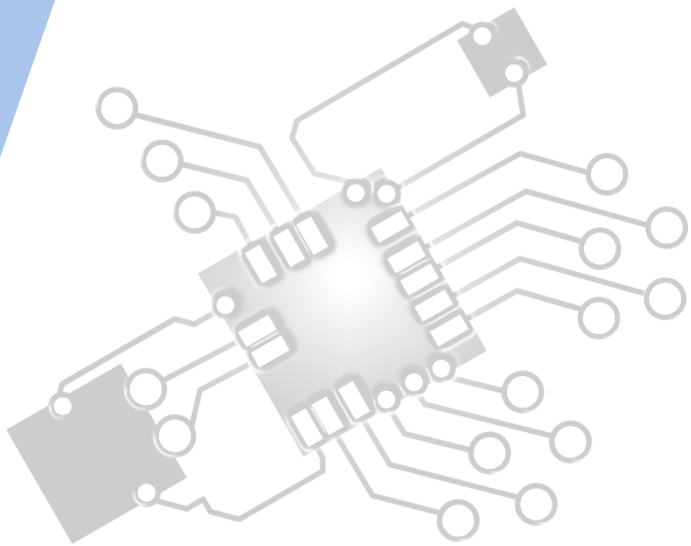
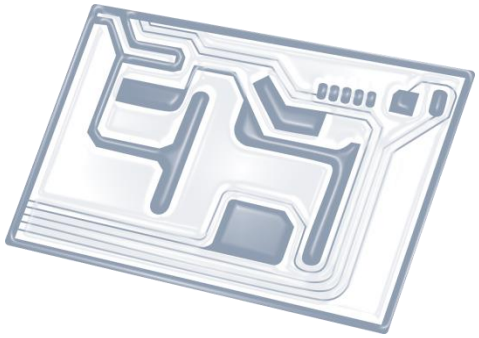
Computer Organisation

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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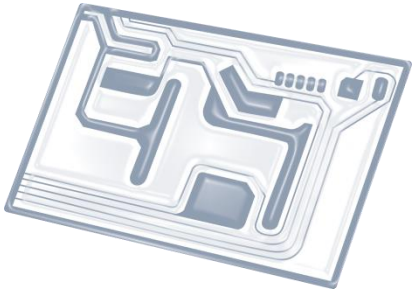


Topic 2.1.1

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 abbreviations

- **CPU** = Central Processing Unit
- **ALU** = Arithmetic Logic Unit
- **CU** = Control Unit
- **MAR** = Memory Address Register
- **MDR** = Memory Data Register

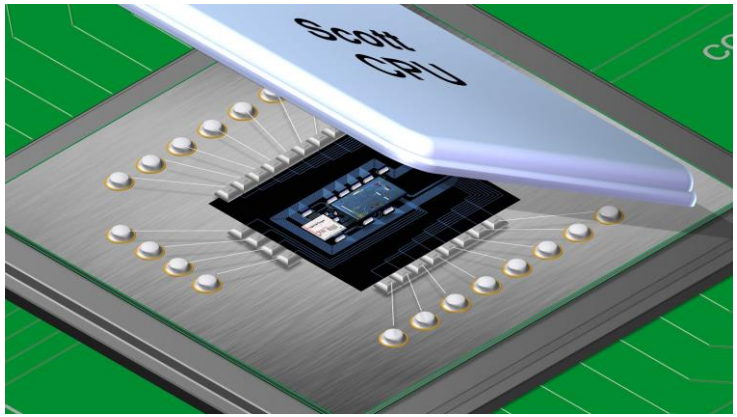
CPU (Central Processing Unit)

