ELE6XXE
Lectures

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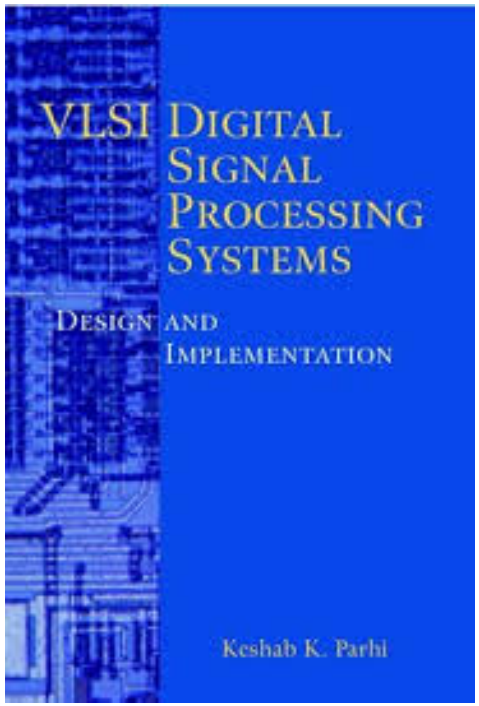
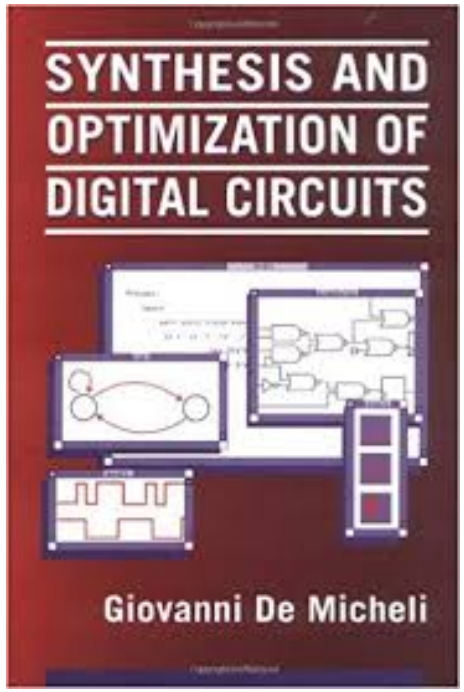
Course information





- K. K. Parhi, VLSI Digital Signal Processing Systems Design and Imp.
- Giovanni De Micheli - Synthesis and Optimization of Digital Circuits.

Reading : Keshab K. Parhi, "High-level algorithm and architecture transformations for DSP synthesis," Journal of VLSI signal processing systems for signal, image and video technology, 10.1007/BF02406474, 1995

