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$$\frac{dx(t)}{dt} = \alpha x(t) \implies x(t)$$

$$x(t) = A e^{\lambda t} \implies \frac{dx}{dt} = \dot{x} = A\lambda e^{\lambda t}$$

$$\cancel{A}\lambda \cancel{e^{\lambda t}} = \alpha \cancel{A} \cancel{e^{\lambda t}} \qquad A \neq 0$$

$$\lambda = \alpha \qquad e^{\lambda t} \neq 0$$

$$x(t) = A e^{\alpha t} \mid \forall A \in \mathbb{R}$$

$$x(t = t_0 = 0) = x_0 \implies x(0) = A e^0 = x_0 \implies A = x_0$$

$$x(t) = x_0 e^{\alpha t} \qquad t \geq 0$$

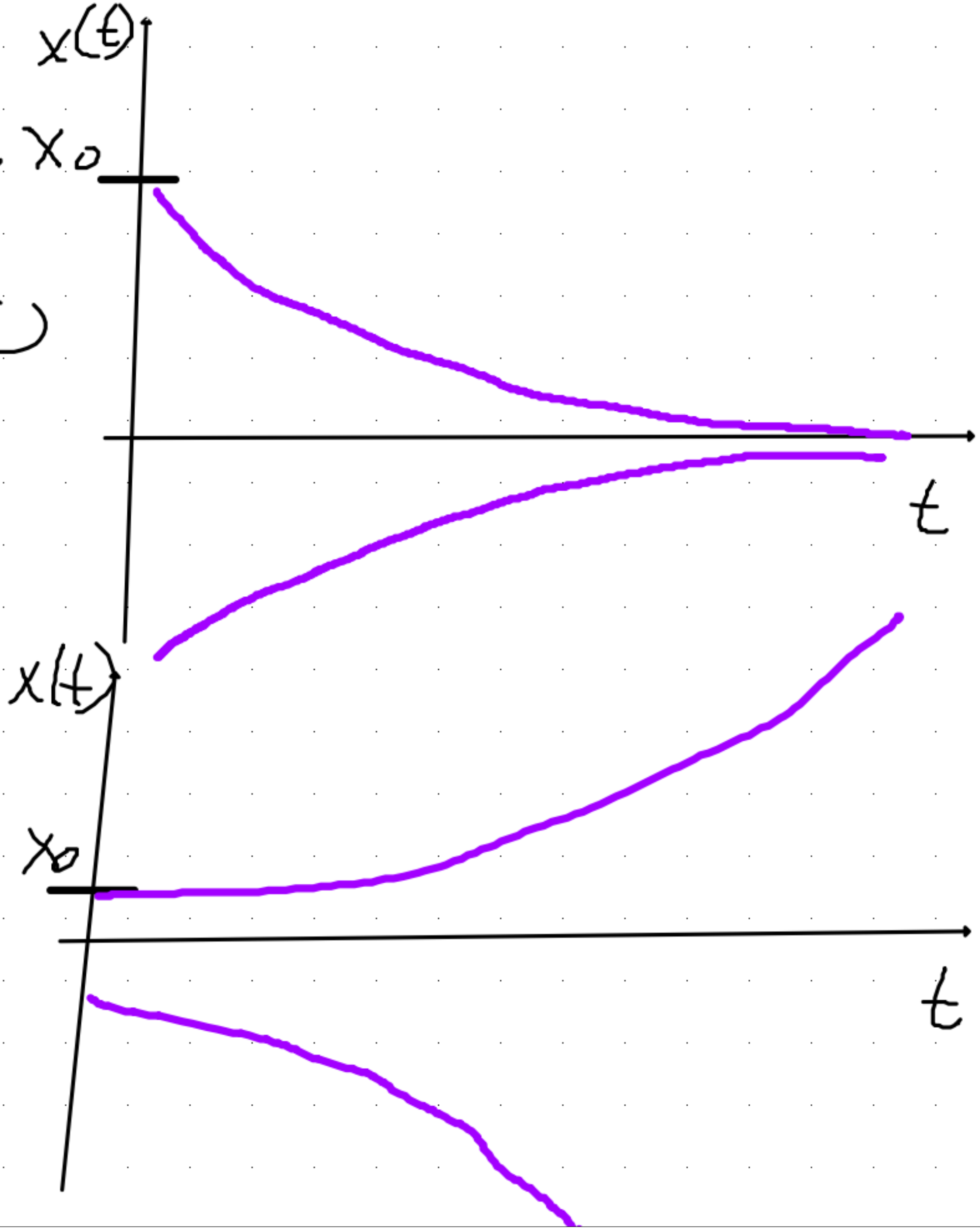
$$\alpha = 0 \Rightarrow x(t) = x_0$$

$$\alpha < 0 \Rightarrow x(t) = x_0 e^{\alpha t}$$

$$\lim_{t \to \infty} x(t) = 0$$

$$\alpha > 0 \Rightarrow x(t) = x_0 e^{\alpha t}$$

$$\lim_{t \to \infty} x(t) \to \pm\infty$$



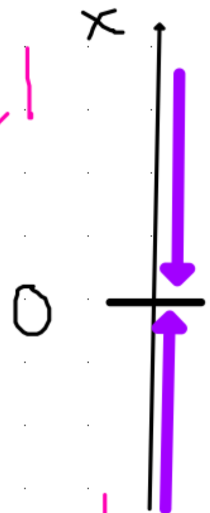
$$\frac{dx}{dt} = \alpha x = f(t, x)$$

