PSI 3442
Projeto de Sistemas Embarcados

Sistemas Ciberfísicos

08/2023

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Antecedentes

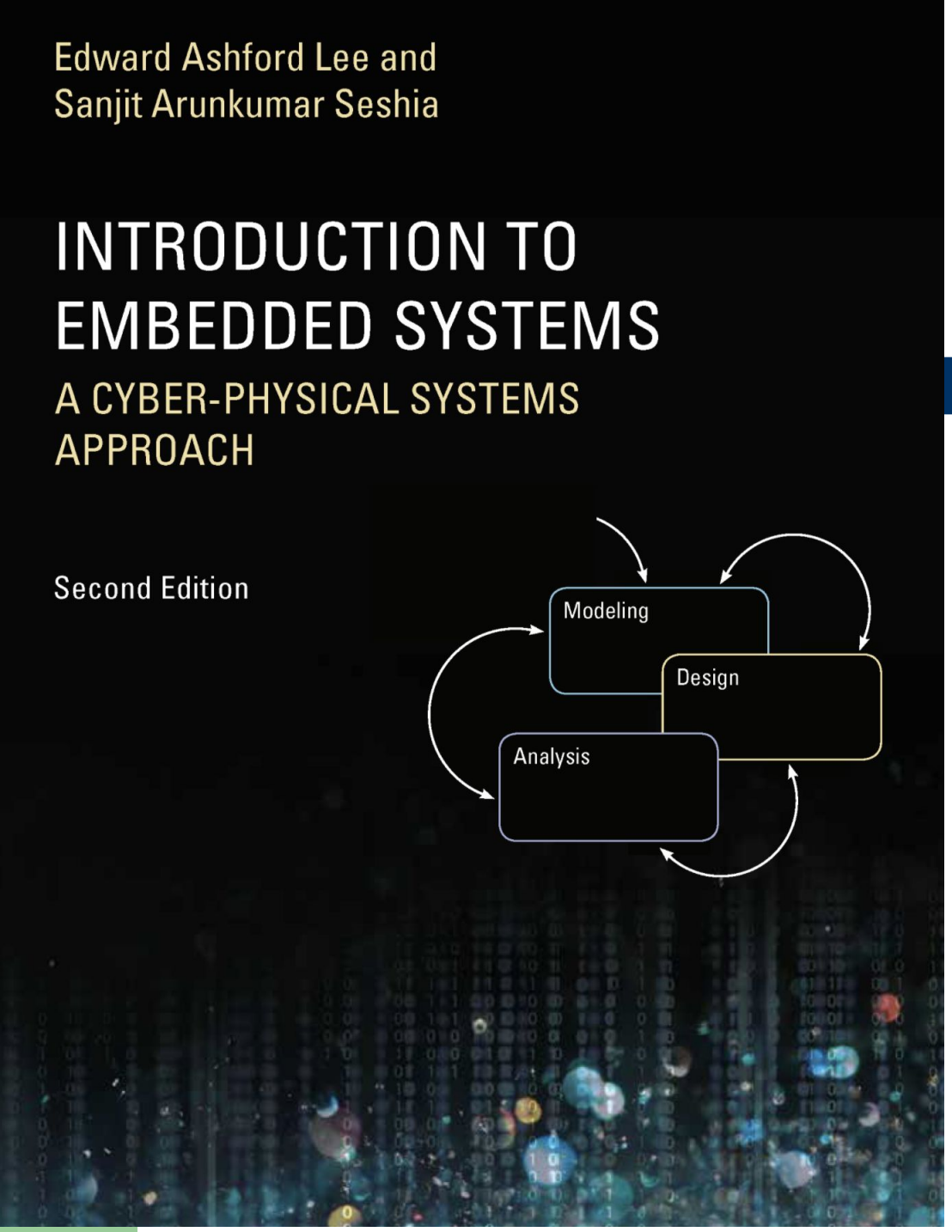
Na semana passada vimos:

a) uma breve introdução aos sistemas embarcados
b) uma apresentação geral sobre drones
c) Leitura do Livro Texto Lee&Sechia
    i) Pag. 1-16

Objetivos da disciplina

Capacitar os alunos a planejar, desenvolver e validar projetos de sistemas embarcados.

Numa Abordagem MODERNA!

