Discrete time complex exponentials

$$x[n] = |A| e^{j(\omega_0 n + \theta)} = |A|\cos(\omega_0 n + \theta) + j|A|\sin(\omega_0 n + \theta)$$

periodic if: $\omega_0 = 2\pi m/N$, m and $N > 0$ + no div.

★ Unit Step + Unit Sample

$$u[n] = \begin{cases} 1 & n \geq 0 \\ 0 & n < 0 \end{cases} \qquad \delta[n] = \begin{cases} 1 & n = 0 \\ 0 & \text{otherwise} \end{cases}$$

IIR Eq (ARMA)

$$y[n] = 0.5\,y[n-1] + x[n] + x[n-1]$$

↑ Clue for IIR!

FIR Eq.

$$y[n] = \sum_{k=0}^{m} h\,x[n-k] \rightarrow \text{no feedback}$$

★ Tabular Method for convolution

★ Causal – no init conditions (no $n<0$) + no feedback

Nyquist: $F_s \geq 2 \cdot f_{max}$

- **Filter Order**

$$N \cong \frac{A}{20(\omega_s - \omega_p)/2\pi}$$

A: attenuation; ω_s, ω_p: pass + stop f.

(add 10%?)

- **Attenuation Eq.**

$$A = 20\log_{10}\left(\frac{y}{x}\right) = 10\log_{10}\left(\frac{P_y}{P_x}\right)$$

Sampling Stuff

$$\text{Latency} = \frac{NB}{2} \cdot T_s \qquad N = 2^{NFFT}$$

(NB: buffer size)

$$\text{Overlap (standard)} = \frac{NFFT}{2} \qquad \Delta f = \frac{F_s}{NFFT}$$

(NFFT: window size)

$$t_w = \frac{NFFT}{F_s}$$

One-Sided Z-transform

(there are more)

$$\delta[n] \rightarrow 1$$

$$u[n] \rightarrow \frac{1}{1 - z^{-1}}$$

$$nu[n] \rightarrow \frac{z^{-1}}{(1 - z^{-1})^2}$$

Ex:

$$Z(u[n]) = \frac{1}{1 - z^{-1}} = \frac{z}{z - 1}$$

mult. by z