CHW 469 : Embedded Systems

Instructor:

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https://piazza.com/fci.bu.edu.eg/spring2017/chw469/home

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Dr. Ahmed Shalaby

Academic Position: Lecturer

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Publications [Titles(4) :: Papers(2) :: Abstracts(4) **]**

Inlinks(6) :: Courses Files(4) | Total points :49

News

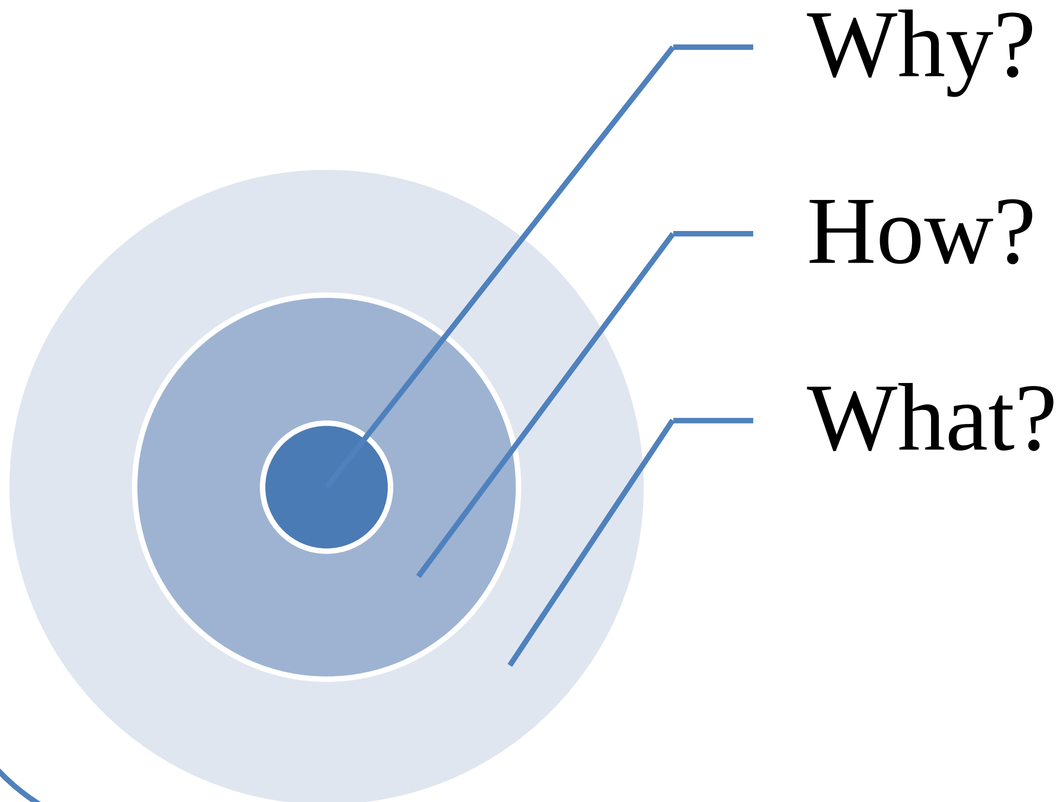
IOT Project Update [2016-11-14]

Smart Water Management Irrigation System (SWMIS) project moves to field test phase on November 2016. more

Research Interests

System on Chip, Network on Chip, VLSI, Embedded System, High Efficiency Video Coding (HEVC)