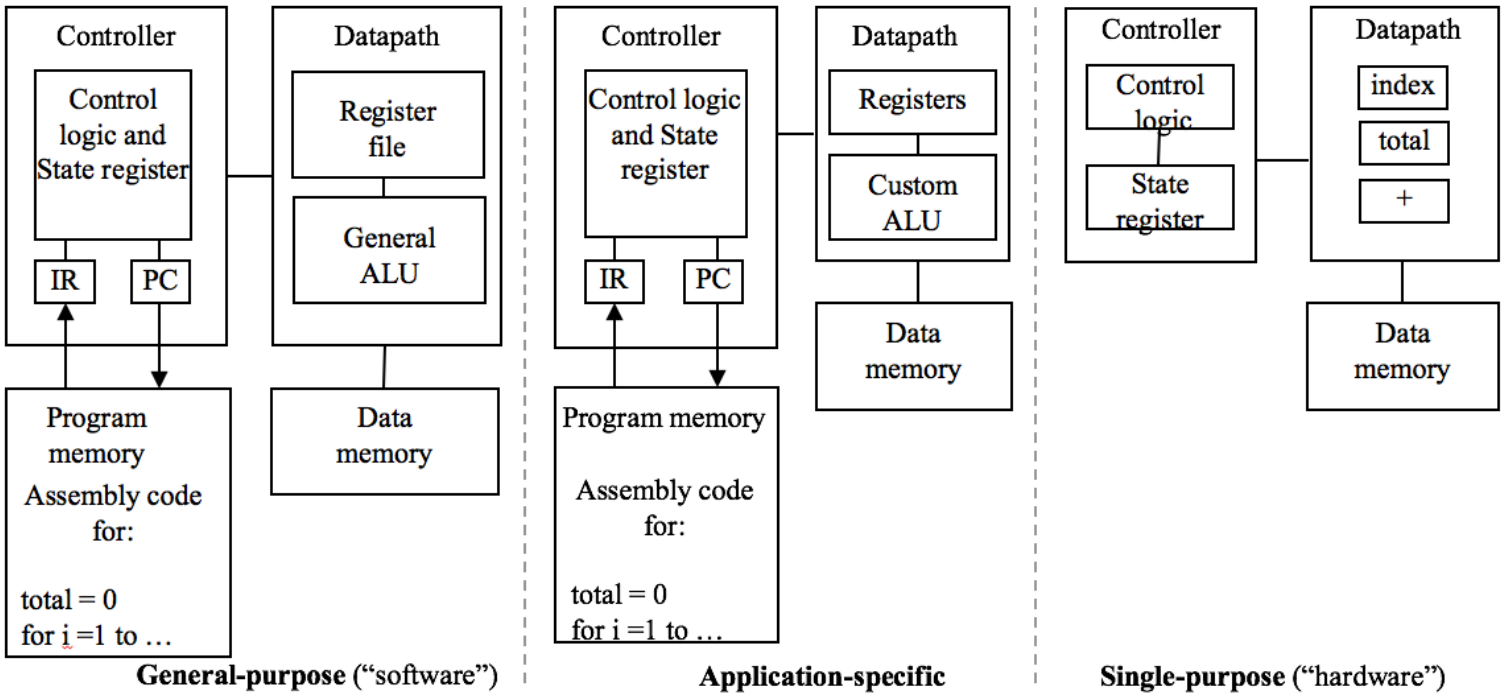
Scope of the Course

To obtain an efficient implementation of a signal processing algorithm in a structured way.

- Folding
- Unfolding
- Pipelining
- Parallelism
- Strength reduction

Three key technologies for embedded systems

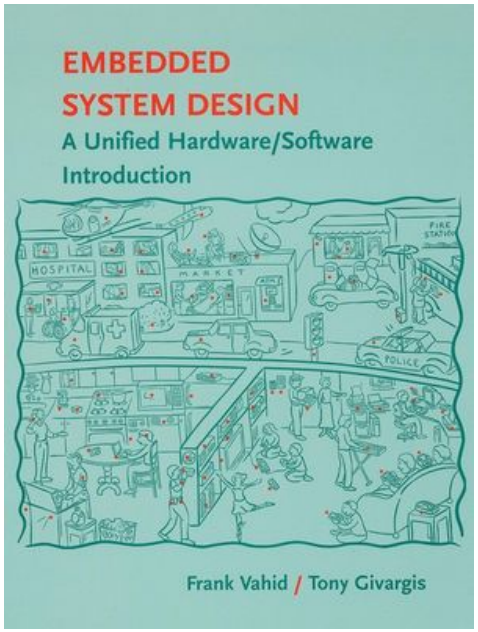
The architecture of the computation engine used to implement a system's desired functionality



Main focus of this Course: FPGA and ASIC

Source: Embedded System Design: A Unified Hardware/Software Introduction Frank Vahid and Tony Givargis John Wiley Sons, 2002.

Introduction to Embedded Systems

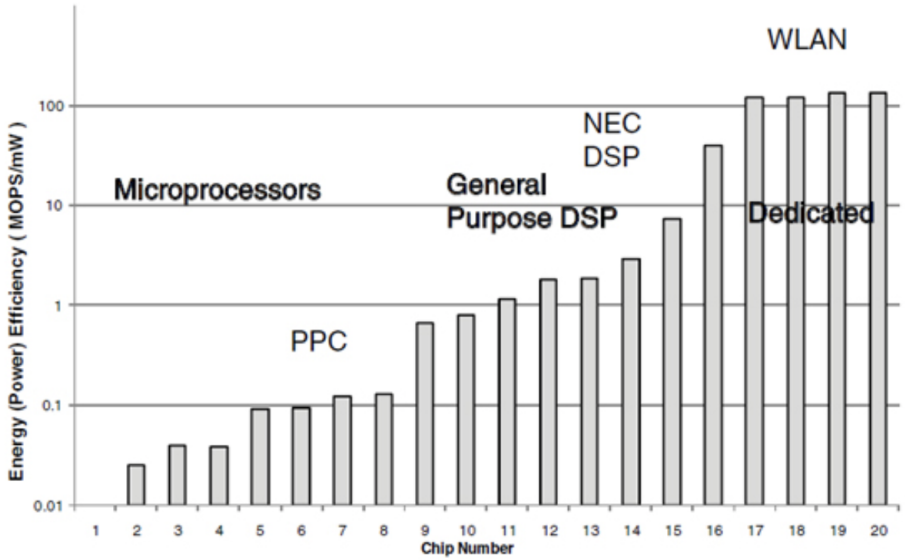


Read: Frank Vahid and Tony Givargis- Embedded System Design: A Unified Hardware/Software Introduction, John Wiley Sons, (2002).