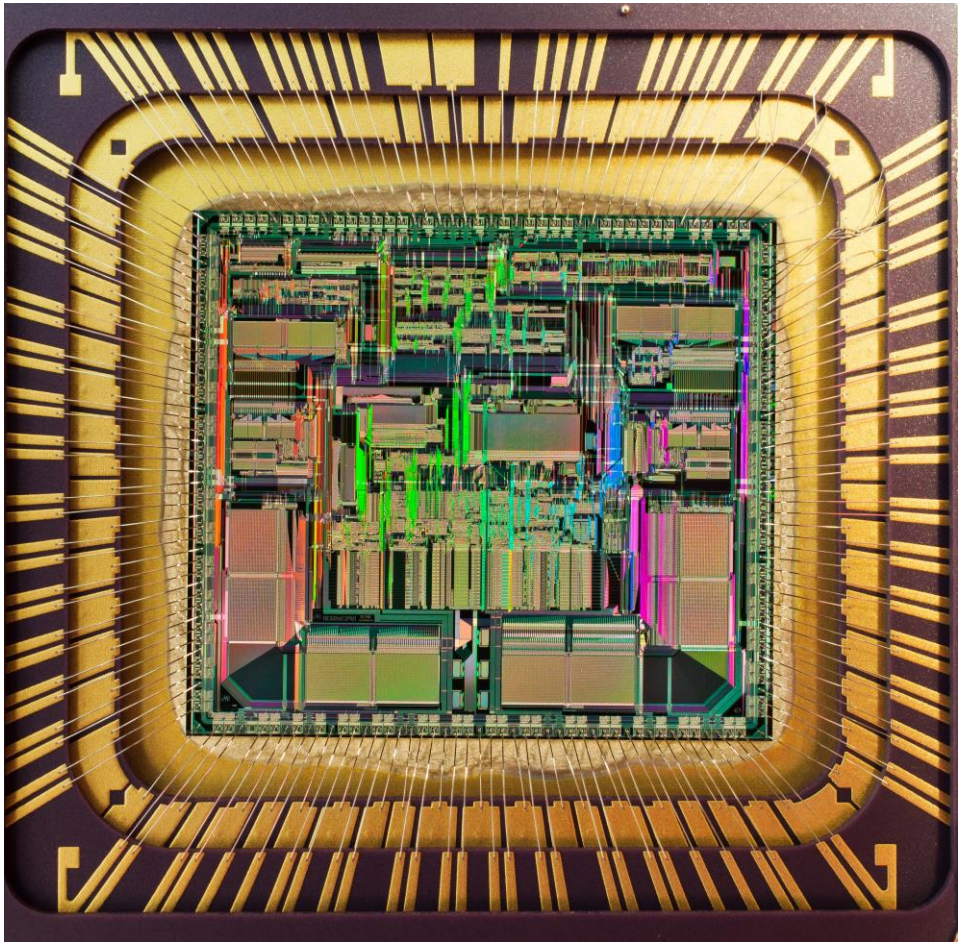
Video (YouTube): How are CPUs made

CPU (Central Processing Unit)

