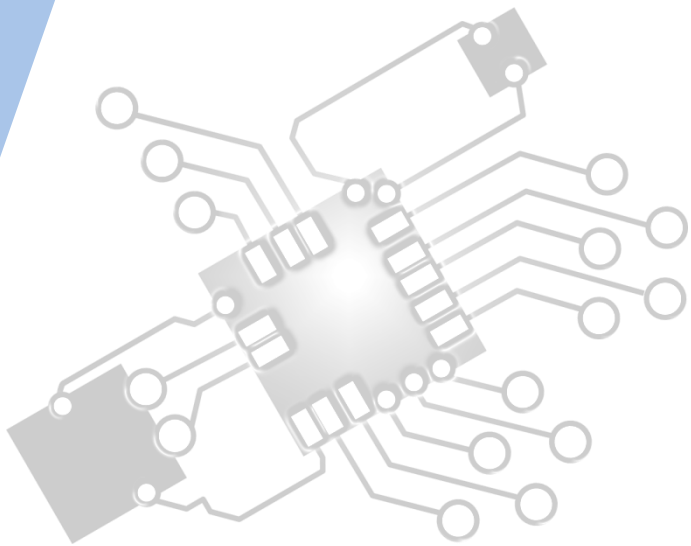
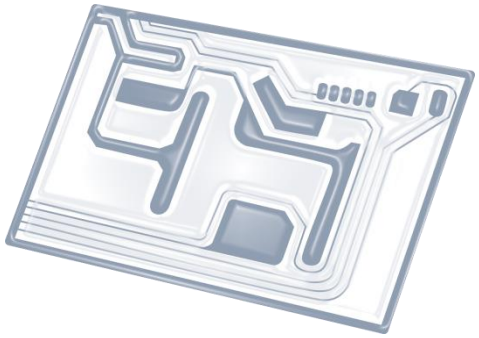
Computer Organisation

IB Computer Science



Content developed by
Dartford Grammar School
Computer Science Department

HL Topics 1-7, D1-4



1: System design

2: Computer Organisation

3: Networks

4: Computational thinking

5: Abstract data structures

6: Resource management

7: Control

D: OOP

HL & SL 2 Overview

Computer architecture

2.1.1 Outline the architecture of the central processing unit (CPU) and the functions of the arithmetic logic unit (ALU) and the control unit (CU) and the registers within the CPU

2.1.2 Describe primary memory. 2 Distinguish between random access memory (RAM) and read-only memory (ROM), and their use in primary memory

2.1.3 Explain the use of cache memory

2.1.4 Explain the machine instruction cycle

Secondary memory

2.1.5 Identify the need for persistent storage

Operating systems and application systems

2.1.6 Describe the main functions of an operating system

2.1.7 Outline the use of a range of application software

2.1.8 Identify common features of applications

Binary representation

2.1.9 Define the terms: bit, byte, binary, denary/decimal, hexadecimal

2.1.10 Outline the way in which data is represented in the computer

Simple logic gates

2.1.11 Define the Boolean operators: AND, OR, NOT, NAND, NOR and XOR

2.1.12 Construct truth tables using the above operators

2.1.13 Construct a logic diagram using AND, OR, NOT, NAND, NOR and XOR gates

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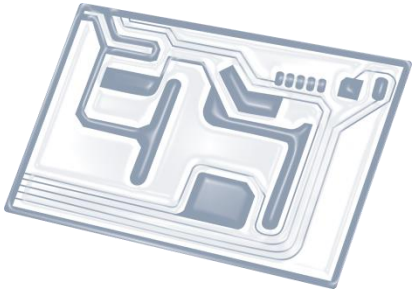


Topic 2.1.1

Outline the architecture of the **central processing unit** (CPU) and the functions of the **arithmetic logic unit** (ALU) and the **control unit** (CU) and the **registers** within the CPU.

