COL788: Advanced Topics in Embedded Computing

Lecture 2 – System Architecture

Vireshwar Kumar
CSE@IITD

August 8, 2022

Semester I
2022-2023

Agenda

- System Architecture

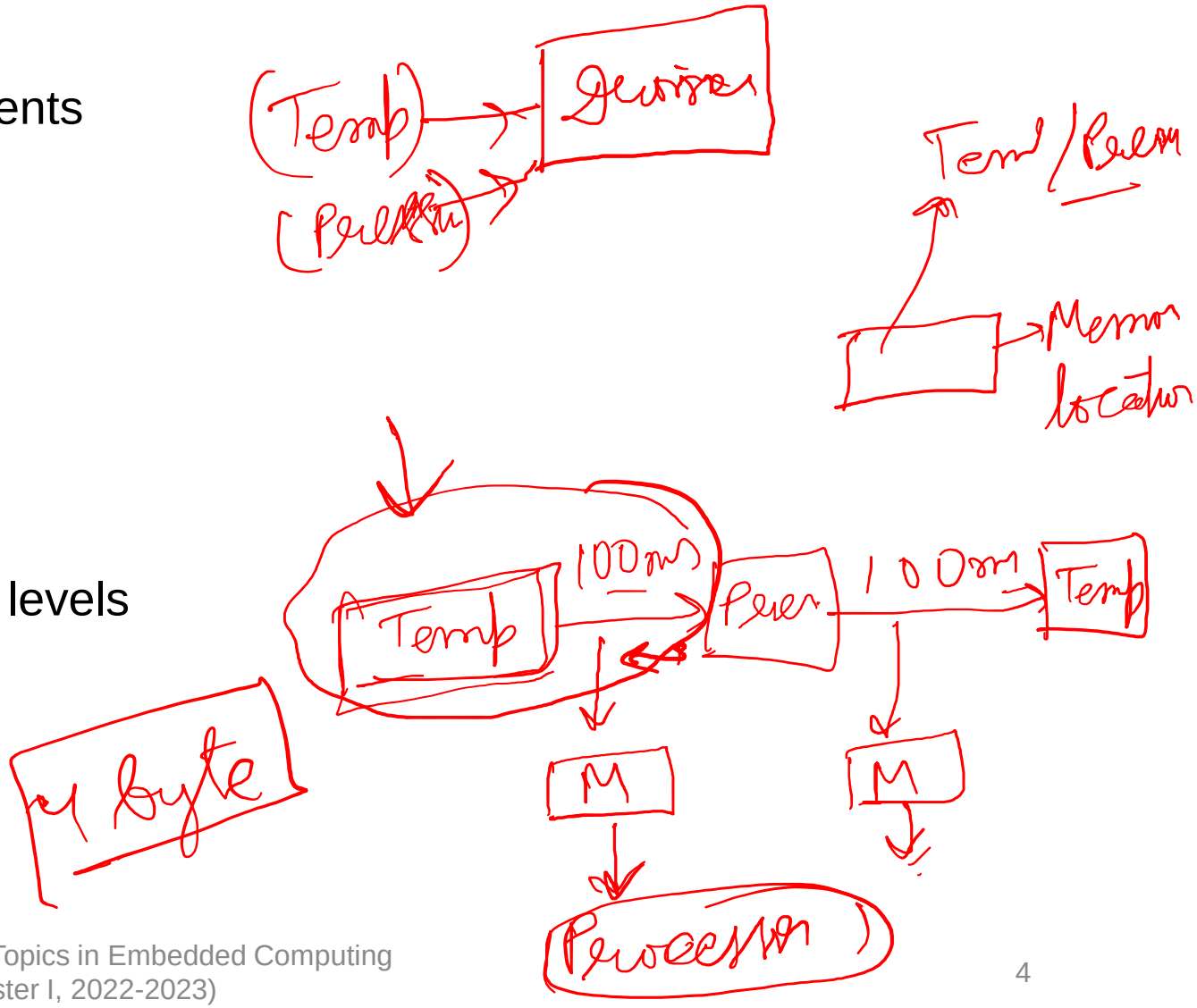
- Book
  - Peter Barry and Patrick Crowley, “Modern embedded computing: Designing connected, pervasive, media-rich systems,” Elsevier, 2nd edition, 2012.

