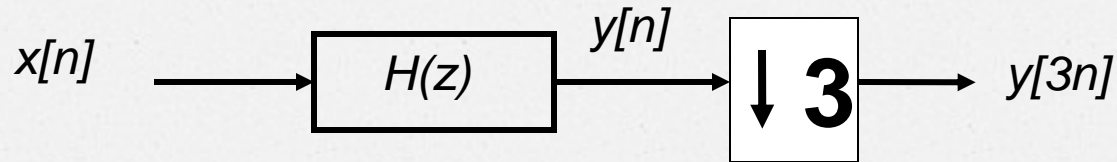# Digital Signal Processing- Lecture 18
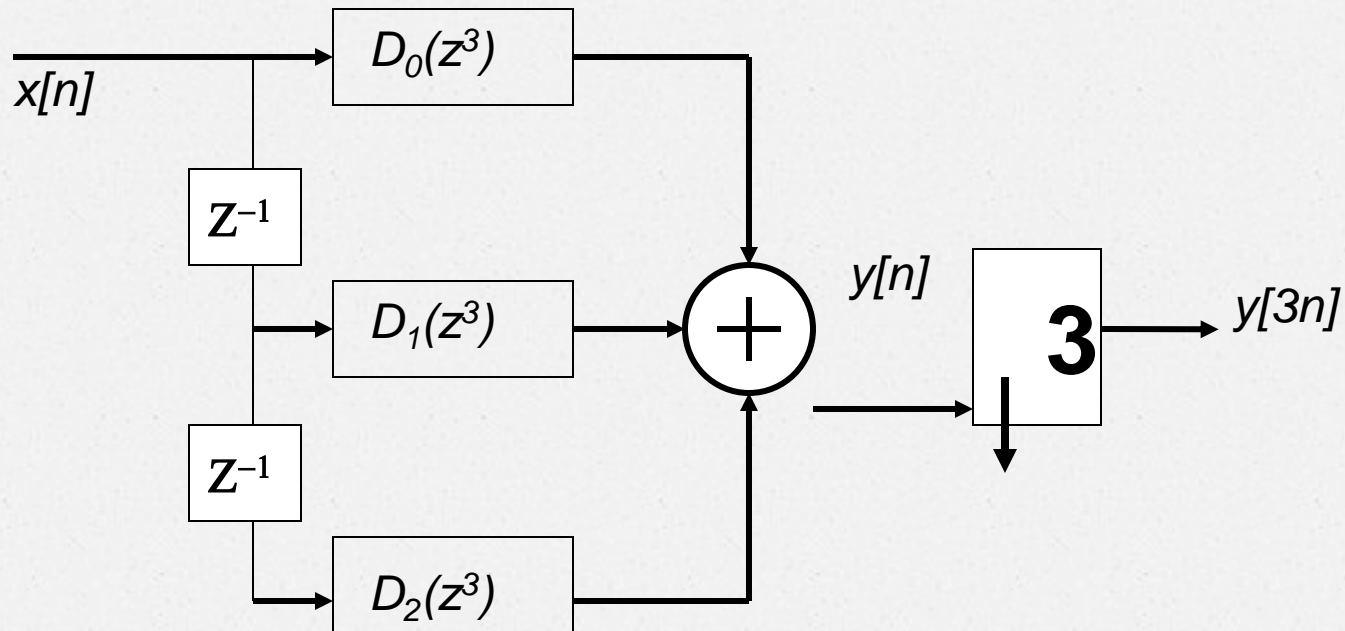
Topics to be covered:

o Poly phase structure of decimation filter

Poly-phase Structure of Decimation Filter

$x[n]$ → $H(z)$ → $y[n]$ → $\downarrow 3$ → $y[3n]$

$$H(z) = D_0(z^3) + z^{-1}D_1(z^3) + z^{-2}D_2(z^3)$$

$x[n]$ → $D_0(z^3)$

z^{-1} → $D_1(z^3)$ → $+$ → $y[n]$ → $3\downarrow$ → $y[3n]$

z^{-1} → $D_2(z^3)$

3

Poly-phase Structure of Decimation Filter

$$H(z) = D_0(z^3) + z^{-1}D_1(z^3) + z^{-2}D_2(z^3)$$

4

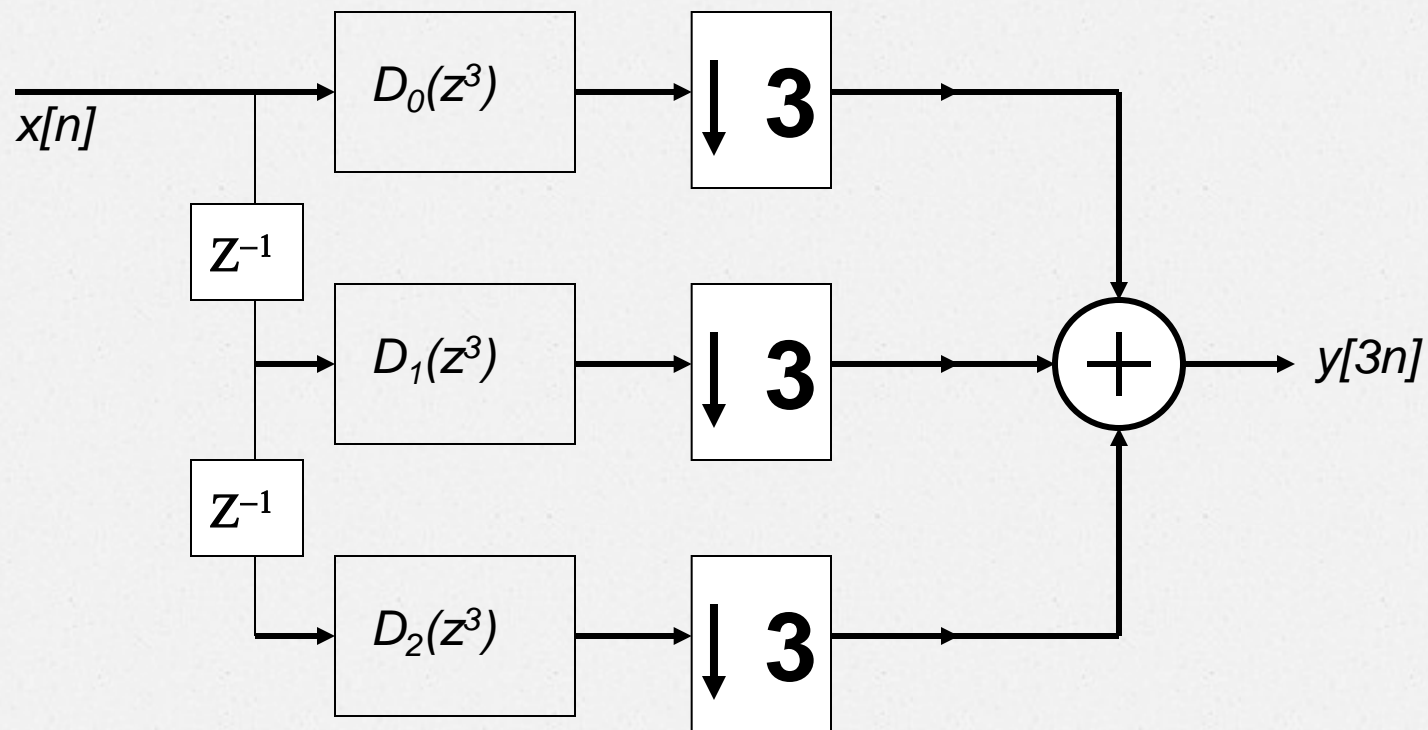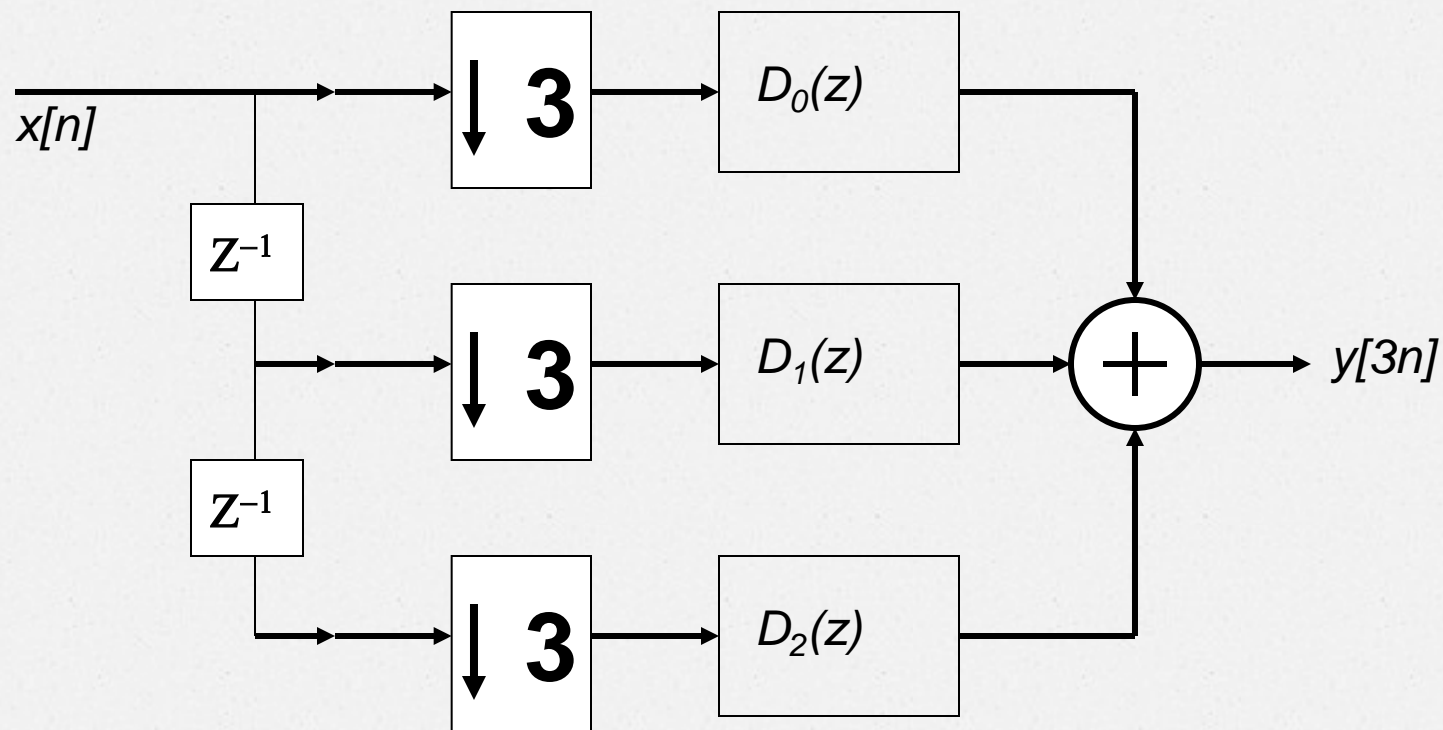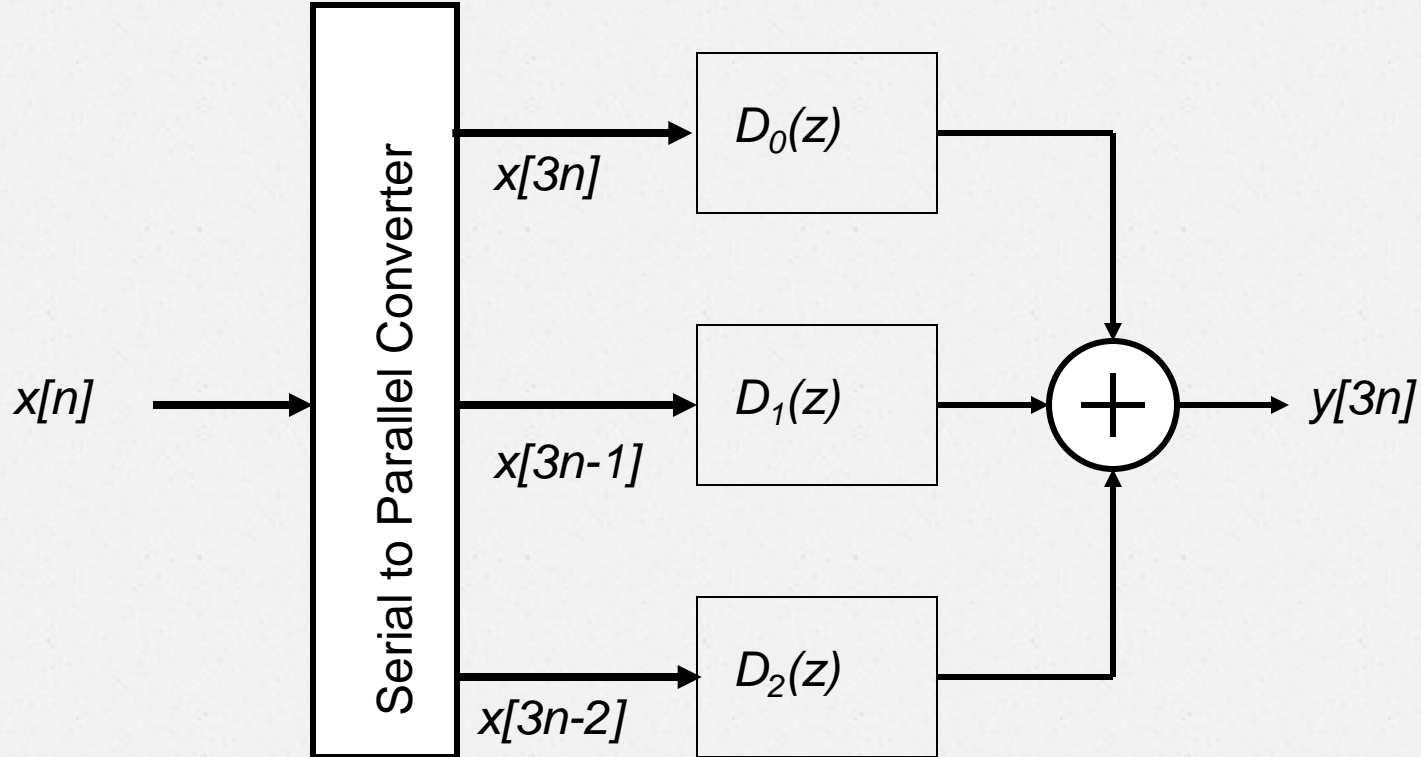# Poly-phase Structure of Decimation Filter