Key terms

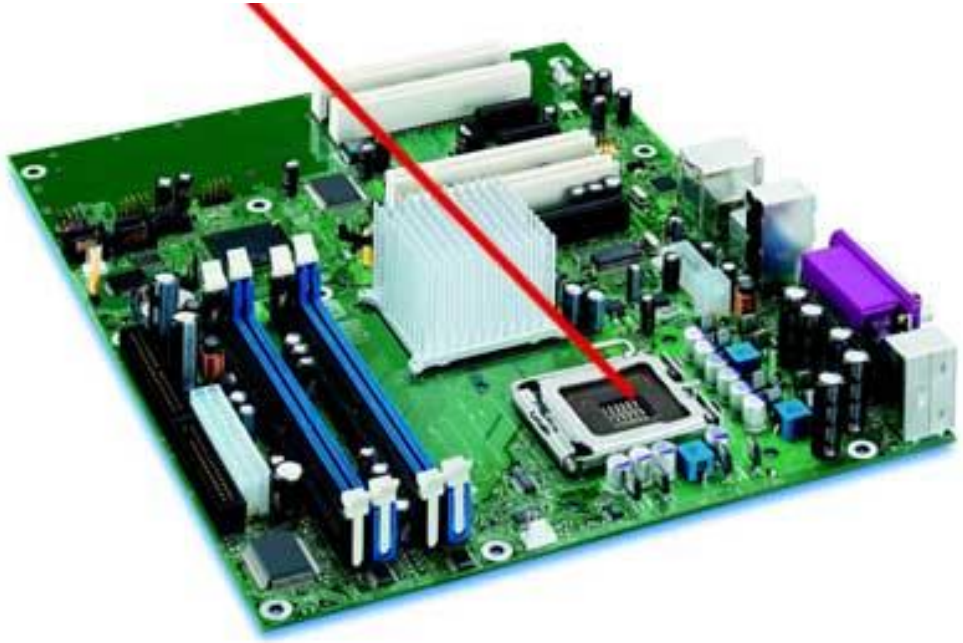
- **CPU** = Central Processing Unit
- **ALU** = Arithmetic Logic Unit
- **CU** = Control Unit
- **Registers** = small temporary storage spaces inside the CPU