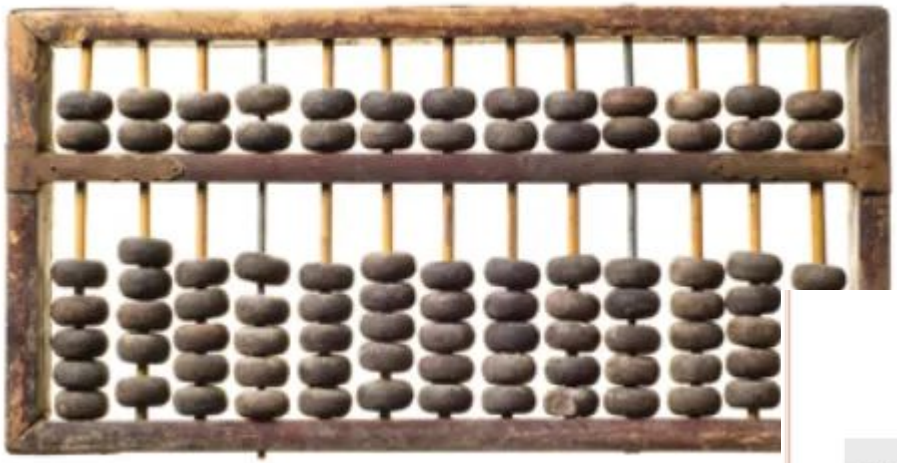


Lee and Seshia

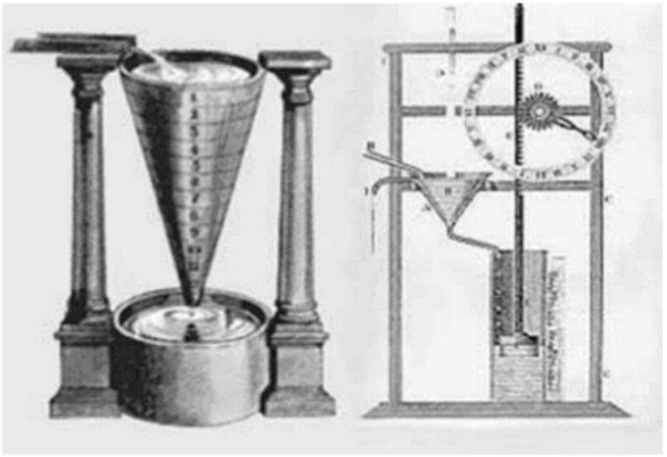
Introduction to Embedded Systems

— A Cyber-Physical Systems Approach
— Second Edition — MIT Press — 2017

Primordios da Computação

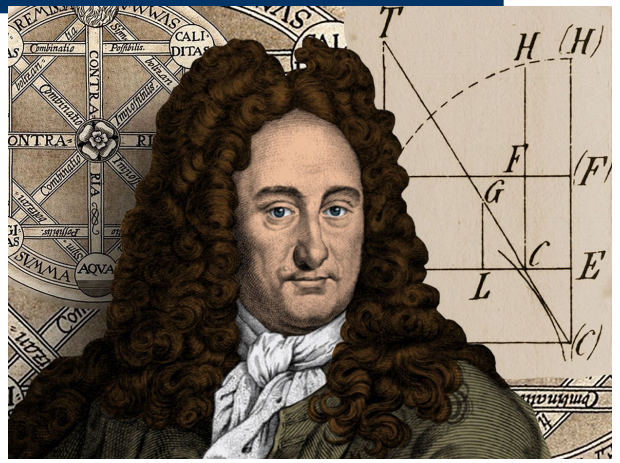


CLEPSIDRA



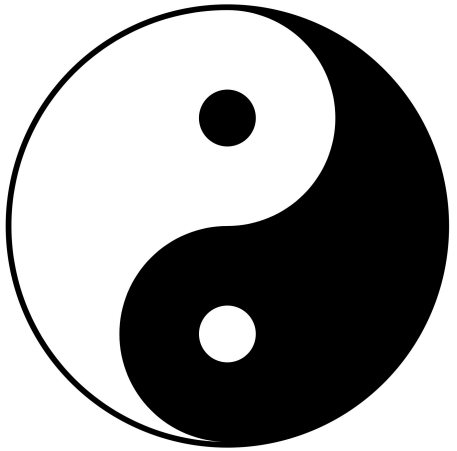
Leibniz Descobriu o Bit

Leibniz foi Diplomata na China e ficou fascinado com o Yin/Yang

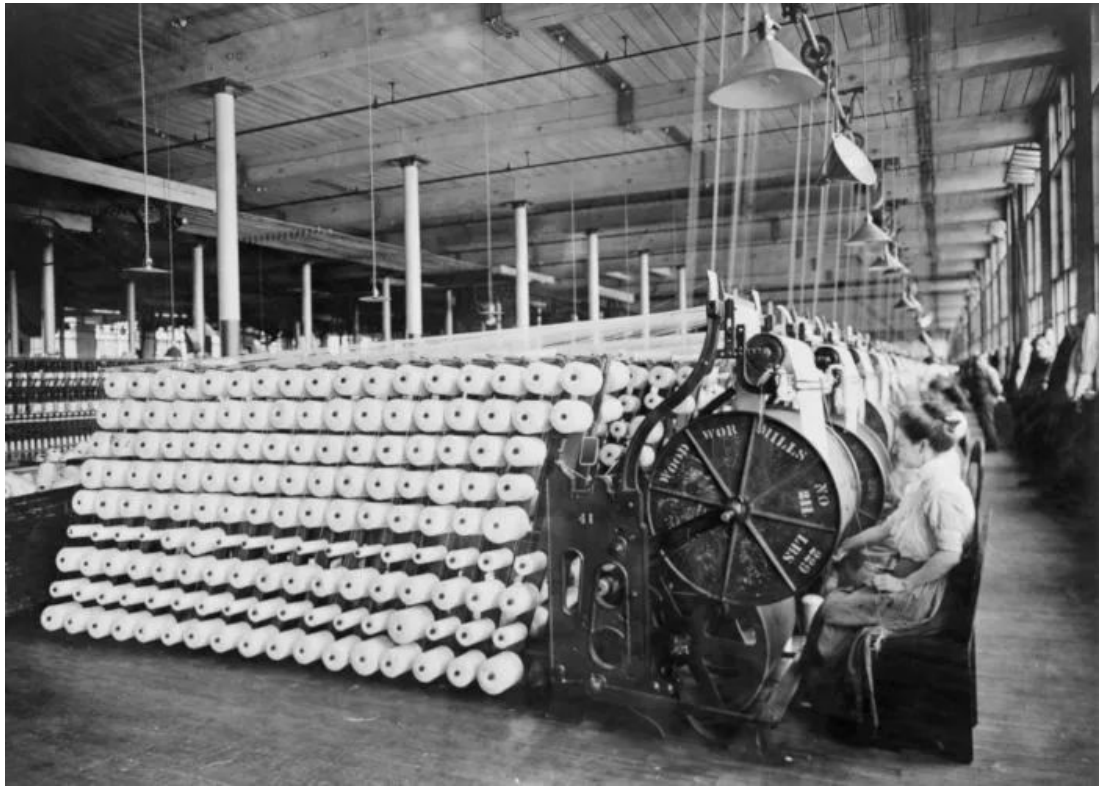


Neste Instante descobriu-se o sistema de representação binário e a computação formal