$$H(z) = D_0(z^3) + z^{-1}D_1(z^3) + z^{-2}D_2(z^3)$$

Poly-phase Structure of Decimation Filter

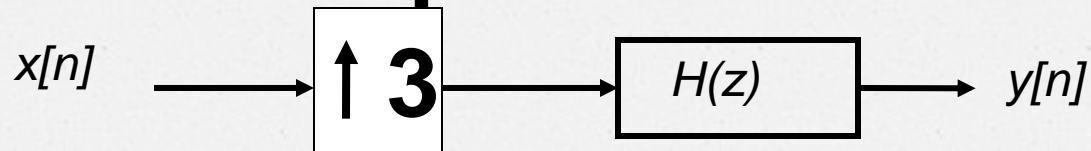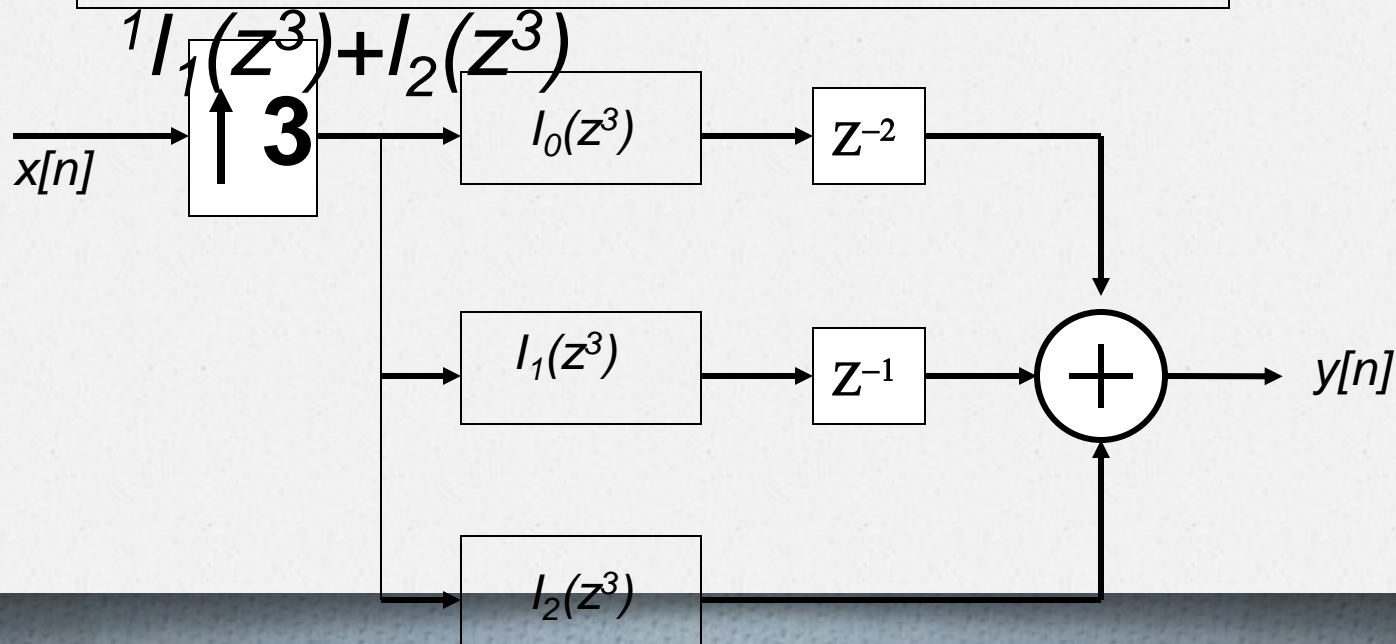$$H(z) = D_0(z^3) + z^{-1}D_1(z^3) + z^{-2}D_2(z^3)$$

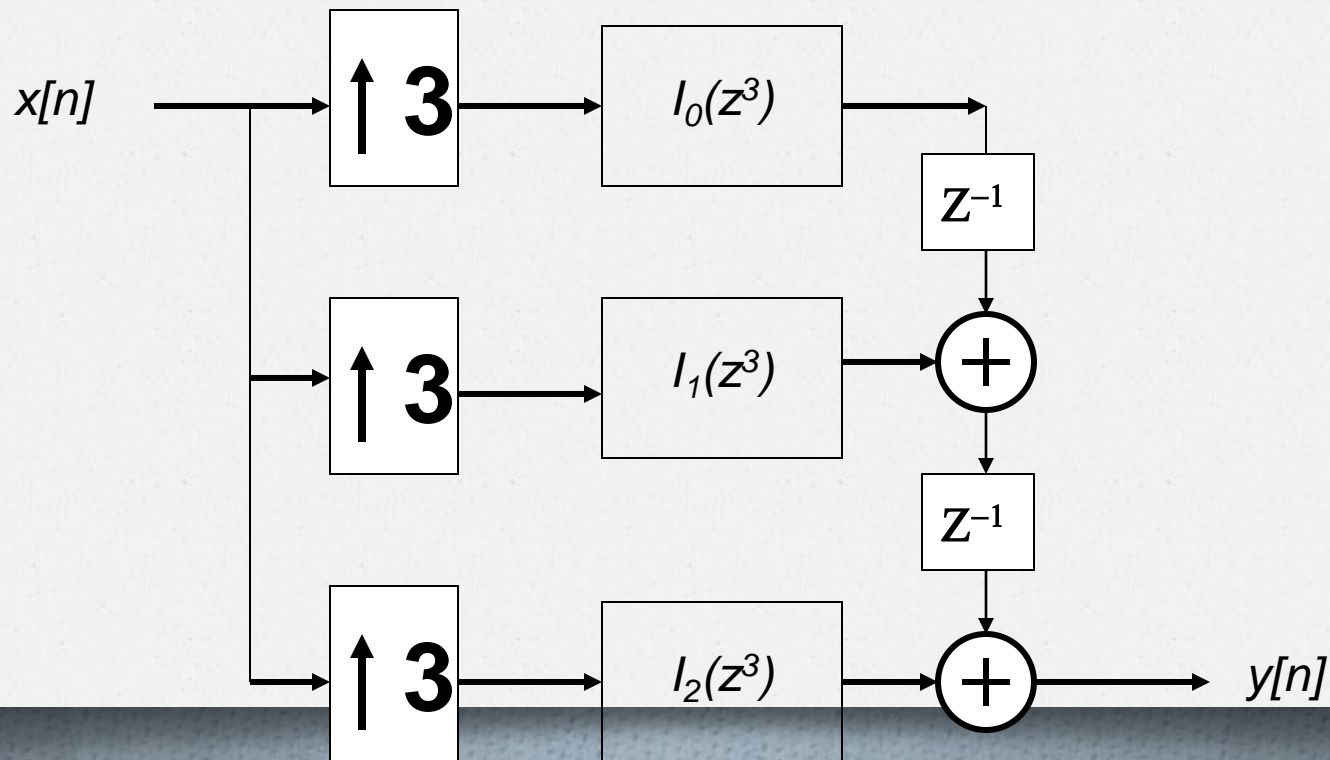# Poly-phase Structure of Interpolation Filter