$$\frac{dx}{dt} = 0 \Rightarrow \alpha x = 0 \Rightarrow x = 0$$

$\alpha > 0$

$x > 0$ $\Rightarrow$ $\frac{dx}{dt} > 0$

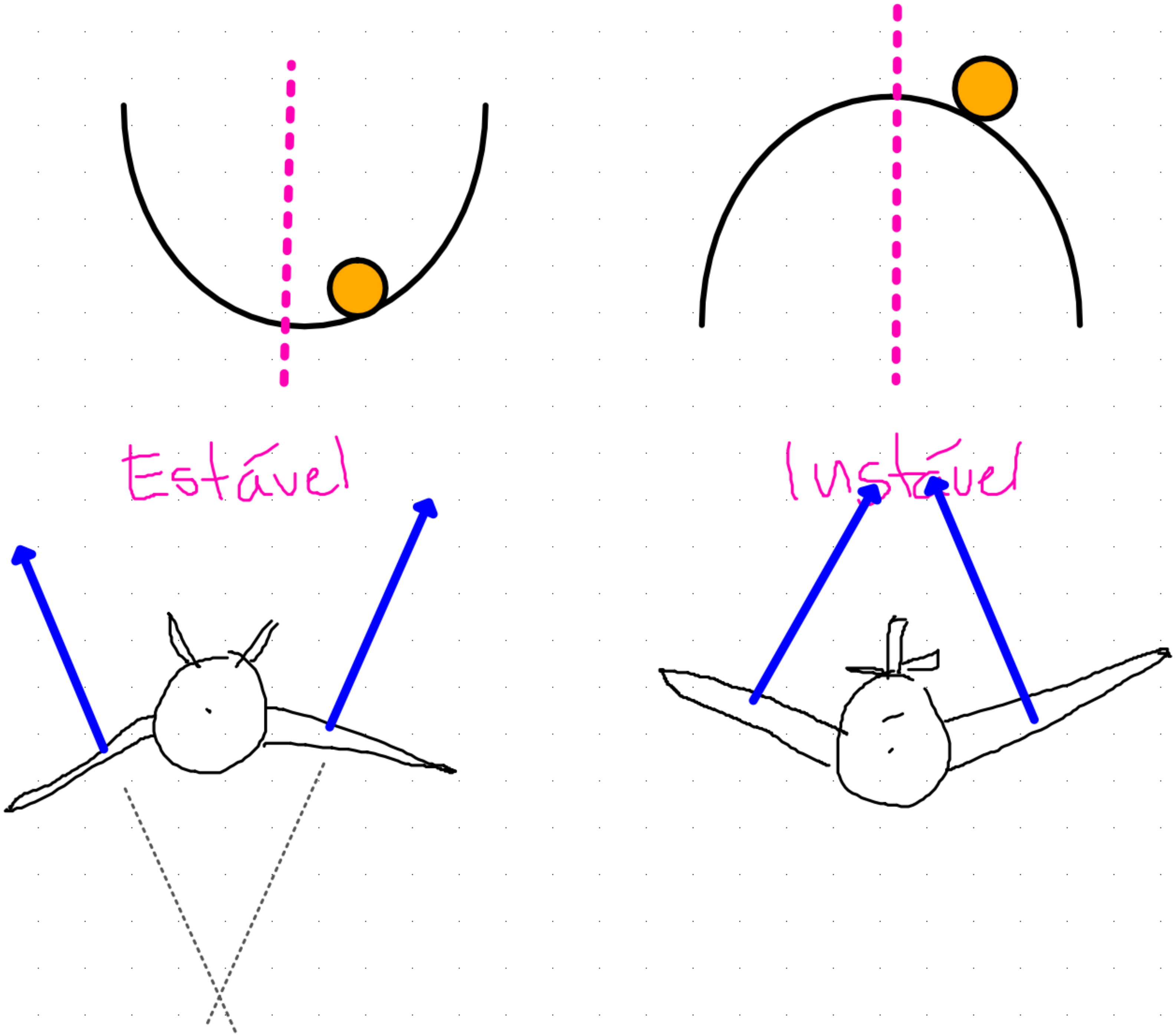
instável



$\alpha < 0$

$x > 0$ $\Rightarrow$ $\frac{dx}{dt} < 0$

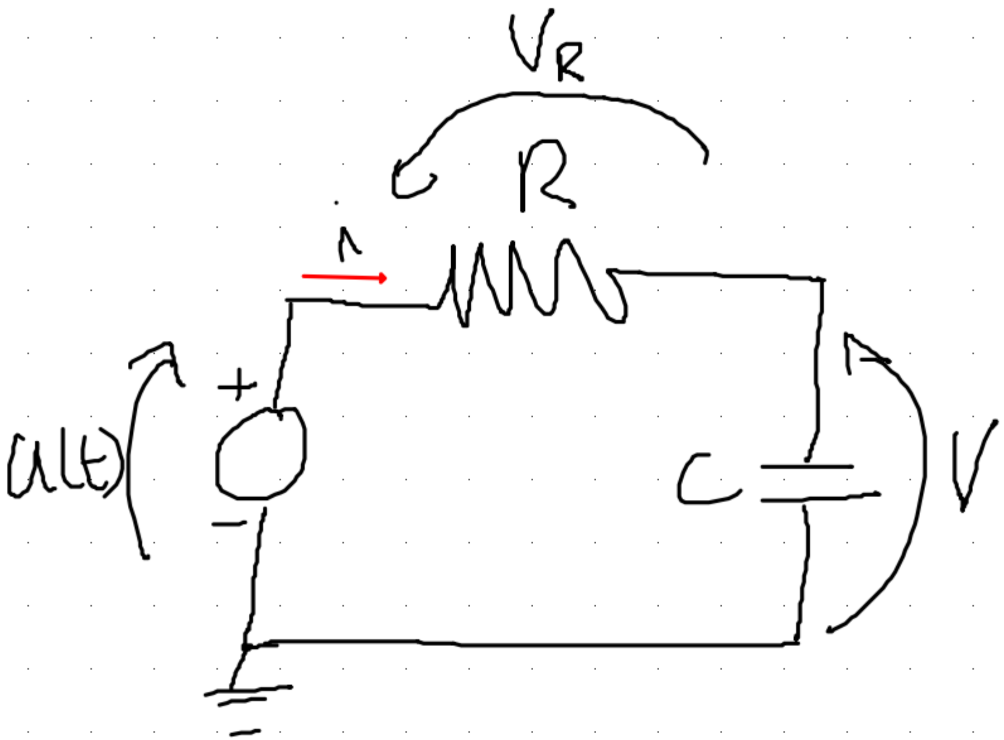
estável


Estável
Instável

$$\frac{dx}{dt} = \alpha x \qquad [\alpha] = \frac{1}{s} \qquad \tau = \frac{1}{\alpha} \qquad [\tau] = s$$

