# CENTRAL PROCESSING UNIT (CPU)

CPU is an acronym for a **Central Processing Unit**, which is considered to be the *brain of a computer*. It is also known as the **processor or microprocessor**.

Central Processing unit is a piece of computer hardware that is used to process data on the computer in order to obtain a useful information. It is the primary element carrying out the functions of the computer. It executes the instructions of a computer program, in sequence, perform the basic arithmetic, logical and input and output operations of the system. It is found on the motherboard. All the functions of the CPU are stored in a component called the **chip**.
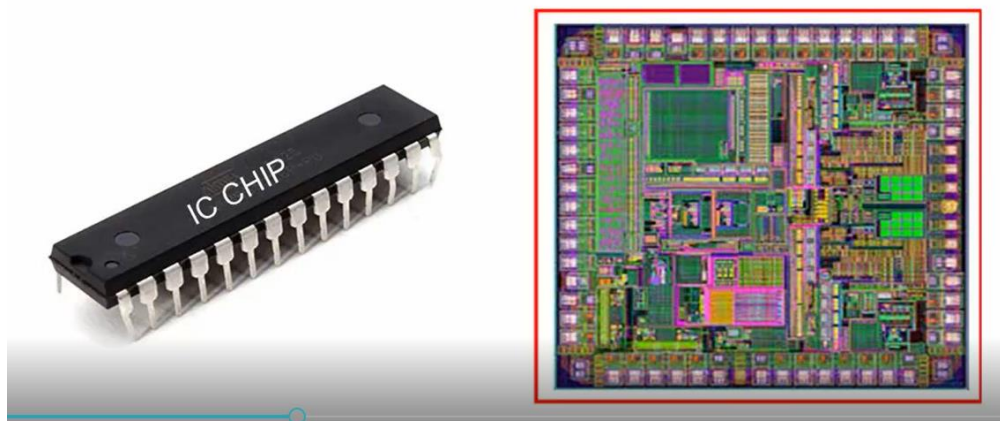
Fig 1 DIAGRAM OF A CHIP

The CPU of PC's are generally implemented on a single chip, called a **Microprocessor**. Most of the devices connected to the computer communicate with the CPU in order to carry out a task. The CPU speed accounts for the amount the cycles that a CPU performs per second which controls how quickly it accomplishes it task. The first intel CPU T operated at a speed of 108KHz ≈ 108,000 cycles per second. But today the speed is 3.5GHz to 3.5 billion cycles per second or over. **The efficiency of CPU is the ability to carry out instructions with high speed and accuracy.**

EXAMPLES OF PROCESSORS

- Intel (Pentium, Celeron, Xeon and Itanium).
- Intel – Compatible (Cyrix, AMD, Power PC, IBM and motoralla)
- Alpha (Compaq).

Fig 2 DIAGRAM OF THE CENTRAL PROCESSING UNIT(CPU)

HOW CENTRAL PROCESSING UNIT WORKS

The CPU carries out a large share of work in the computer. Data pass continually through it. The data come from the RAM and the units, keyboard, drives etc. and after processing the data it is sent back to the RAM and the units. The data is mostly calculations and data transport.

COMPONENTS OF CPU

CPU consists to two main units namely:

- Arithmetic and logic unit (ALU)
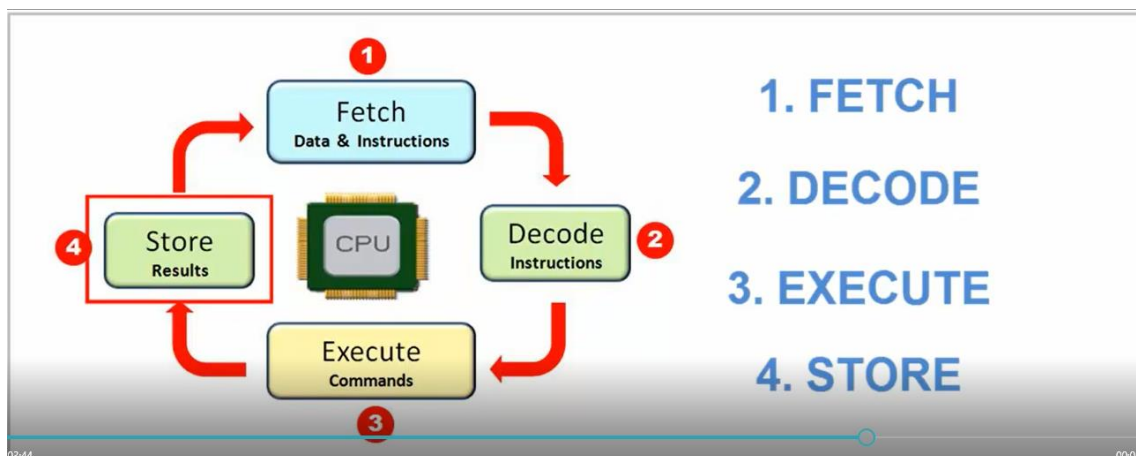- Control Unit (CU)

Note: Some materials include memory unit as components of CPU.