- Estado
- Permutação

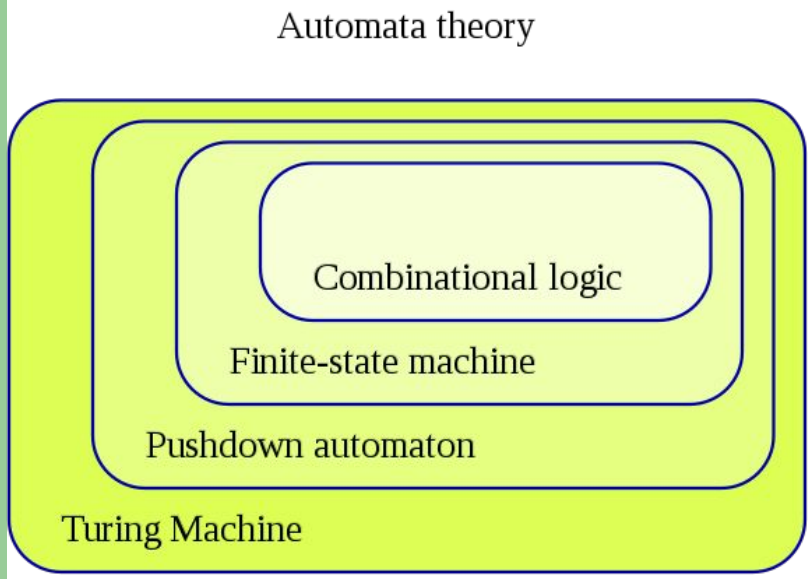


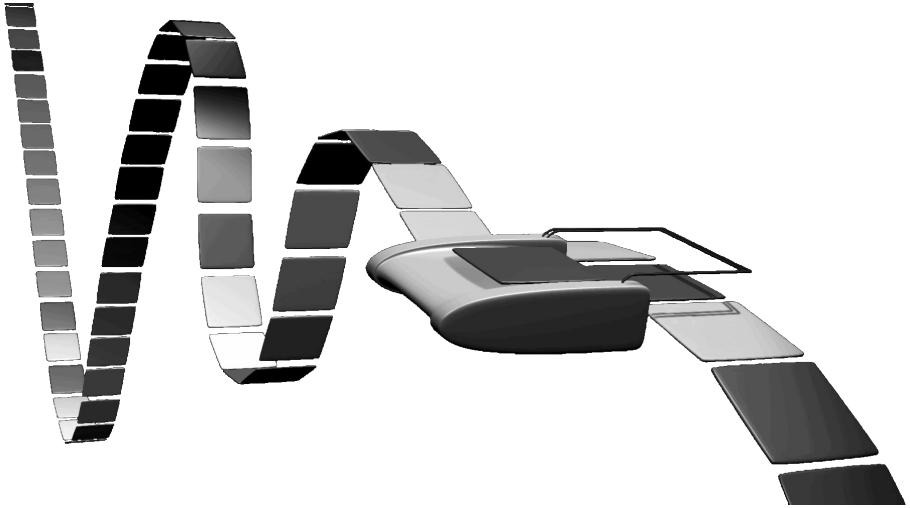
Maquina de tear



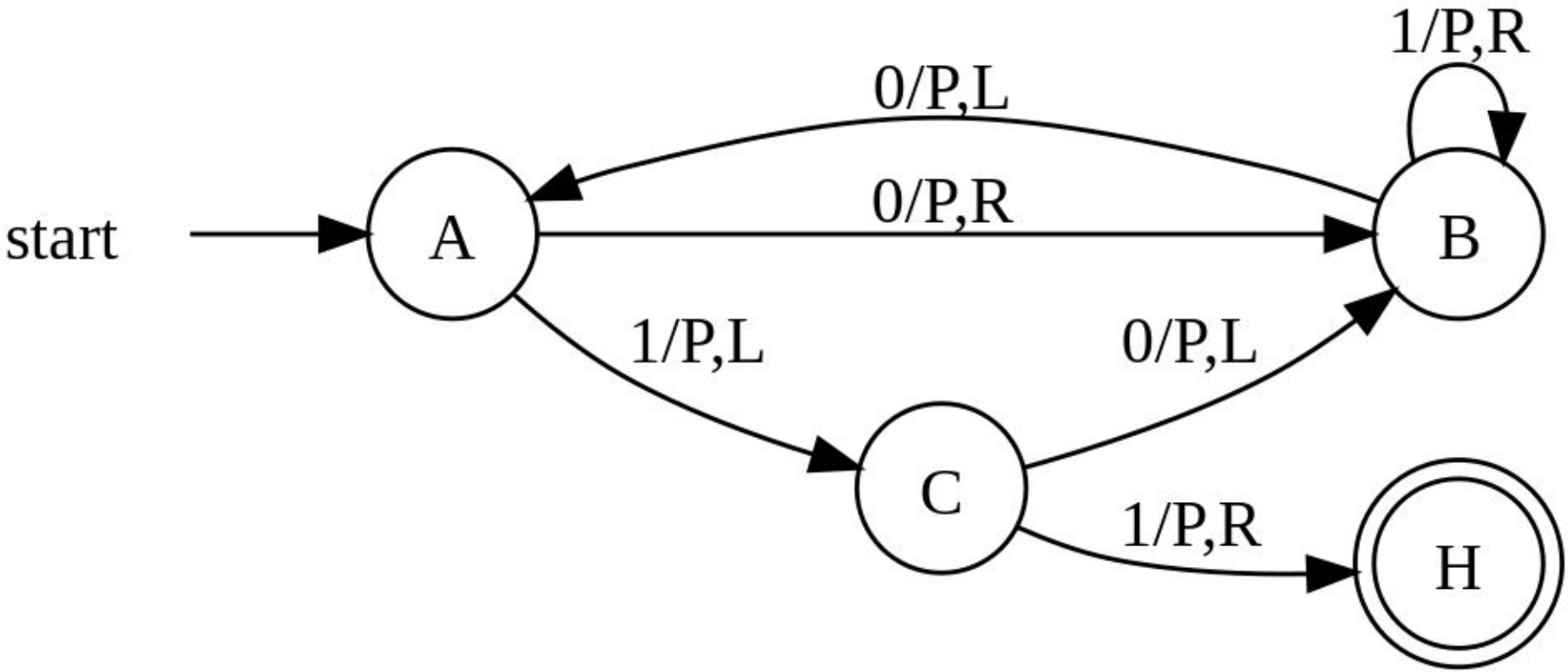
Máquina de Turing

Esforço Formal Pioneiro de Arquitetura de Computadores

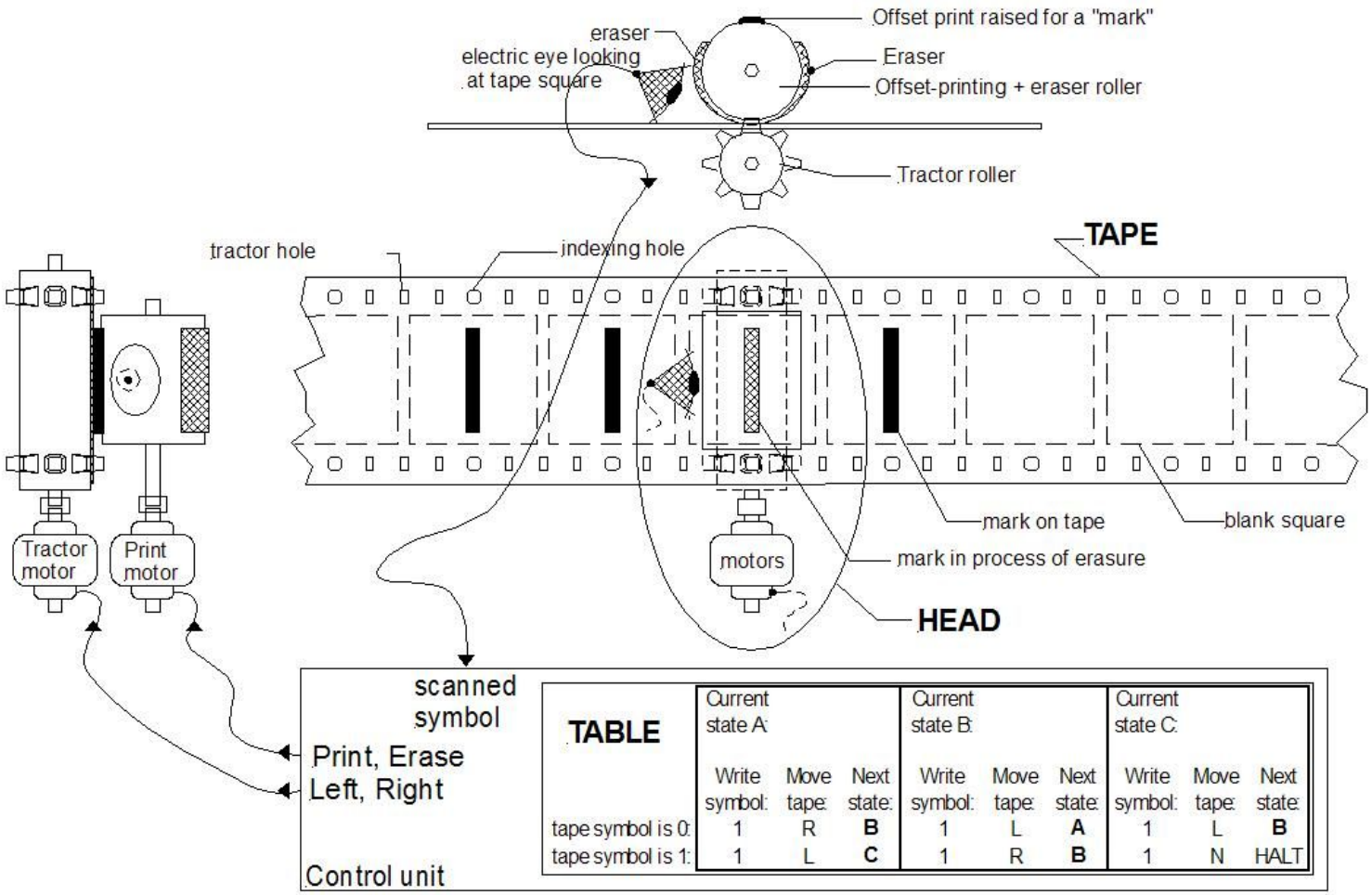




Máquina de Turing



Máquina de Turing



TABLE

	Current state A:			Current state B:			Current state C:		
	Write symbol:	Move tape:	Next state:	Write symbol:	Move tape:	Next state:	Write symbol:	Move tape:	Next state:
tape symbol is 0:	1	R	**B**	1	L	**A**	1	L	**B**
tape symbol is 1:	1	L	**C**	1	R	**B**	1	N	HALT

A fanciful mechanical Turing machine's TAPE and HEAD. The TABLE instructions might be on another

Determinismo x Desempenho

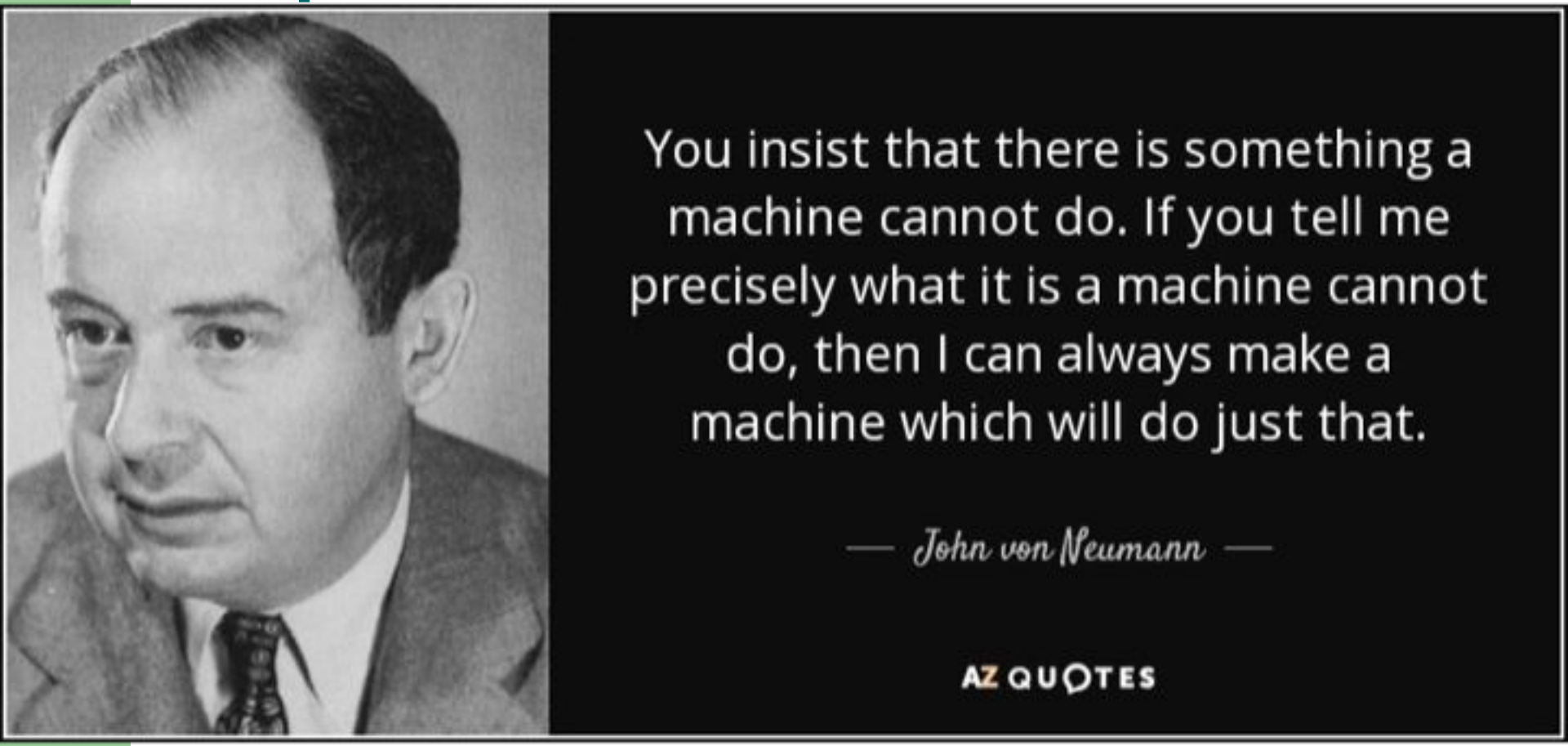
Engineering is (computer science) as “procedural epistemology,”

Abelson, H. and G. J. Sussman, 1996: Structure and Interpretation of Computer Programs. MIT Press, 2nd ed.