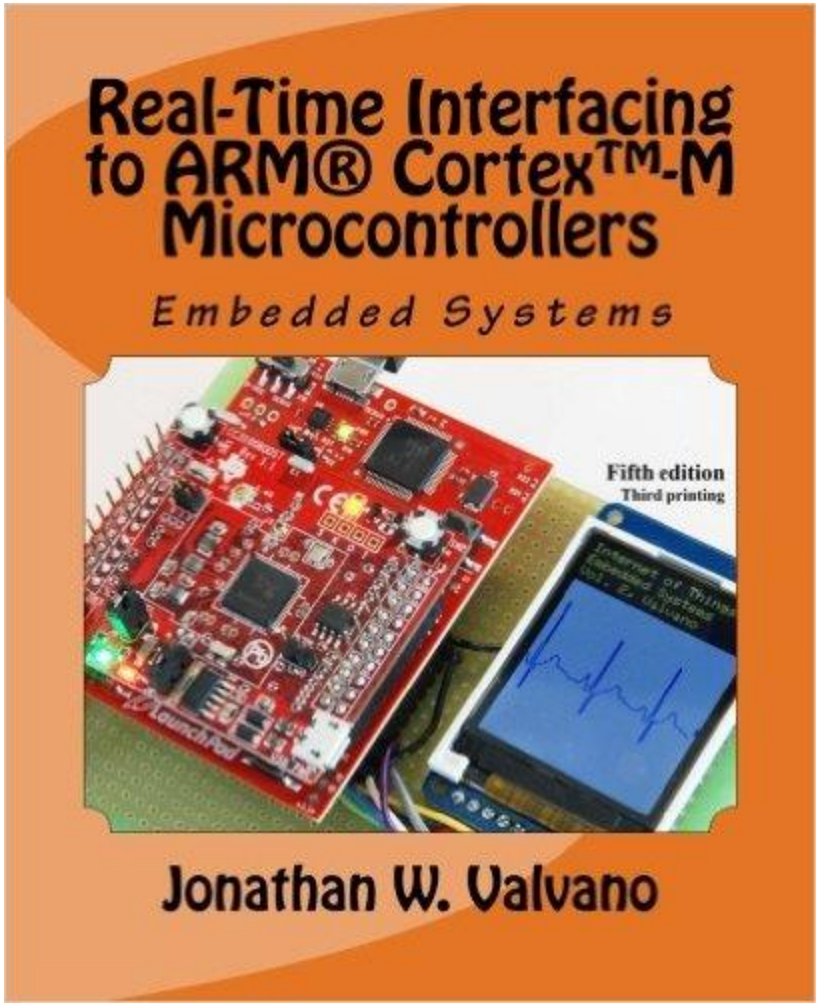
Study: CHW 469 Embedded Systems

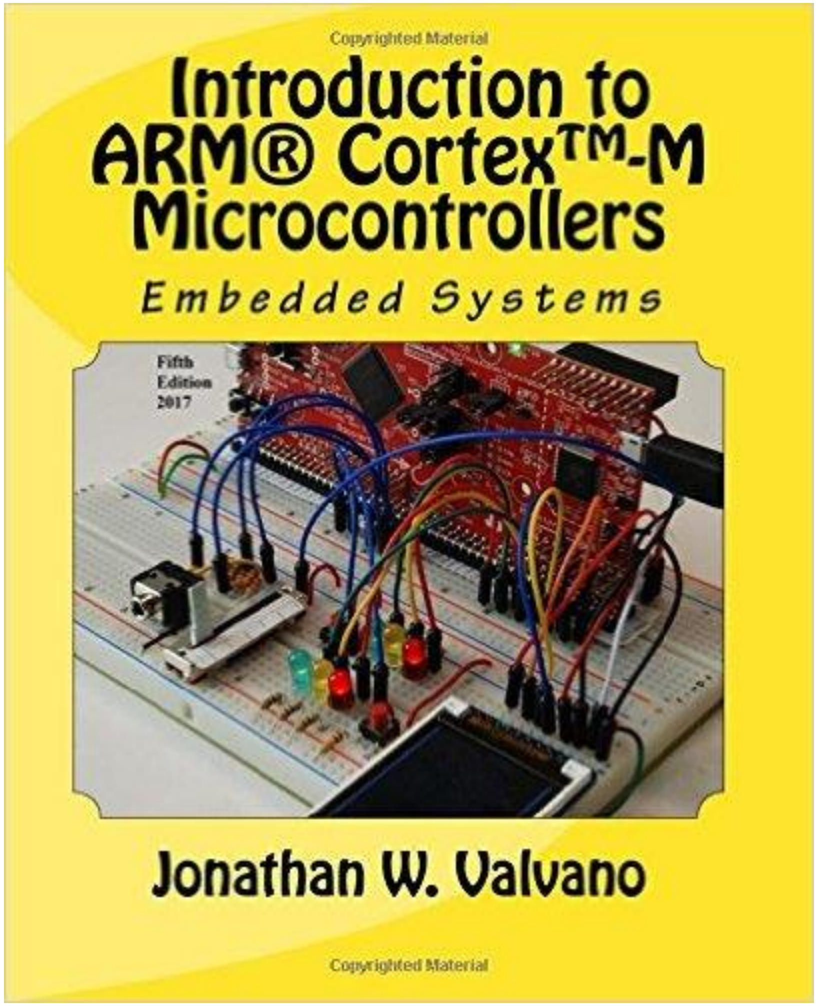


What ? Embedded Systems

- **Embedded computing system: any device that includes a programmable computer but is not itself a general-purpose computer.**
- **Take advantage of application characteristics to optimize the design.**