$x[n] \longrightarrow \boxed{\uparrow 3} \longrightarrow \boxed{H(z)} \longrightarrow y[n]$

$$H(z) = z^{-2}I_0(z^3) + z^{-1}I_1(z^3) + I_2(z^3)$$

Poly-phase Structure of Interpolation Filter

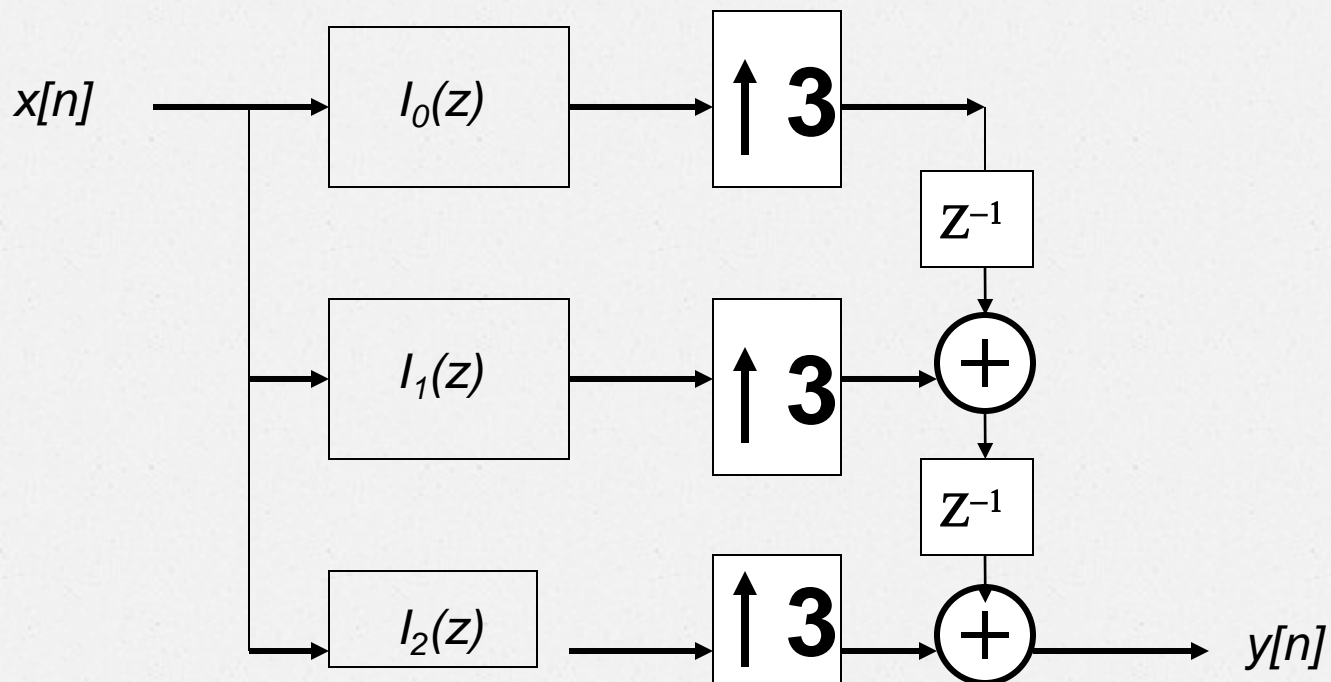$$H(z) = z^{-2}I_0(z^3)+ z^{-1}I_1(z^3)+I_2(z^3)$$
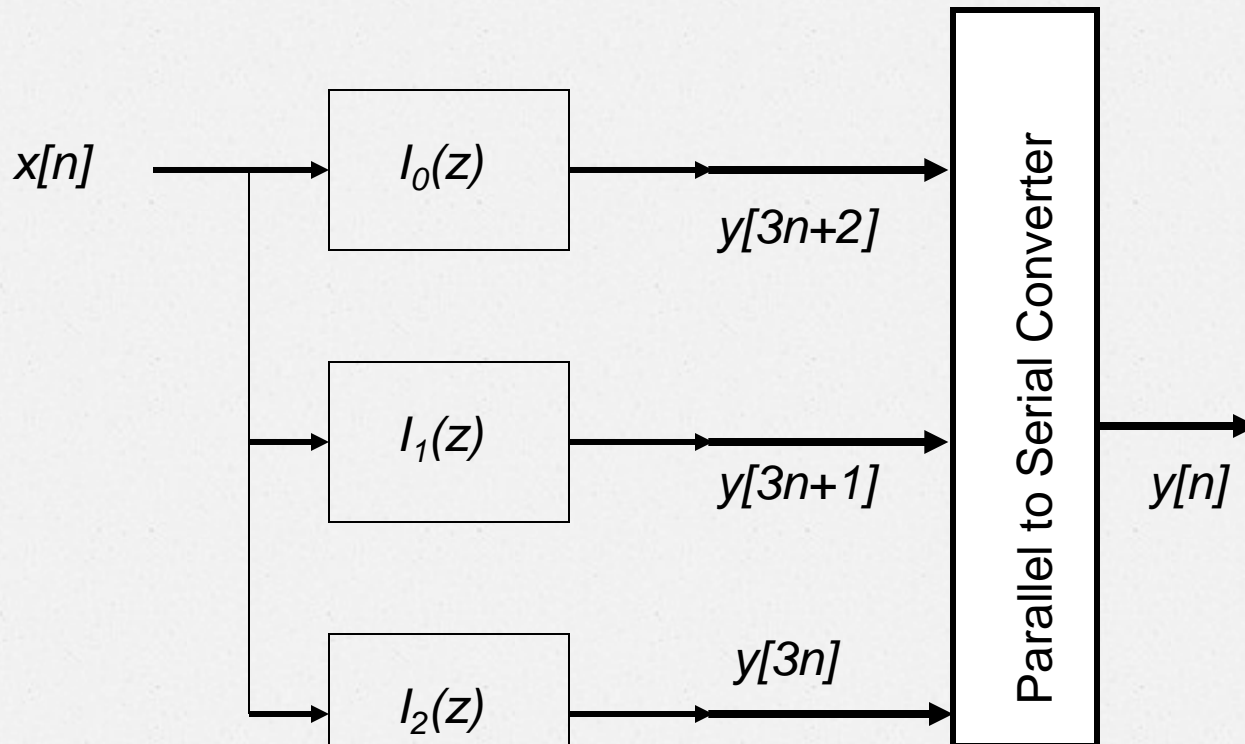