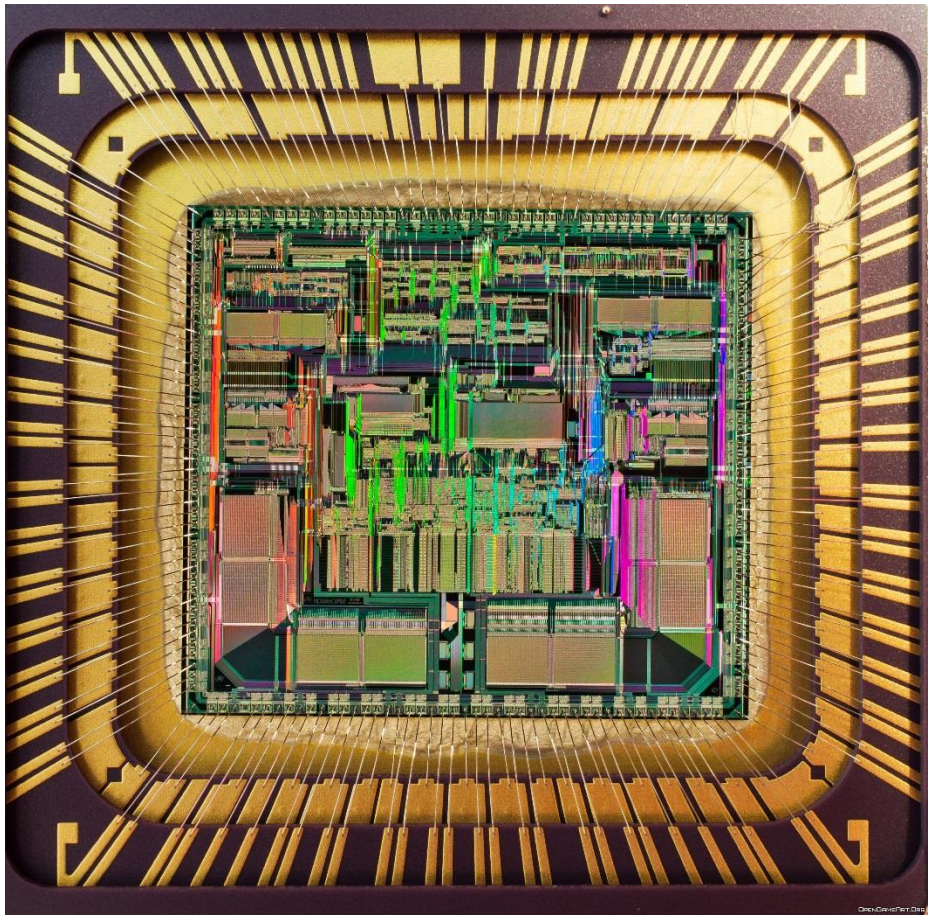
Central Processing Unit

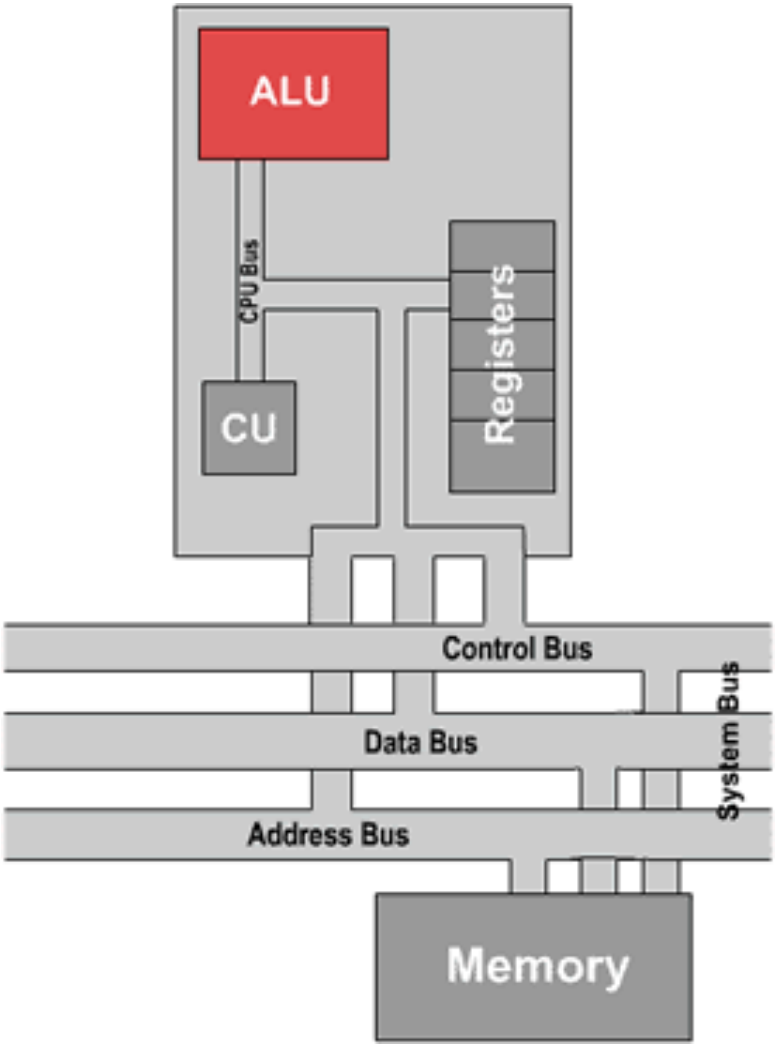
Video: How are CPUs made

CPU definition

The key component of a computer system, which contains the circuitry necessary to interpret and execute program instructions.

