Systémy

$x(t) \longrightarrow \boxed{} \longrightarrow y(t)$

- kauzalita
- stabilita "bounded input → bounded output"
- časová invariance
- linearita $x_1(t) \to y_1(t)$, $x_2(t) \to y_2(t)$ $\quad a x_1(t) + b x_2(t) \longrightarrow a y_1(t) + b y_2(t)$

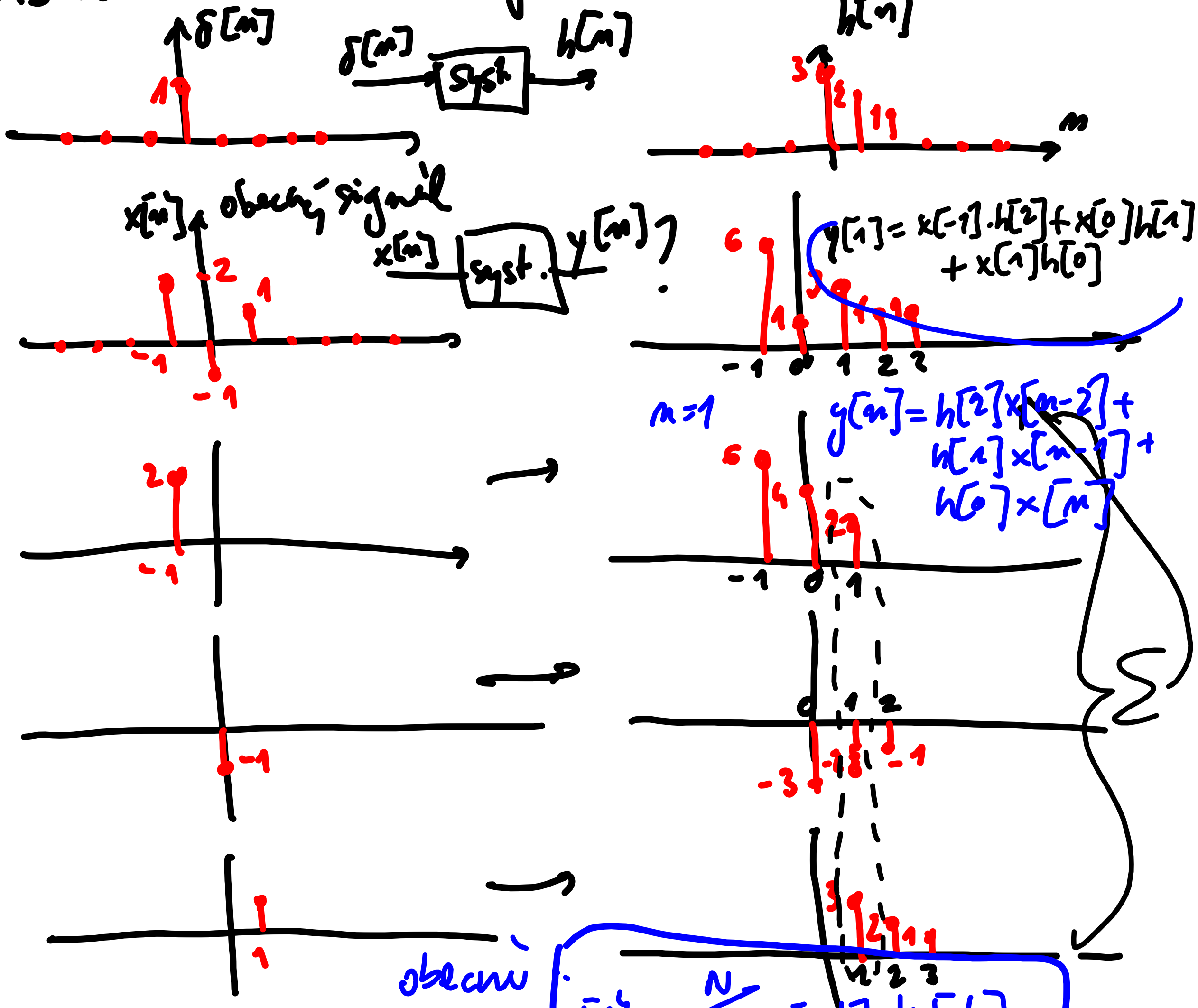
LTI systémy lineární a časově invariantní

složitý vstup $\longrightarrow \boxed{\text{syst.}} \longrightarrow$?