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Poly-phase Structure of Interpolation Filter

$$H(z) = z^{-2}I_0(z^3) + z^{-1}I_1(z^3) + I_2(z^3)$$

Poly-phase Structure of Interpolation Filter

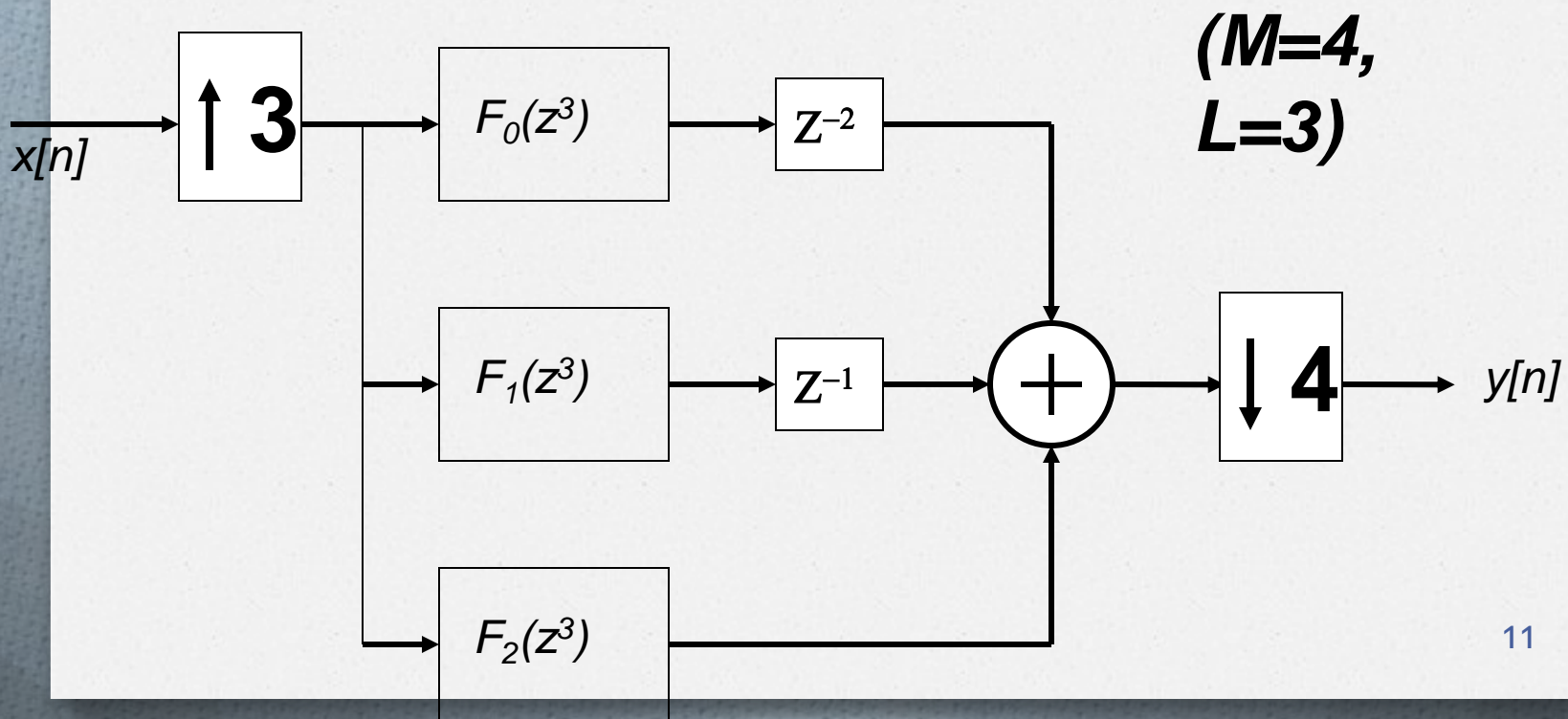$$H(z) = z