How ? Course Book





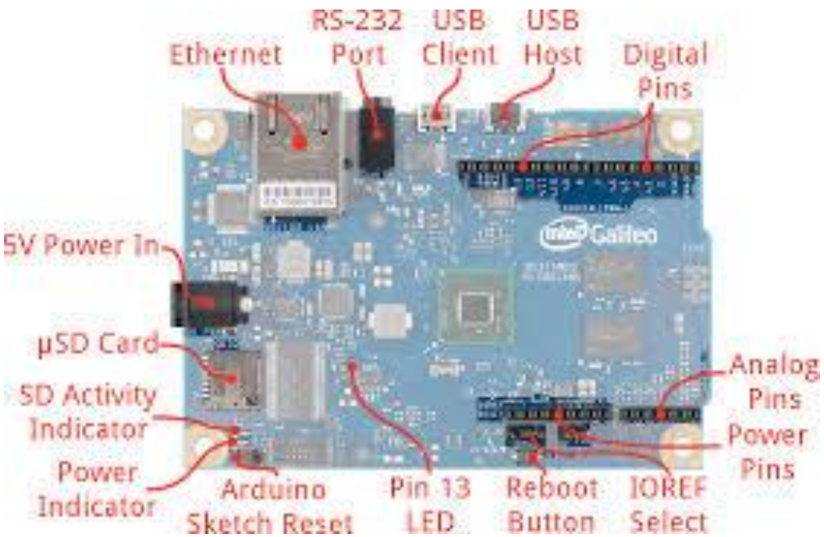
http://users.ece.utexas.edu/~valvano/arm/

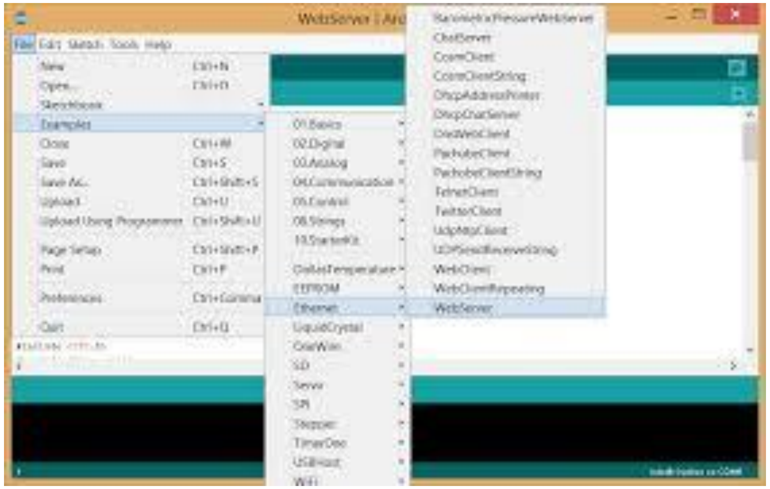
How ? Course Content

Lec #	Subject	Week #
Lec1	Introduction to Computers and Electronics	Week #1
Lec2	Introduction to Embedded Systems	Week #2
Lec 3	Introduction to the ARM Cortex-M	Week #3
Lec 4	ARM- architecture	Week #4
Lec 5	Introduction to Input/ Output	Week #5
Lec 6	Modular Programming	Week #6
	Mid-term	Week #7
Lec 7	Pointers and Data Structures	Week #8
Lec 8	Variables, Numbers, and Parameter Passing	
Lec 9	Serial and Parallel Port Interfacing	Week #9
Lec 10	Interrupt Programming and Real-time Systems	Week #10
Lec 11	Analog I/O Interfacing	Week #11
Lec 12	Communication Systems	Week #12
Lec 13		Week #13

