GCSE Computer Science
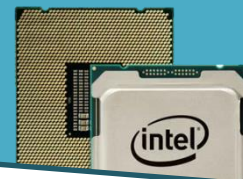# Topic 1.1 Systems Architecture

Von Neumann designed a computer system where the CPU runs programs stored in memory.

The **Central Processing Unit** processes data and instructions following the FDE cycle.

A computer systems is a combination of *hardware* and *software* that work together to process data.

Hardware: physical components that make up a computer system.
Software: programs/applications that run on a computer.

An *embedded system*: a dedicated system built into a larger system to control it.
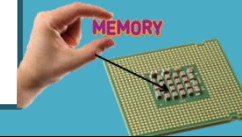
Registers are the smallest & fastest type of memory in a computer system. They hold data the CPU needs immediately.

REGISTER

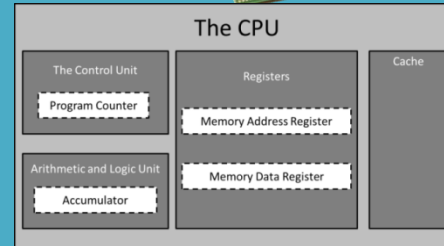MEMORY

The *PC* holds the address of the next instruction to be fetched.

The *Accumulator* holds the results of any calculations done by the ALU.

The **CPU**

The Control Unit — Program Counter
Registers — Memory Address Register, Memory Data Register
Arithmetic and Logic Unit — Accumulator
Cache

Memory (RAM)

The *MAR* holds the address of the memory location to fetch the data from / write to for the current cycle.

The *MDR* holds the data fetched from memory.

Benefits of embedded systems:
- ✓ Easier to design.
- ✓ Cheaper to produce.
- ✓ More **efficient** at doing their job.

FETCH Instruction
EXECUTE instruction
DECODE instruction

Copy the memory address from the Program Counter to the MAR.

Copy the instruction or data stored in the address held in the MAR, to the MDR.

Update the Program Counter with the address of the next instruction, ready for the next cycle.
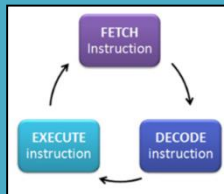
Clock Speed: the number of FDE cycles a single processor can carry out per second.
The HIGHER the clock speed, the faster the data can be processed.

- The *control Unit* is in overall control of the CPU.
- Its main job is to execute instructions by following the FDE cycle.
- It also controls the flow of data inside and outside the CPU.
- The control unit contains the decoder.

- The *Arithmetic Logic Unit* performs all the calculations.
- It completes arithmetic operations (+ , - , *, /).
- It also completes logic operations (binary shifts, AND OR NOT.
- The ALU contains the accumulator register.

- *Cache* is very fast memory.
- It is slower than the registers but faster than RAM.
- It stores regularly used data so that the CPU can access it quickly next time it is needed.
- If the data is not in cache, it will be fetched from RAM.
- Caches have very low capacity and are expensive compared to RAM.

The instruction in the MDR is decoded by the Control Unit(decoder).

The instruction is carried out.
The ALU performs the calculations (and stores the results in the Accumulator).

Number of cores:
each core in the CPU can process data independently.
The MORE cores, the FASTER the data can be processed.

The *cache* is memory inside the CPU. The MORE cache, the faster data can be fetched to be processed.

GCSE Computer Science - Topic 1.1 Systems Architecture

What I need to know:

1. What is the purpose of the CPU?			
What does CPU stand for ?			
2. Describe the Von Neumann architecture.			
What is a register?			
What does MAR stand for? What does the MAR hold?			
What does MDR stand for? What does the MDR hold?			
What does PC stand for? What does the PC hold?			
What does the accumulator hold? In which component is the accumulator?			
3. Common CPU components and their function:			
What does ALU stand for? Describe the function of the ALU.			
What does CU stand for? Describe the function of the CU.			
What is cache memory? What data does cache memory hold?			
4. What does FDE stand for?			
Describe each stage of the FDE Cycle.			
5. How common characteristics of CPUs affect their performance:			
What is clock speed? How does clock speed affect the speed of processing?			
How does the amount of cache affect the speed of processing?			
What can each core do? How does the number of cores affect the speed of processing?			
6. What is an computer system?			
Define the terms hardware and software.			
What is an embedded system?			
What are the benefits of embedded systems over general purpose systems?			
Name 3 examples of embedded systems.			