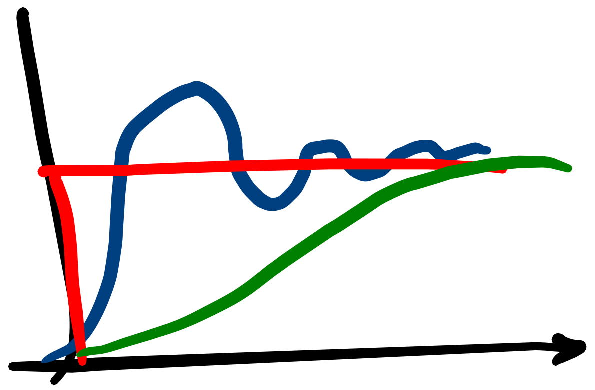
Minicurso Sistemas Lineares



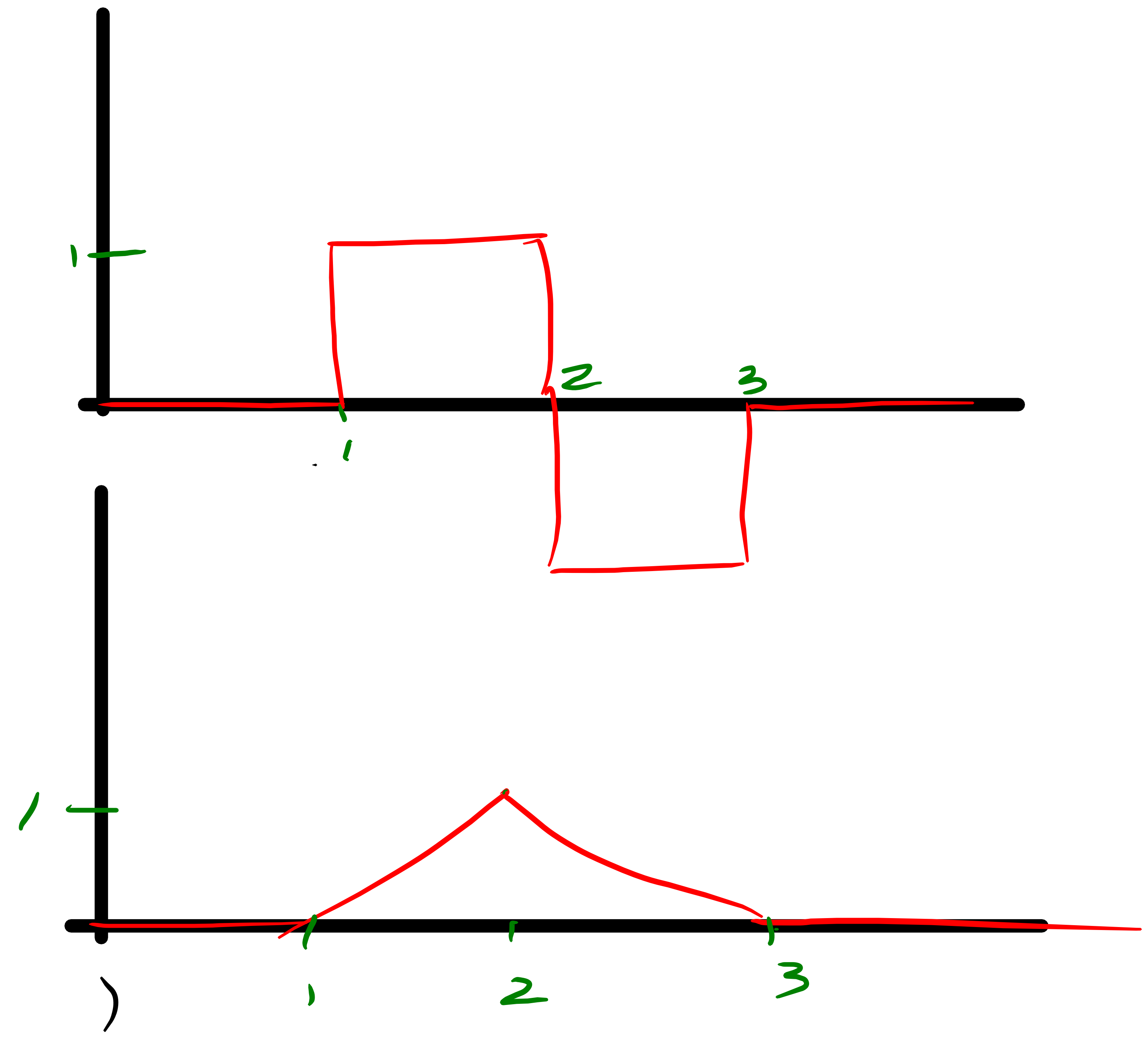
Aula 2