Assessment

Final-Term Examination	**65**
Mid-Term Examination	**10**
Practical Examination	**15**
Oral Examination	**10**



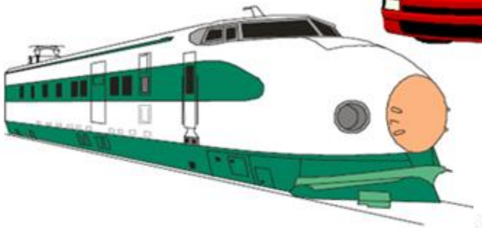


Why ? Embedded Systems

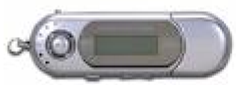






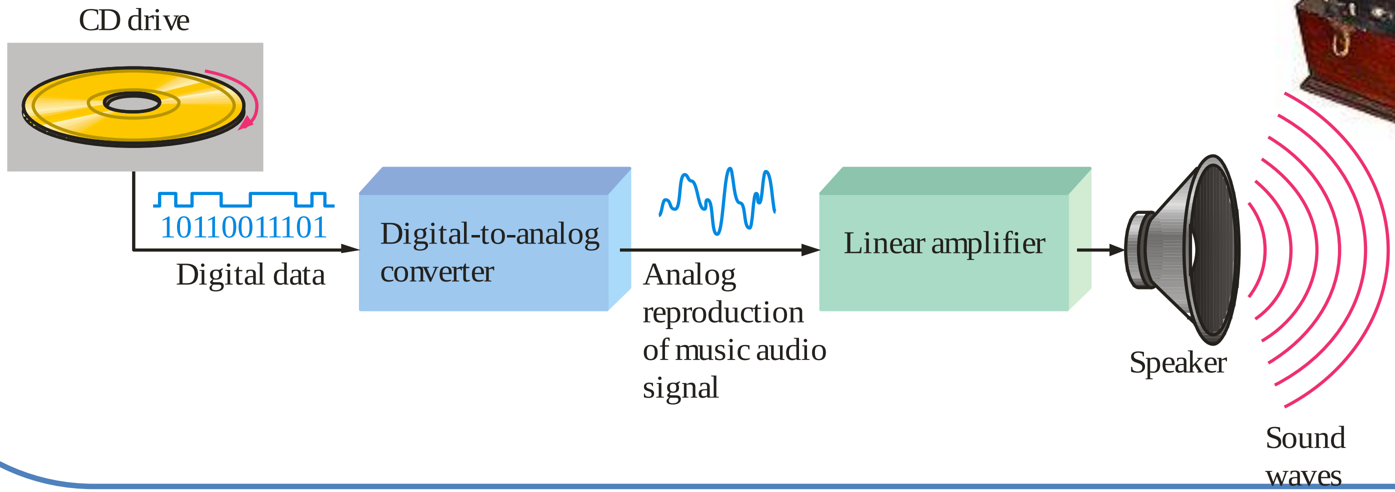








Digital System (Why)

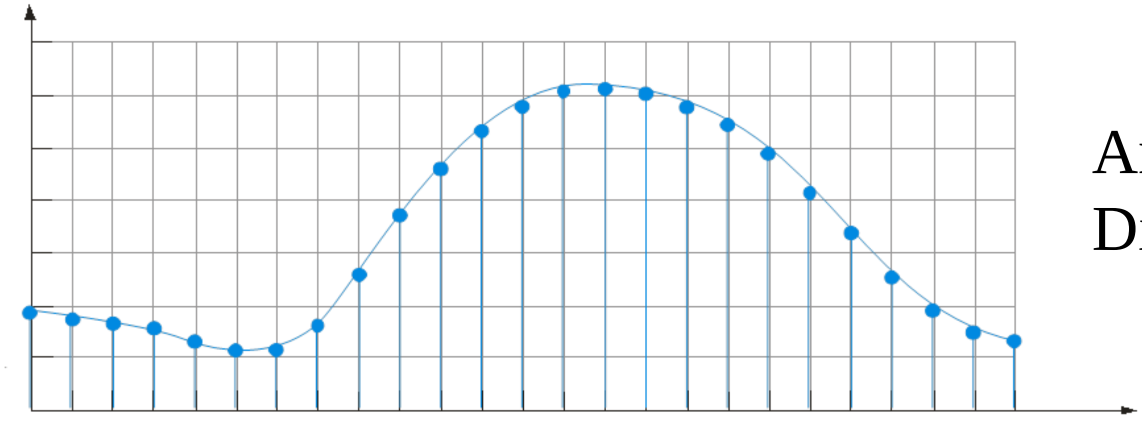
- Easier to design.
- Flexibility and functionality.
  easier to store, transmit and manipulate information.
- Cheaper device.



