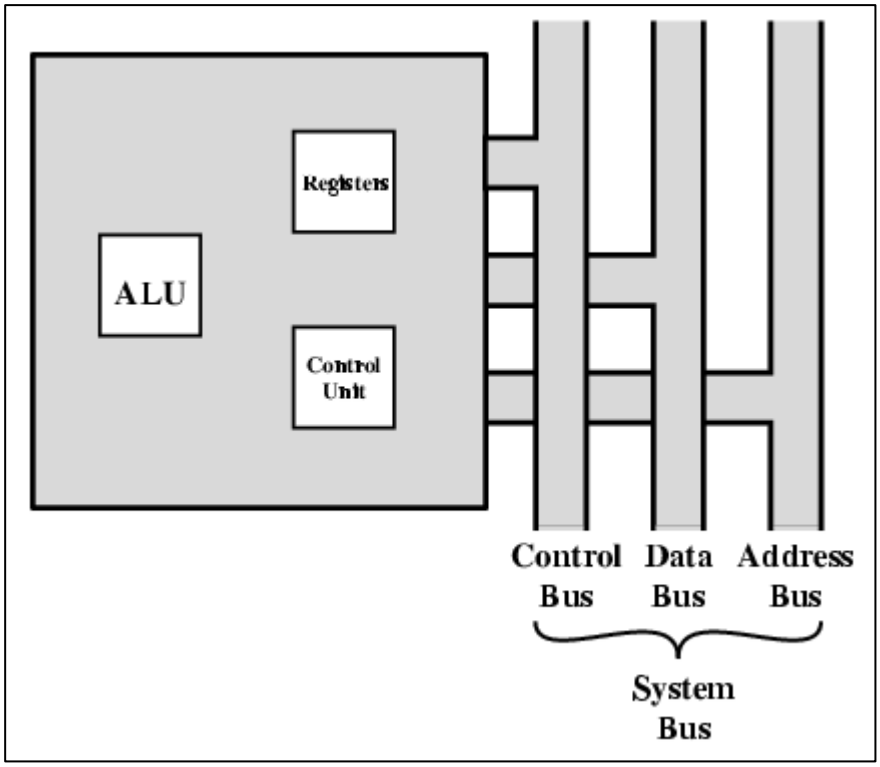
2.2.5 The CPU

CPU

- Stands for **Central Processor Unit**
- Also called: Processor



Processor

- Executes instructions
- It is made up of
  - ALU
  - CU
  - Registers
- It sends and receives instructions and data by means of 3 buses.
  - The Data Bus
  - The Address Bus
  - The Control Bus

CU

- Stands for **Control Unit**
- It is found in the CPU
- Its function is the following:
  1. It extracts an instruction from memory.
  2. It decodes it.
  3. It tells the ALU what it has to do.
  4. It repeats the first three steps
- Control Units can be:
  - **Hardwired**
  - **Micro-programmed**

ALU

- Abbreviation of **Arithmetic Logic Unit**
- It is found inside the CPU
- It is the part performs all arithmetic computations (such as addition and multiplication) and all comparison operations (such as evaluating X AND Y).

Register

- It is a high-speed storage location within the CPU.
- A 32-bit CPU is one in which each register is 32 bits wide.
- Only assembly language programs can manipulate registers.
- Three of the most common registers are the following:
  - Program Counter
  - Instruction Register
  - Accumulator

Program Counter (**PC**)

- It is a register found in the control unit of the CPU.
- It is used to keep track of the address of the next instruction.

Instruction Register (IR)

- This register holds the current instruction being executed.

Accumulator

- An accumulator is a register that can:
  - Hold a value, and
  - Perform a calculation on that value.
- In modern computers any register can function as an accumulator.

Main Memory

- Also called RAM (Random Access Memory).
- A location is indicated by an address.

Address Bus

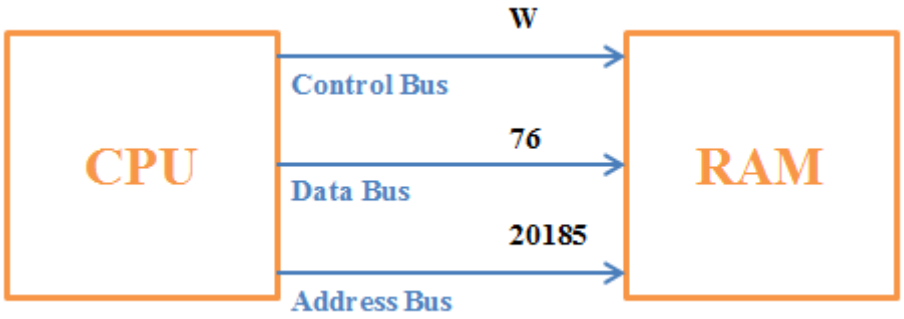
- Used when the CPU sends an address to RAM.
- The number of bits of the bus is called its width.
- An address bus of n bits can indicate 2^n locations. These range from address 0 to address $2^n - 1$.

Data Bus

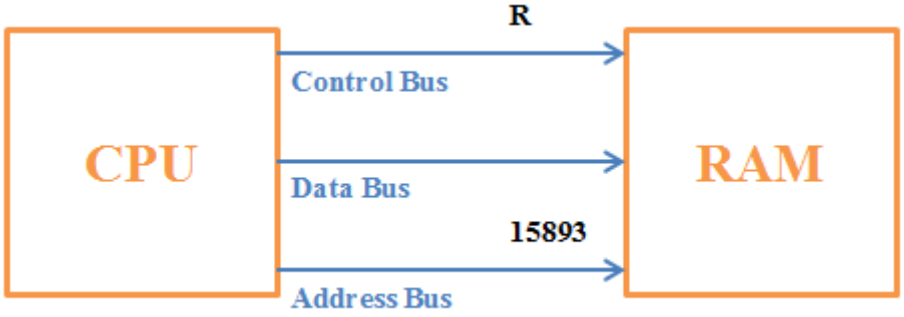
- Used when the CPU sends data to RAM or vice versa.

Control Bus

- Used by the CPU to send a command to RAM.
- Examples:
  - A **Write instruction** is shown in the following diagram. The instruction that the CPU is giving to RAM is this: Write the number 76 in the location of address 20185.



  - A **Read instruction** is shown in the following diagram. In it the CPU is instructing the RAM to read the contents of the location 15893 and then send this content to the CPU (via the Data bus).



Word

- In programming, a word indicates the data size of a computer.
- The size of a word varies from one computer to another, depending on the CPU.
    - For computers with a 16-bit CPU, a word is 16 bits (2 bytes). In this case we say that the word size (or word length) is 16 bits.
    - On large mainframes, a word can be as long as 64 bits (8 bytes).

Instruction Set

- Also called a **command set**.
- It is the set of commands, or instructions, that a processor understands.

CISC Processor

- CISC stands for "**complex instruction set computer**"
- It has a large number of commands.
- Advantage:
    - Assembly language programs are shorter.
- Disadvantage:
    - Expensive

RISC Processor

- RISC stands for "**reduced instruction set computer**"
- The instruction set is made up of a few instructions.
- Advantages:
    - Cheaper
- Disadvantage:
    - Longer programs