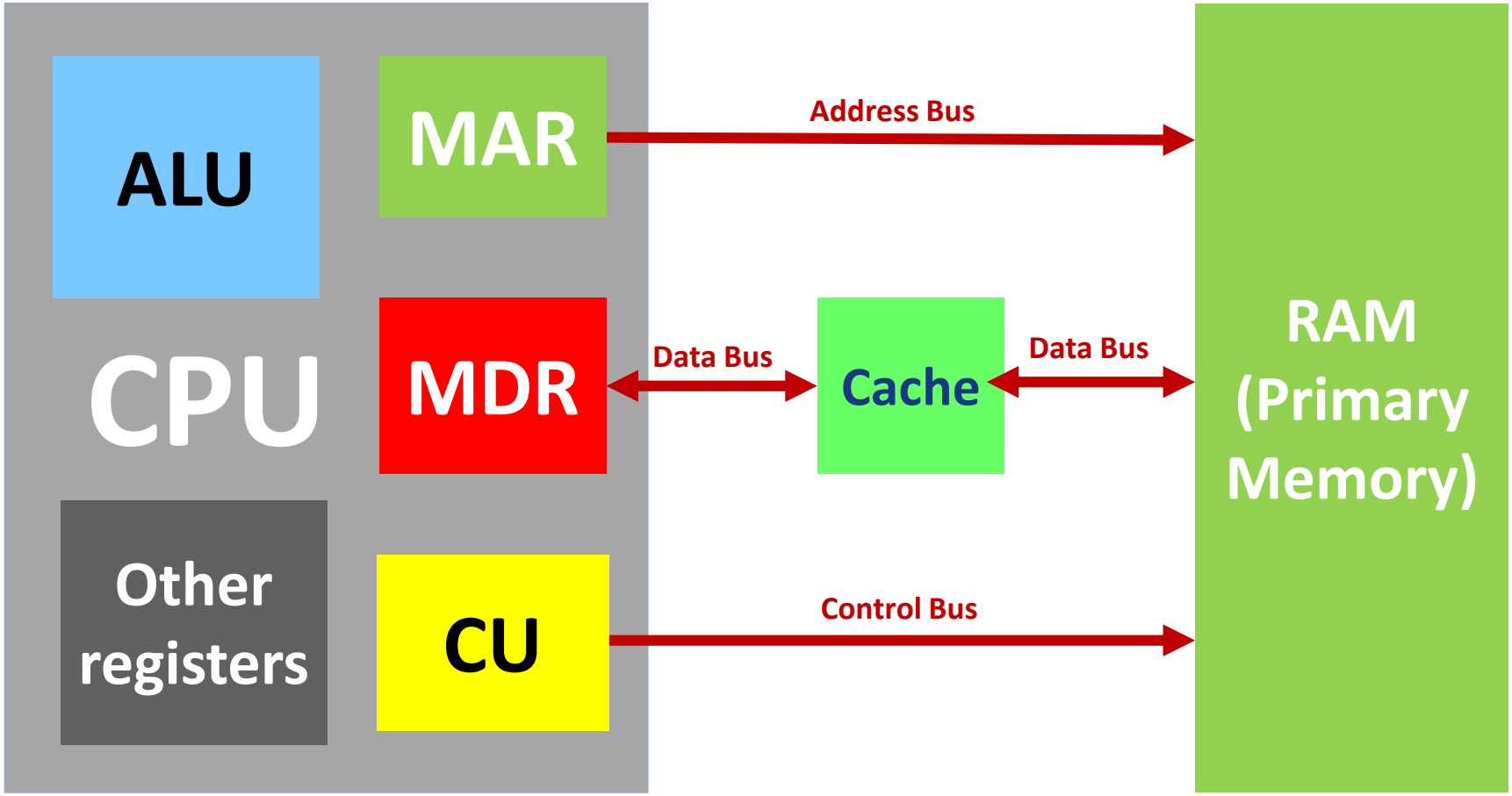
The key component of a computer system, which contains the circuitry necessary to fetch, decode and execute program instructions from and to main memory (RAM).