- ▸ EHB326E, Introduction to Embedded Systems, Week 1-6

Design issues

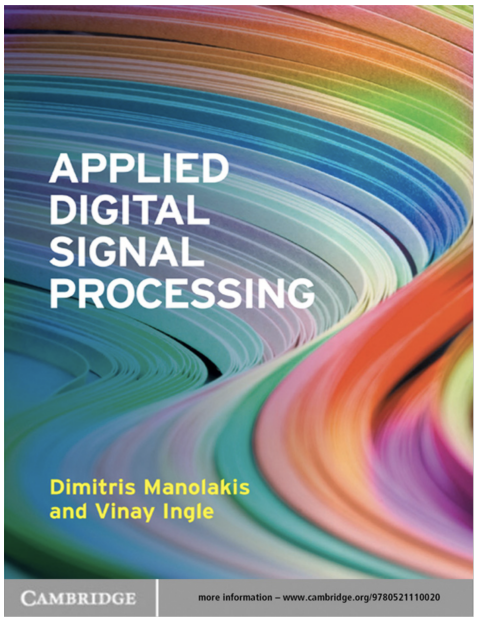
Specialized architectures which will be introduced in this course could be used for either FPGA or ASIC. ▸ Features and Benefits of Single-purpose/Application-specific
Key design issues: Energy Efficiency



▸ National Research Council. 2011. The Future of Computing Performance.

The data are somewhat dated, but all chips were designed for similar 0.18- to 0.25-m CMOS technology, and one can see that the ASIC designs are roughly 3 orders of magnitude more energy-efficient than the general-purpose processors.

Introduction to DSP



Read: Dimitris G. Manolakis, Vinay K. Ingle - Applied Digital Signal Processing Theory and Practice -Cambridge University Press (2011), Chapter 1.

- Digital Signal Processing, MIT Open Courseware
- Digital signal processor (also DSP), From Wikipedia
- EHB433: Sayısal Filtreler ve Sistemler, Week-1 and Week-2

Recursive and non-recursive systems

- non-recursive system

$$y(k) = \sum_{i=0}^{m} b_i x(k-i)$$

Finite impulse response (FIR) ▸ EHB433: Sayısal Filtreler ve Sistemler, Week-5 and Week-6

- recursive system

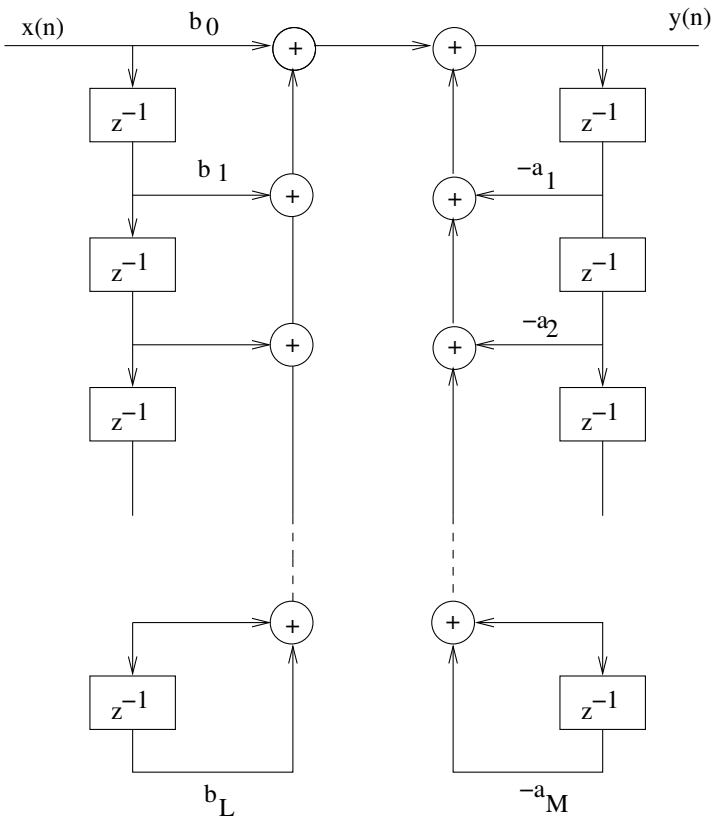
$$y(k) = \sum_{i=1}^{n} a_i y(k-i) + \sum_{i=0}^{m} b_i x(k-i)$$

Infinite impulse response (IIR) ▸ EHB433: Sayısal Filtreler ve Sistemler, Week-3 and Week-4

