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Microprocessor and Embedded Systems

Faculty of Automatic Control, Electronics and Computer Science, Informatics, Bachelor Degree

Lecture 1

Microprocessor systems structure and elements

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Microprocessor systems structure…

Program:

(today)

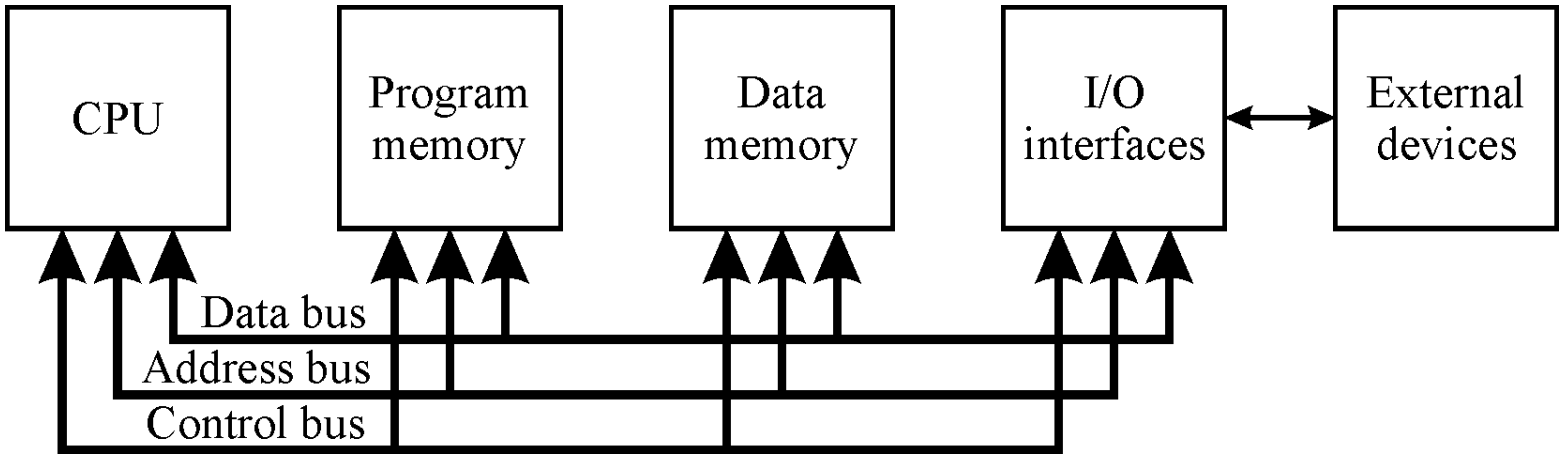
- Elements of a microprocessor system
- Fundamental microprocessor structure
- Microprocessor operation cycles
- Basic addressing modes

(next week)

- Data exchange between a microprocessor and its environment

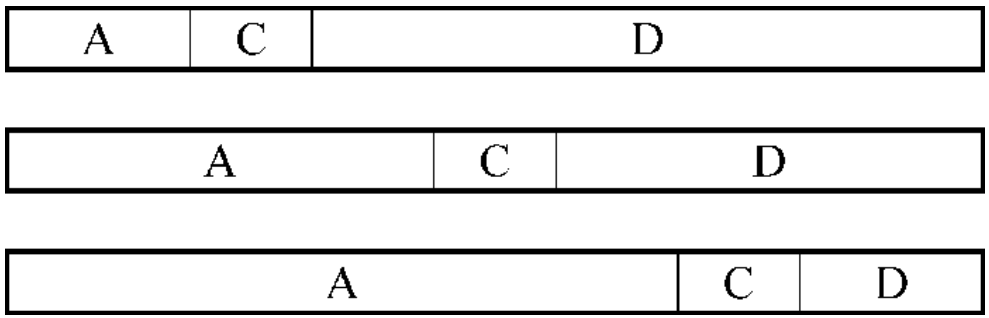
Microprocessor systems structure…

- Elements of the computer system



Microprocessor systems structure…

- Elements of the computer system
  - Bus
    - Parallel
      - Separate address, data, control signals
    - Serial
      - Common signals for address, data & control