Inside a CPU

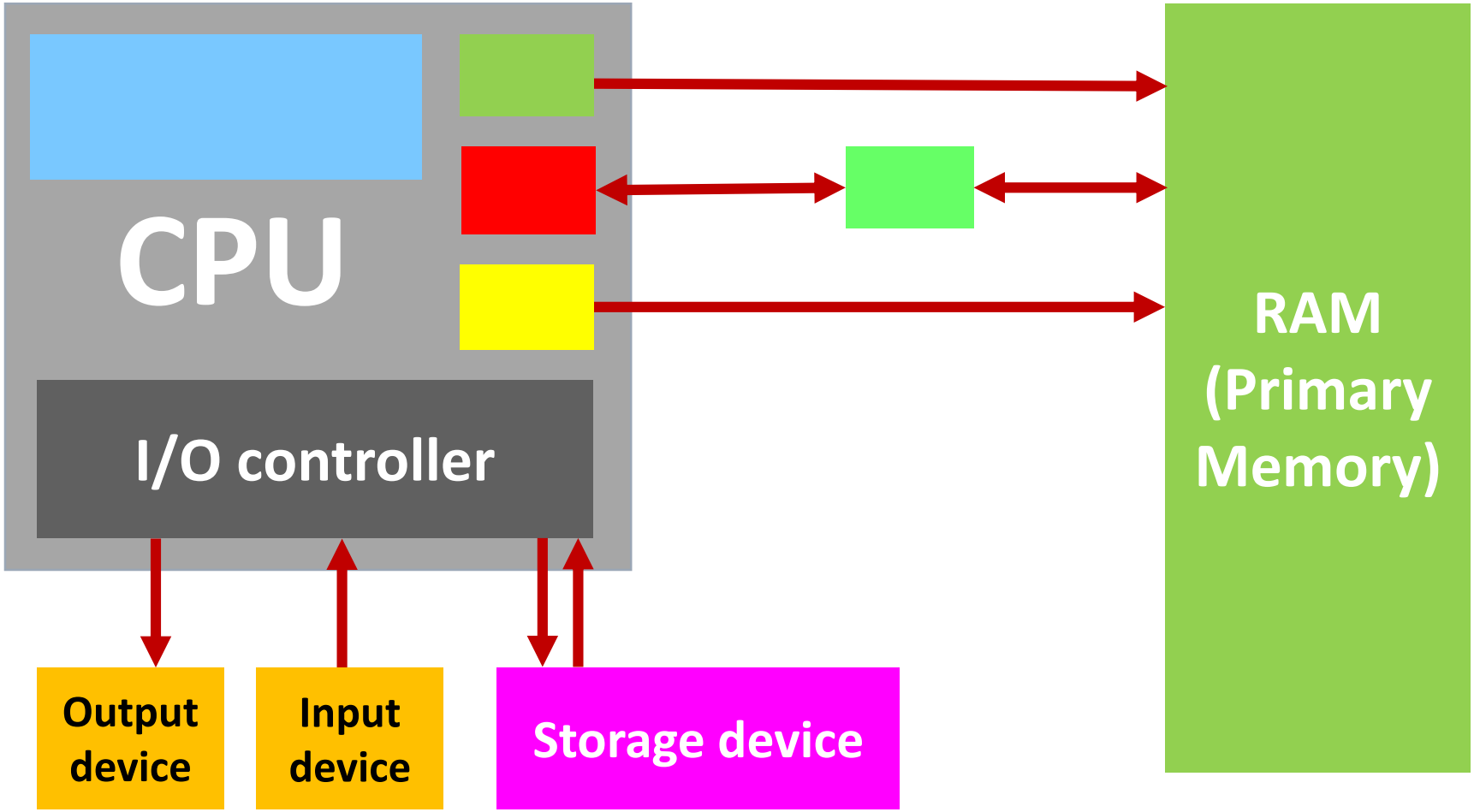




Simplified model: CPU, RAM



Simplified model: CPU, I/O devices, Storage



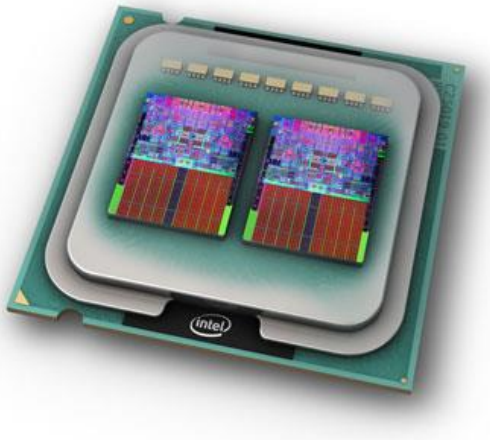
Exam note!