Filter Design

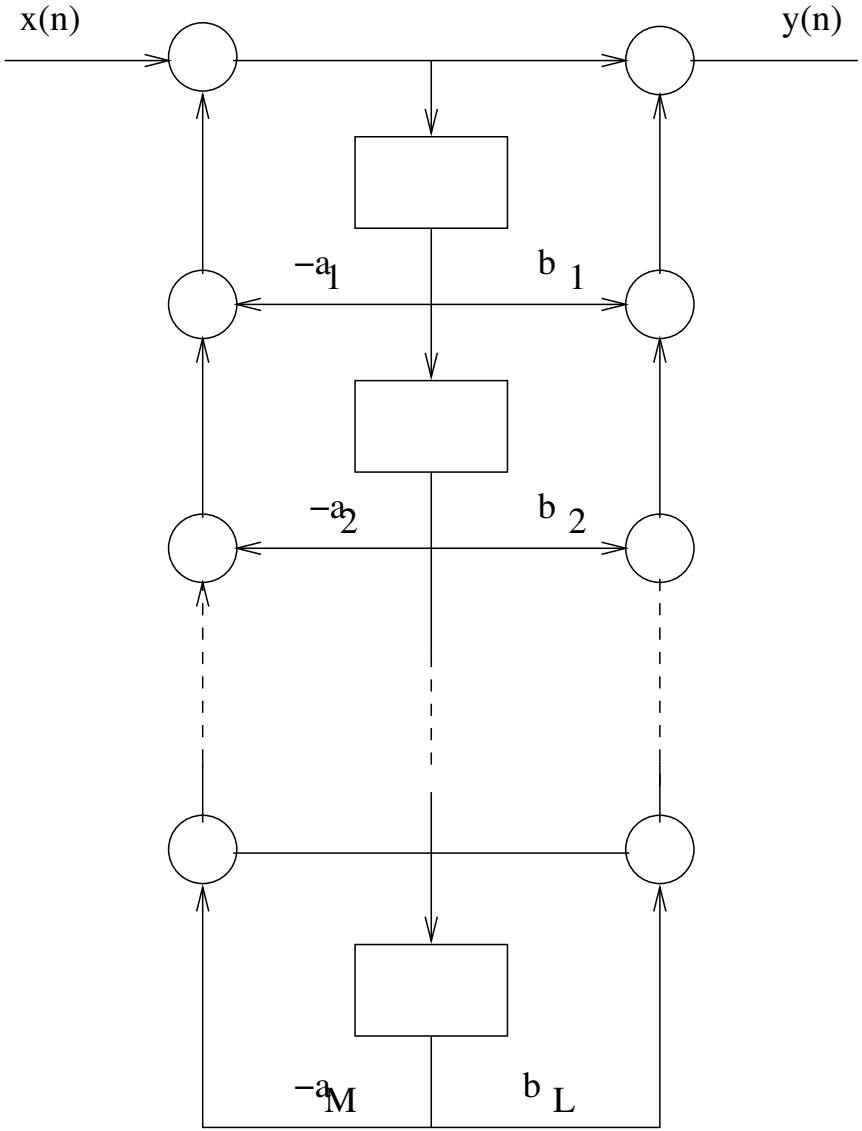
- *Infinite impulse response (IIR) Filter Design*

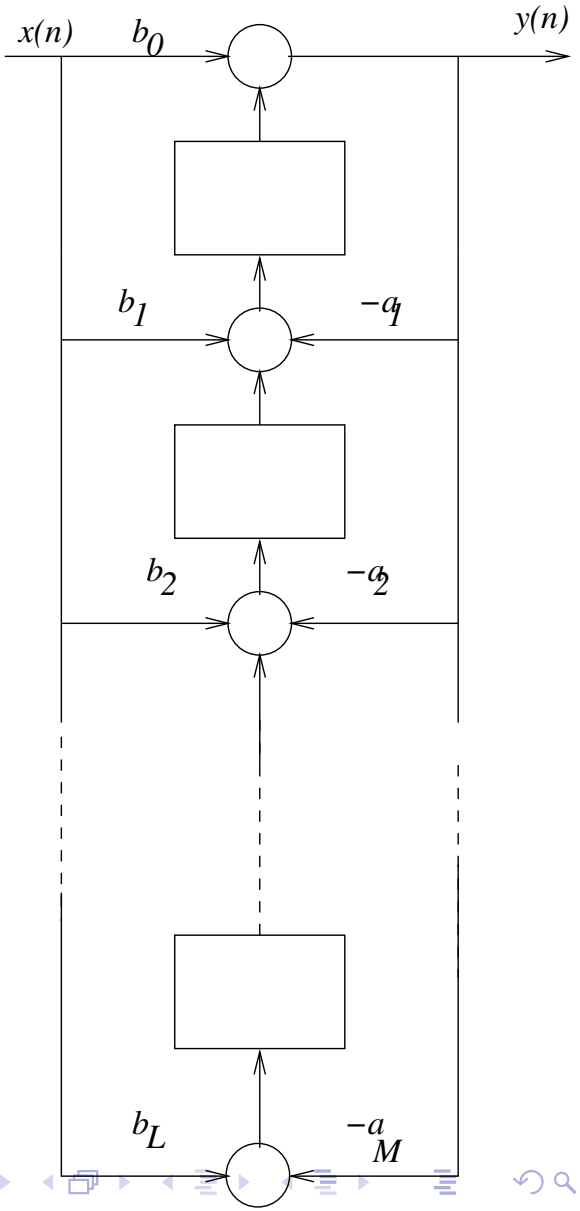
$$H(z) = \frac{Y(z)}{X(z)} = \frac{\sum_{i=0}^{L} b_i z^{-i}}{1 + \sum_{i=1}^{M} a_i z^{-i}}$$



