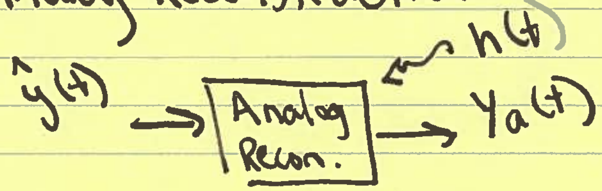
Lecture 3:

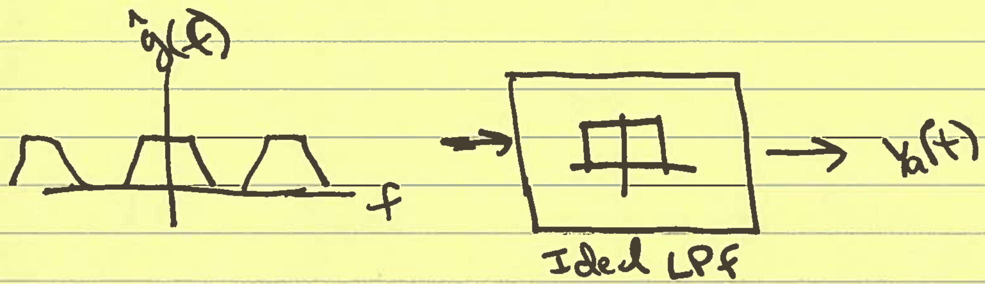
Analog Reconstruction:



$$\hat{y}(t) = \sum_{n=-\infty}^{\infty} y(nT)\,\delta(t-nT)$$

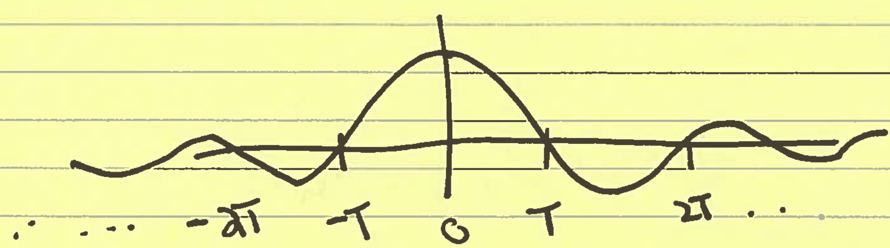
$$y_a(t) = \sum_{n=-\infty}^{\infty} y(nT)\,h(t-nT)$$

$$Y_a(f) = H(f)\,\hat{Y}(f) \qquad \hat{Y}(f) = \frac{1}{T}\sum_{m=-\infty}^{\infty} Y(f-mf_s)$$

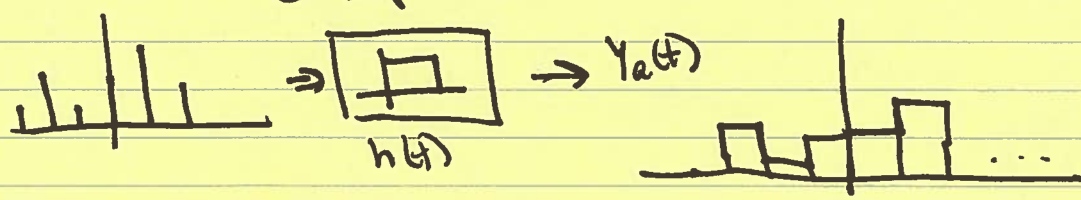


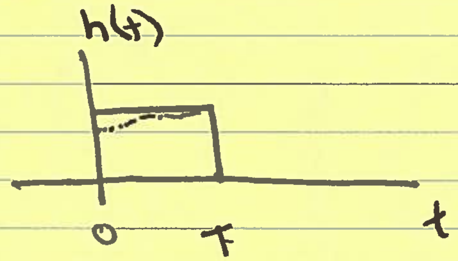
$$H(f) = \begin{cases} T & |f| < f_s/2 \\ 0 & \text{elsewhere} \end{cases}$$

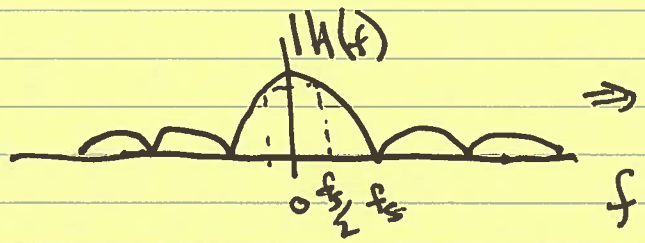
$$h(t) = \frac{\sin(\pi t/T)}{\pi t/T} = \frac{\sin(\pi f_s t)}{\pi f_s t} = \mathrm{sinc}(\pi f_s t)$$



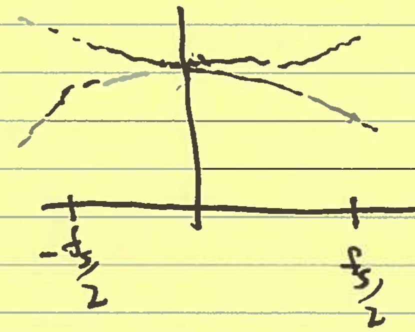
Sample and Hold







⇒



spectral distortion

How do we evaluate quality?

$$\text{Error} = \sum \left(x(t) - x_a(t)\right)$$

$$= \int_0^{T_W} \left[x(t) - x_a(t)\right]^2 dt$$

mean-squared error

$$\text{Normalized Error} = \frac{\int_0^{T_W} \left[x(t) - x_a(t)\right]^2 dt}{\int_0^{T_W} \left(x(t)\right)^2 dt} = \frac{\text{Energy error}}{\text{Energy}}$$

$$10\log_{10}(\text{norm energy})\Big|_{dB} \quad \text{or} \quad \text{SNR} \quad \frac{\text{Energy}}{\text{Error Energy}}$$

$$10 \log_{10} \left[\frac{\text{signal energy}}{\text{error energy}} \right] = SNR\Big|_{dB}$$