Microprocessor systems structure…

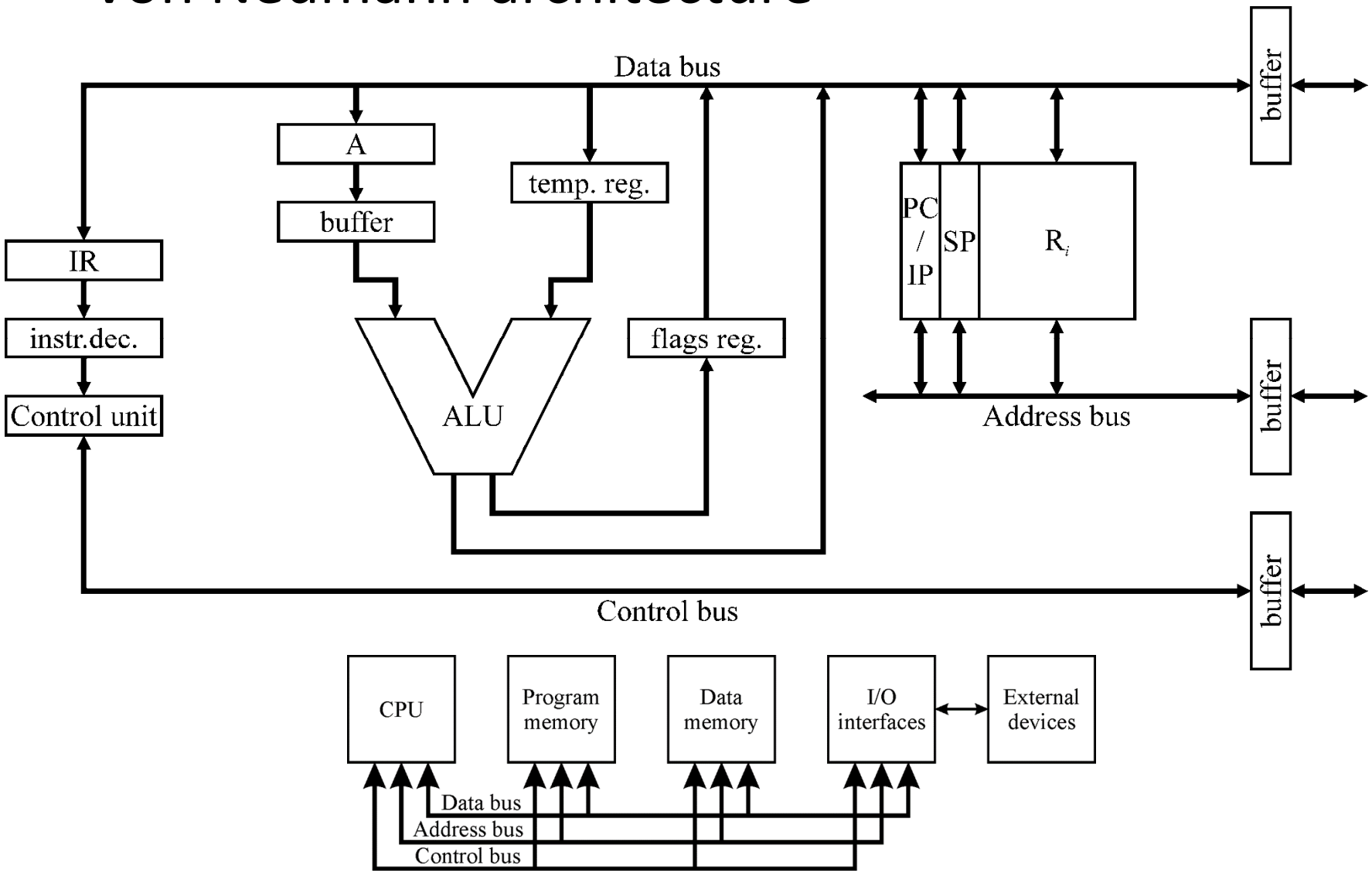
- Elements of the computer system
  - CPU (µp)
    - Data processing centre
    - Capabilities depend on command list
      - CISC/RISC
      - Functionally complete: can implement every algorithm
    - Algorithm → program
      - Algrorithm = elementary operations sequence
      - Elementary operation → command
      - Commands sequence = program
      - Commands executed after µp reads its binary code

Microprocessor systems structure…

- Elements of the computer system
  - Program memory
    - *RAM or ROM?*
    - Single-purpose vs. multi-purpose µp system
      - Single-purpose: program → ROM (EPROM, FLASH)
      - Multipurpose: program → RAM
  - Data memory
    - *RAM or ROM?*
    - Data change more frequently than code
      - *Really always?*

Microprocessor systems structure…

- Von Neumann architecture



Microprocessor systems structure…

- Von Neumann architecture
  - µp operates on „words”
    - Word → elementary data unit
      - Command code, data in some format, etc.
      - Length (*typically*): 4, 8, 16, 32, 64… bits
  - Data bus
    - For data transfer
      - State determined by µp or environment
  - Address bus
    - To specify the address
      - State determined mostly/exclusively by µp

Microprocessor systems structure…

- Von Neumann architecture
  - ALU
    - Processes data
      - ADD, SUB, AND, OR, NOT, SHL, SHR, CMP, …
    - Result may influence on command exec. sequence
  - Flags
    - „popular” flags
      - Carry
      - Auxilliary carry/half carry
      - Zero
      - Sign
      - Parity
      - Overflow
    - Can be set, reset or tested → conditional jumps

Microprocessor systems structure…

- Von Neumann architecture
  - A(accumulator)
    - Outlined register for most of operations
      - Arithmetical, logical, M↔IO, etc.
      - Input argument, result
    - In some µp's
      - Shorter execution time
      - Shorter command code
    - *n*-bits in accumulator → *n*-bit µp

Microprocessor systems structure…

- µp operation cycles
  - Clock cycle
    - µp is a sequential synchronous circuit
    - f_{max}
    - f_{min} (dynamic/static µp's)
  - Machine cycle
    - Operation performed on bus
      - Fetch, MemRd, MemWr, IORd, IOWr, …
  - Command cycle
    - Fetch phase → 1..few Fetch machine cycles
    - Execution phase → 0..many machine cycles

Microprocessor systems structure…

- Addressing modes
  - Methods of data address determination