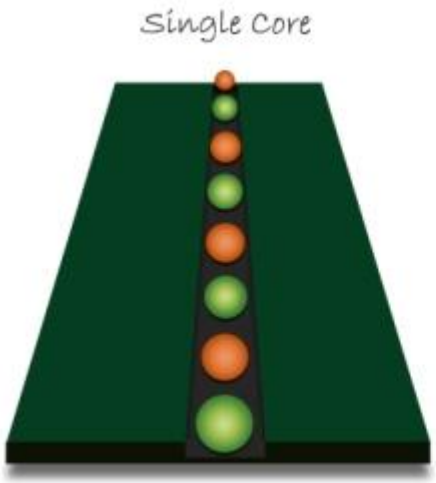
Students must be able to reproduce a ***block diagram*** showing the relationship between the elements of the **CPU**, **input/output** and **storage**.

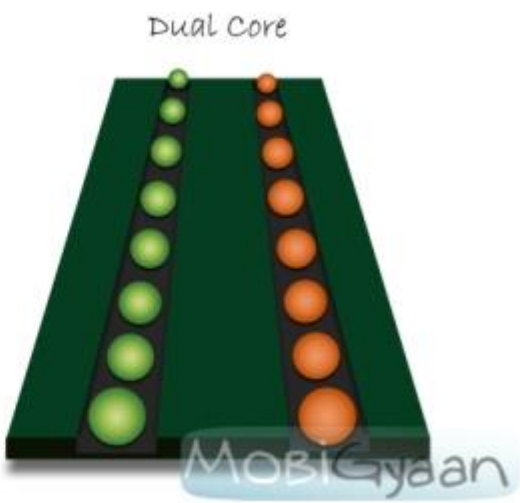
The only registers that need to be indicated are the **MDR** and **MAR**.

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**.



