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جامـــــعة المـــــستقبل
AL MUSTAQBAL UNIVERSITY

كلية العـــــــلوم
قـســـــــم علوم الأنظمة الطبية الذكية

LECTURE: (3)

Subject: COMPUTER TYPES

Level: First

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COMPUTER TYPES

A computer can be defined as a fast electronic calculating machine that accepts the (data) digitized input information process it as per the list of internally stored instructions and produces the resulting information. List of instructions are called programs & internal storage is called computer memory.

The different types of computers are

1. **Personal computers: -** This is the most common type found in homes, schools, Business offices etc., It is the most common type of desk top computers with processing and storage units along with various input and output devices.
2. **Note book computers: -** These are compact and portable versions of PC
3. **Work stations: -** These have high resolution input/output (I/O) graphics capability, but with same dimensions as that of desktop computer. These are used in engineering applications of interactive design work.
4. **Enterprise systems: -** These are used for business data processing in medium to large corporations that require much more computing power and storage capacity than work stations. Internet associated with servers have become a dominant worldwide source of all types of information.
5. **Super computers: -** These are used for large scale numerical calculations required in the applications like weather forecasting etc.,

BASIC TERMINOLOGY

•Input: Whatever is put into a computer system.

•Data: Refers to the symbols that represent facts, objects, or ideas.

•Information: The results of the computer storing data as bits and bytes; the words, umbers, sounds, and graphics.

•Output: Consists of the processing results produced by a computer.

•Processing: Manipulation of the data in many ways.

•Memory: Area of the computer that temporarily holds data waiting to be processed, stored,or output.

•Storage: Area of the computer that holds data on a permanent basis when it is notimmediately needed for processing.

•Assembly language program (ALP) –Programs are written using mnemonics

•Mnemonic –Instruction will be in the form of English like form

•Assembler –is a software which converts ALP to MLL (Machine Level Language)

•HLL (High Level Language) –Programs are written using English like statements

•Compiler -Convert HLL to MLL, does this job by reading source program at once

•Interpreter –Converts HLL to MLL, does this job statement by statement

•System software –Program routines which aid the user in the execution of programs eg: Assemblers, Compilers

•Operating system –Collection of routines responsible for controlling and coordinating allthe activities in a computer system

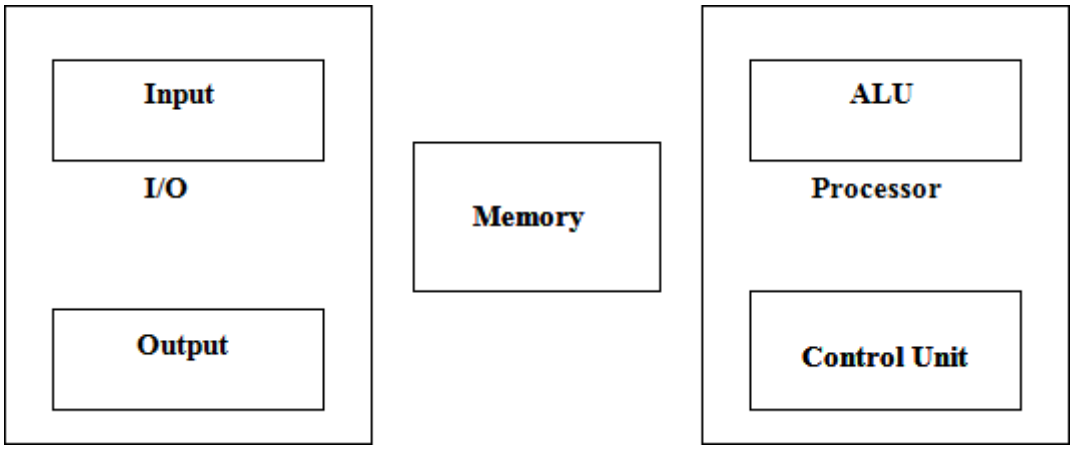
Computers has two kinds of components:

Hardware, consisting of its physical devices (CPU, memory, bus, storage devices, ...)