Trevize frowned. How do you decide what is injurious, or not injurious, to humanity as a whole? Precisely, sir, said Daneel. In theory, the Zeroth Law was the answer to our problems. In practice, we could never decide. A human being is a concrete object. Injury to a person can be estimated and judged. ***Humanity is an abstraction****.*

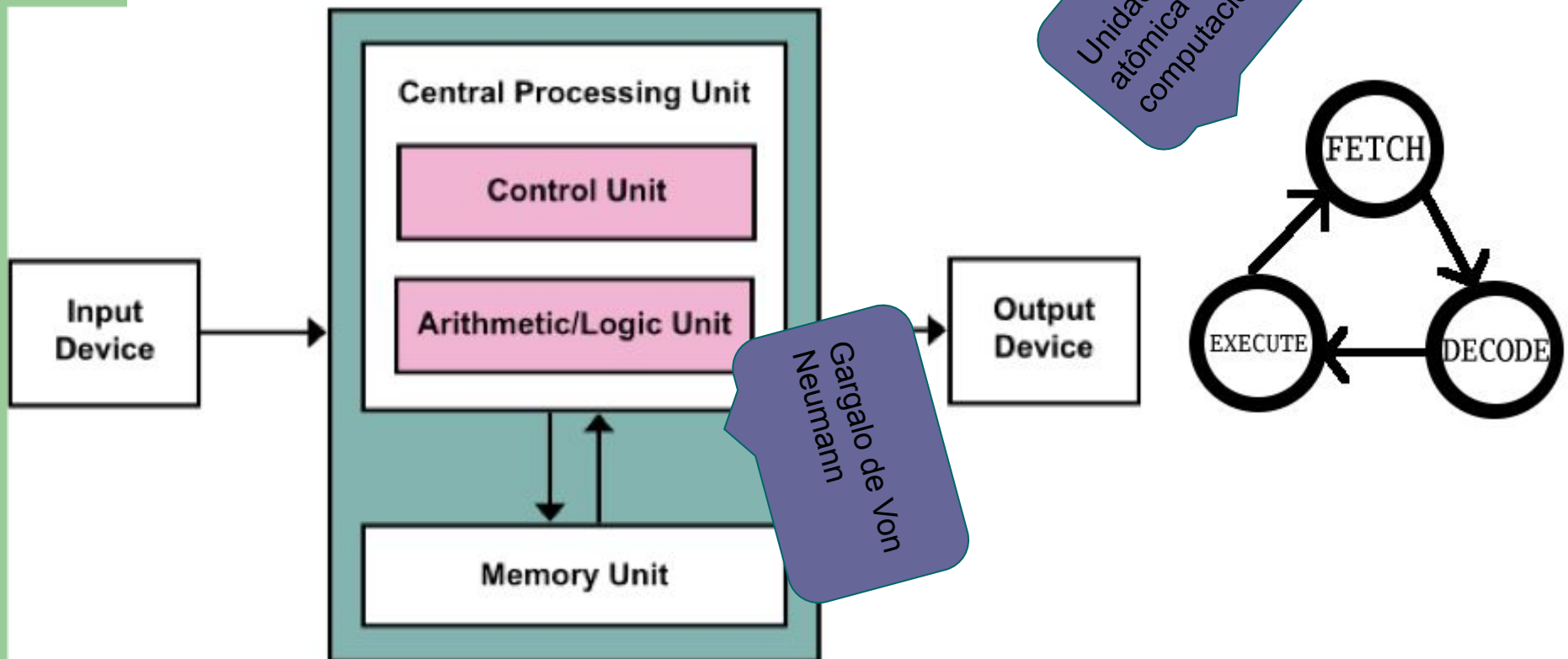
Passagem do Livro Fundação e a Terra – Isaac Asimov 1986

Máquina Von Neumann

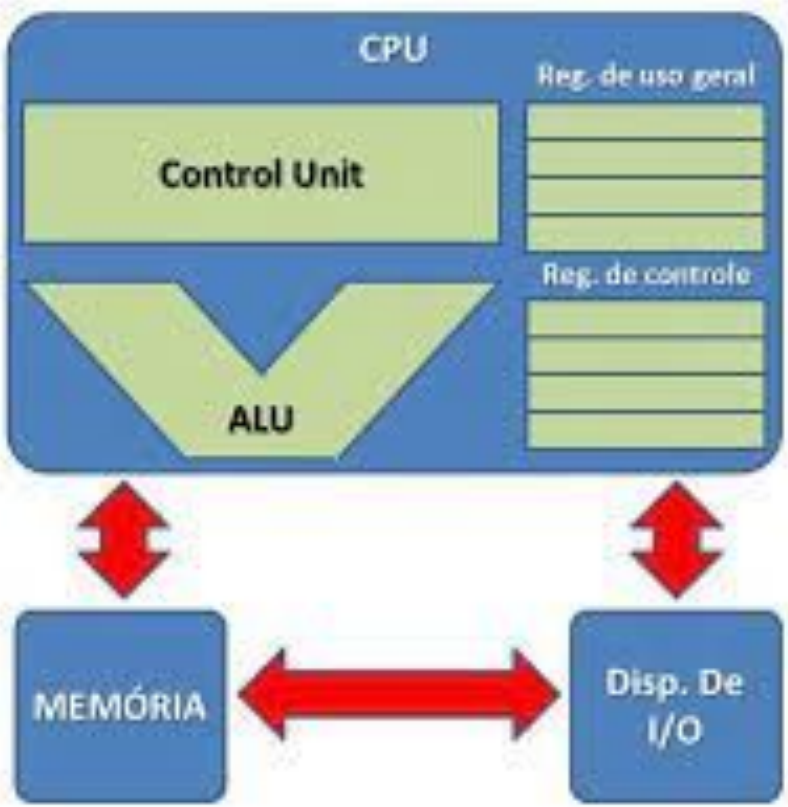


Sistemas Embarcados Clássicos

Máquina de Von Neumann



Maquina von neumann expandida



Escopo
Sistemas Embarcados

Um **sistema embarcado** (ou **sistema embutido**) é um sistema microprocessado no qual o computador é completamente encapsulado ou dedicado ao dispositivo ou sistema que ele controla

Escopo
Sistemas Embarcados

Sistema computacional com função dedicada que faz parte de um sistema maior.

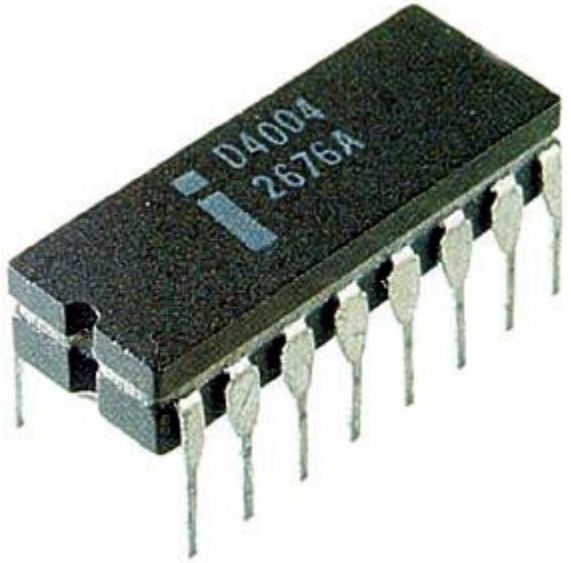
Michael Barr; Anthony J. Massa (2006). "Introduction". *Programming embedded systems: with C and GNU development tools*. O'Reilly. pp. 1–2. ISBN 978-0-596-00983-0.

