Digital Filter Structures

- To implement a digital filter, we need to translate a given transfer function into a difference equation. For example,

$$H(z) = \frac{z^2 - 0.2z - 0.08}{z^2 + 0.5}$$

- Thus

$$H(z) = \frac{1 - 0.2z^{-1} - 0.08z^{-2}}{1 + 0.5z^{-2}} = \frac{Y(z)}{X(z)}$$

$$\Rightarrow Y(z)(1 + 0.5z^{-2}) = X(z)(1 - 0.2z^{-1} - 0.08z^{-2})$$

- Then, the inverse z-transform yields the difference equation

$$y(n) + 0.5y(n-2) = x(n) - 0.2x(n-1) - 0.08x(n-2)$$

$$\Rightarrow y(n) = x(n) - 0.2x(n-1) - 0.08x(n-2) - 0.5y(n-2)$$

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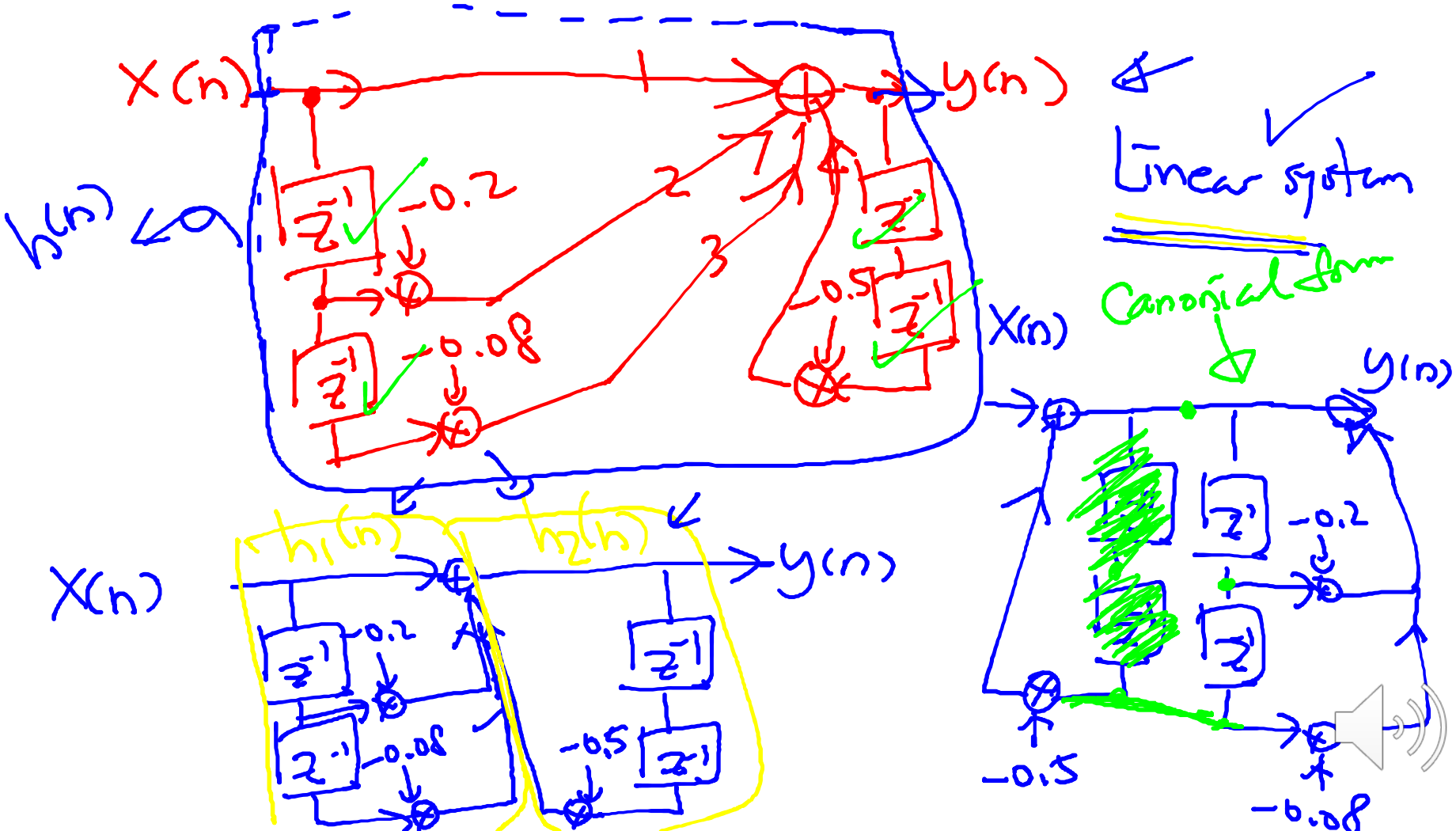
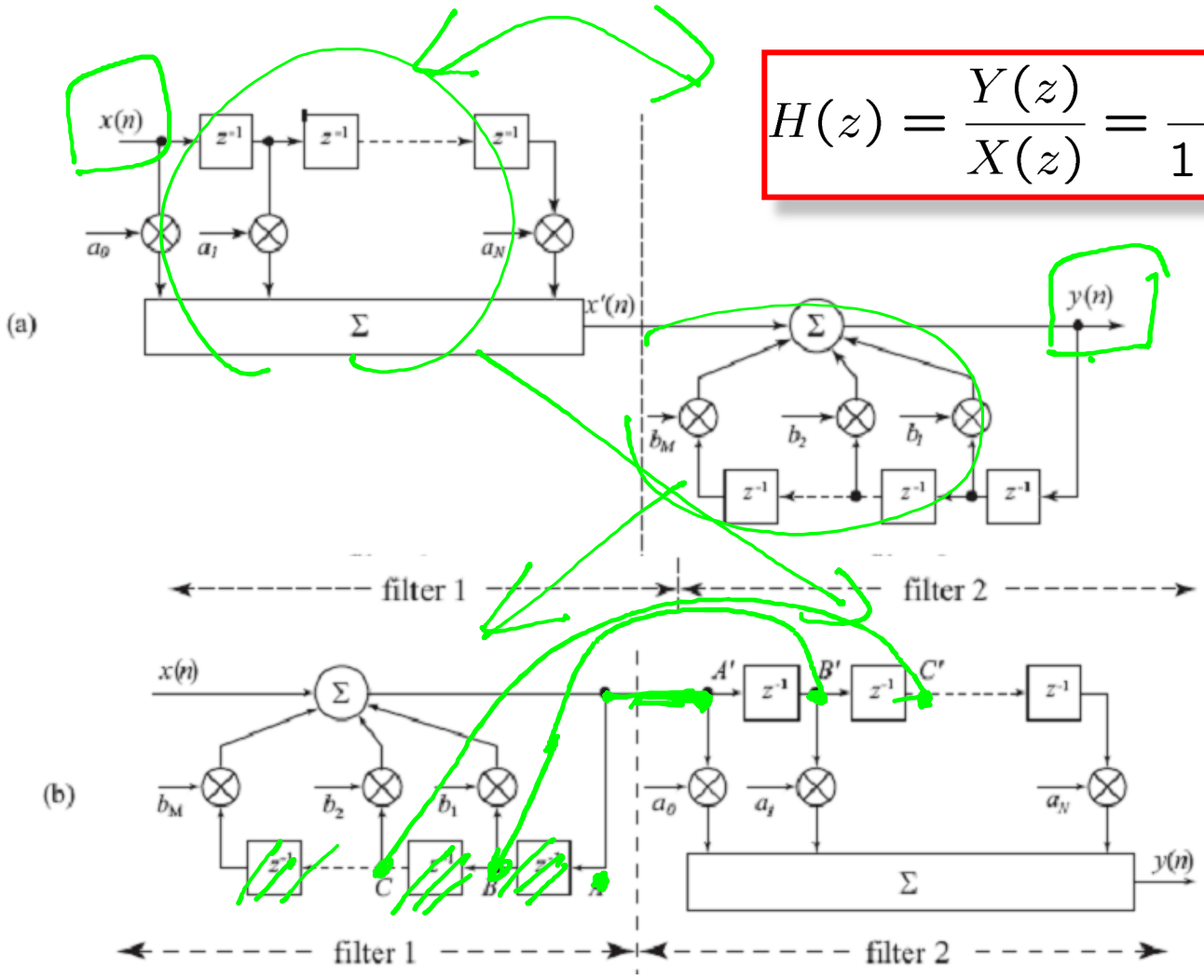
$$\Rightarrow y(n) = x(n) - 0.2x(n-1) - 0.08x(n-2) - 0.5y(n-2)$$