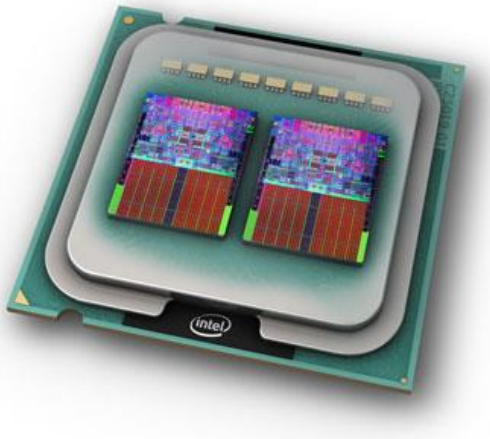


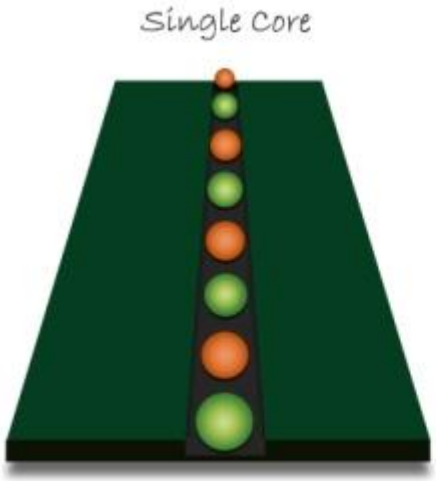


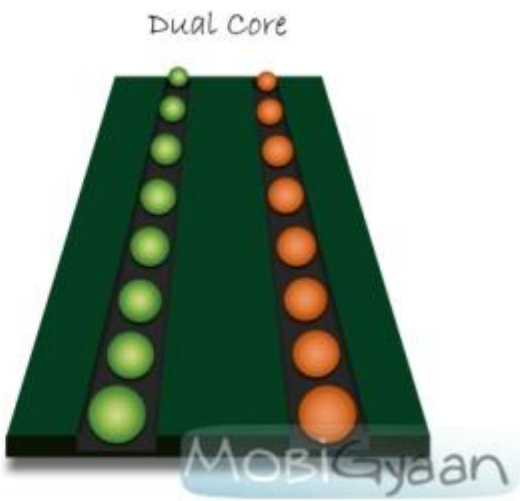

ALU
CPU Bus
Registers
CU
Control Bus
Data Bus
System Bus
Address Bus
Memory

Function of the ALU

- Part of the CPU that does all the **arithmetic** (+/-) and **logical** (AND/OR) calculations
- Sometimes an ALU is referred to a '**core**', hence computers with **dual core** technology have two ALUs to process two calculations **simultaneously**.