Design Characteristics

- Interaction with the physical world
- Specific task
- Real-time (safety-critical)
- Large numbers
- Low cost
- Resource constraints

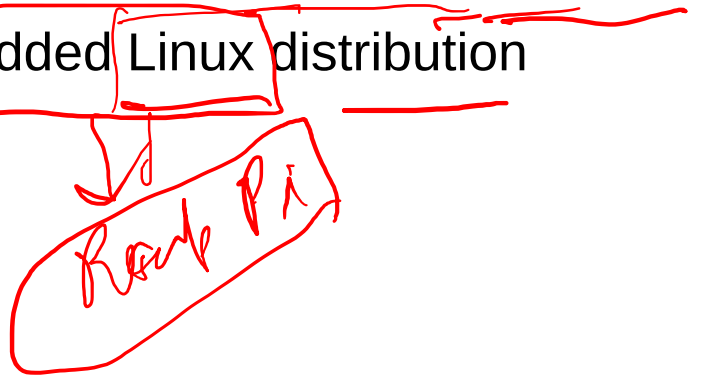
Design Process

- Highly optimized
  - Interactions among different components
  - Detailed implementation details
- Concurrency
  - Timing
- Correctness
  - Modeling at high and low abstraction levels



Operating System

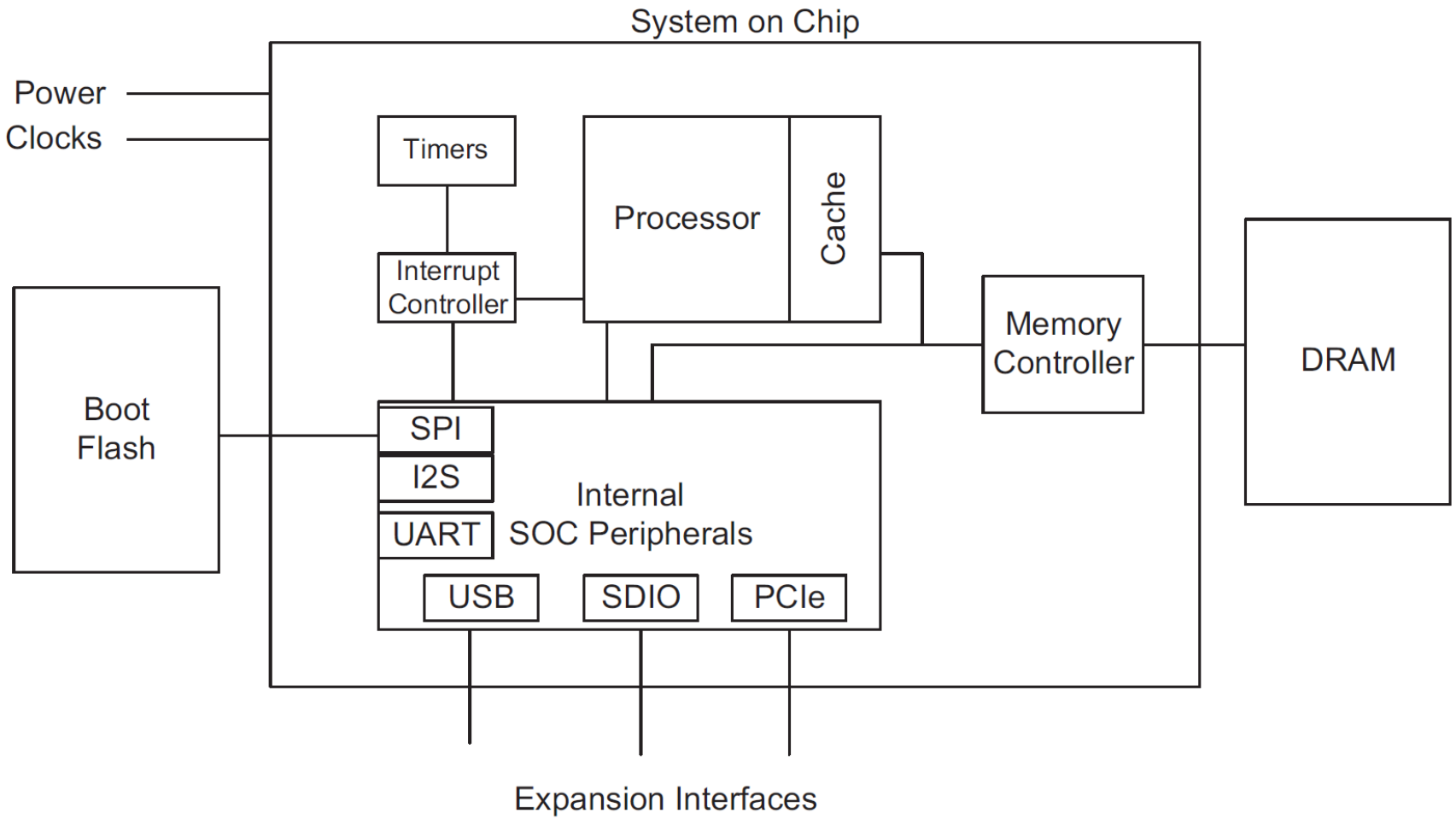
- No OS
- Real-time operating system (RTOS)
- Embedded Linux distribution