$$x = x_0 e^{\alpha t} \implies x(t) = x_0^{t/\tau}$$

Costante di Tempo



$$u(t) = V_R + V$$

$$Ri + V = u(t)$$

$$0 + RC\frac{dV}{dt} + V = u(t) + 0$$

Foute Degrau

$$u(t) = \begin{cases} 0 & \mid t < t_0 \\ U_0 & \mid t \geq t_0 \end{cases}$$

$$V_R = Ri$$

$$i = C\frac{dV}{dt}$$

$$V(t) = V_h(t) + V_p(t)$$

$$RC \frac{dV_h}{dt} + V_h = 0 \quad \Rightarrow \quad \frac{dV_h}{dt} = -\frac{1}{RC} V_h$$

$$V_h(t) = A e^{-t/\tau} \qquad \tau = RC$$

$$RC \frac{dV_p(t)}{dt} + V_p(t) = U_0 \qquad t \geq t_0 = 0$$

$$V_p(t) = B \quad \Rightarrow \quad \frac{dV_p}{dt} = 0$$

$$RC \cdot 0 + B = U_0 \quad \Rightarrow \quad B = U_0$$

$$V_p(t) = U_0$$

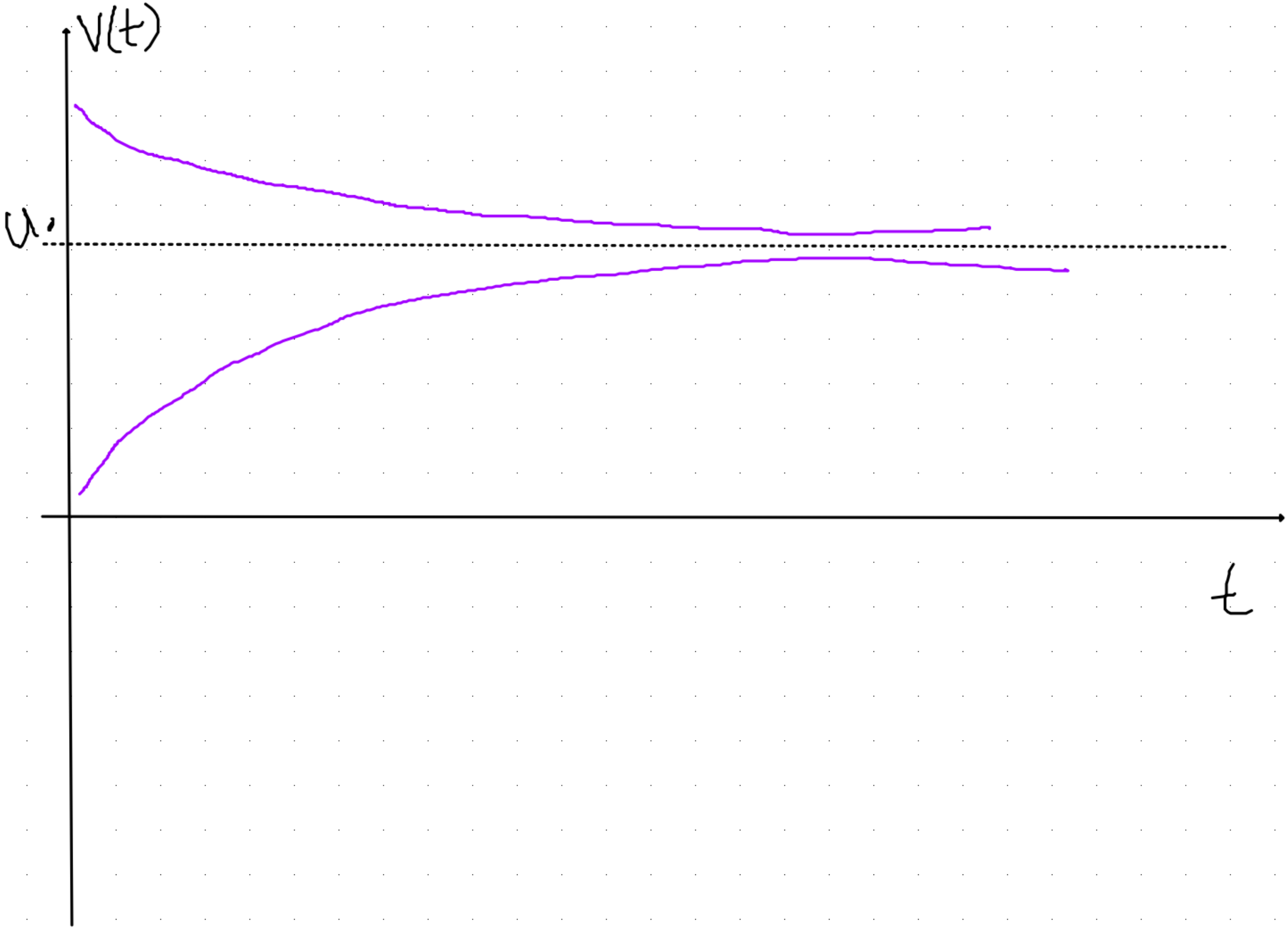
$$V(t) = A e^{-t/\tau} + U_0 \qquad \Big| \; \tau = RC$$