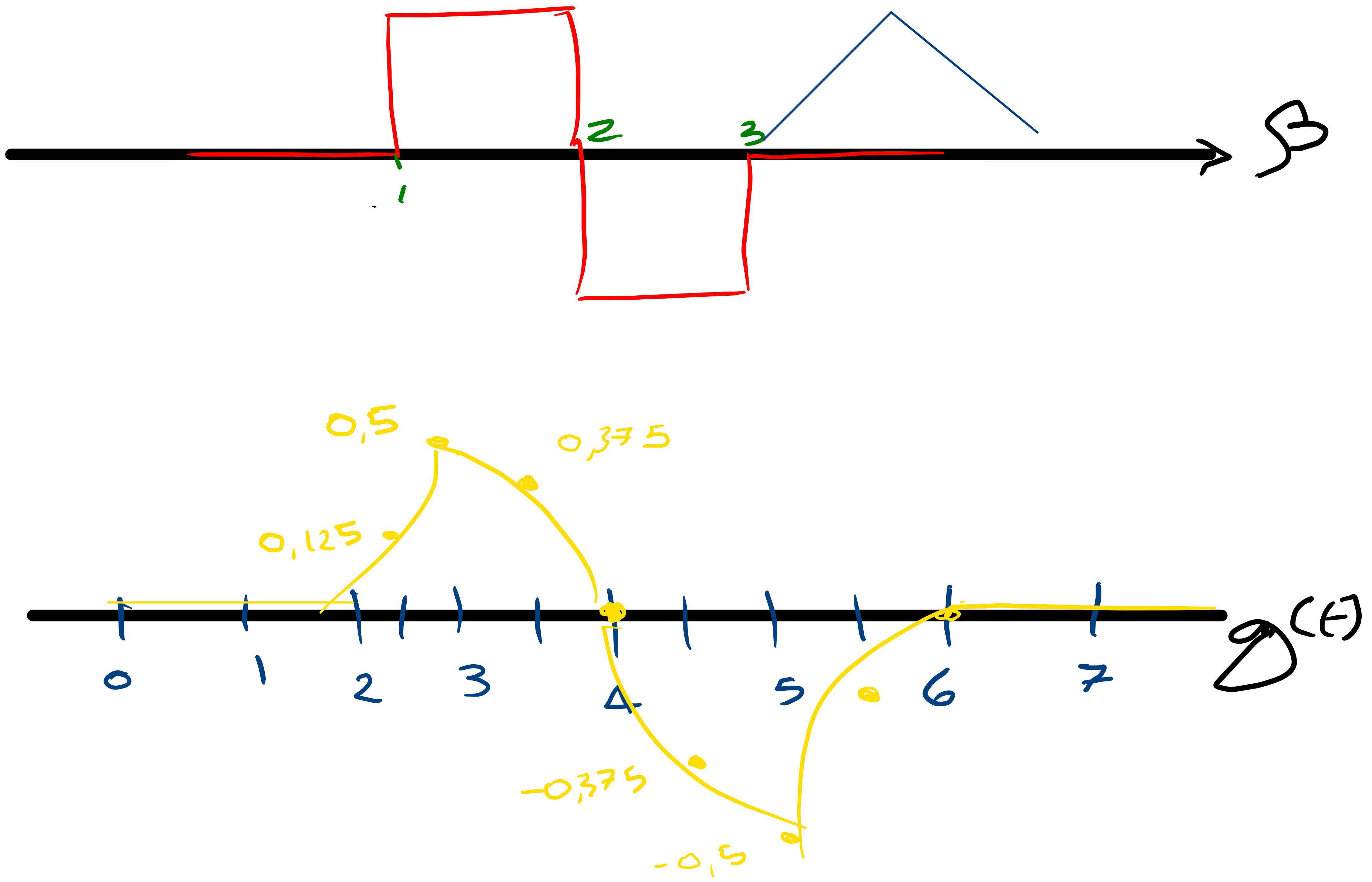
CAEEL

Lucas Zischler

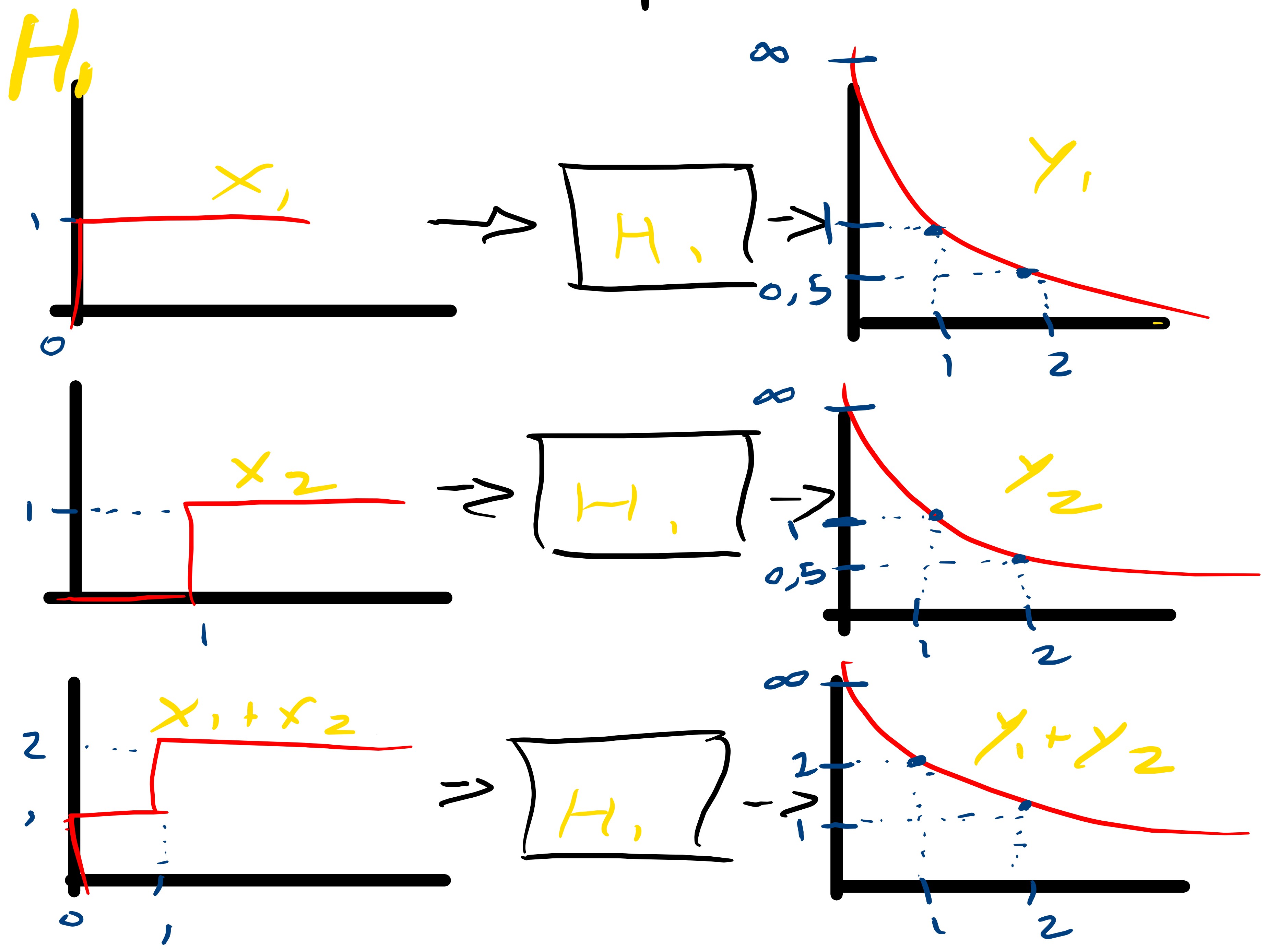
Exercícios :

