# Computer Architecture - Lecture 3

- Any program shall have a **parallel** and a **serial** part.
- Increase data bus on memory capacity rather than instruction.
- Based on the Amdahl's low: **RISC** architecture is developed
  - **RISC:** reduced instruction set computers.
  - **CISC:** complex instruction set computer.
- Examples of **CISC** machines: Intel 86 family.
- Examples of **RISC** machines: MIPS [used in embedded systems and mobiles].
- Memory capacity: maximum size of memory that can be connected to a processor.
- Memory capacity = 2^n where n is the number of address lines.
- Address bus is between the processor and memory [8 bytes].
- Processor → address lines → address decoder → enable → memory.
- Enable: accessible [read or write].
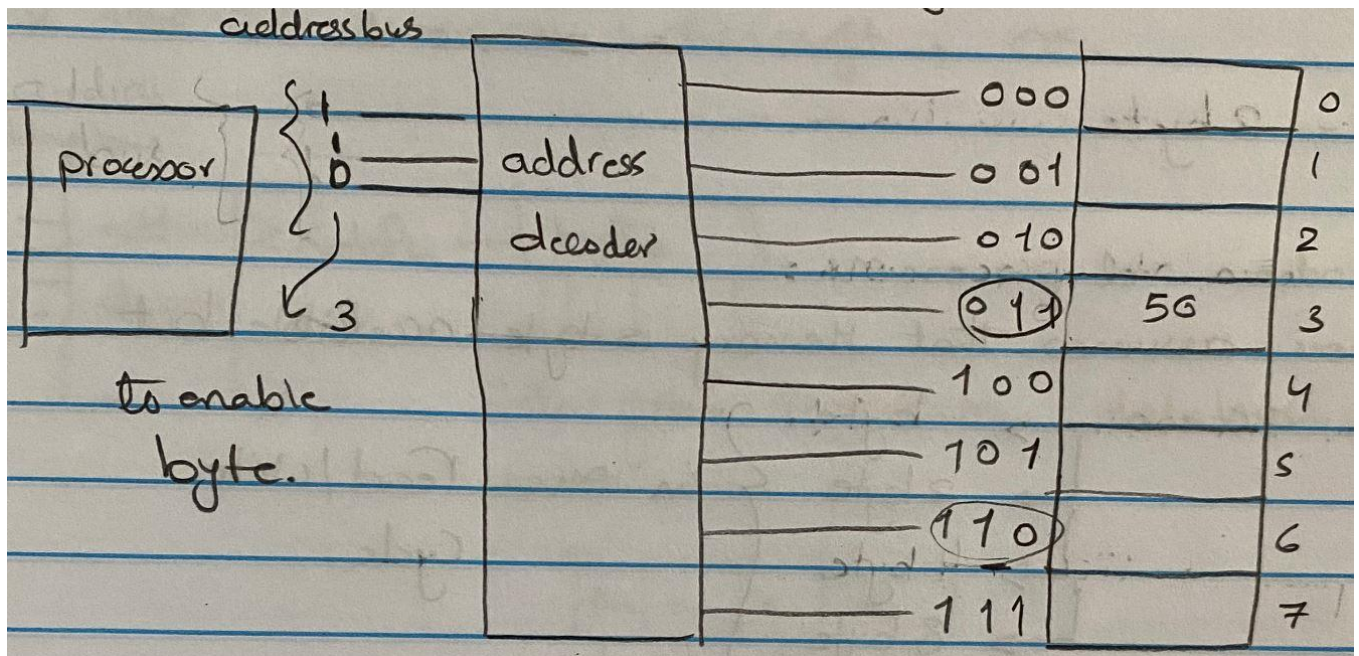
- **1 byte = 8 bits**
- 3 address lines = 2^3 = 8.
- 20 address lines = 2^{20} → up to 1 megabyte.
- 10 address lines = 2^{10} = 1024 bye [kilobyte].
- 24 address lines = 2^{24} = 16 mega [Maximum memory size].
- 32 address lines = 2^{32} = 2^{30} (giga) x 2^2 = 4 Gigabyte.
- 64 address lines = 2^{64} → very huge.
- Memory can be:
  - Byte addressable [each byte has a separate address) = 2^n bytes.
  - Word addressable [each word has a separate access) = 2^n word.

- In modern Intel processor:
  - Processor assumes that memory is byte accessible, but it can access:
    - 1 byte
    - 2 bytes
    - 4 bytes
    - 8 bytes
- Data bus size determines the max number of bytes that can be accessed in one R/W cycle.
- In Intel 8088 processors: Data bus size = 8 lines (single byte)
- In Intel 8086: Data bus size = 16 lines (2 bytes) [support 1- or 2-byte access]
- In Modern Intel processor: Data bus size = 64 line, can access:
  - 1 byte
  - 2 bytes (word)
  - 4 bytes (double word)
  - 8 bytes (quad word)
- **Intel 86 architecture and assembly programming:**
  - Control Unit
  - ALU
  - Register file
  - 8086/8088 registers:
    - Group 1: AX, BX, CX, DX [general purpose group].
    - Each one of them 16 bite (2 byte) [word].
    - Divided into two 8-bit register.
    - AX
      - AL (low)
      - AH (high)
    - BX
      - BL (low)
      - BH (high)
    - CX
      - CL (low)
      - CH (high)
    - DX
      - DL (low)
      - DH (high)
    - Group 2: Index and pointer group
      - SI (source index)
      - DI (destination index)
      - SP (stack pointer)
      - BP (Base pointer)

- IP (instruction pointer)
- Each one of them is 16 bits. مينفعش يتقسموا

  - Group 3: Segment group
    - CS (code segment)
    - DS (data segment)
    - ES (extra data segment)
    - SS (stack segment)