direct form I

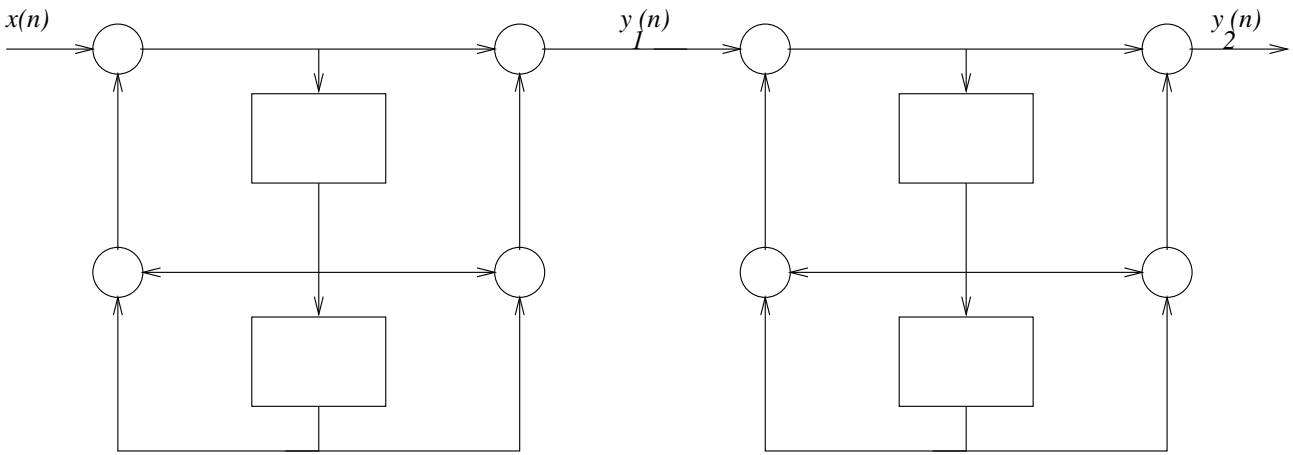
Direct form I and II





Cascade form

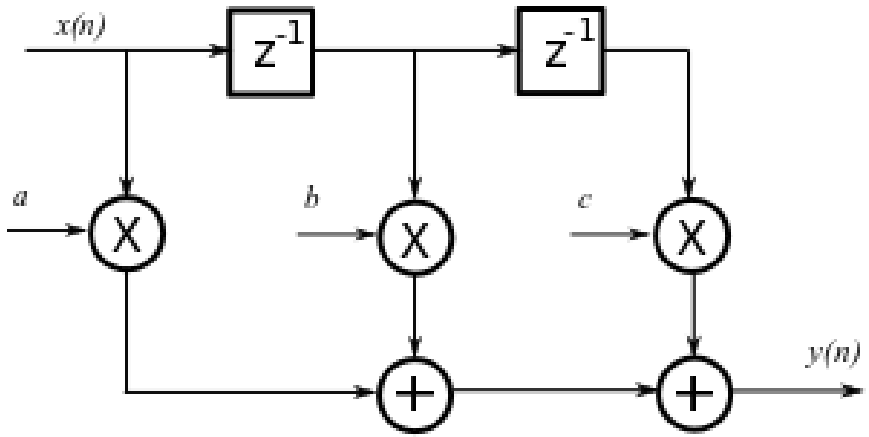
$$H(z) = G \prod_{i=1}^{K} \frac{b_{k0} + b_{k1} z^{-1} + b_{k2} z^{-2}}{1 + a_{k1} z^{-1} + a_{k2} z^{-2}}$$



$[sos, G] = tf2sos(b, a)$

Finite impulse response (FIR)

$$y(n) = ax(n) + bx(n-1) + cx(n-2)$$



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Finite impulse response (FIR)

