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Often not only one ODE, i.e. scalar, but a whole system

Def.: A (general) first order IVP is given by

$$\dot{\vec{y}}(t) = \vec{f}(t, \vec{y}(t)) \quad \text{system of ODEs}$$

$$\vec{y}(t_0) = \vec{y}_0 \quad \text{IVs}$$

and an interval $I = [t_0, T]$ on which the solution $\vec{y}(t)$ is sought.

Ex.: (2) CSTR

(3) Linear system of ODEs

$$\dot{\vec{y}}(t) = A \vec{y}(t)$$

$$\vec{y}(t_0) = \vec{y}_0$$

————— A matrix

Analytical solution $\vec{y}(t) = e^{A(t-t_0)} \vec{y}_0$

$$= \left(\sum_{k=0}^{\infty} \frac{1}{k!} A^k (t-t_0)^k \right) \vec{y}_0$$

matrix exponential