1. Realize a Convolução





2 Classifique os Sistemas

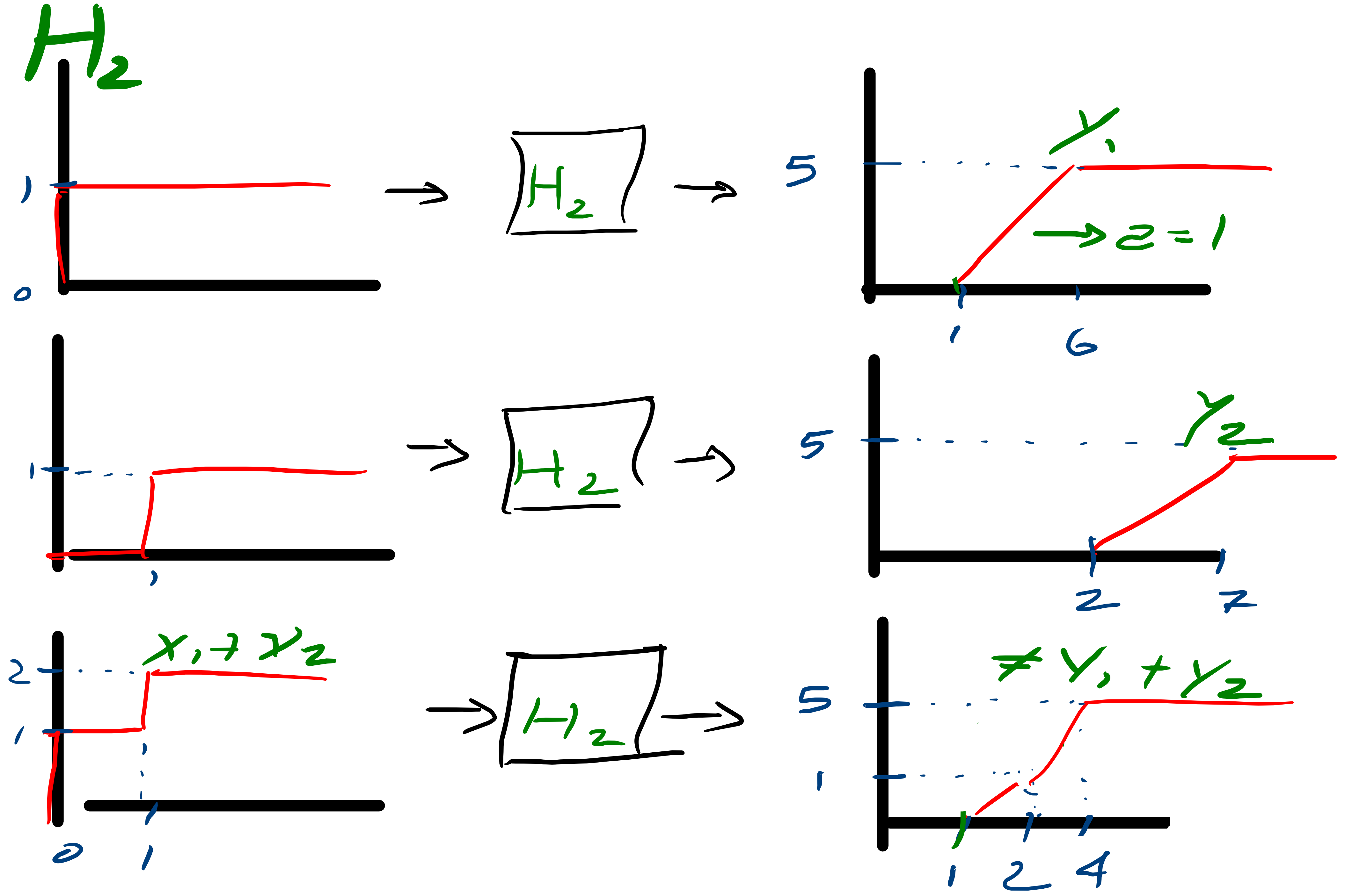


BIBO instável

não causal

linear

2 Classifique os Sistemas



BIBO estável

causal

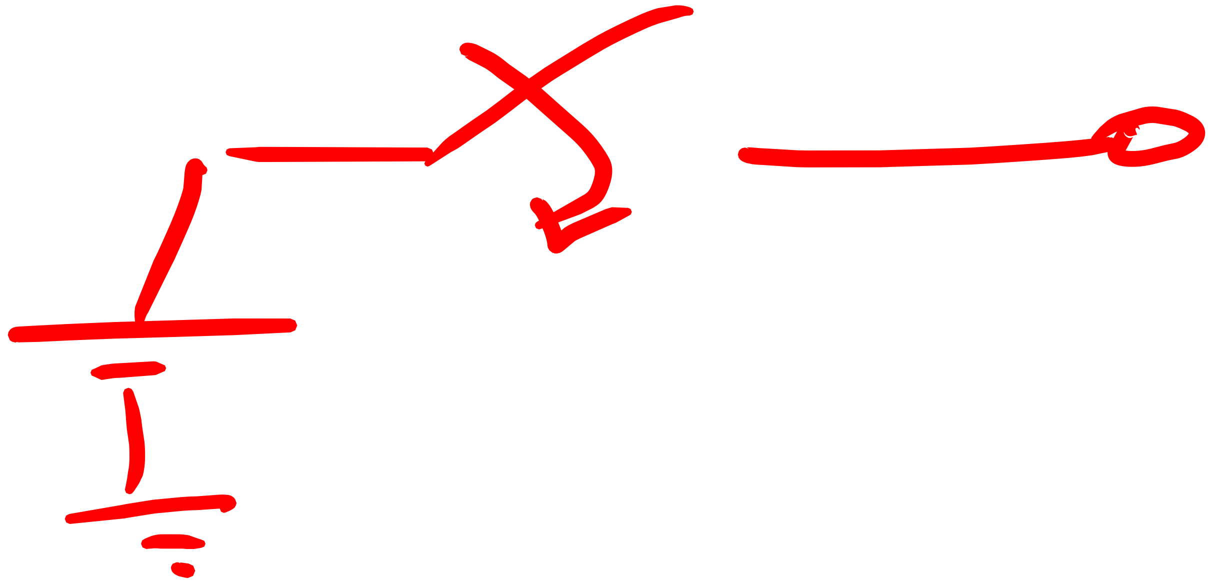
Não linear

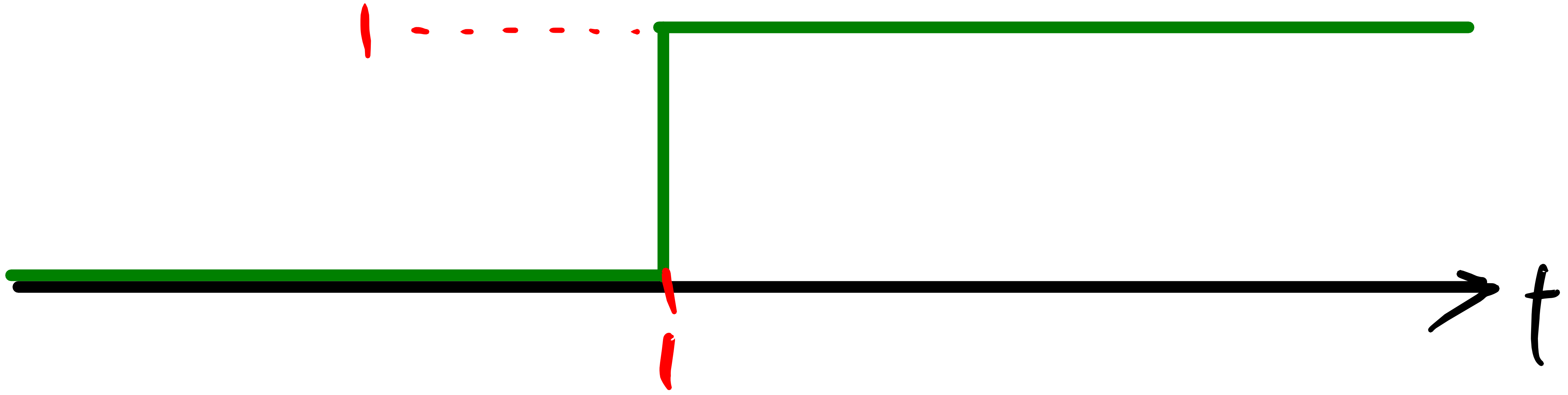
SINAIS COMUNS

Degrau

"Heaviside"