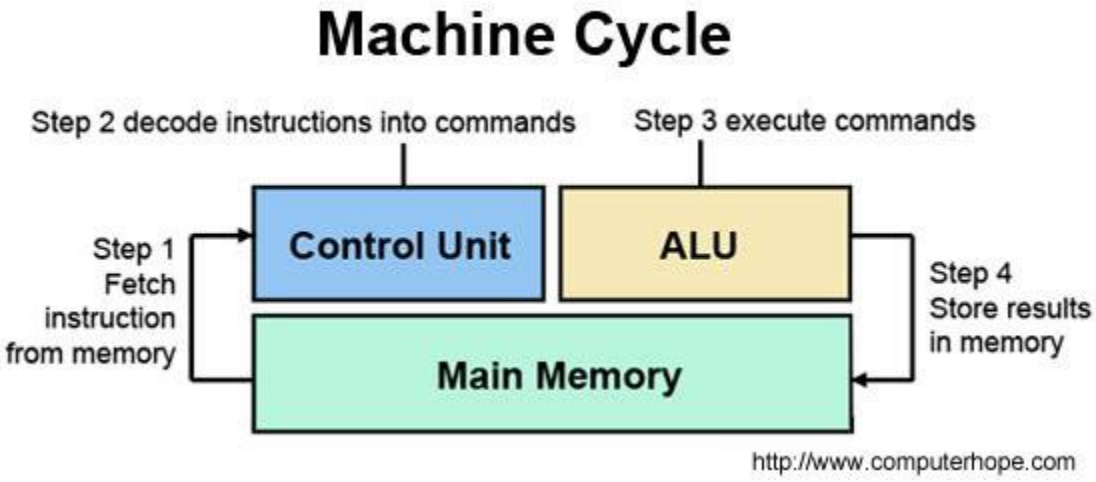




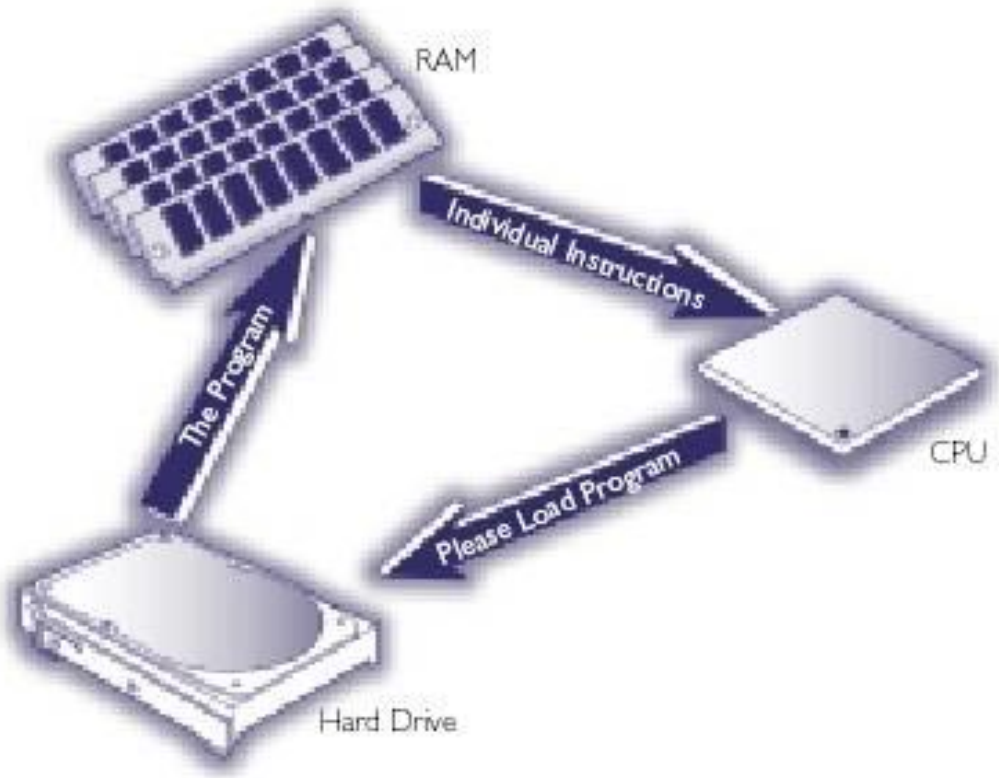
Two functions of the CU

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.

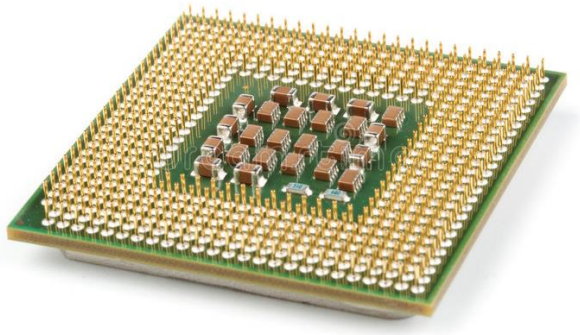


Programs are loaded from storage, into memory (RAM) and executed one instruction at a time by the CPU



CPU needs it's own 'memory'

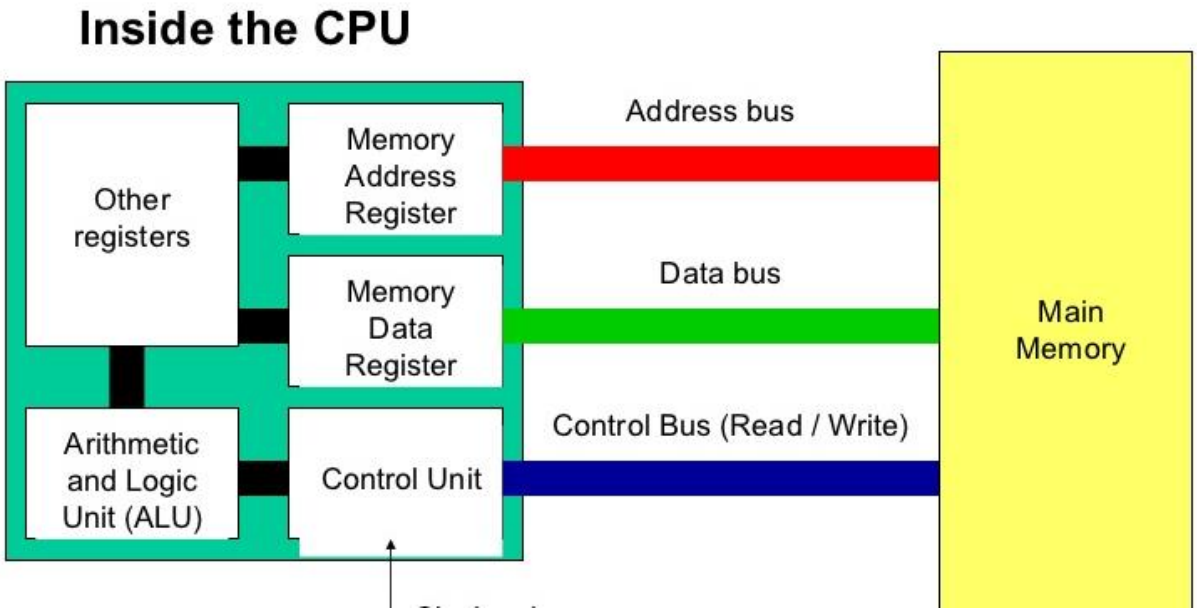
- **Registers:** they are small, very fast circuits that store intermediate values from calculations or instructions inside the CPU.
- There are **many registers**, but the three most important ones are:
  - **MAR**
  - **MDR**
  - **Accumulator***