Digital System (Why)

Analog vs. Digital

Most natural quantities (such as temperature, pressure, light intensity, …) are **analog** quantities that vary continuously.



Analog = continuous
Digital = discrete

Digital systems can process, store, and transmit data more efficiently but can only assign discrete values to each point.

Digital System Implementation Spectrum

Hardware
ASIC

Reconfigurable Architectures

Software

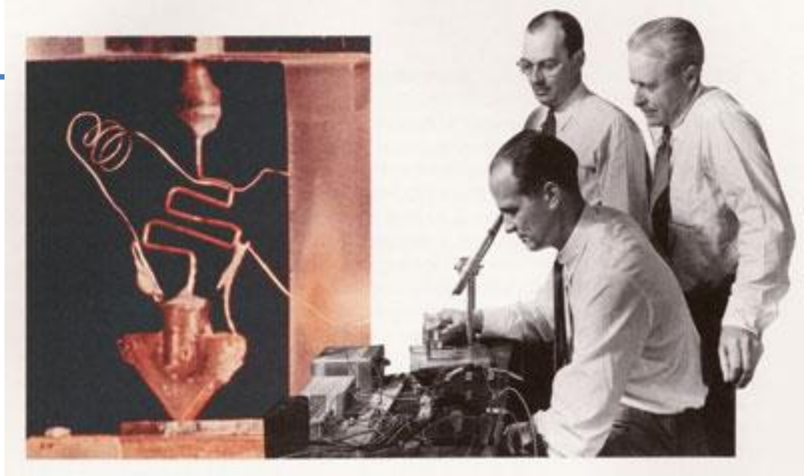
- μProcessor
- μController
- DSP

- CPLD
- FPGA
- Customized Processors
- Coarse Grain
- Reconfigurable Array

flexibility ⟷ efficiency

trade-off

History Snapshots



- **1947:** The **transistor** was invented

- **1958:** **Integrated Circuit (IC),** A transistor was integrated with resistors and capacitors on a single semiconductor chips.

- **1971:** **first commercially microprocessor**, Intel Corporation produced the Intel 4004 , giving birth to a family of **processors on a chip**.

- **1981:** The IBM PC (5150) was announced.

Moore's Law

- **Moore predicted that number of transistors on a chip doubles every 1.5 years.**
- Moore's Law implies :
  - – Processor speed doubles every 1.5 years.
  - – Memory density doubles every 1.5 years.
  - – Size of chip design team doubles every 1.5 years.
  - – Chip cost remains the same.