$u(t-1)$



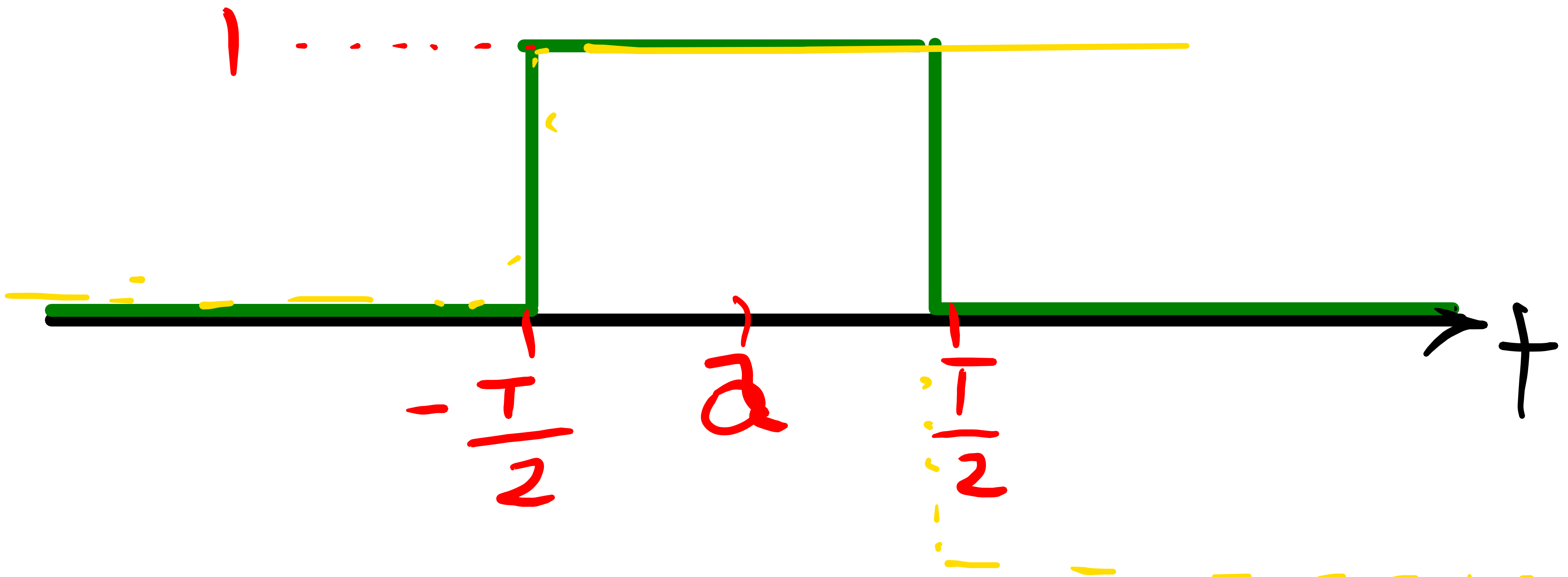


SINAIS COMUNS

Gate

$$G_T(t-a)$$

$$G_T(t) = u\left(t+\frac{T}{2}\right) - u\left(t-\frac{T}{2}\right)$$