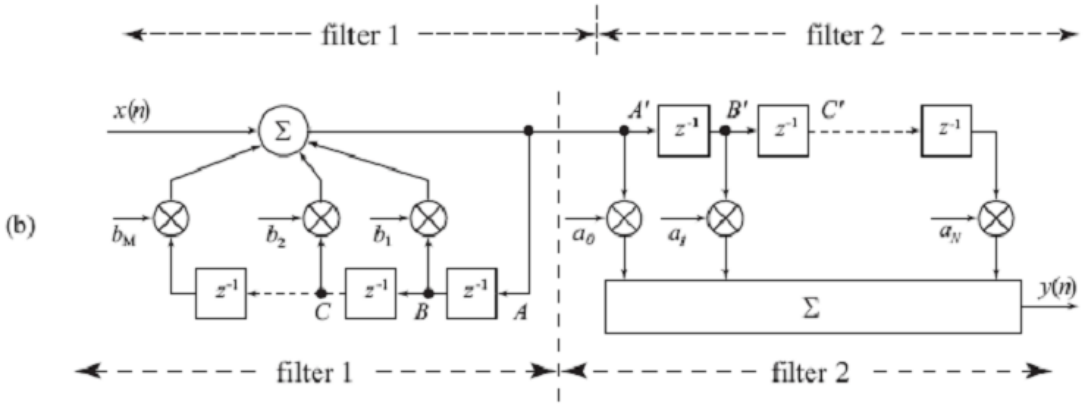


IIR Digital Filter Realisation

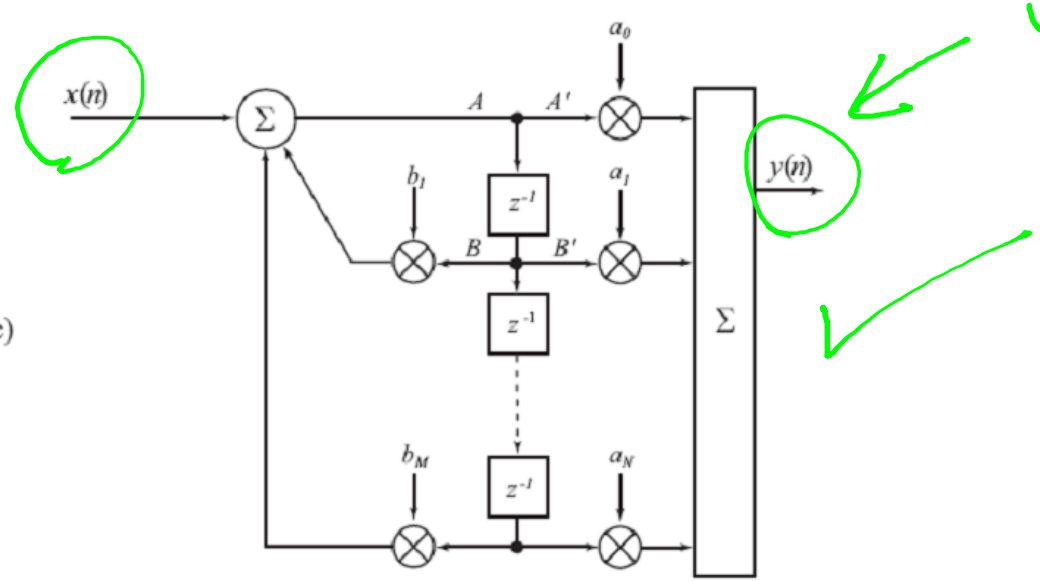
$$H(z) = \frac{Y(z)}{X(z)} = \frac{\sum_{i=0}^{N} a_i z^{-i}}{1 - \sum_{i=1}^{M} b_i z^{-i}}$$



The Canonical Form Implementation



(b)



(c)