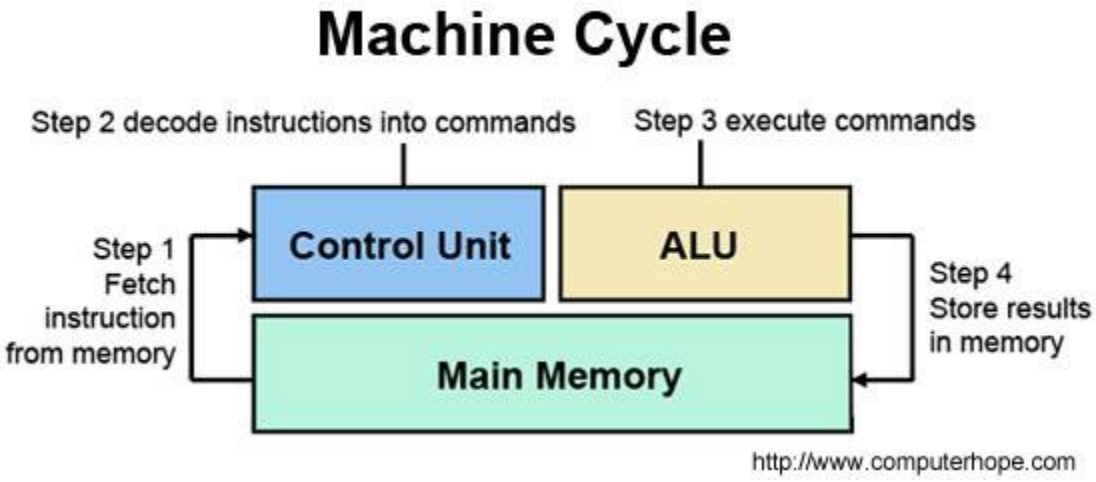




Two functions of the CU

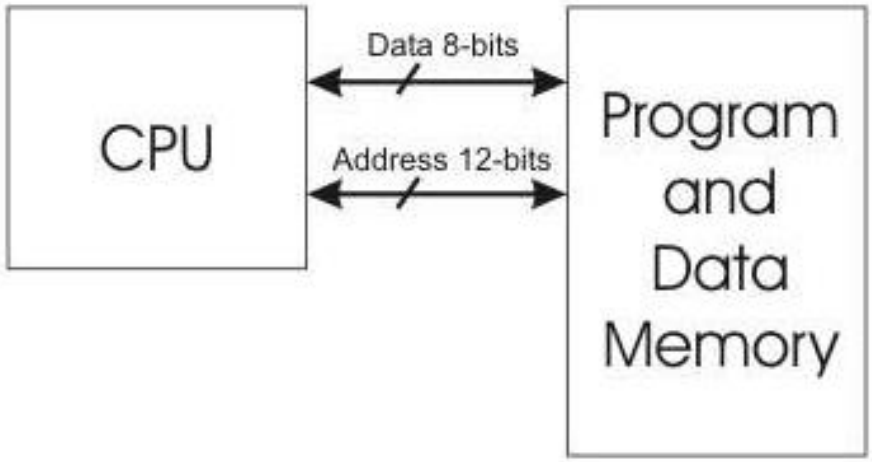
It handles the **loading** of new commands into the CPU and the **decoding** of these commands.

Also, it **directs** the **data flow** and the operation of the ALU.