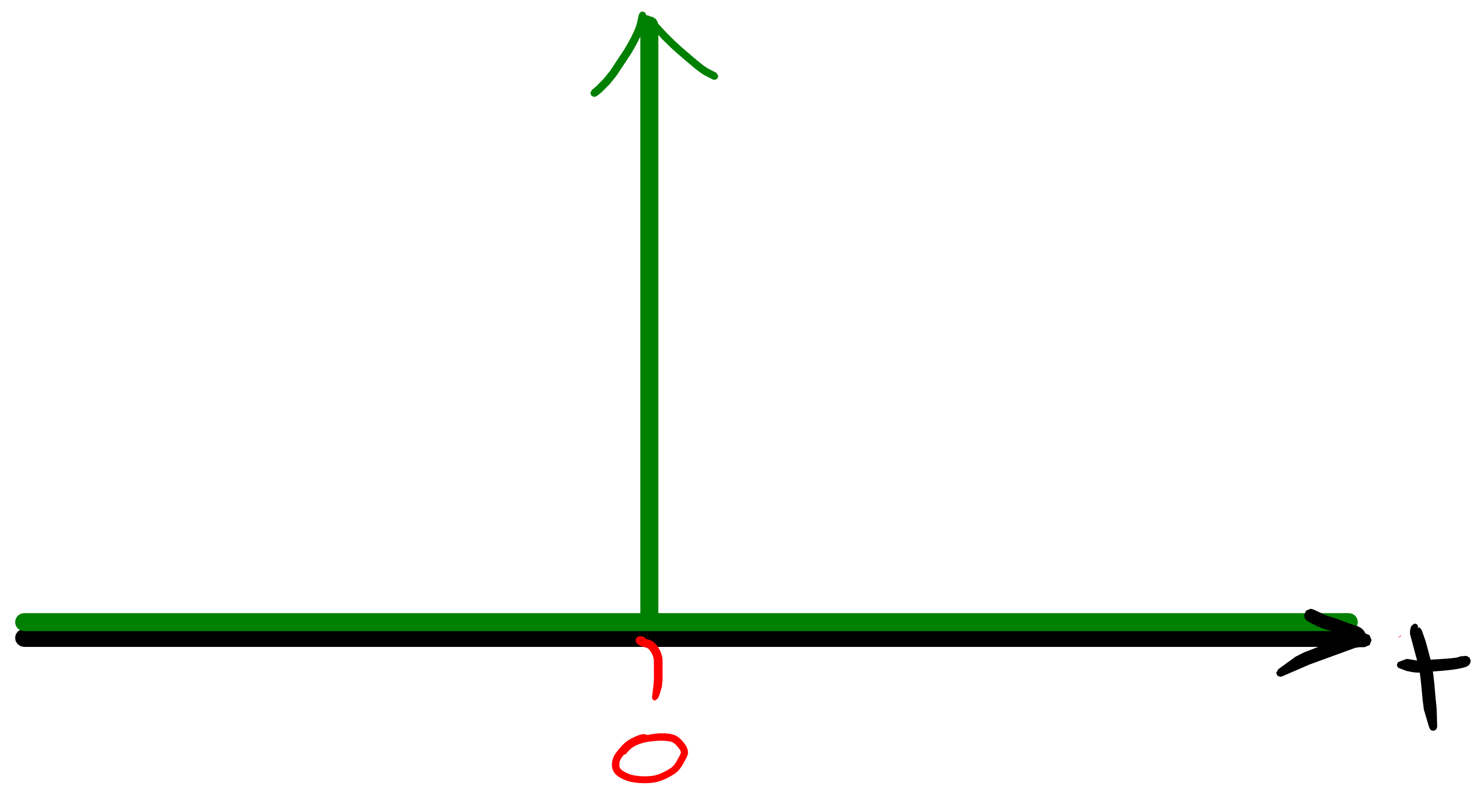


SINAIS COMUNS

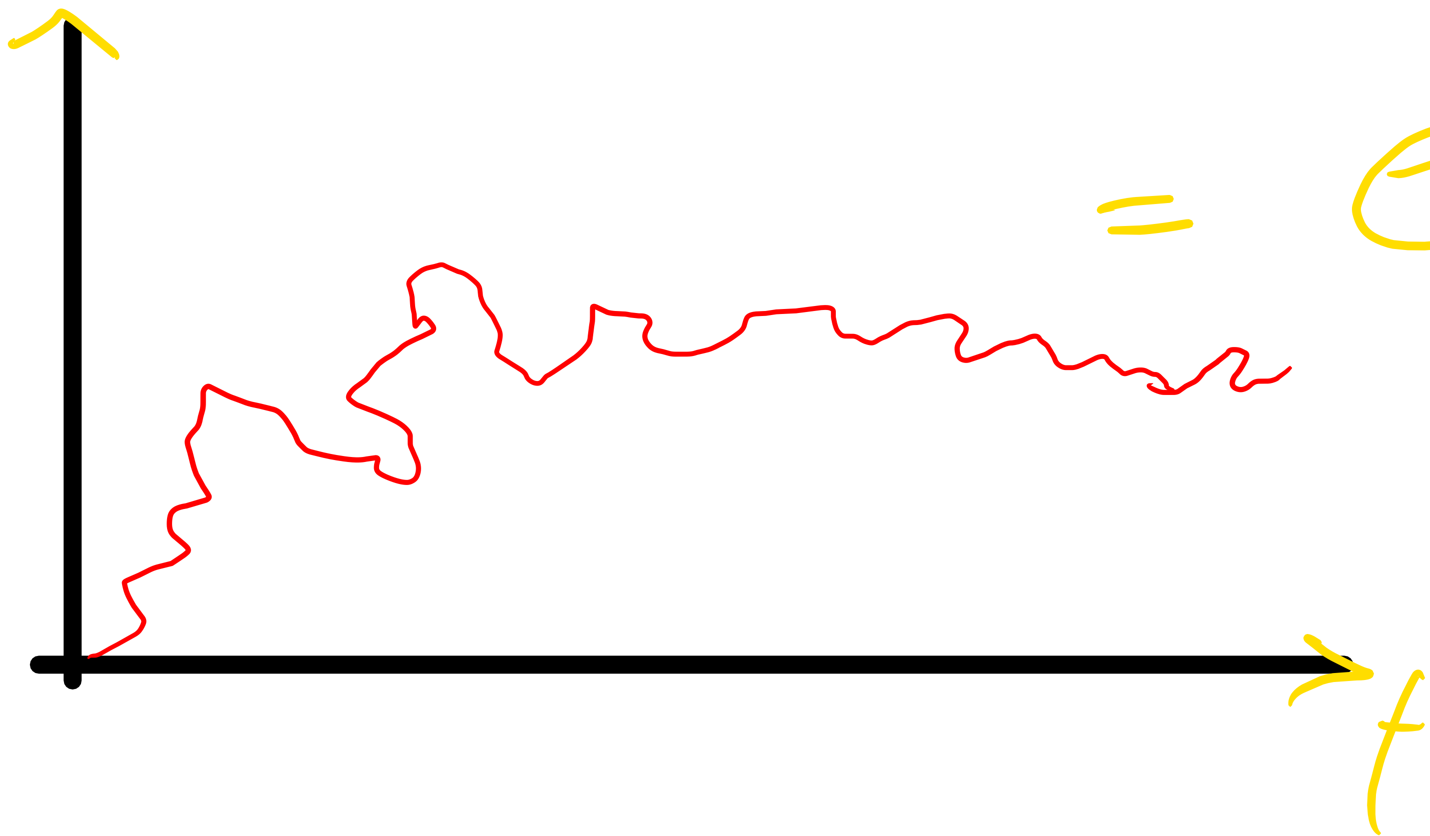
Impulso

$\delta(t)$

"Delta de Dirac"