Not assessed in this course

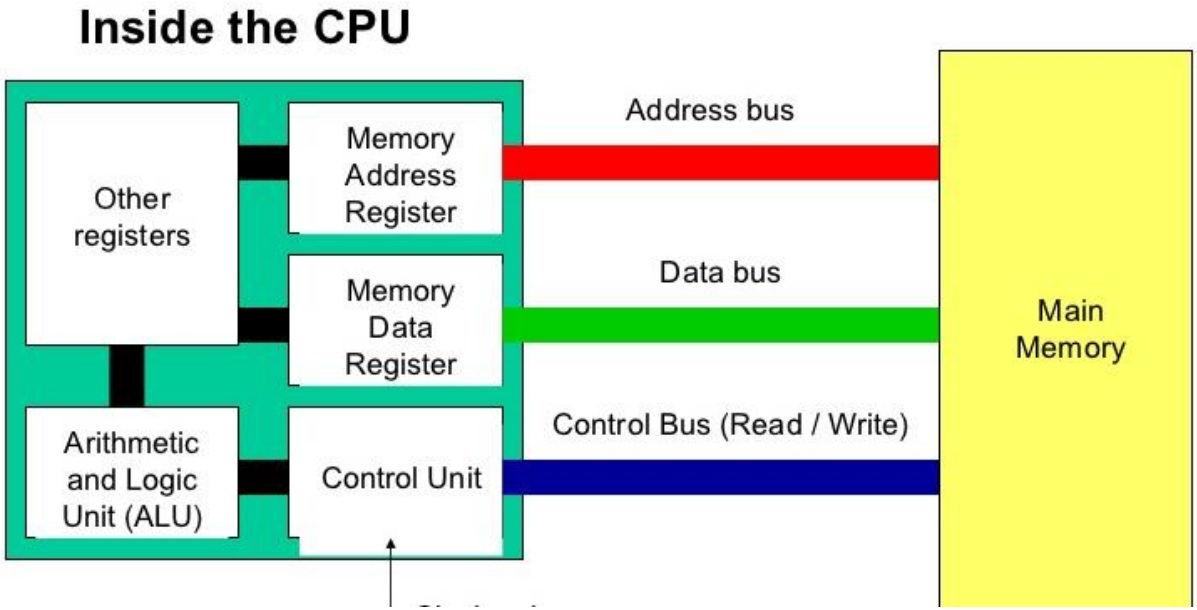
MAR (Memory Address Register)

- 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.



Busses

Busses are the **connecting wires** that connect the CPU to other devices, carrying instructions to/from components.

They are normally **built into the motherboard**.

The **three most important busses** are:

- **Data bus** (links RAM to CPU via MDR)
- **Control bus** (links RAM to CPU via CU)
- **Memory bus** (links RAM to CPU via MAR)