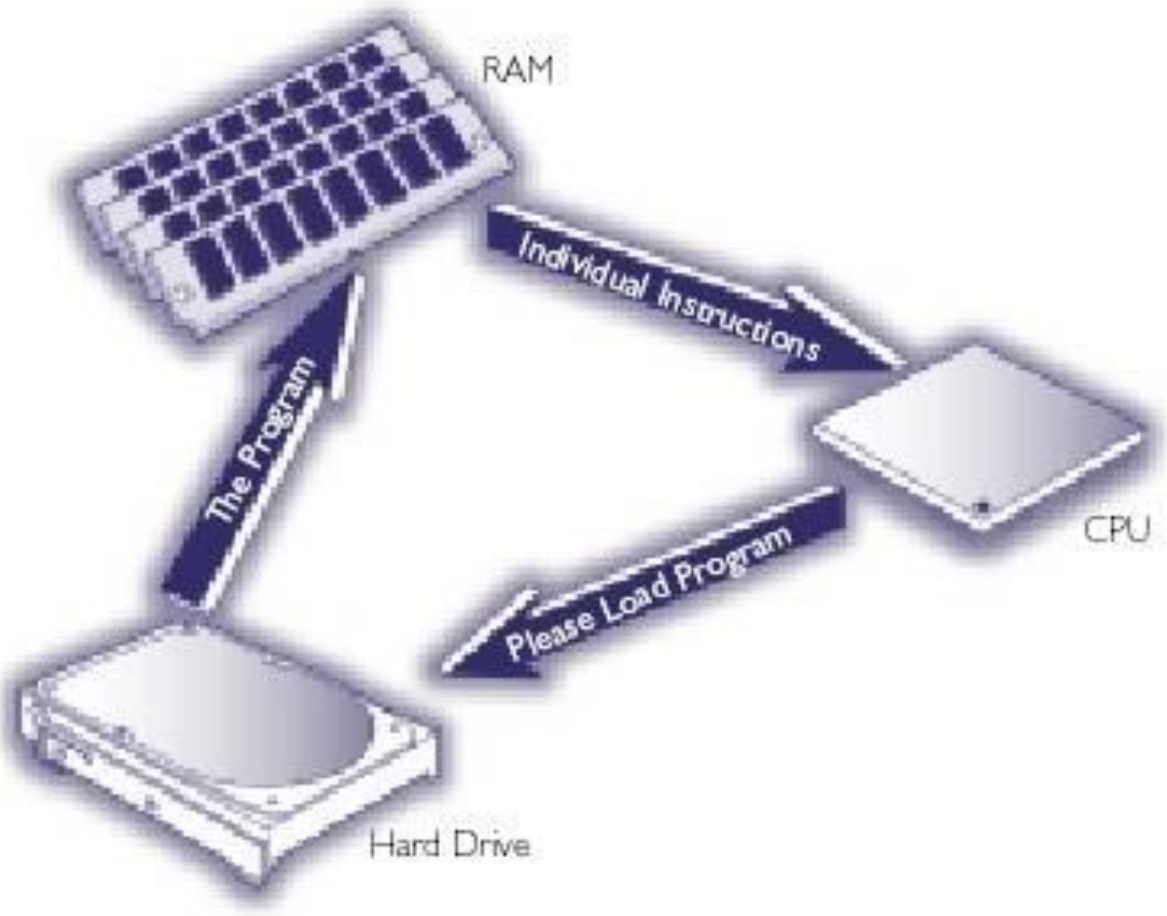


Computer Architecture

- In 1945, an scientist called **Von Neumann** suggested that a computer system be split in to a processor module (where the instructions are calculated) and a memory module (where instructions and data are stored).
- We still use this model today: **CPU** and **Primary Memory**



Special relationship between CPU & RAM

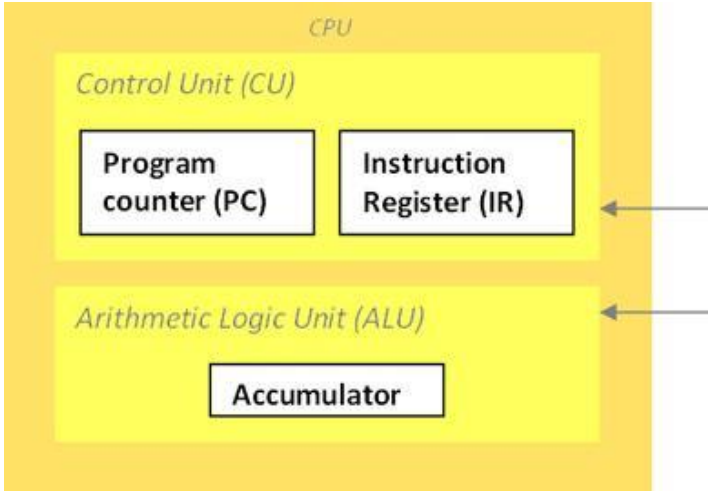


CPU needs it's own 'memory'

- **Registers:** they are small, very fast circuits that store intermediate values from calculations or instructions inside the CPU.
- There are many small units, but the four most important ones are:
  - **MAR**
  - **MDR**
  - **Accumulator**
  - **Program Counter**