$$V(0) = V_0$$

$$V_0 = A e^{0} + U_0 \Rightarrow \quad A = V_0 - U_0$$

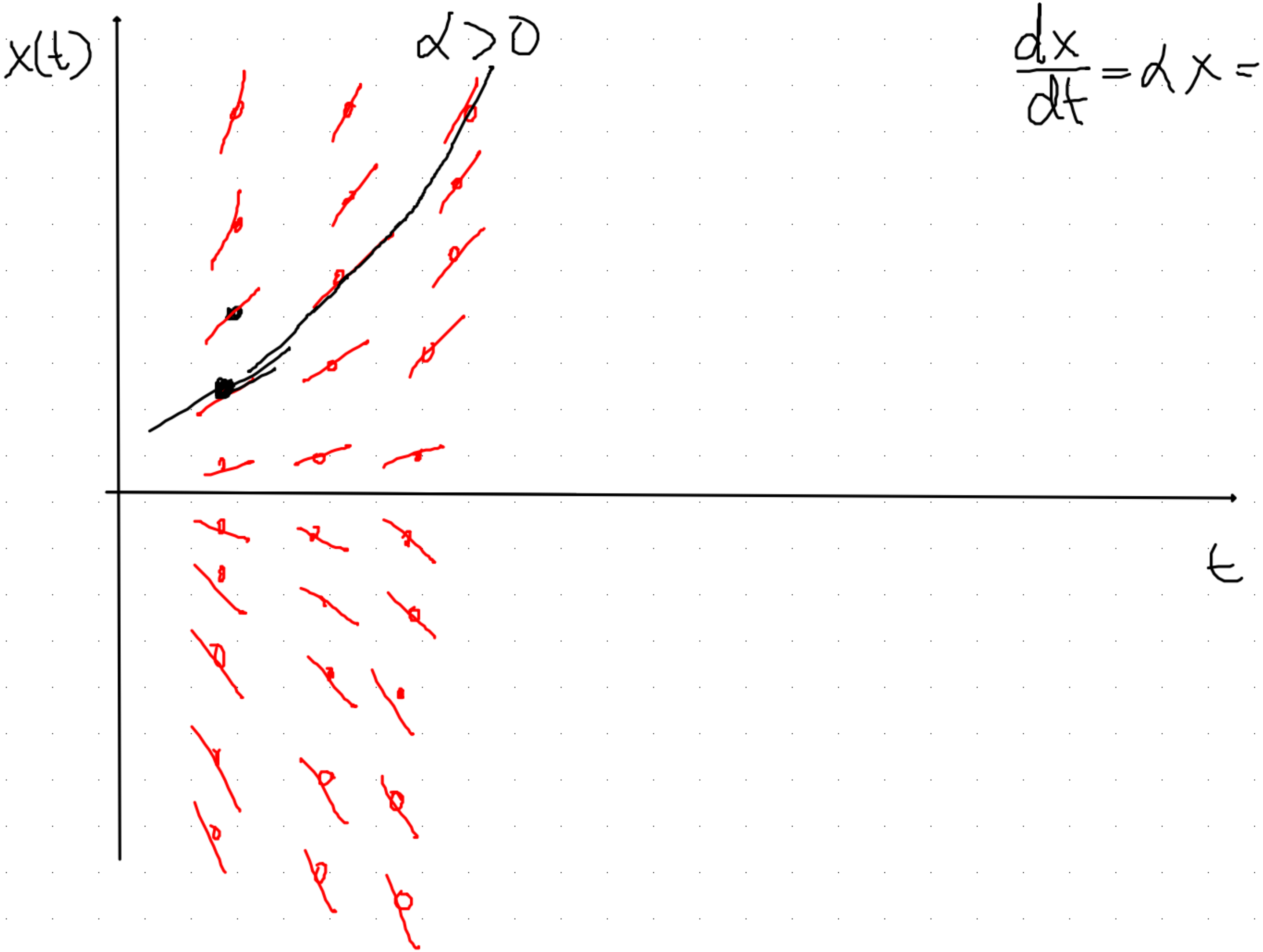
$$V(t) = (V_0 - U_0)\, e^{-t/\tau} + U_0$$