Transformada de Laplace



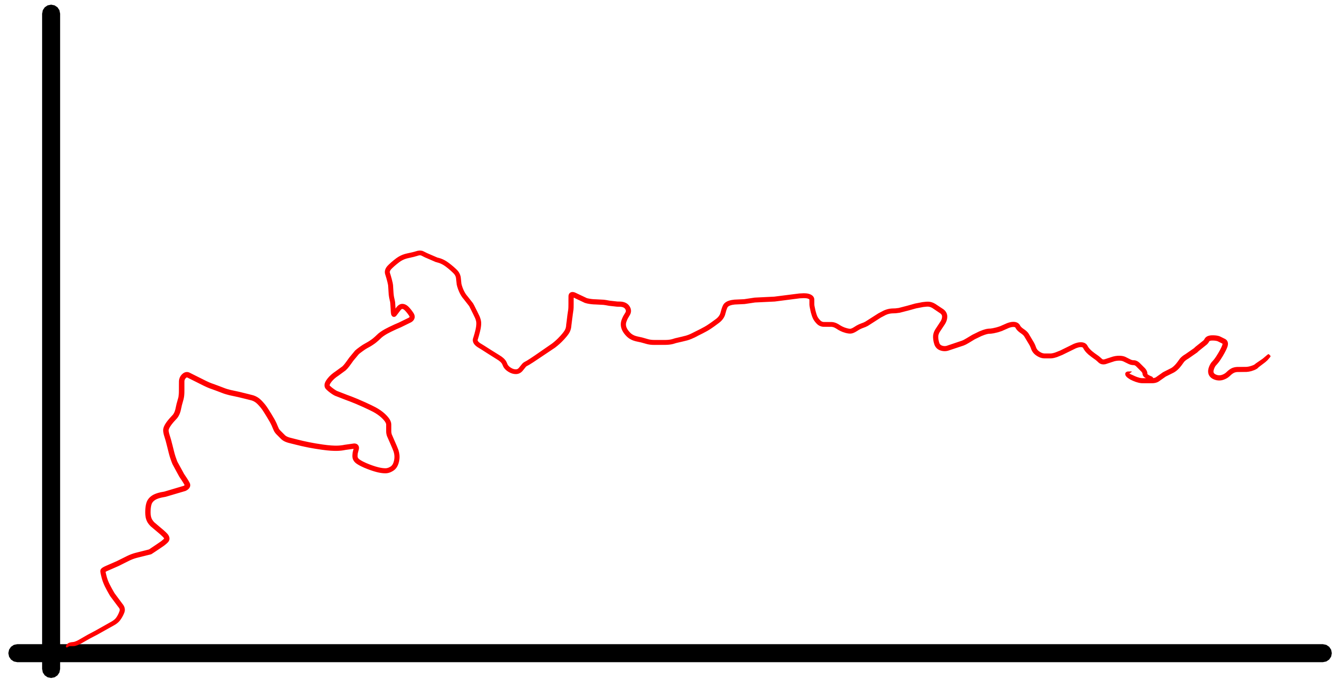
$$= e^{At} + e^{Bt} + e^{Ct} + e^{Dt}$$

$$A + B + C + D$$

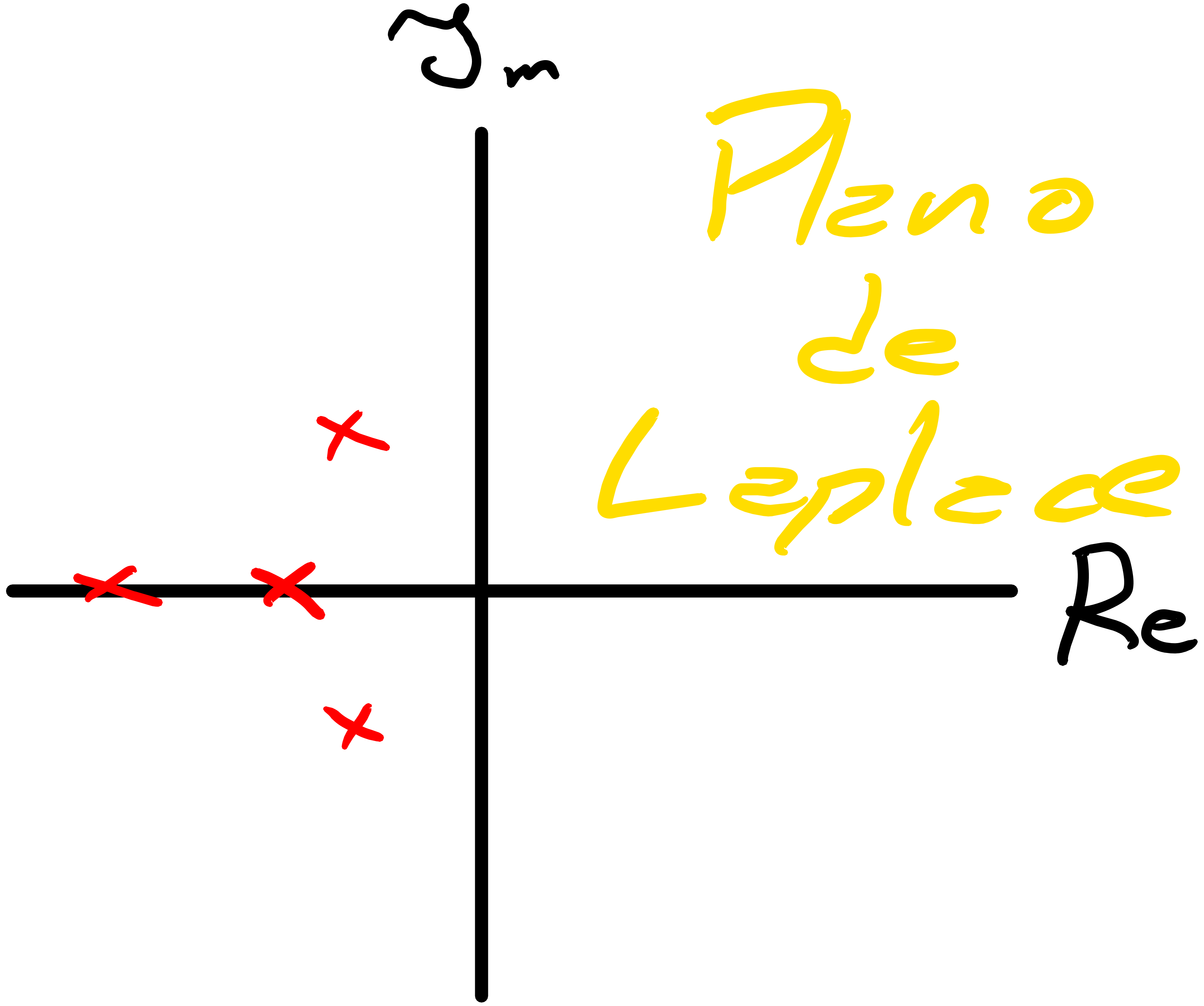
$$\mathcal{L}\{f(t)\} = \int_{-\infty}^{\infty} f(t)\, e^{-st}\, dt = F(s)$$

