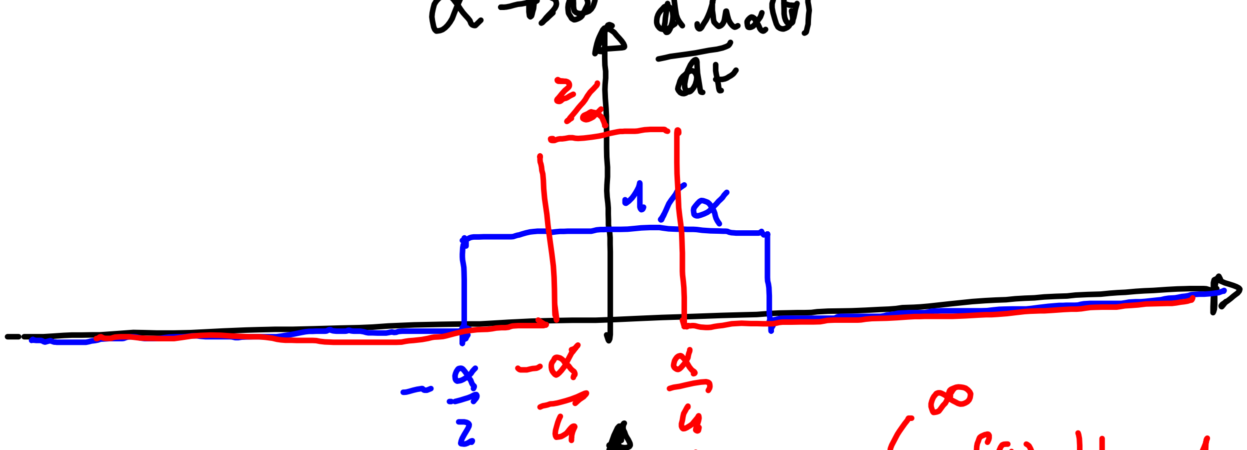
$\delta(t-\tau)$

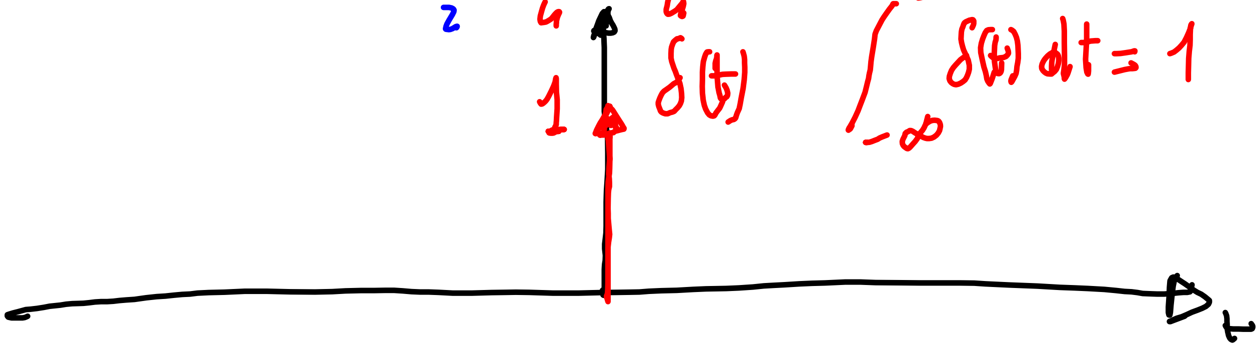




$$u(t) = \lim_{\alpha \to 0} u_\alpha(t)$$

gradino reale





$$\int_{-\infty}^{\infty} \delta(t)\, dt = 1$$