Primeira CPU Embarcada

Intel 4004

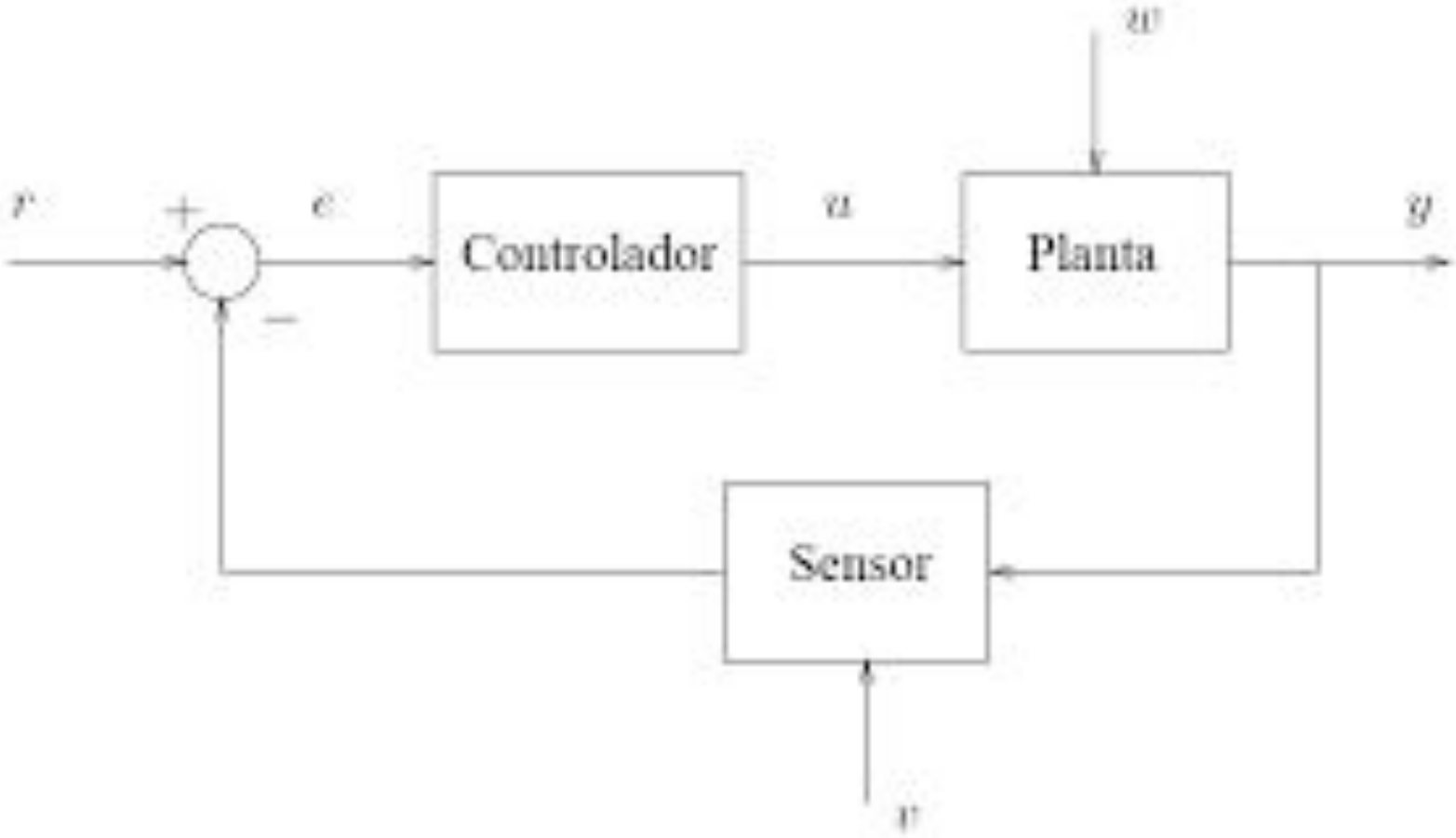
Embarcado para máquinas de venda

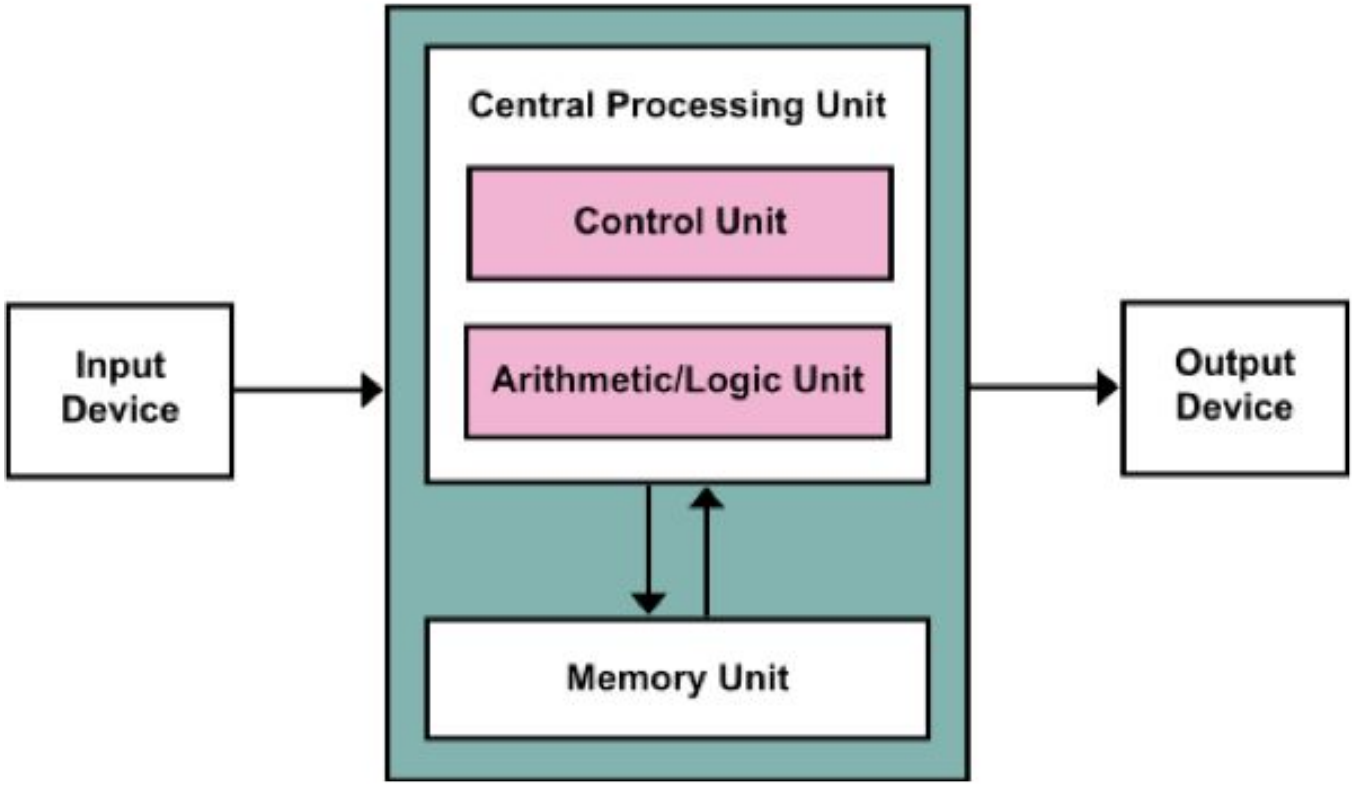
4 Bits



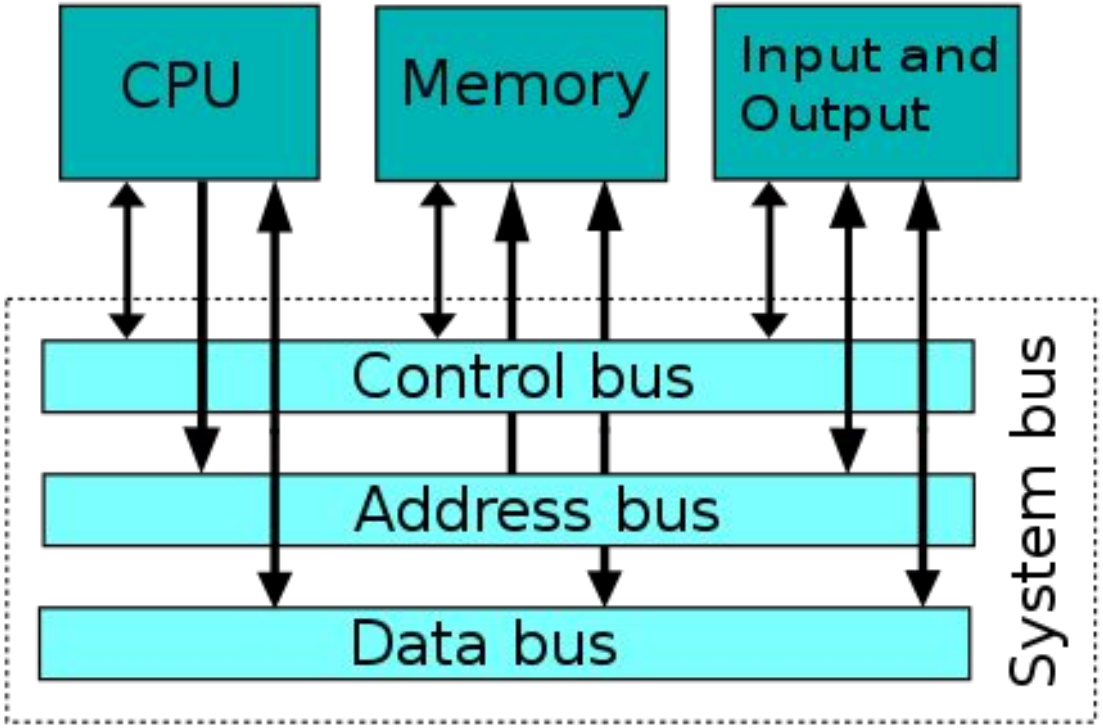
Concepção de um Sistema Embarcado 1980

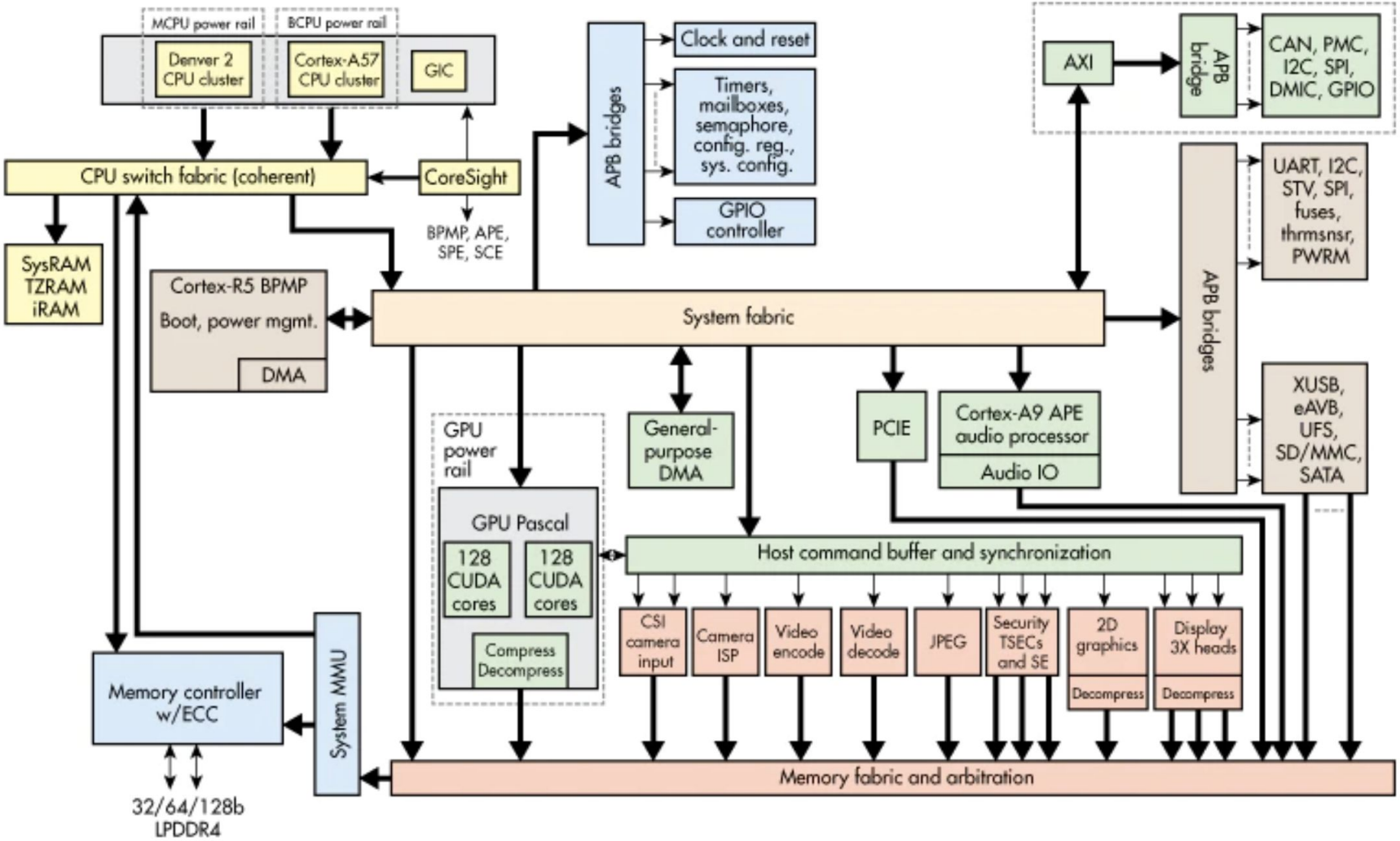
Controle




Central Processing Unit
Control Unit
Arithmetic/Logic Unit
Input Device
Output Device
Memory Unit

Evolução da Máquina de Von Neumann





2. The Jetson TX2 has a 256 CUDA core Pascal-based GPU plus multiple ARM-based cores.

Sistema Embarcado clássico