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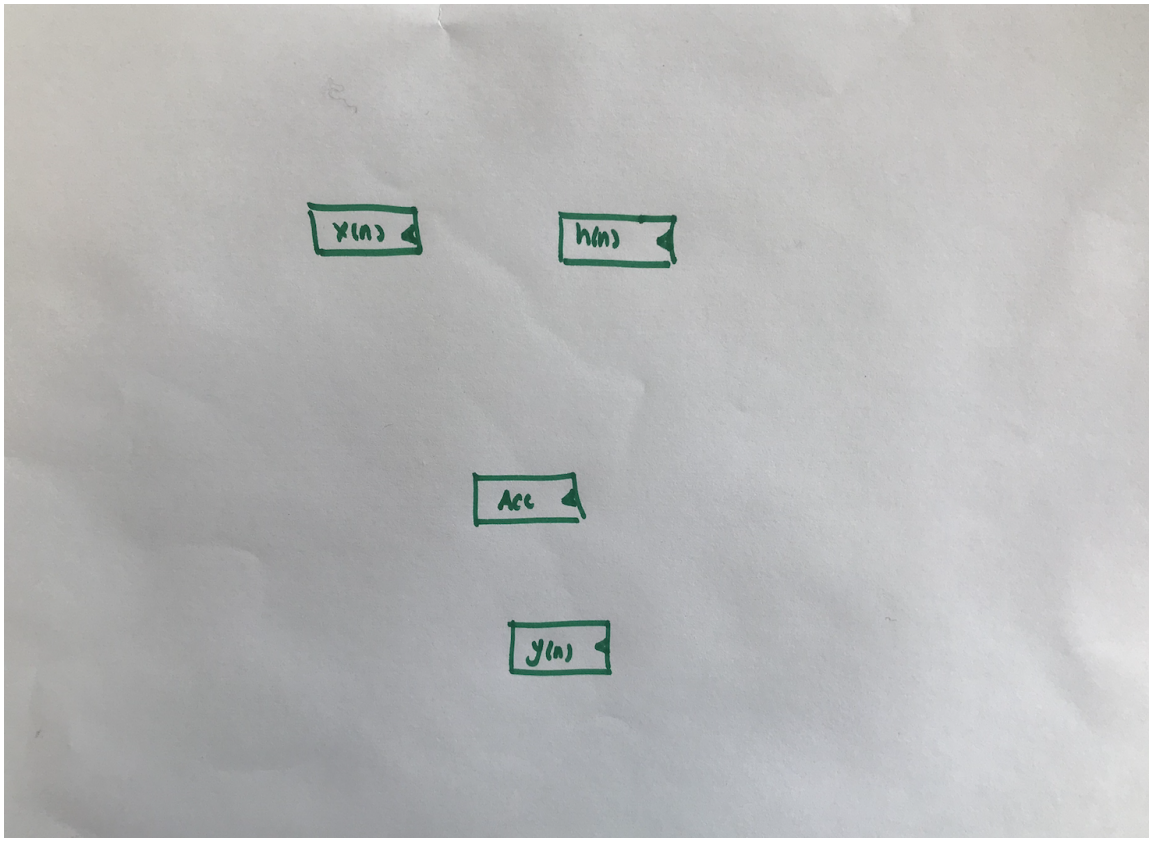

- EHB326E Introduction to Embedded Systems, Algorithm to FSDM and then Hardware, Week-5

Finite impulse response (FIR)

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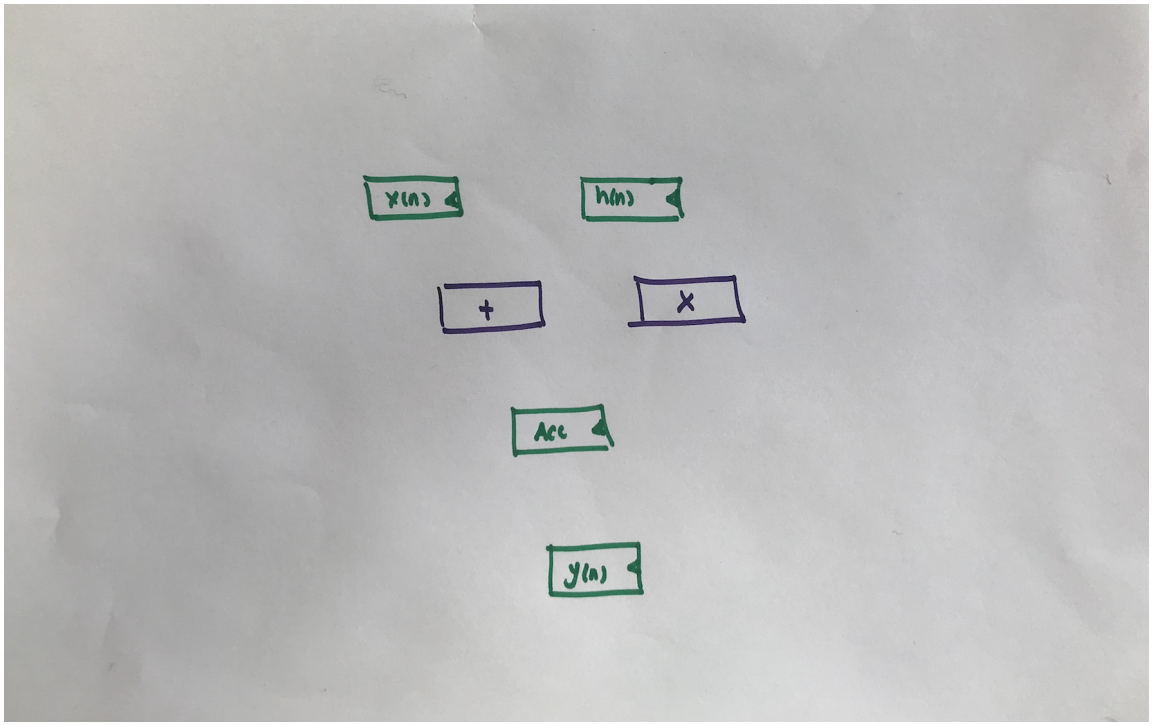