$$V(t) = V_0\, e^{-t/\tau} + U_0 \left(1 - e^{-t/\tau}\right)$$



V(t)
v₀
t

$$\frac{dx}{dt} = \alpha x = f(t,x)$$



$$\frac{dx}{dt} = \dot{x} = f(t, x)$$

$$\frac{dx}{dt} \simeq \frac{\Delta x}{\Delta t} = f(t, x) \qquad h = \Delta t$$

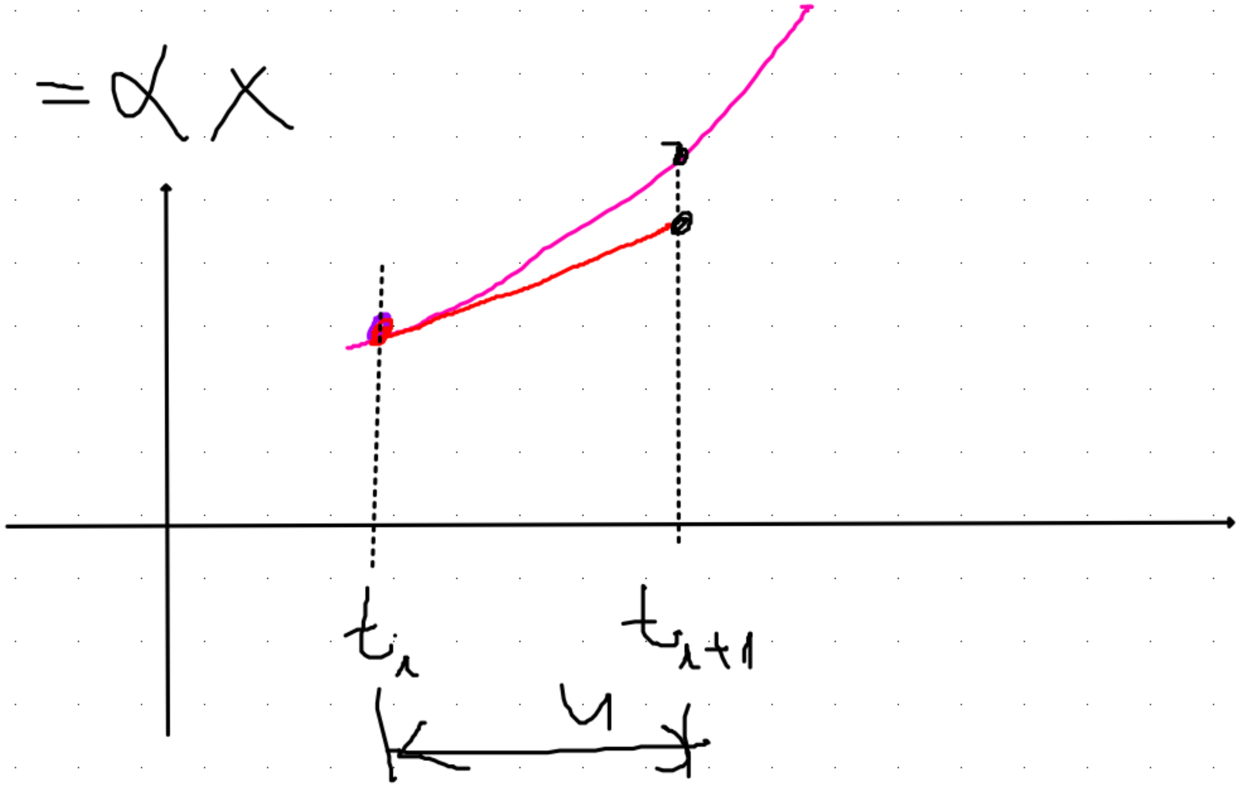
$$\Delta x = x(t_{i+1}) - x(t_i) = x_{i+1} - x_i$$

$$\begin{cases} x_{i+1} = x_i + f(t, x) \cdot h \\ t_{i+1} = t_i + h \end{cases}$$