Computação Embarcada "com restrições", voltada a aplicações em tempo real (processamento de sinais ou malha de controle) em algum equipamento físico.

Abordagem Ciberfísica

A cyber-physical system (CPS) is an integration of computation with physical processes whose behavior is defined by both cyber and physical parts of the system.

Lee&Seshia, 2017

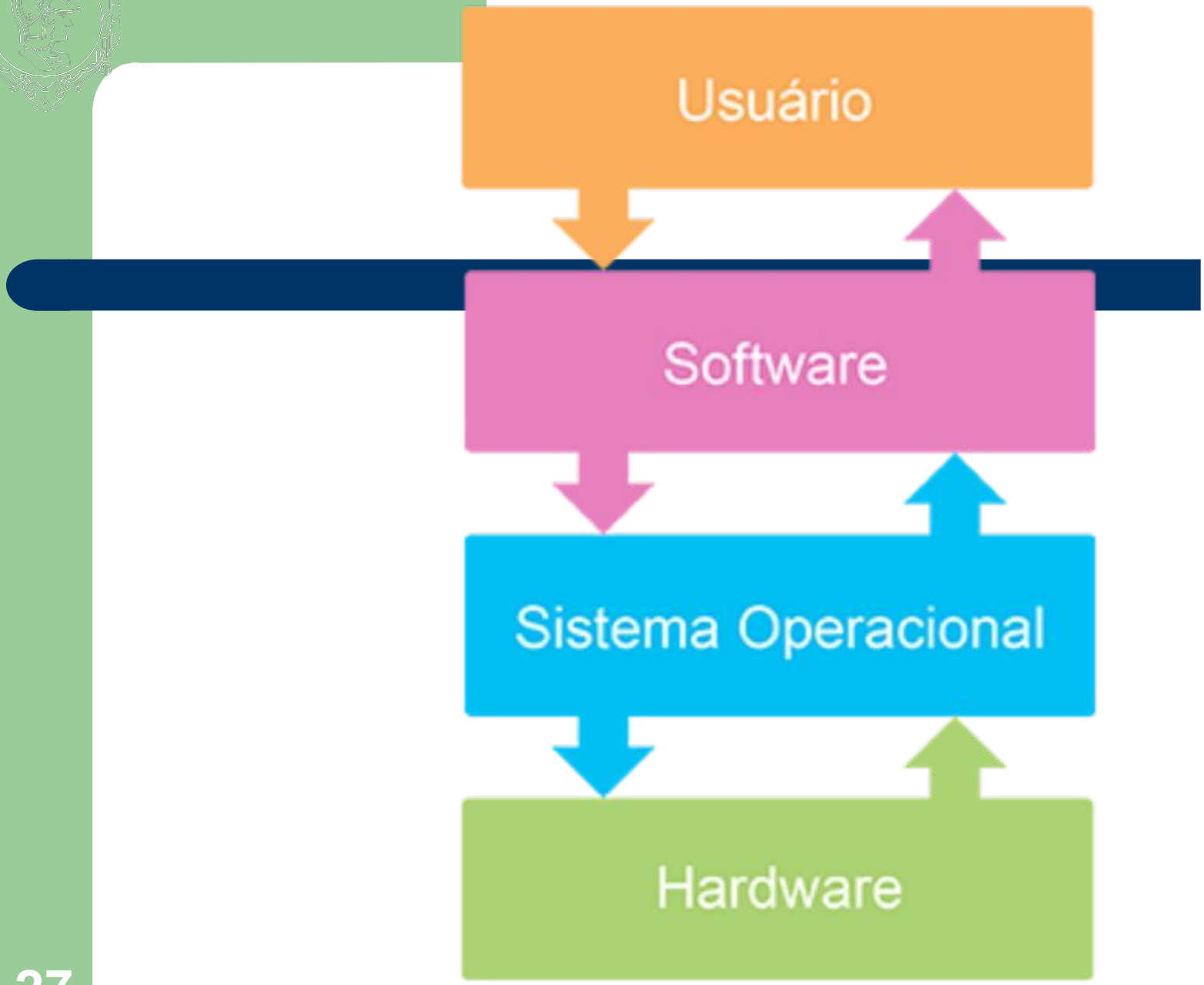
Determinismo x Desempenho

Computador -> Desempenho

Sistema Embarcado -> DETERMINISMO!

Dilema:

Determinismo x Desempenho


Usuário
Software
Sistema Operacional
Hardware

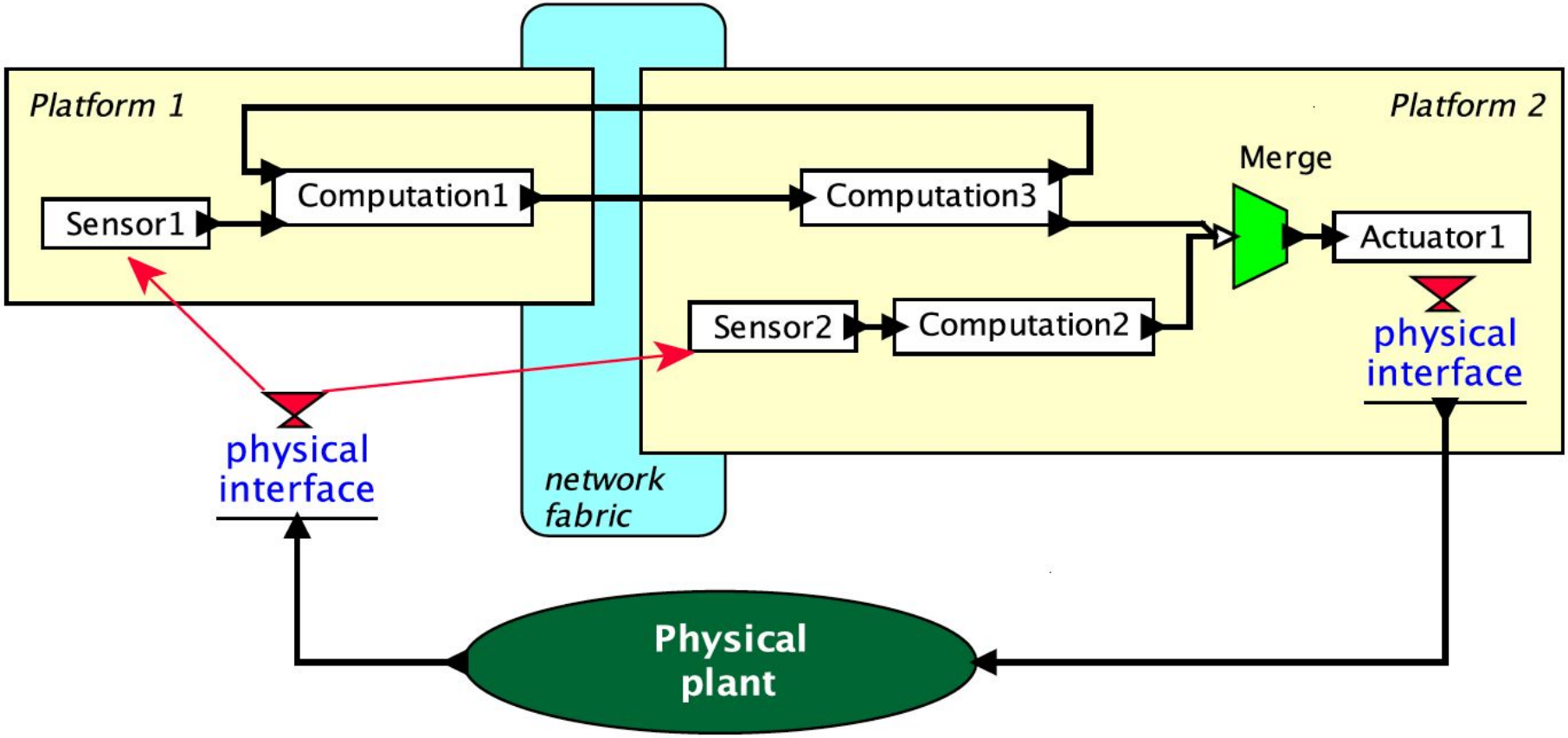


Figure 1.1: Example structure of a cyber-physical system.