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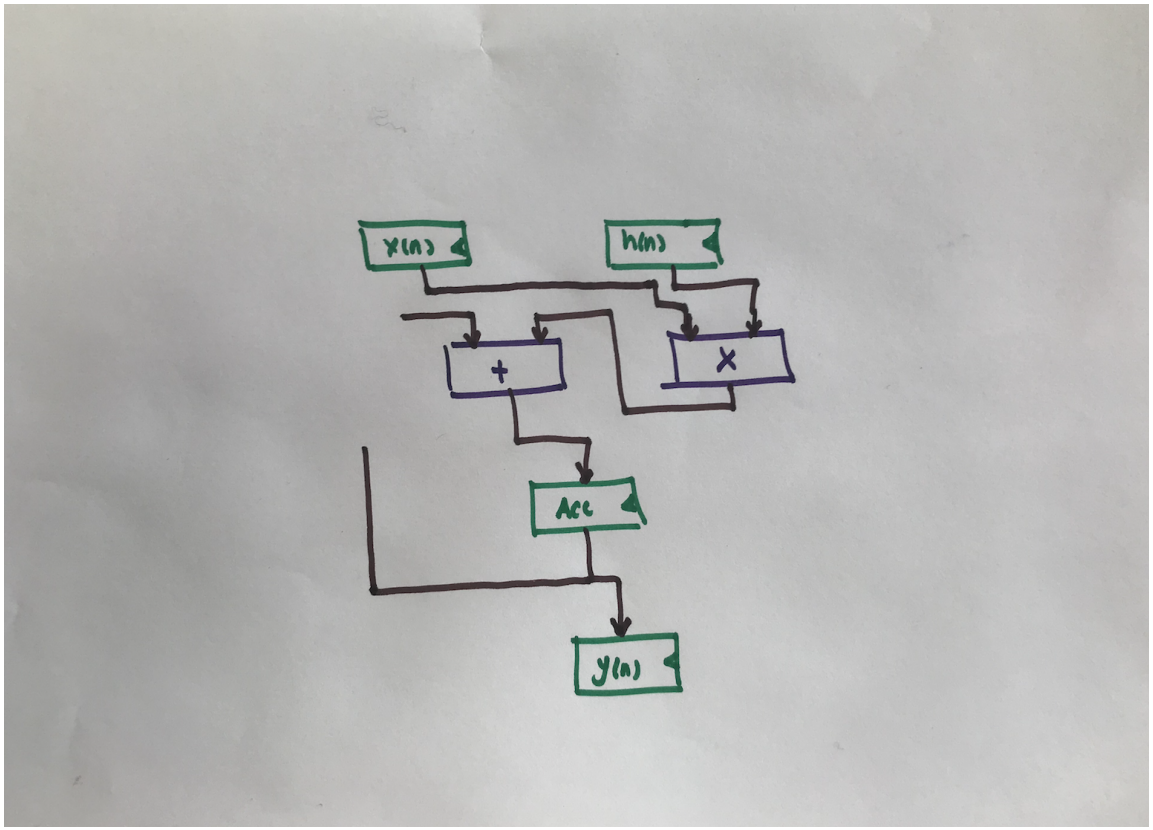

