



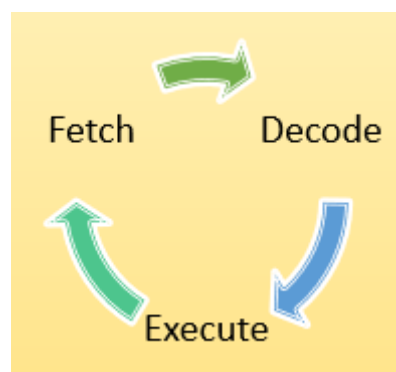
4.7.2 The Processor & the FDE Cycle

Stored Program Concept

The stored program concept:

Machine code instructions are stored in main memory and executed serially by a processor that performs arithmetic and logical operations.

In order to execute a program, the program's instructions must be retrieved from main memory, decoded and executed one at a time. This cycle is called the fetch-decode-execute cycle.





Registers

Registers are small, temporary memory locations in the CPU with very high read/write speed.

Most modern computer have many registers that can be general purpose or special purpose registers.

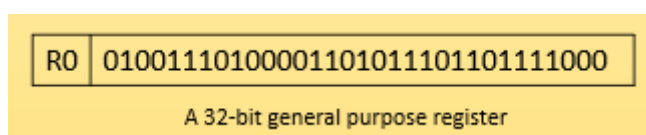
General purpose registers (normally named R0, R1, R2, etc) can be used to hold values that need to be accessed frequently.

They hold values that are used as operands during the execution of instructions or to store results of calculations.

The programmer determines that role of a general purpose register when writing a program.

Special purpose registers have specific roles. Some special purpose registers are:

- The **Program Counter (PC)** which holds the address of the next instruction to be fetched from main memory.
- The **Memory Address Register (MAR)** which holds the address of the memory location in main memory where data or instructions are to be fetched from, or data is to be written to.
- The **Memory Buffer Register (MBR)** which temporarily holds the data read from memory or to be written to memory.
- The **Current Instruction Register (CIR)** which holds to instruction to be decoded and executed.
- The **Status Register (SR)** stores information about the result of the last (arithmetic or logical instruction. Its contents is used to control conditional branch instructions. It stores flags which affect the operation of the control unit.





Control Unit

- The control unit **controls and coordinates the activities of the CPU.**
- Sends out **control signals** to other components.
- Decodes the instruction to determine what operation is required.
- Manages the execution of some instructions.

System Clock

The system clock sends out a steady pulse to **synchronize the components of a computer.**

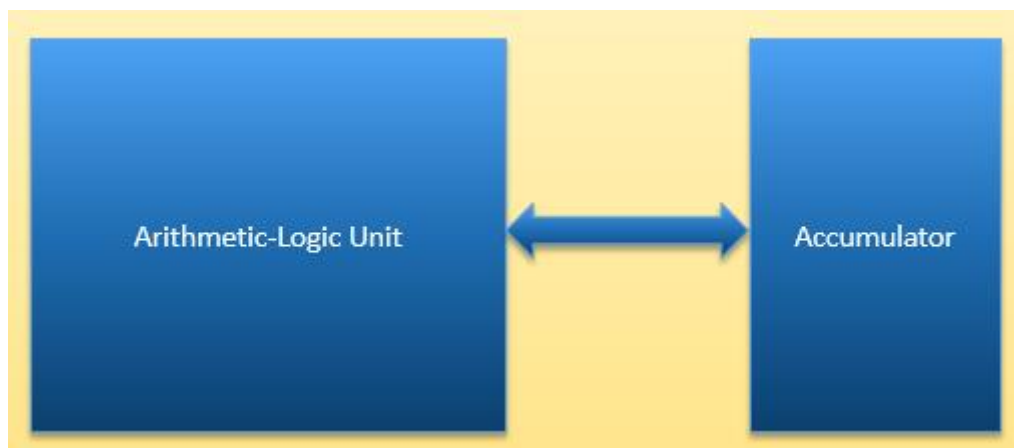
Arithmetic Logic Unit

The arithmetic logic unit (ALU) **performs arithmetic and logical operations** on the data.

Arithmetic operation such as add, subtract, multiply and divide on fixed or floating point numbers.

Logical operations such as AND, OR and XOR.

The result of these operations will be placed in the **accumulator** or general purpose registers





FDE Cycle

Fetch

- The **program counter (PC)** holds the address of the instruction that needs to be fetched.
- The contents of the PC is copied to the **memory address register (MAR)**
- The address is sent along the address bus to main memory.
- The control unit sends a read signal along the control bus.
- The instruction at the memory address on the address bus is accessed and placed on the data bus.
- This is then stored in the **memory buffer register (MBR)**
- At the same time the **program counter** is incremented.
- Lastly the contents of the memory buffer register is copied to the **current instruction register (CIR)**.

Decode

During the decode stage the instruction is split into:

- **Opcode** – The type of operation that is to be carried out
- **Operand** – The data, or address of the data, for the operation to be carried out on.

The control unit has a decode unit which decodes the instruction.

Opcode				Operand			
Basic Machine Operation			Addressing Mode				
0	0	1	0	1	1	1	1

The **addressing mode** determines what the operand is.

- **Immediate addressing** – the operand **is the data** that the opcode should be applied to.
- **Direct addressing** – the operand **is the address of the data** that the opcode should be applied to.





Execute

During the execute stage the operation of the opcode is carried out on the operand.

These operations could be:

- Perform arithmetic calculations in the ALU
- Perform bitwise logic calculations in the ALU
- Retrieve data from memory
- Store data to memory
- Change the contents of the PC due to a branch in a program

EXAM TIP: When in the exam, if you need examples of possible instructions that could be executed, just have a look at the AQA assembly code table in the exam paper.