FUNCTIONS OF CPU

1. It controls all activities of the computer system.
2. It controls the transfer of data and instructions.

3. It runs programs by fetching instructions from RAM, evaluating them and executing them in sequence, which known as FETCH – EXECUTE – CYCLE
4. It processes data or converts data into information.
5. It is responsible for detecting errors.

Fig 3 FETCH – EXECUTE – CYCLE/MACHINE CYCLE/INSTRUCTION CYCLE

EXECUTING PROGRAMS

FETCH- the next instruction is fetched from main memory.

DECODE – The instruction gets interpreted (decoded) by the control unit (CU).

EXECUTE – The instructions get executed (carried out).

- CU notifies the appropriate part of hardware to take action e.g., ALU
- Control is transferred to the appropriate part of the hardware.
- Task is performed e.g., ALU carries out mathematical calculations.

NOTE: The CPU also contains other parts i.e., components such as registers (memory units), system bus (control bus, data bus, address

bus), CPU cache, CPU clock, Interface unit (IU) etc. Registers are special – purpose high speed temporal storage located inside CPU.

FIG 4: CPU IN RELATION TO OTHER HARDWARE UNITS OF THE COMPUTER.
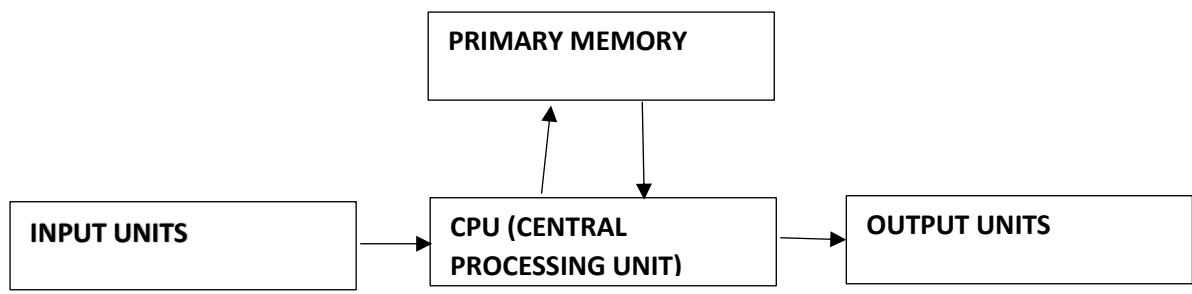
FIG 5: CPU IN REALTION TO OTHER HARDWARE UNITS OF THE COMPUTER .
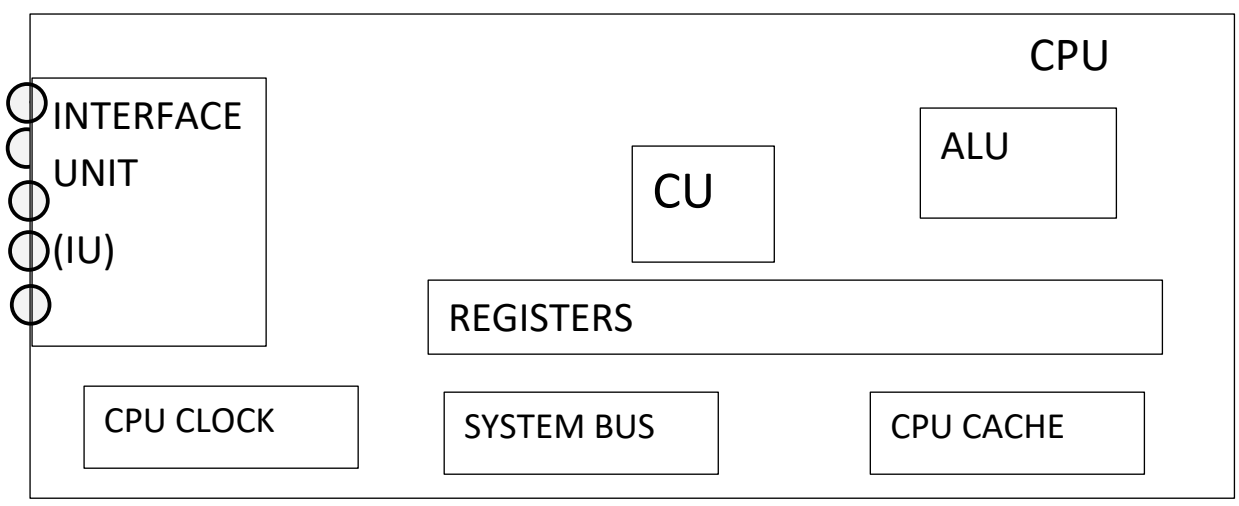
Control Unit (CU): - This is the most complicated part of CPU it controls and co-ordinates computer components. It does it by issuing control signals to the other areas of the processor, instructing them on what