složitý vstup → jednoduché signály → $\boxed{\text{syst}}$, $\boxed{\text{syst}}$, …, $\boxed{\text{syst}}$ $\Big\}\ \Sigma \longrightarrow y(t)$!

Impulsní odezva a jak vypočítat reakci systému na libovolný vstup

Diskrétní čas. - impulsní odezva



$y[1] = x[-1]\cdot h[2] + x[0]h[1] + x[1]h[0]$

$n=1$

$y[n] = h[2]x[n-2] + h[1]x[n-1] + h[0]x[n]$

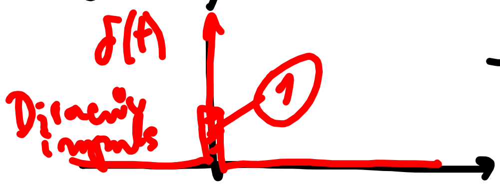
obecně

$$\boxed{y[n] = \sum_{k=0}^{N} x[n-k]\, h[k]}$$

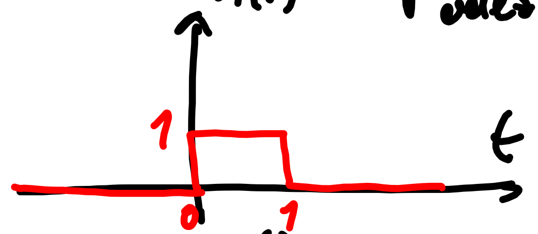
konvoluční suma,

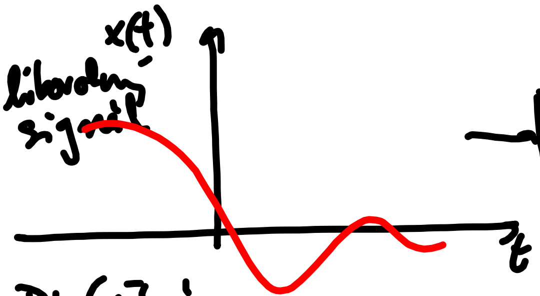
$$\boxed{y[n] = \sum_{k=n-2}^{n} x[k]\, h[n-k]}$$

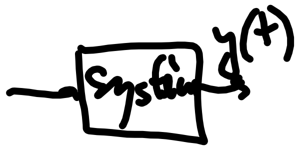
Systémy se spojitým časem

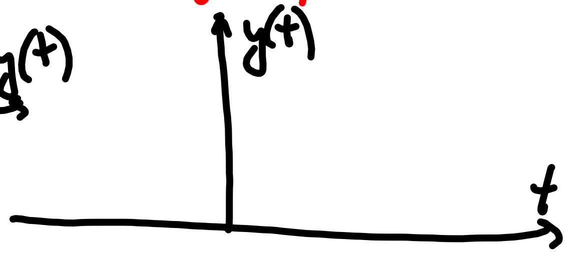


h(t) impulsní odezva







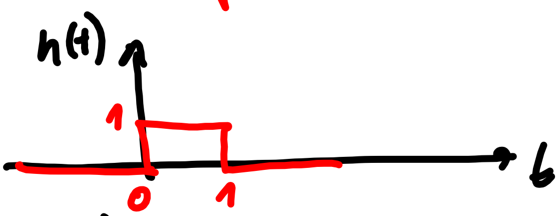


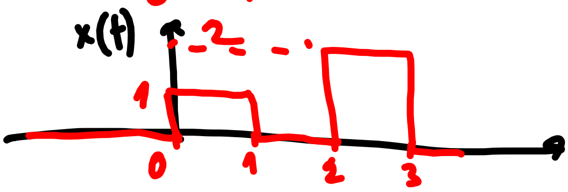
Diskrétní:

$$y[n] = \sum_{k=-\infty}^{\infty} h[k]x[n-k] \rightarrow$$

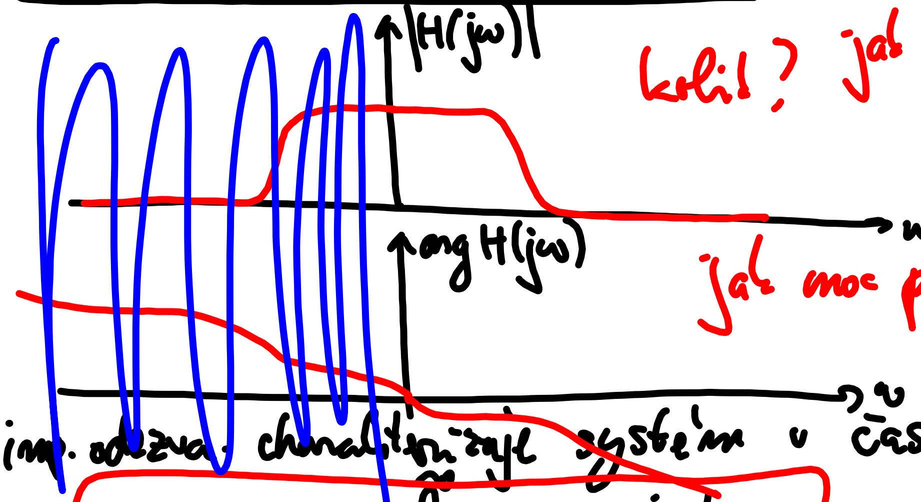
Konvoluční integrál pro spojitý čas.

$$\boxed{\begin{aligned} y(t) &= \int_{-\infty}^{\infty} h(\tau)x(t-\tau)d\tau \\ &= \int_{-\infty}^{\infty} x(\tau)h(t-\tau)d\tau \end{aligned}}$$





Frekvenční charakteristika.



kolik? jak zesiluje nebo zeslabuje?

jak moc posunuje?

imp. odezva charakterizuje systém v čase: $h(t)$

$$\boxed{H(j\omega) = \int_{-\infty}^{\infty} h(t)\, e^{-j\omega t}\, dt}$$

F.T. impulsní odezvy

$$H(-j\omega) = H^*(j\omega)$$

$$|H(-j\omega)| = |H(j\omega)|$$

$$\arg H(-j\omega) = -\arg H(j\omega)$$

Frekvenční char. přímo z popisu systému . .

$$b_0 x(t) + b_1 \frac{dx(t)}{dt} + \dots + b_Q \frac{d^Q x(t)}{dt^Q} = a_0 y(t) + a_1 \frac{dy(t)}{dt} + \dots + a_P \frac{d^P y(t)}{dt^P}$$

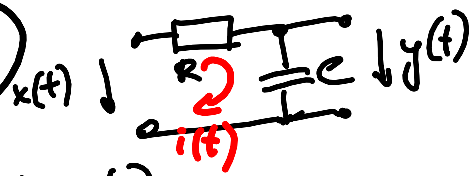
1. derivace vstupu

Q-tá der. vstupu

$$\boxed{\sum_{m=0}^{Q} b_m \frac{d^m x(t)}{dt^m} = \sum_{m=0}^{P} a_m \frac{d^m y(t)}{dt^m}}$$

Diferenciální rovnice

diskr. systémy mají diferenční rovnici!



$$i(t) = \frac{x(t) - y(t)}{R}$$

$$i(t) = C \frac{dy(t)}{dt}$$

$$\frac{x(t) - y(t)}{R} = C \frac{dy(t)}{dt}$$

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

$Q = 0$ $\quad P = 1$

$b_0 = 1$ $\quad a_0 = 1 \quad a_1 = RC$