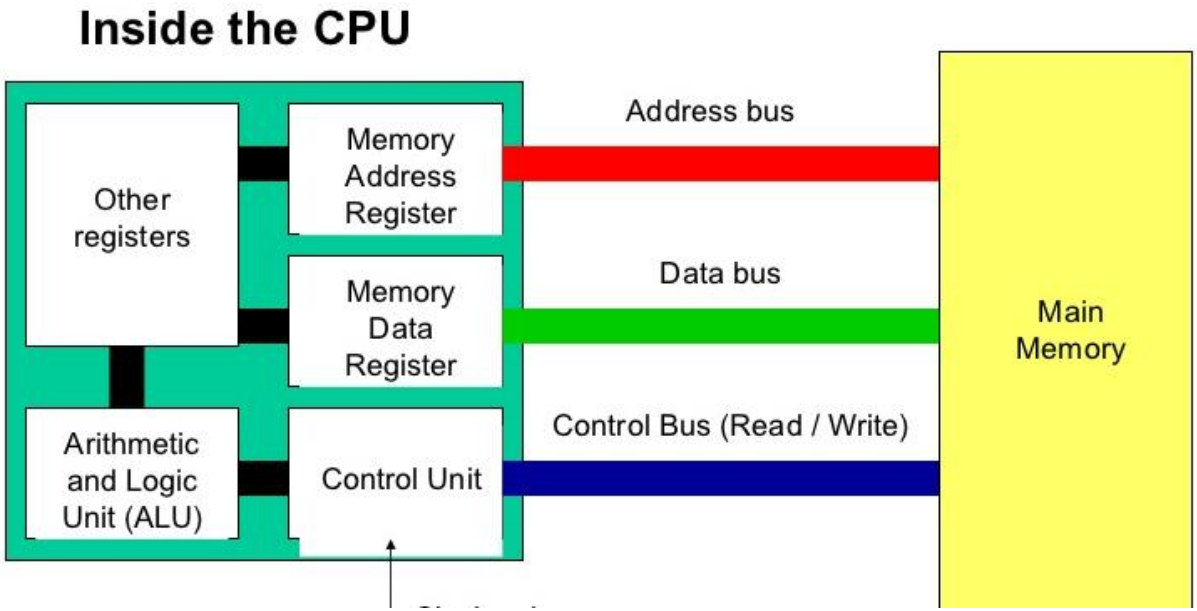
Program Counter & Accumulator

- **Program Counter** holds the memory address of the next instruction.
- **Accumulator** holds the intermediate results of the currently running instructions.



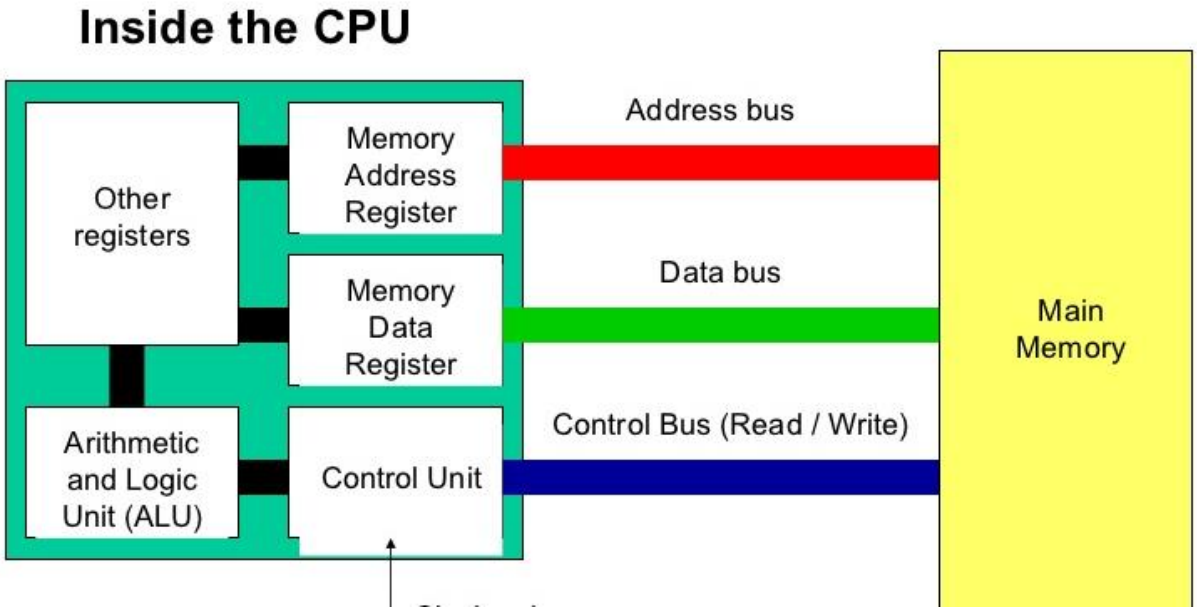
MAR (Memory Address Register)