should be performed next. It extracts instructions from memory and decodes the program instruction in (IR) and executes them e.g., selecting machine resources such as Alu to carry out an operation. It communicates with ALU and memory unit.

The control unit can be broken down into three parts:

a. **Decoder** – This is used to decode instructions that make up a program when they are being processed and to determine what actions must be taken in order to process them.
b. **Time/Clock** – this ensures that all processes and instructions are carried out and completed at the right time.
c. **Control logic circuits** – these are used to create the control signals themselves, which are sent around the processor. The signals inform ALU and register array what actions and step they should be performing.

FUNCTIONS OF THE CONTROL UNIT

1. It is the part of hardware that is in-charge of the other hardware units.
2. It controls the movement of instructions in and out of the processor.
3. Directs the operation of the processor.
4. Fetches or reads program instructions from RAM.
5. It consists of a decoder to interpret or decode the program instructions.
6. It directs ALU to execute stored program instructions.
7. It controls the operations of the ALU
8. It communicates with other parts of the hardware (input).
9. It consists of a clock to ensure that everything happens at the correct time.
10. It is also responsible for performing the instruction execution – cycle.

NOTE: CU performs the following basic functions on instructions:

- It fetches instruction from the main memory.
- Decodes instruction – it interprets the instructions that was fetched to determine the operation it will perform.
- Execution: it controls the execution of the instruction.
- Storing results – the process of writing result to the memory is called **storing**. CU ensures that output(s) gotten from the execution of an instruction are stored in the memory **these four functions together are referred to as machine cycle or Instruction cycle of the CPU.**

  See fig 3

ARITHMETIC AND LOGIC UNIT (ALU): this is a section of the processor that is involved with executing operations of an arithmetic or logical nature. It works in conjunction with the register array mainly accumulator (holds results of operations) and flag registers (contains a number of individual bits that are used to store information i.e., fast operation carried out by the ALU).

ALU HAS TWO SUB SECTION:

1. **Arithmetic section** – it carries out all arithmetic operations like addition, subtraction, multiplication, division and other complex actions.
2. **Logical section** – this carries out all logic operations like comparison operation, selecting, matching and merging data. Comparison operation (<, >, = etc.). other logic operation e.g., AND, OR, NOT etc.

FUNCTIONS OF ALU

1. It carries out arithmetic operations like +, -, x, /
2. It carries out logical operations like AND, OR, NOT.

3. It compares numbers letters and special characters.

OTHER COMPONENTS OF CPU

1. **Register** – are special – purpose high speed temporary storage located inside CPU. They are used for quick storage and retrieval of data and instructions. They are two types namely: Special-purpose registers and general-purpose registers,
1. **System bus** – comprises of control bus, data bus and address bus. It is used for connection between the processor memory and peripherals and transferal if data between the various parts. Data bus carries information, address bus – determines where it should be sent, and a control bus determines its operation.
2. **CPU cache** – cache memory stores the most recent data the CPU has accessed from RAM, it is volatile. It is faster but more expensive than RAM.
3. **CPU clock** – the performance of the speed of CPU depends on the clock speed: Measured in Megahertz or Gigahertz. The clock keeps track of how many cycles a chip operates at per second. It acts as regulator for CPU data flow.
4. **Interface unit (IU)** – transmits and receives program instructions and data from other computer components.

References

- *Welcome to computer studies for ss1 by Dele Kelani and Boye Jokotoye*
- *Computer Studies for senior secondary schools by HiiT PLC*
- *Principles of computer studies for senior secondary schools.by V.C. Eze*
- [*www.learncomputerscience*](http://www.learncomputerscience) *online.com (central processing unit*