# FACTFILE:
# GCSE
# DIGITAL TECHNOLOGY
## Unit 1 – DIGITAL DATA

Rewarding Learning

## Fact File 11: Computer Hardware

### Learning Outcomes

Students should be able to:

- Explain the purpose of central processing unit (CPU);
- Describe the role of the following components of the CPU:
  - The arithmetic logic unit (ALU);
  - Control unit;
  - Immediate-access store.
- Describe the role played by the following in the fetch-execute cycle:
  - Program counter;
  - Memory address register (MAR);
  - Memory data register(MDR);
  - Instruction address register (IAR);
  - ALU.
- Describe the impact of clock speed, cache size and number of cores on CPU performance.

### Contents in Computer Hardware Fact File

- Central Processing Unit
- Fetch-Execute Cycle
- Clock Speed

## Central Processing Unit (CPU)

The CPU can be described as the brain of the computer. Its job is to process all data and complete instructions given by the user. For example if you ask a computer to print a document the CPU will instruct the printer to complete the task.

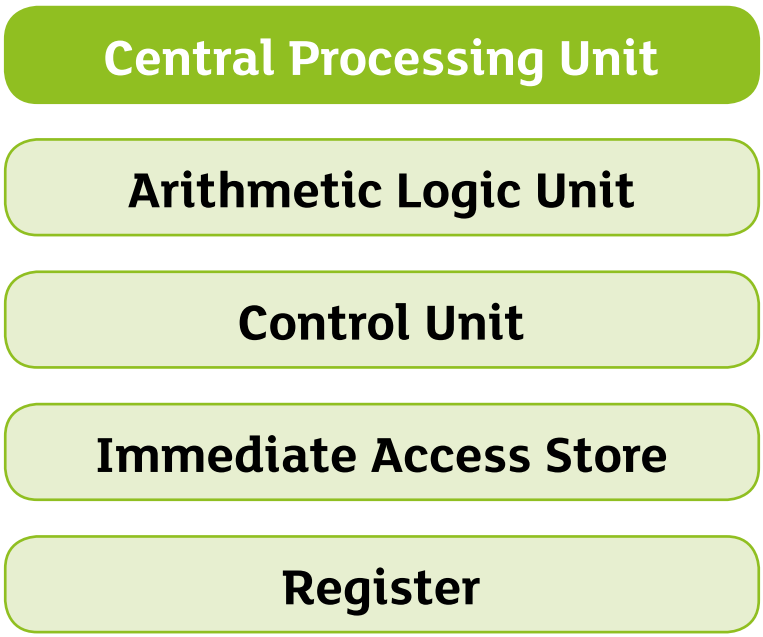
A computer appears to be completing many tasks at once for example playing music while you complete homework or surf the internet. However, the Central Processing Unit is only completing one task at a time.

The central processing unit uses a quartz clock to control how much time is given to each task. With each second that goes by the CPU processes one piece of data or executes one instruction.

The CPU has many very important components:

- The Arithmetic Logic Unit (ALU);
- Control Unit;
- Immediate-access store;
- Register.

**Parts of a CPU**



## The Arithmetic Logic Unit (ALU)

The ALU processes all data inside the CPU. As it name suggests it handles both Arithmetic (mathematical) operations and Logical operations.

| Arithmetic Operations | Logic Operations |
|---|---|
| Add | True |
| Subtract | False |
| Multiply | > (greater than) |
| Divide | < (less than) |
| | = (is equal to) |

## The Control Unit

The control unit manages how data is processed by the CPU, it manages how the CPU and other components communicate, for example communicating with a printer or USB device. It executes all instructions provided by programs. It informs the ALU, IAS along with input and output devices how to respond to instructions from a program.

## Immediate Access Store

The Central Processing Unit must have access to data as fast as possible. Each piece of data is stored in the random access memory chip so that the CPU can retrieve data immediately. Each memory location has a unique address assigned to it.

## Register

Is normally used for a specific purpose, where data or control information is temporarily stored. Some registers are used in the fetch-execute cycle while others may be used by the program being executed. Registers are much faster to access because they have to be accessed so often.

## Fetch-Execute Cycle

The Fetch-Execute Cycle explains the basic steps the Central Processing Unit takes to process an instruction. There are 5 stages the fetch-execute cycle goes through:

1. Program Counter
2. Memory Address Register (MAR)
3. Memory Data Register (MDR)
4. Instruction Address Register (IAR)
5. Arithmetic Logic Unit (ALU)

### Program Counter

There can be many instructions loaded in the computer memory, each one has its own unique number or starting address. It is the program counters job to have the address of the first instruction of the fetch-execute cycle.

### Memory Address Register (MAR)

The memory address register stores the current instruction or data being executed.

### Memory Data Register (MDR)

When the instruction is fetched the memory data register temporarily holds it. All data from memory to CPU goes via MDR.

### Instruction Address Register (IAR)

The Instruction Address Register holds the current instruction to be executed.

### Arithmetic Logic Unit (ALU)

This is a vital part and end of the fetch-execute cycle. The ALU will carry out the logical part of the instruction for example a calculation.

### Clock Speed

The CPU clock speed is measured in cycles per second. 1 cycle per second = 1 Hertz. A typical desktop computer is extremely quick, running at 3000 million times per second or 3GHz. It is this speed that makes it look as though the computer is completing multiple tasks at once. The faster the clock speed of a computer the more powerful the computer is, the quicker the central processing unit will work.

### Cache Size

Cache memory has extremely fast access, so sections of a program and its associated data are copied there to take advantage of its short fetch-execute cycle. The use of cache memory can greatly reduce processing time therefore the greater the Cache size the quicker the processing time.

### Number of Cores

Modern computers speed up their clock speed/processing power by containing more than one processor. Some companies call these CPU's 'core'. Therefore a 'dual core' device means the computer contains 2 processors, a 'quad core' device means the computer contains 4 processors.

# Bibliography

## Books

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BCS Glossary of Computing and ICT, 13th ed., BCS Academy Glossary Working Party pg 201 &202

## Websites

http://teach-ict.com/glossary/I/ias.htm

http://www.teach-ict.com/glossary/A/alu.htm

http://www.computerhope.com/jargon/c/cpu.htm

http://www.sciencehq.com/computing-technology/cpu-registers.html

## Questions

1. Expand the following acronyms:

   a. CPU _____ (1)

   b. ALU _____ (1)

2. What is the main purpose of the CPU?

   _____

   _____

   _____

   _____ (2)

3. Name 2 parts of the CPU and explain what they do.

   Part 1: _____

   _____

   _____ (2)

   Part 2: _____

   _____

   _____ (2)

4. What is the difference between a “dual-core” and a “quad-core” processor?

   _____

   _____

   _____ (1)

5. Explain the term Clock Speed.

   _____

   _____

   _____

   _____

   _____ (3)