Moore's Law

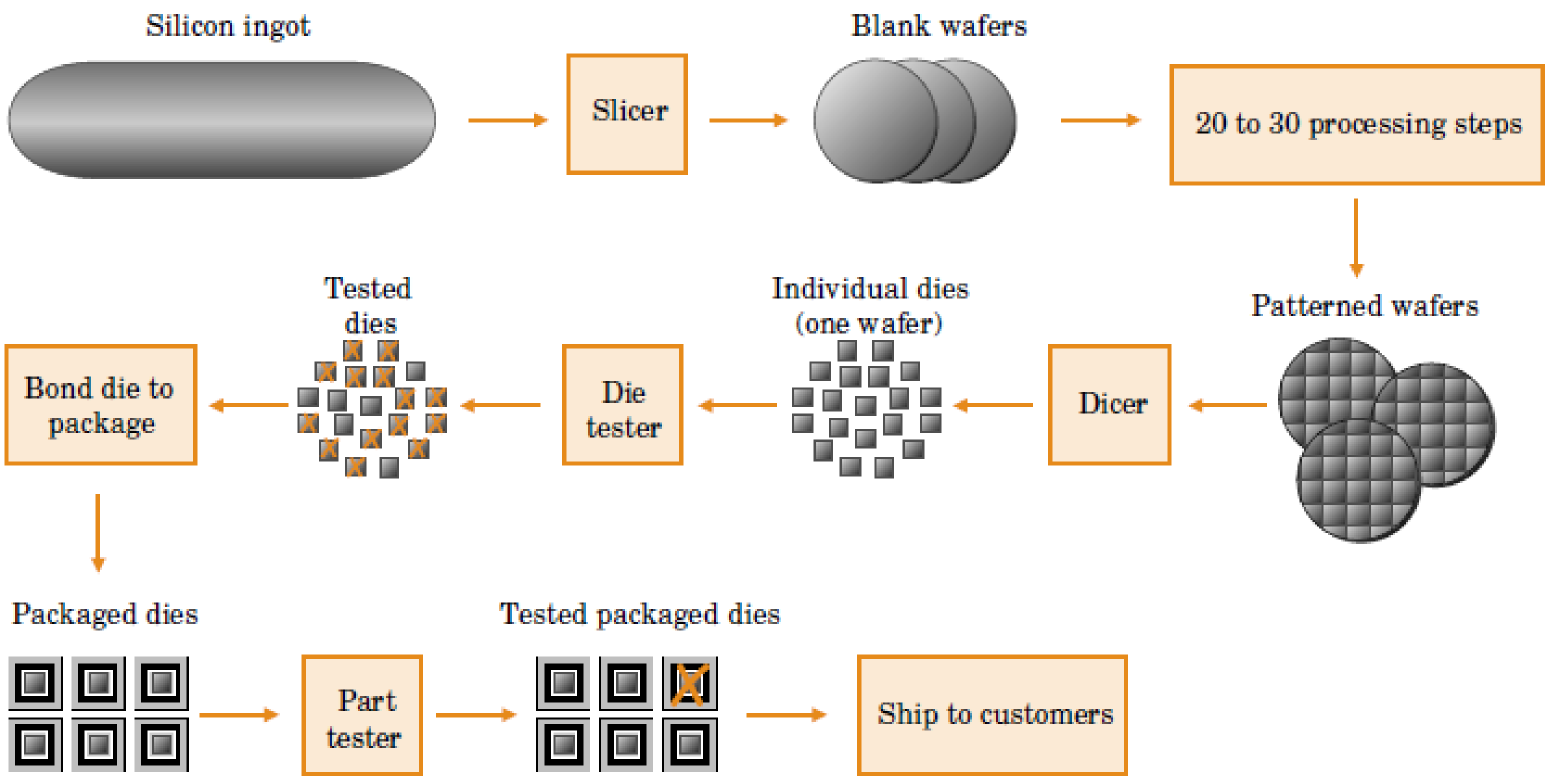
Microprocessor	Year of Introduction	Transistors
4004	1971	2,300
8008	1972	2,500
8080	1974	4,500
8086	1978	29,000
Intel286	1982	134,000
Intel386™ processor	1985	275,000
Intel486™ processor	1989	1,200,000
Intel® Pentium® processor	1993	3,100,000
Intel® Pentium® II processor	1997	7,500,000
Intel® Pentium® III processor	1999	9,500,000
Intel® Pentium® 4 processor	2000	42,000,000
Intel® Itanium® processor	2001	25,000,000
Intel® Itanium® 2 processor	2003	220,000,000
Intel® Itanium® 2 processor (9MB cache)	2004	592,000,000

http://www.intel.com/pressroom/kits/events/moores_law_40th/

Digital System (How)

[Silicon Run]

Digital System (How)



IC Technologies

- ASIC (Application Specific Integrated Circuit)
  - ❑ Full Custom (Transistor Level)
  - ❑ Standard Cell (Gate Level – libraries)
  - ❑ Gate Array (Gate Level already created of the wafer)
- Filed Programmable Devices
  - ❑ Complex
    - **Complex Programmable Logic Devices (CPLD)**
    - **Field Programmable Gate Array (FPGA)**
  - ❑ Simple
    - **Programmable logic Devices (PLD)**
- Off-The-Shelf Components
  - ❑ MSI / SSI (Transistor Transistor Logic TTL - Series 7400), (Complementary Metal Oxide Semiconductor CMOS - Series 4000)

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flexibility ⟵ trade-off ⟶ efficiency