$$s = \sigma + j\omega$$

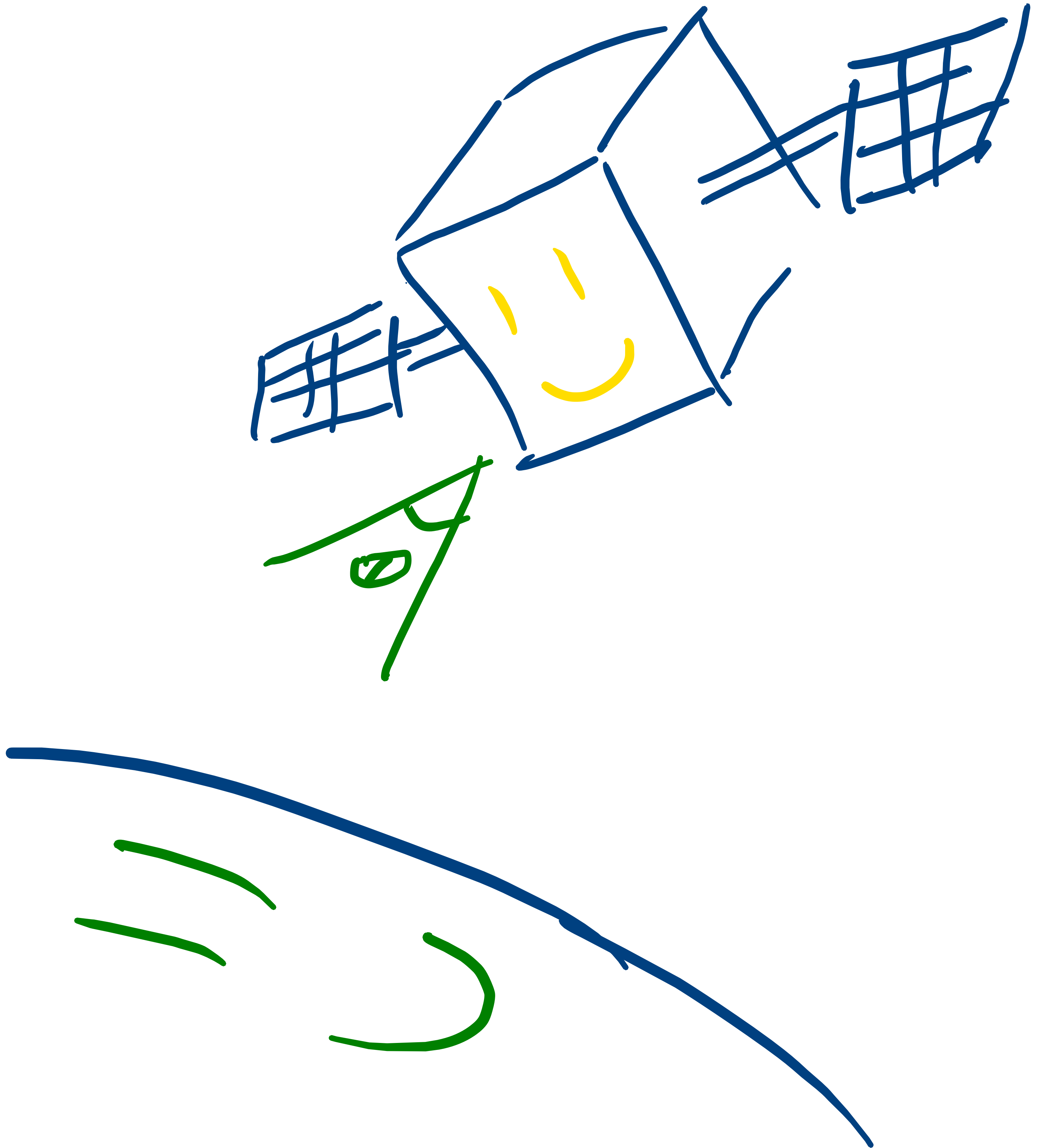
Transformada de Laplace

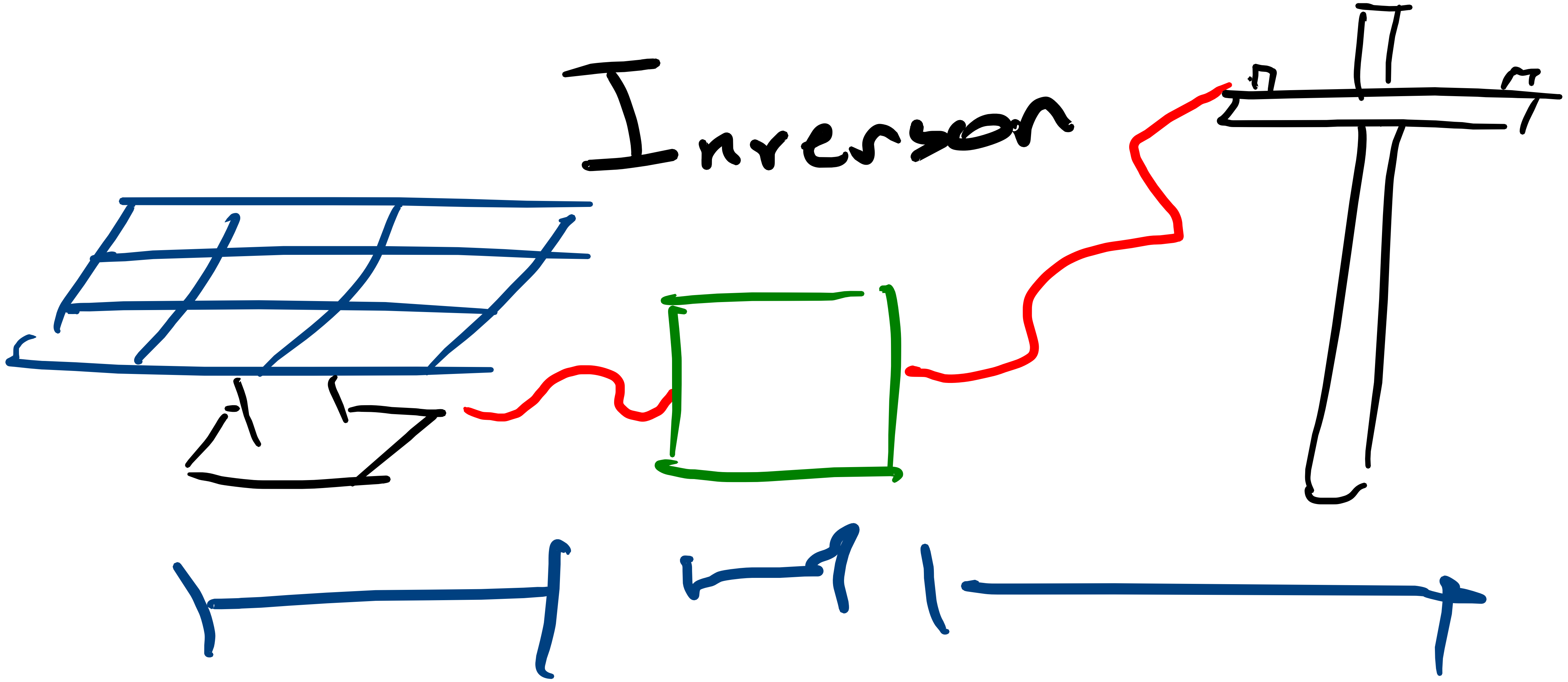


$\mathcal{L}\{\ \}$



$$\mathcal{L}\{f(t)\} = \int_{-\infty}^{\infty} f(t)\, e^{-st}\, dt$$

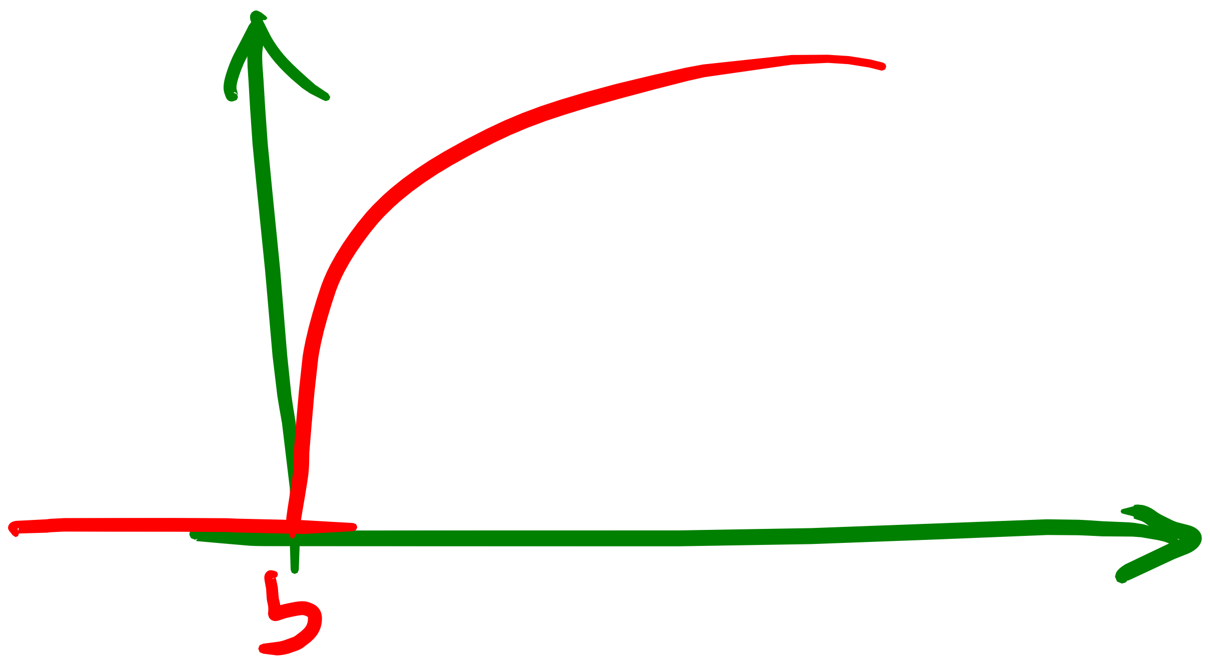



Inverson

$$\mathcal{L}\{f_1(t)+f_2(t)\}=\mathcal{L}\{f_1(t)\}+\mathcal{L}\{f_2(t)\}$$

$$\int_{-\infty}^{\infty}[f_1(t)+f_2(t)]e^{-st}dt=\int f_1e^{-st}dt+\int f_2e^{-st}dt$$