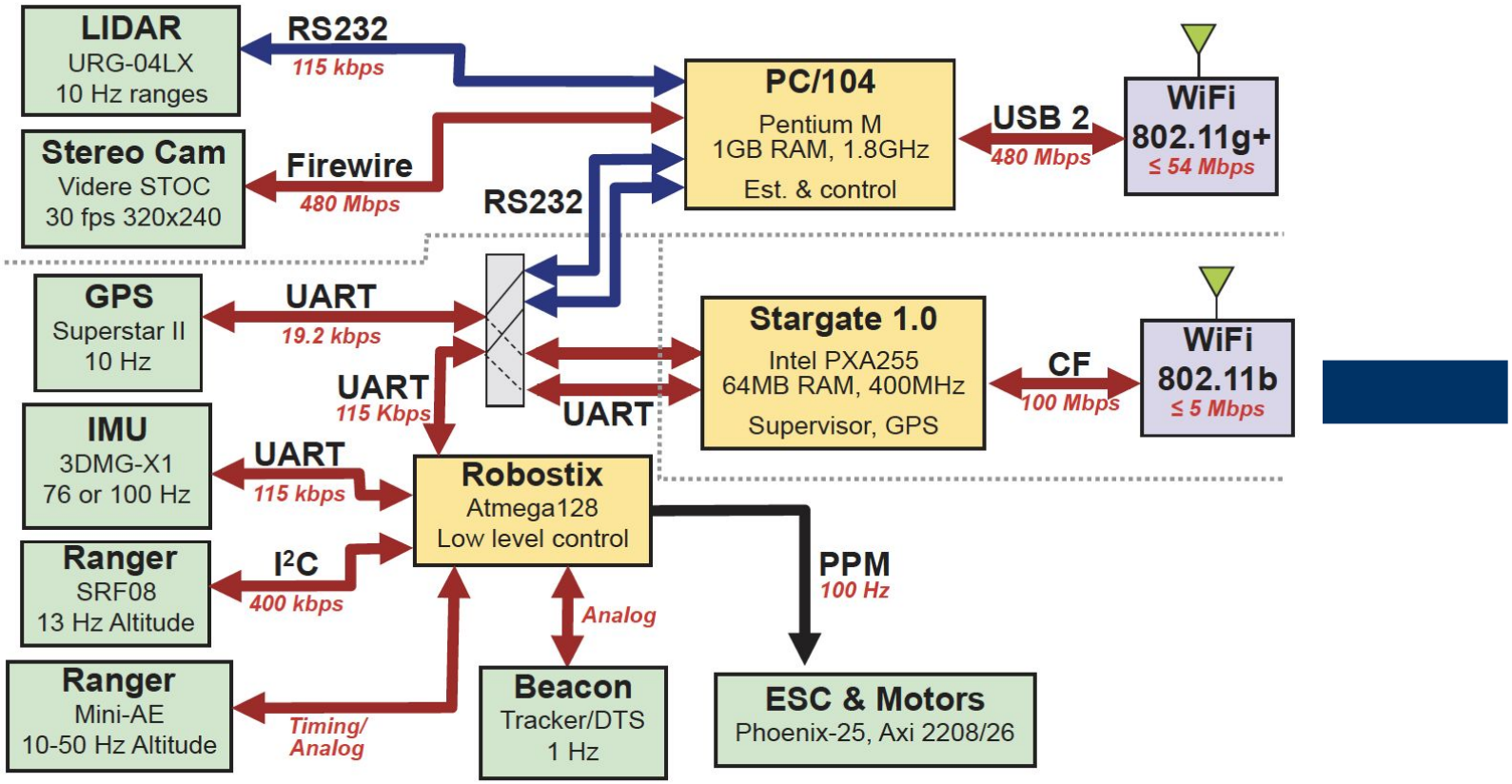
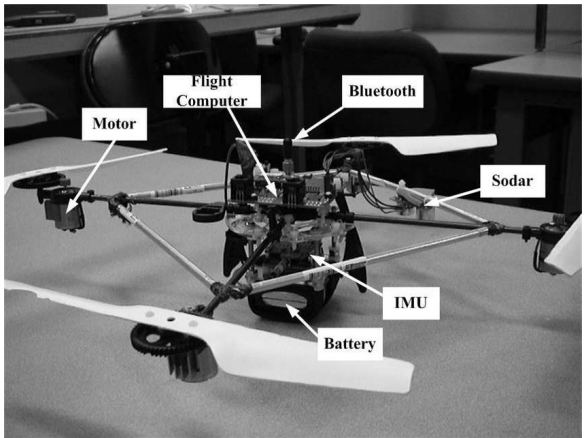


Figure 1.4: The STARMAC architecture (reproduced with permission).



Hoffmann, Gabriel & Rajnarayan, D.G. & Waslander, Steven & Dostal, D. & Jang, J.S. & Tomlin, C.J.. (2004). The Stanford testbed of autonomous rotorcraft for multi agent control (STARMAC). 12.E.4 - 121. 10.1109/DASC.2004.1390847.

Model Based Design

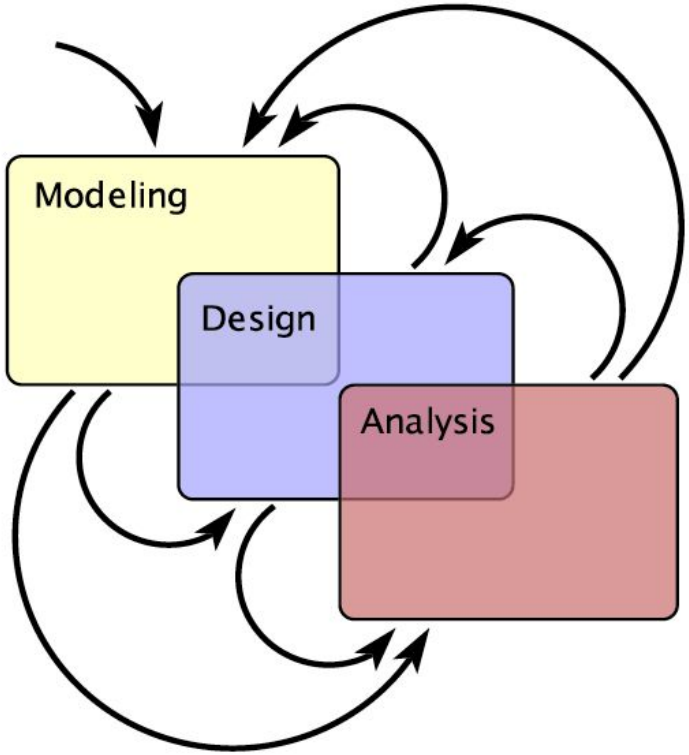
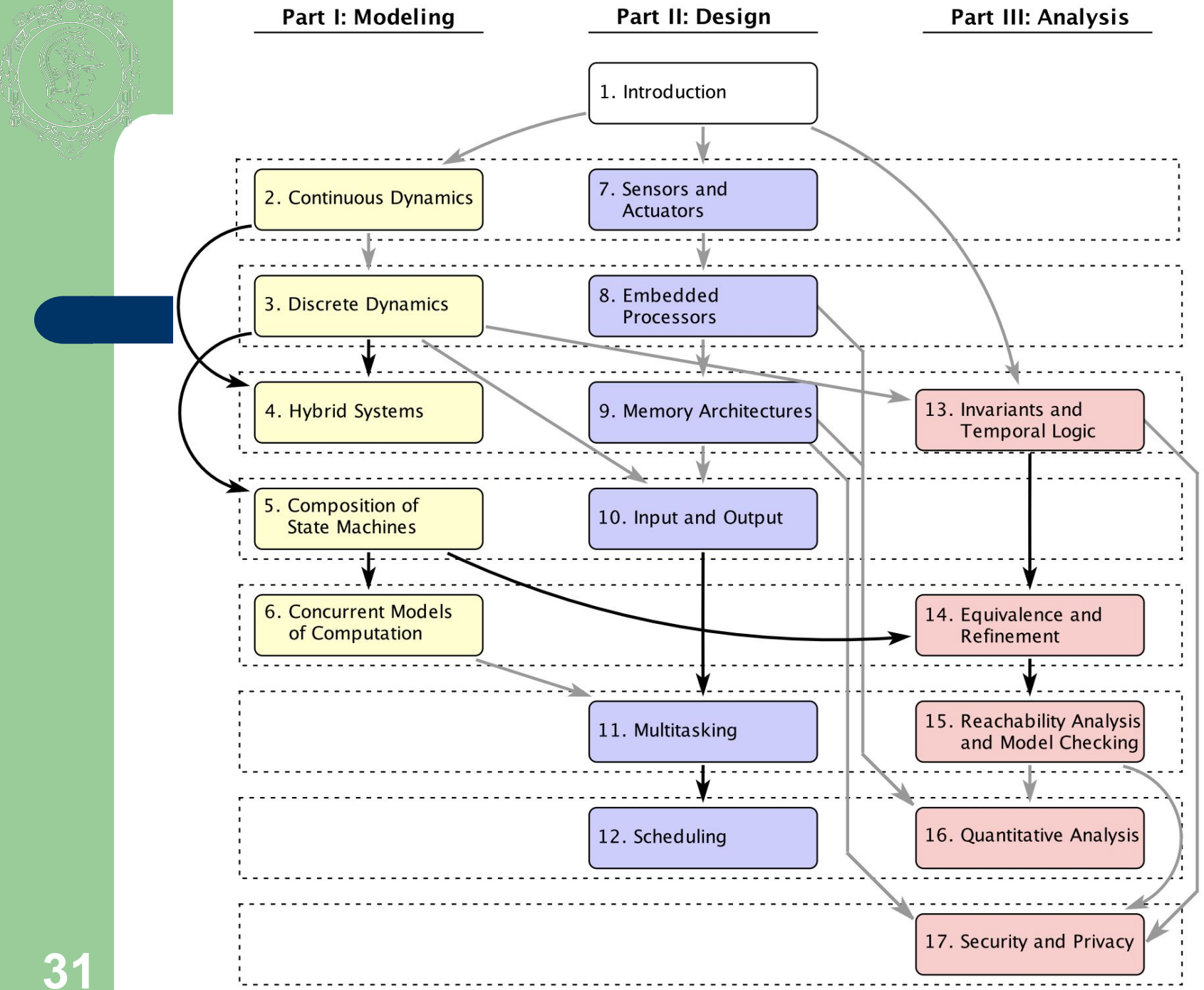