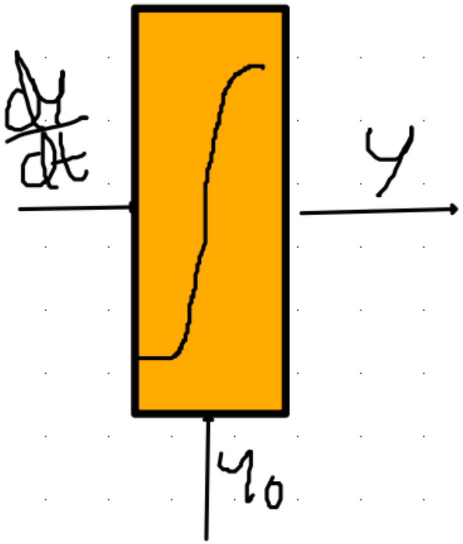
Método de Euler Explícito

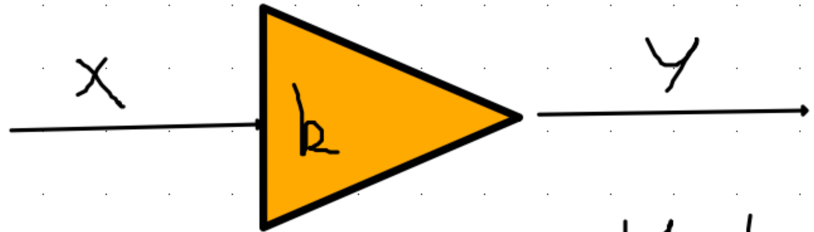
$$\begin{cases} x_{i+1} = x_i + f(t_i, x_i)\,h \\ t_{i+1} = t_i + h \end{cases}$$

$$f(t, x) = \alpha x$$

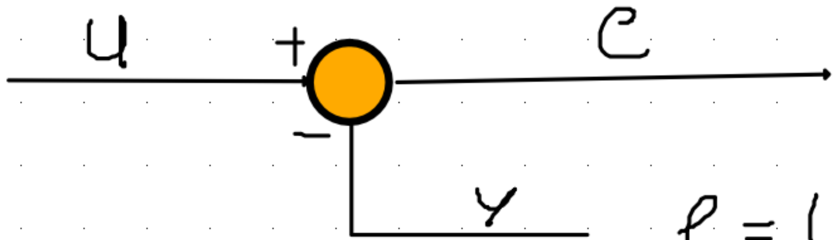


$$\frac{dy}{dt} = \frac{1}{RC}(u - v)$$

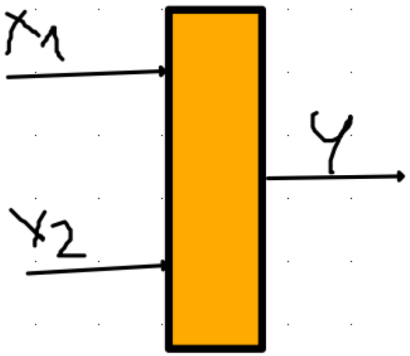




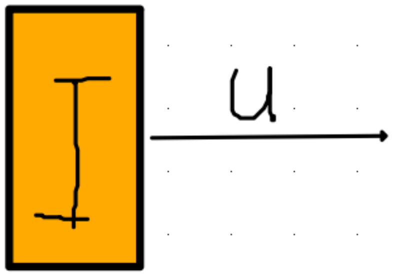
$$y = kx$$



$$e = u - y$$



$$y = x_1 + x_2$$



$$\frac{dv}{dt} = \frac{1}{RC}(u - v)$$