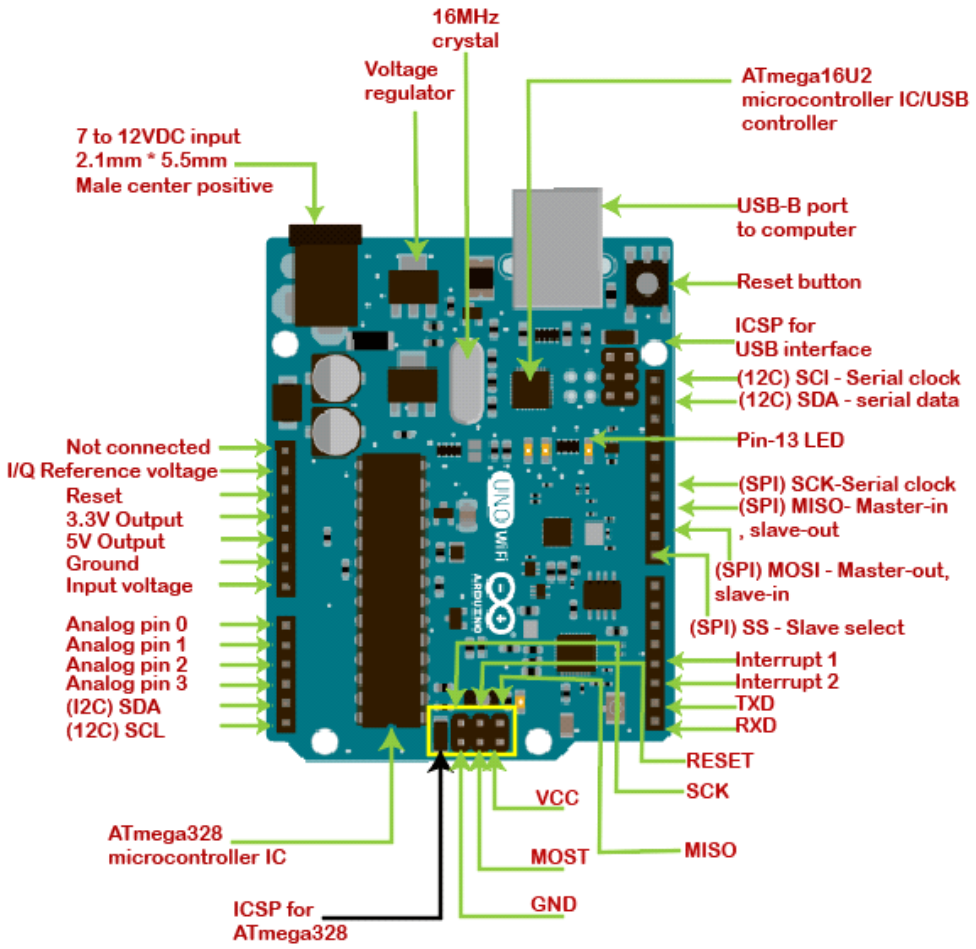
CPU

- Atmel AVR Microcontroller
  - 8-bit
  - Example: Arduino Uno
- MicroChip PIC microcontroller
  - 16-bit
- ARM Cortex-M microcontroller
  - 32-bit
- ARM Cortex-A microcontroller
  - 64-bit
  - Example: Raspberry Pi 4

System on Chip (SoC)



Arduino Uno Board



Parallelism

- Instruction-level
  - Instruction pipelining
  - Superscalar execution
  - Out-of-order execution

- Data-level
  - Single instruction, multiple data (SIMD)

- Thread-level
  - Multithreading

Instruction Set Architecture (ISA)

- ARM
  - In-order cores
  - Low power and lesser area

- Intel Atom
  - In-order execution
  - Data-level parallelism

What’s Next?

- Next Lecture (August 10, Wednesday, 11 am – 12 pm)
  - Lecture 3