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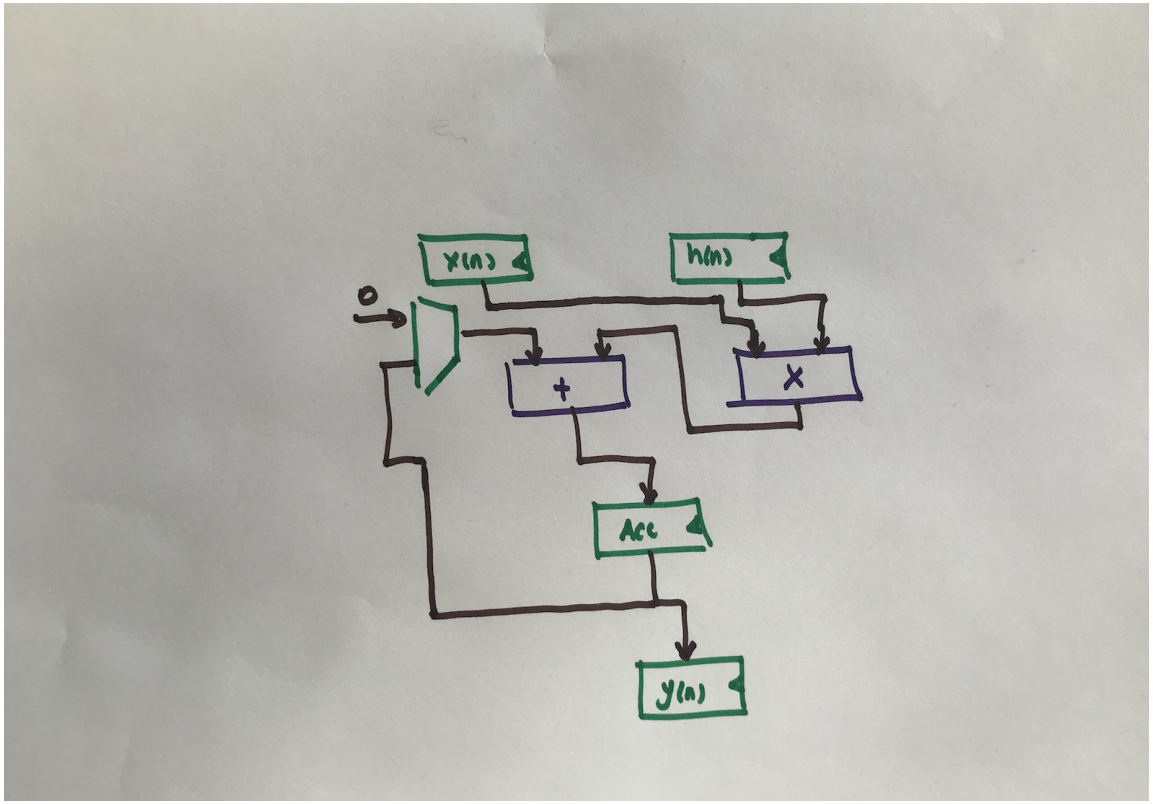
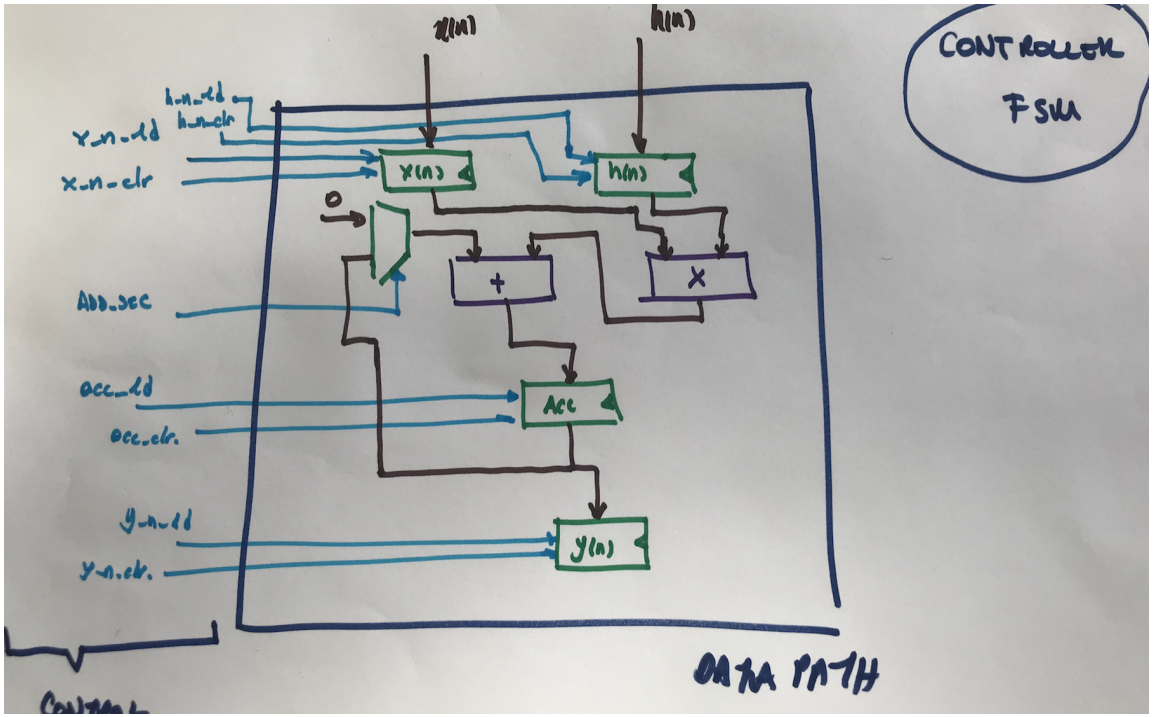


Finite impulse response (FIR)

$$y(n) = ax(n-1) + bx(n-1) + cx(n-2)$$



Solution for $h(n)$ and $x(n)$?