^{-2}I_0(z^3) + z^{-1}I_1(z^3) + I_2(z^3)$$

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Poly-phase Structure of Fractional Sampling Rate Filter

$$H(z) = z^{-2}F_0(z^3) + z^{-1}F_1(z^3) + F_2(z^3)$$
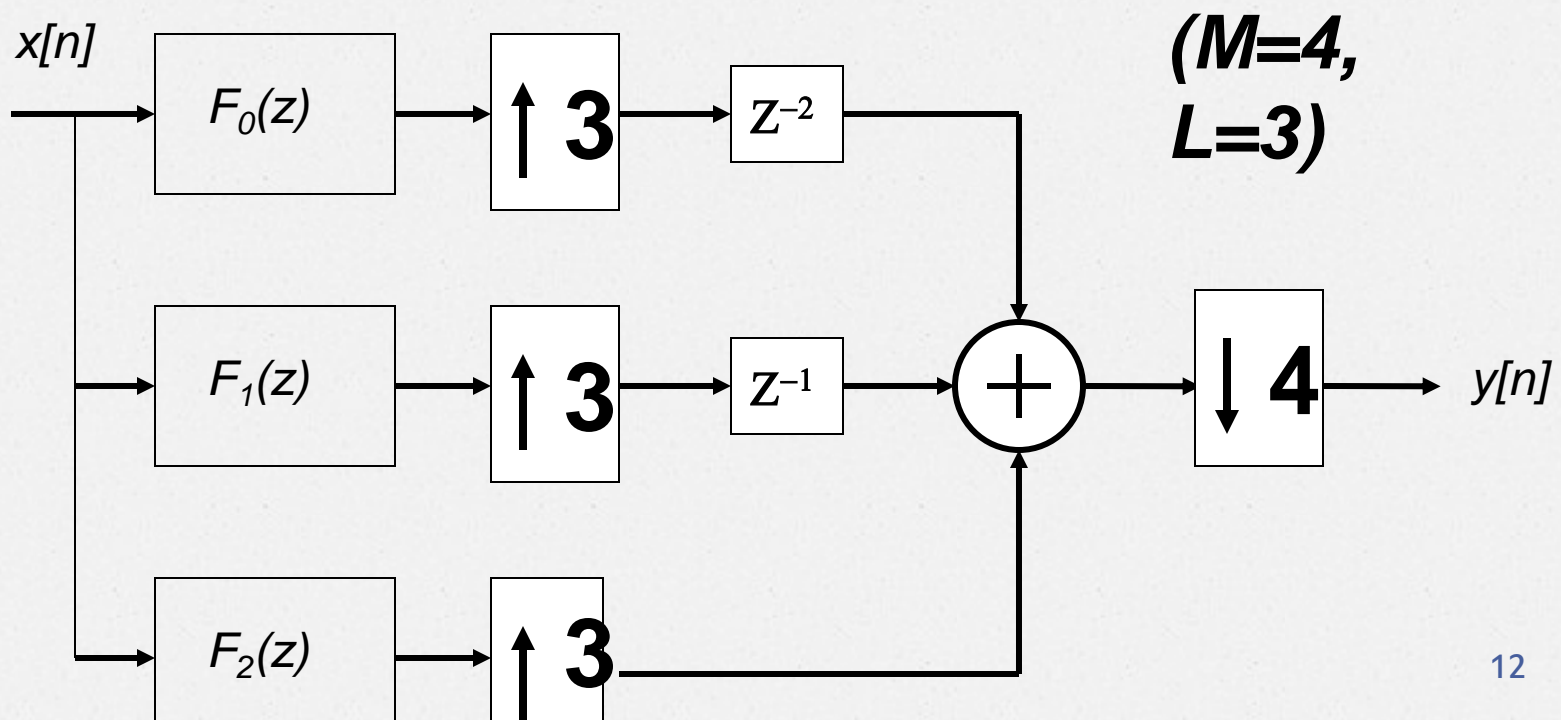