$$\int_{-\infty}^{\infty}f_1e^{-st}+f_2e^{-st}dt$$



$$e^{2(t-b)}u(t-b)$$

$$\int_{-\infty}^{\infty} e^{2(t-b)}u(t-b)e^{-st}\,dt = \frac{e^{-sb}}{s-2}$$

$$\int_{-\infty}^{\infty} e^{a(t-b)} u(t-b)\, e^{-st}\, dt$$

$$\int_{b}^{\infty} e^{a(t-b)} e^{-st}\, dt = \int_{b}^{\infty} e^{-ab} e^{(a-s)t}\, dt$$

$$e^{ab}\int_{b}^{\infty} e^{(a-s)t}\, dt = e^{-ab} \left. \frac{e^{(a-s)t}}{a-s} \right|_{b}^{\infty}$$

$$e^{-2b}\left.\frac{e^{(2-s)t}}{2-s}\right|_{b}^{\infty}$$

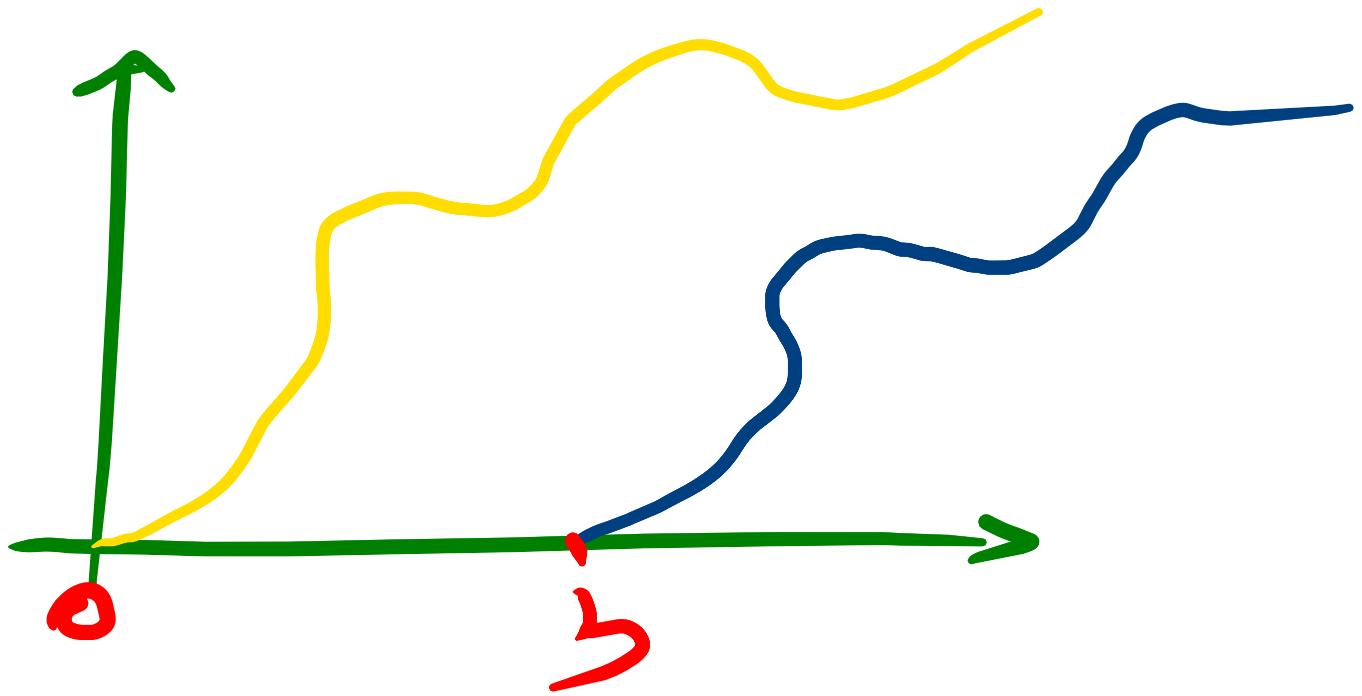
$$e^{(2-s)\infty} \longrightarrow 0$$

$$2-s<0$$

$$2<s$$

$$-e^{\cancel{-2b}}\,\frac{e^{\cancel{(2-s)b}}}{2-s} = -\frac{e^{-sb}}{2-s} = \boxed{\frac{e^{-sb}}{s-2}}$$

Propriedade do deslocamento em t



$$f(t) \rightarrow f(t-b)$$

$$\mathcal{L}\{f(t-b)\} = e^{-sb}\,\mathcal{L}\{f(t)\}$$

Exemplo

$$\mathcal{L}\{\operatorname{sen}(\theta t)\,u(t)\} = \frac{\theta}{s^2+\theta^2}$$

$j = \sqrt{-1}$

$$\operatorname{sen}(\theta t) = \frac{e^{j\theta t} - e^{-j\theta t}}{2j}$$

$$\mathcal{L}\left\{\frac{e^{j\theta t}}{2j}\right\} = \frac{1}{2j}\,\frac{1}{s-j\theta}$$

$$\mathcal{L}\left\{\frac{-e^{-j\theta t}}{2j}\right\} = \frac{-1}{2j}\,\frac{1}{s+j\theta}$$

$$\frac{1}{2j}\,\frac{1}{s-j\theta}\quad-\frac{1}{2j}\,\frac{1}{s+j\theta}$$

$$\frac{1}{2j}\left[\frac{1}{s-j\theta}-\frac{1}{s+j\theta}\right]$$

$$\frac{1}{2j}\left[\frac{\cancel{s}+j\theta-(\cancel{s}-j\theta)}{(s-j\theta)(s+j\theta)}\right]$$

$$\frac{1}{2j}\left[\frac{2j\theta}{s^2+sj\theta-sj\theta-j^2\theta^2}\right]$$

$$\frac{1}{\cancel{2j}}\left[\frac{\cancel{2j}\theta}{s^2+\cancel{sj\theta}-\cancel{sj\theta}-j^2\theta^2}\right]$$

$j=\sqrt{-1}$ $j^2=-1$

$$\frac{\theta}{s^2+\theta^2}$$

Exercício

$$\mathcal{L}\{G_2(t)\} \qquad G_2 = u(t+1) - u(t-1)$$

$$\mathcal{L}\{\cos(\theta t)\,u(t)\} \qquad \cos(\theta t) = \frac{e^{j\theta t} + e^{-j\theta t}}{2}$$

Material e informações de contato:

www.lucas.zischler.nom.br

Obrigado pela atenção