$$e^{At} \longrightarrow A$$

$$\frac{d}{dt} e^{At} = A e^{At}$$

$$\left[\frac{d}{dt} e^{At}\right]_{t=0} = A \left[e^{At}\right]_{t=0}$$

$$\left[\frac{d}{dt} e^{At}\right]_{t=0} = A \cdot I$$

$$MatExp := \begin{bmatrix} e^t \cos(t) & e^t \sin(t) \\ -e^t \sin(t) & e^t \cos(t) \end{bmatrix}$$

$$MatExp = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} e^t \cos(t) + \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} e^t \operatorname{sen}(t)$$

$$AA = \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix} \longleftarrow$$

$$\boxed{\begin{aligned} \frac{dx(t)}{dt} &= x(t) + y(t) \\ \frac{dy(t)}{dt} &= -x(t) + y(t) \end{aligned}}$$

$x(0) = 8$

$y(0) = -8$

$$\boxed{\begin{aligned}\frac{dx_1(t)}{dt} &= x_2(t)\\ \frac{dx_2(t)}{dt} &= -x_1(t)\end{aligned}}$$

$$\frac{d}{dt}\bar{x}(t) = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$$

AA.

$$\frac{d^2x_1(t)}{dt^2} = \frac{dx_2(t)}{dt}$$

$$\frac{d^2x_1(t)}{dt^2} = -x_1(t)$$

$$\frac{d^2x_1(t)}{dt^2} + x_1(t) = 0 \qquad \text{EDO(2)LccH}$$

$$m^2+1=0 \qquad m_1 = I \quad m_2 = -I.$$

$$x_1(t) = C_1\cos(t) + C_2\,\mathrm{sen}(t)$$

$$x_2(t) = -C_1\,\mathrm{sen}(t) + C_2\cos(t)$$

$$\bar{x}(t) = \begin{bmatrix} \cos(t) & \mathrm{sen}(t) \\ -\mathrm{sen}(t) & \cos(t) \end{bmatrix}\begin{bmatrix} C_1 \\ C_2 \end{bmatrix} \qquad A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

$$e^{At}$$

$$\frac{d}{dt}e^{At} = \begin{bmatrix} -\mathrm{sen}(t) & \cos(t) \\ -\cos(t) & -\mathrm{sen}(t) \end{bmatrix}$$

$$\left.\frac{d}{dt}e^{At}\right|_{t=0} = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

$$\frac{d^2 x_1(t)}{dt^2} + a_1 \frac{dx_1(t)}{dt} + a_2 x_1(t) = 0$$

EDO(2) L ccH.

$$m^2 + a_1 m + a_2 = 0 \qquad \left.\begin{array}{l} m_1 = a + bi \\ m_2 = a - bi \end{array}\right\} m_1, m_2 \in \mathbb{C}$$

$$y_g = C_1 e^{at} \cos(bt) + C_2 e^{at} \operatorname{sen}(bt)$$

$$m^2 + a_2 = 0 \qquad m_1 = \sqrt{a_2}\, i \quad m_2 = -\sqrt{a_2}\, i$$

$$y_g = C_1 \cos(\sqrt{a_2}\, t) + C_2 \operatorname{sen}(\sqrt{a_2}\, t)$$

$$\begin{cases} x + y = 4 \\ 2x + 2y = 5 \end{cases}$$

$$\frac{dx(t)}{dt} = x(t) + y(t) \qquad A = \begin{bmatrix} 1 & 1 \\ 2 & 2 \end{bmatrix}$$

$$\frac{dy(t)}{dt} = 2x(t) + 2y(t)$$

$$x(0) = 2 \qquad y(0) = -2$$

$$\begin{aligned} x(t) &= \_C1 + \_C2\, e^{3t} \\ y(t) &= 2\,\_C2\, e^{3t} - \_C1 \end{aligned} \iff \begin{aligned} x(t) &= \left(\frac{2}{3} + \frac{1}{3} e^{3t}\right) x_0 + \left(\frac{1}{3} e^{3t} - \frac{1}{3}\right) y_0 \\ y(t) &= \left(\frac{2}{3} e^{3t} - \frac{2}{3}\right) x_0 + \left(\frac{1}{3} + \frac{2}{3} e^{3t}\right) y_0 \end{aligned}$$

$$x(t) = \left(\frac{2}{3}x_0 - \frac{1}{3}y_0\right) + \left(\frac{1}{3}x_0 + \frac{1}{3}y_0\right)e^{3t}$$

$$y(t) = \left(-\frac{2}{3}x_0 + \frac{1}{3}y_0\right) + \left(\frac{2}{3}x_0 + \frac{2}{3}y_0\right)e^{3t}$$

$$C_1 = \frac{2}{3}x_0 - \frac{1}{3}y_0 \qquad C_2 = \frac{1}{3}x_0 + \frac{1}{3}y_0$$

$$x(t) = C_1 + C_2 e^{3t}$$

$$y(t) = -C_1 + 2C_2 e^{3t}$$

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