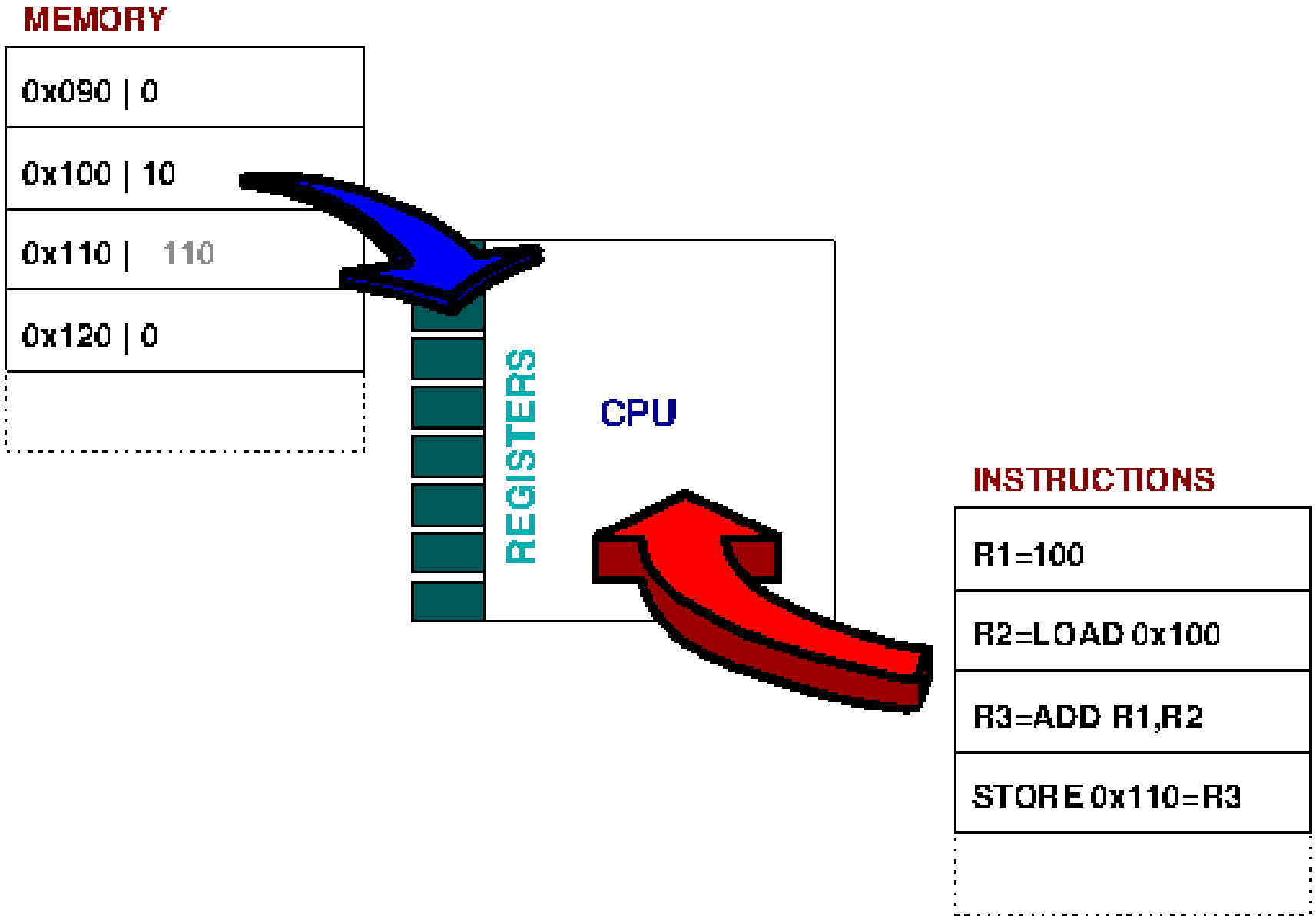
- MAR is connected to the **address bus**.
- MAR is contains a **memory address**.
- MAR's sole function contain the **RAM address** of the instruction the CPU wants next.



MDR (Memory Data Register)

- MDR is connected to the **data bus**.
- MDR holds data that will be **written to** the RAM or that was **read from** RAM.
- **Relationship** between MAR & MDR: The MAR gives the address the data of the MDR will be read from or written to.




MEMORY
0x090 | 0
0x100 | 10
0x110 | 110
0x120 | 0
REGISTERS
CPU
INSTRUCTIONS
R1=100
R2=LOAD 0x100
R3=ADD R1,R2
STORE 0x110=R3