Figure 1.3: Creating embedded systems requires an iterative process of modeling, design, and analysis.


Part I: Modeling
Part II: Design
Part III: Analysis
1. Introduction
2. Continuous Dynamics
7. Sensors and Actuators
3. Discrete Dynamics
8. Embedded Processors
4. Hybrid Systems
9. Memory Architectures
13. Invariants and Temporal Logic
5. Composition of State Machines
10. Input and Output
6. Concurrent Models of Computation
14. Equivalence and Refinement
11. Multitasking
15. Reachability Analysis and Model Checking
12. Scheduling
16. Quantitative Analysis
17. Security and Privacy

Metodologia geral

- Aprendizado ativo
  - Participação dos alunos
  - Debates
  - Trabalho colaborativo
  - Alternância entre Teoria é Prática
- Aulas serão construídas em torno de um projeto prático
  - Code classes >> Mini hackatons
- Competição

Apresentação: PSI3442 Projeto de Sistemas Embarcados

Escopo

Escopo
Projeto

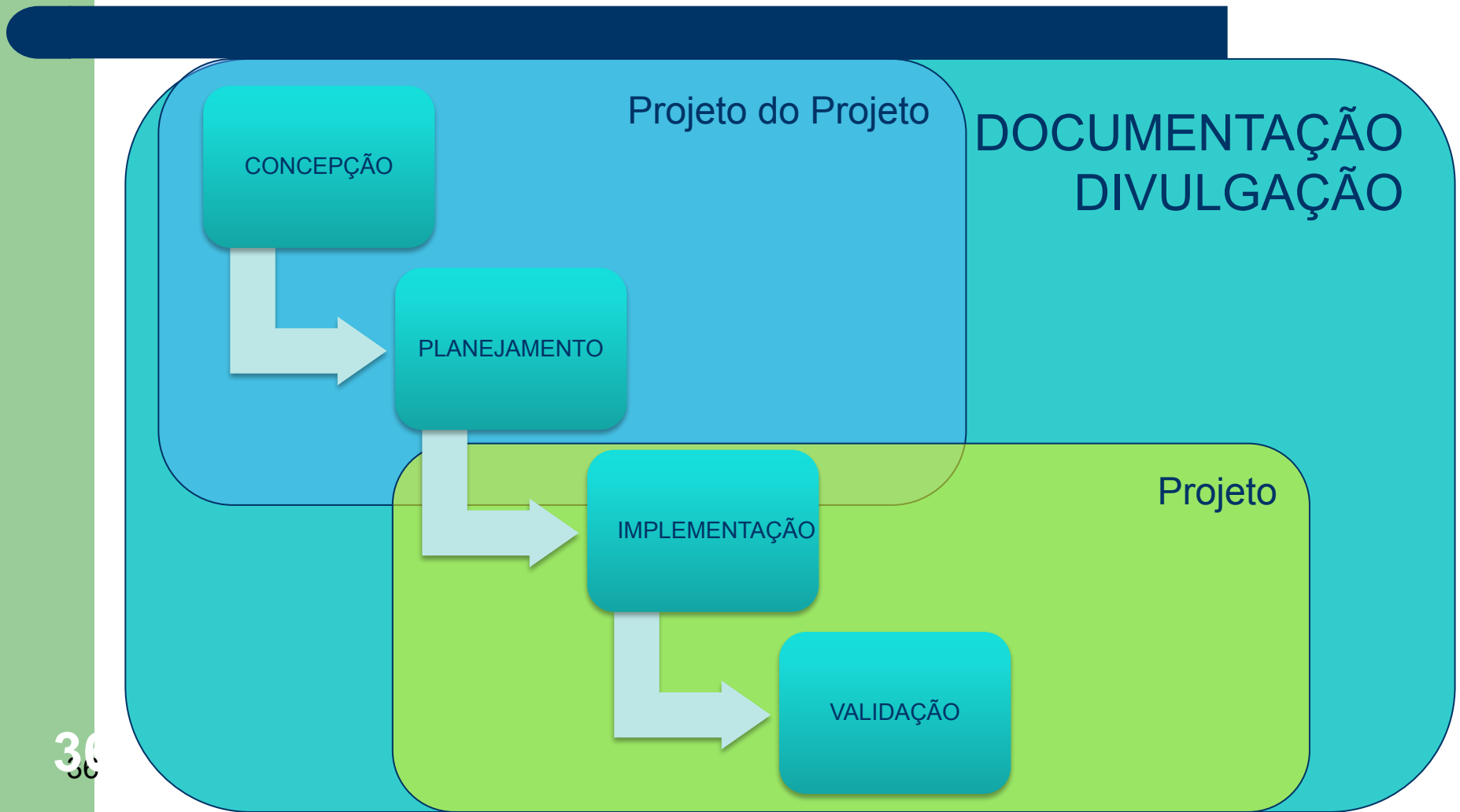
O que é um projeto?
Quais são as suas fases?

Escopo
Projeto

Conjunto de tarefas correlacionadas que devem ser executadas sob uma série de restrições, tais como um período de tempo, recursos e custo.

www.businessdictionary.com/definition/project.html

Escopo
Projeto

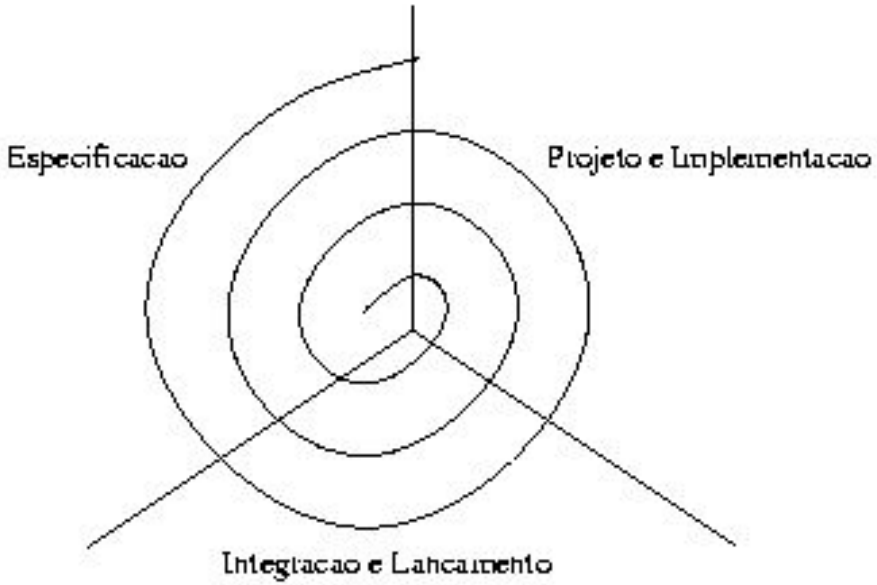


Escopo
Projeto

Modelo espiral => Sprints

Ciclos de desenvolvimento curtos

- Listening
- Design
- Coding
- Testing



Atividade para a Aula que vem

Ler o texto do Capítulo 2 do Livro Lee&Seshia

Pag 18-38