(M=4, L=3)

Poly-phase Structure of Fractional Sampling Rate Filter

$$H(z) = z^{-2}F_0(z^3) + z^{-1}F_1(z^3) + F_2(z^3)$$

(M=4, L=3)

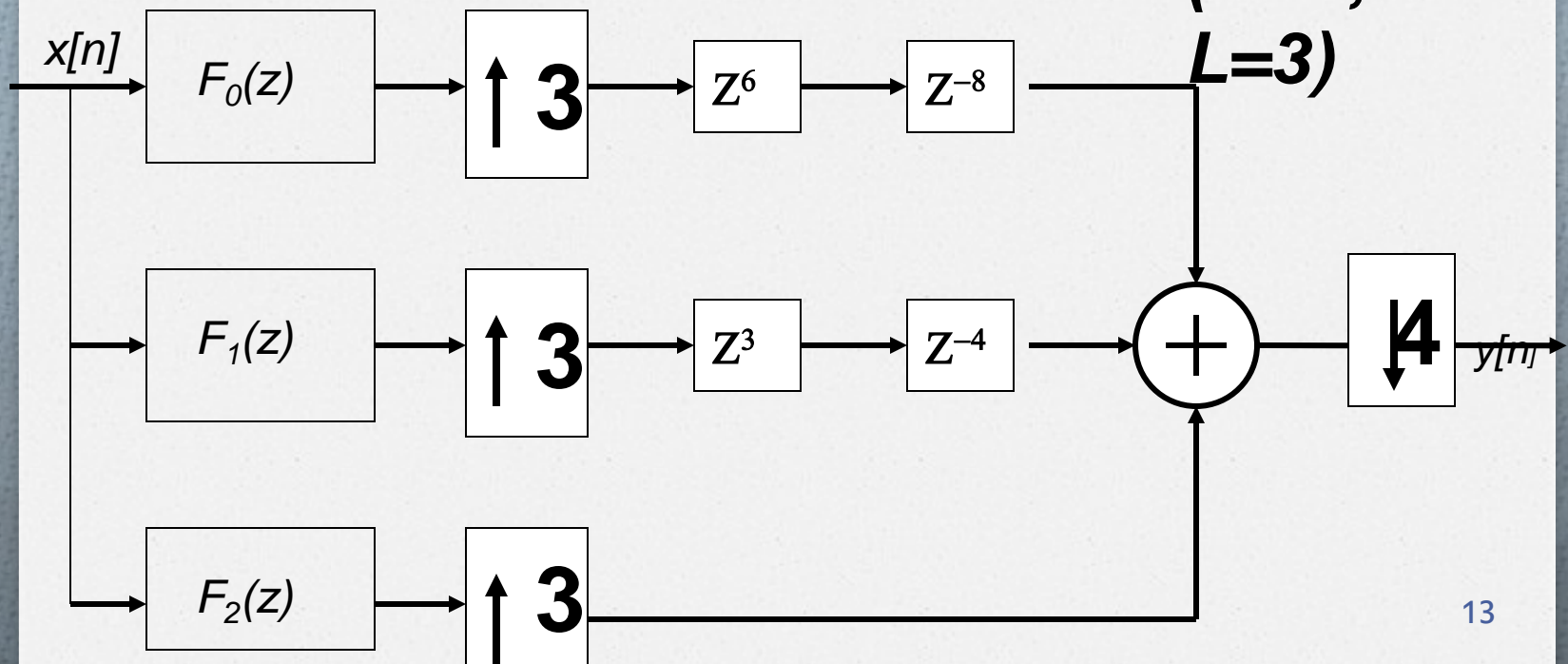# Poly-phase Structure of Fractional Sampling Rate Filter

$$H(z) = z^{-2}F_0(z^3) + z^{-1}F_1(z^3) + F_2(z^3)$$

(M=4, L=3)

Poly-phase Structure of Fractional Sampling Rate Filter

$$H(z) = z^{-2}F_0(z^3) + z^{-1}F_1(z^3) + F_2(z^3)$$

(M=4, L=3)

$x[n]$

| $F_0(z)$ | z^2 | ↑ **3** | ↓ **4** | z^{-2} |

| $F_1(z)$ | z^1 | ↑ **3** | ↓ **4** | z^{-1} |

| $F_2(z)$ | | ↑ **3** | ↓ **4** |

$+$ $y[n]$

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