Software, consisting of the programs it has (Operating system, applications, utilities, ...)

FUNCTIONAL UNIT

A computer consists of five functionally independent main parts input, memory, arithmetic logic unit (ALU), output and control unit.

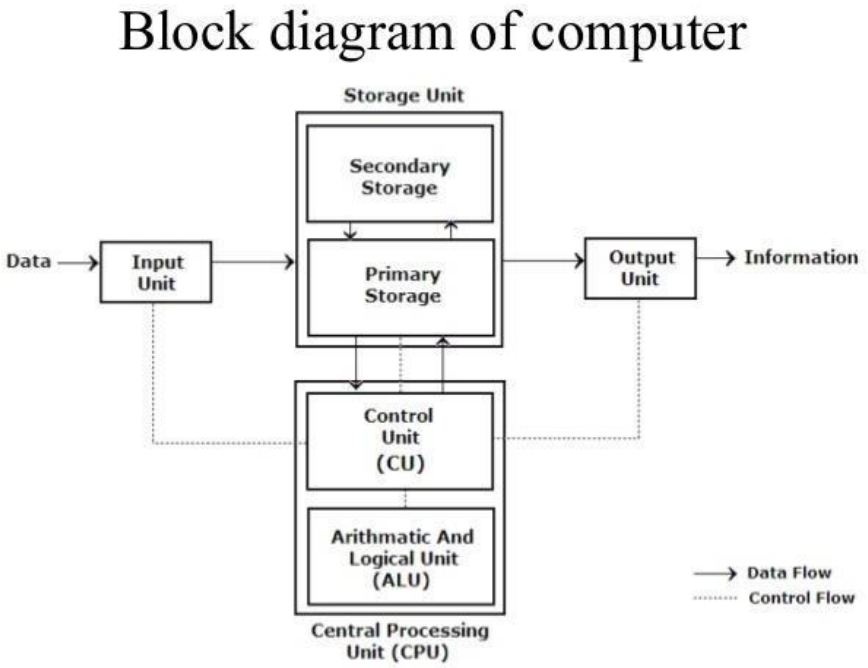


Functional units of computer

Input device accepts the coded information as source program i.e. high level language. This is either stored in the memory or immediately used by the processor toperform the desired operations. The program stored in the memory determines the processing steps. Basically the computer converts one source program to an object program.

i.e. into machine language.

Finally the results are sent to the outside world through output device. All of these actions are coordinated by the control unit.



Input unit: -

The source program/high level language program/coded information/simply data is fed to a computer through input devices keyboard is a most common type. Whenever a key is pressed, one corresponding word or number is translated into its equivalent binary code over a cable & fed either to memory or processor

Memory unit: -

Its function into store programs and data. It is basically to two types

1. **Primary memory**
2. **Secondary memory**

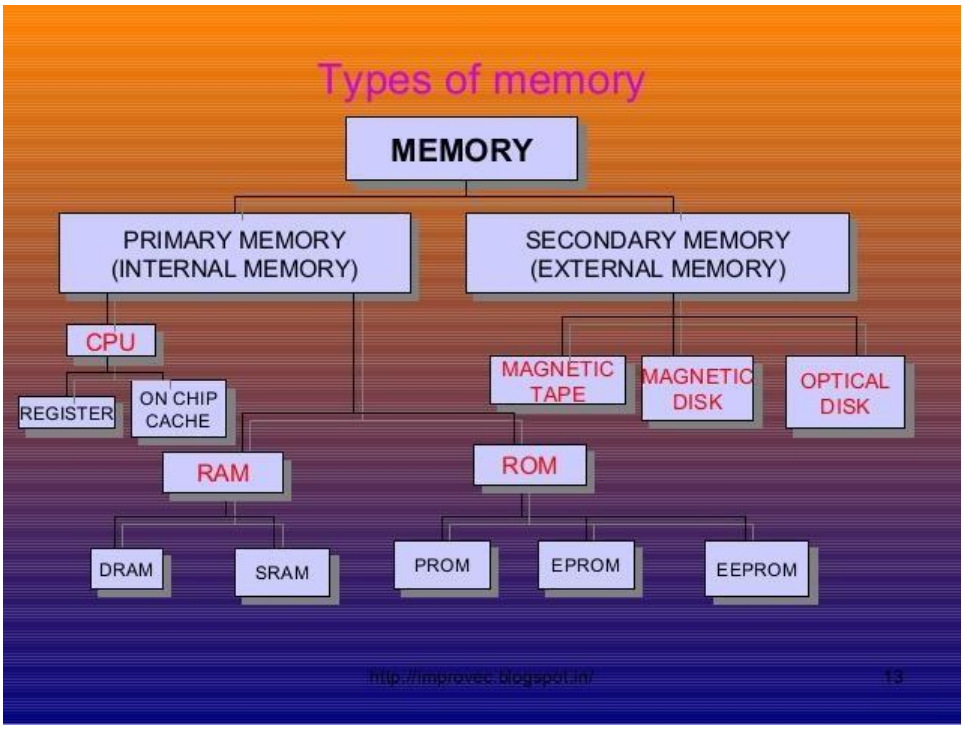
Word:

In computer architecture, a word is a unit of data of a defined bit length that can be addressed and moved between storage and the computer processor. Usually, the defined bit length of a word is equivalent to the width of the computer's data bus so that a word can be moved in a single operation from storage to a processor register. For any computer architecture with an eight-bit byte, the word will be some multiple of eight bits. In IBM's evolutionary System/360 architecture, a word is 32 bits, or four contiguous eight-bit bytes. In Intel's PC processor

architecture, a word is 16 bits, or two contiguous eight-bit bytes. A word can contain a computer instruction, a storage address, or application data that is to be manipulated (for example, added to the data in another word space).

The number of bits in each word is known as word length. Word length refers to the number of bits processed by the CPU in one go. With modern general purpose computers, word size can be 16 **bits** to **64 bits**.

The time required to access one word is called the memory access time. The small, fast, RAM units are called caches. They are tightly coupled with the processor and are often contained on the same IC chip to achieve high performance.



1. **Primary memory: -** Is the one exclusively associated with the processor and operates at the electronics speeds programs must be stored in this memory while they are being executed. The memory contains a large number of semiconductors storage cells. Each capable of storing one bit of information. These are processed in a group of fixed site called word.

To provide easy access to a word in memory, a distinct address is associated with each word location. **Addresses are** numbers that identify memory location.

Number of bits in each word is called word length of the computer. Programs must reside in the memory during execution. Instructions and data can be written into the memory

or read out under the control of processor. Memory in which any location can be reached in a short and fixed amount of time after specifying its address is called random- access memory (RAM).

The time required to access one word in called memory access time. Memory which is only readable by the user and contents of which can't be altered is called read only memory (ROM) it contains operating system.

Caches are the small fast RAM units, which are coupled with the processor and are often contained on the same IC chip to achieve high performance. Although primary storageis essential it tends to be expensive.

2 Secondary memory: - Is used where large amounts of data & programs have to be stored, particularly information that is accessed infrequently.

Examples: - Magnetic disks & tapes, optical disks (ie CD-ROM's), floppies etc.,

Arithmetic logic unit (ALU):-

Most of the computer operators are executed in ALU of the processor like addition, subtraction, division, multiplication, etc. the operands are brought into the ALU from memory and stored in high speed storage elements called register. Then according to the instructions the operation is performed in the required sequence.

The control and the ALU are may times faster than other devices connected to a computer system. This enables a single processor to control a number of external devices such as key boards, displays, magnetic and optical disks, sensors and other mechanical controllers.

Output unit:-

These actually are the counterparts of input unit. Its basic function is to send the processed results to the outside world.

Examples:- Printer, speakers, monitor etc.

Control unit:-

It effectively is the nerve center that sends signals to other units and senses their states. The actual timing signals that govern the transfer of data between input unit, processor, memory and output unit are generated by the control unit.

BASIC OPERATIONAL CONCEPTS

To perform a given task an appropriate program consisting of a list of instructions is stored in the memory. Individual instructions are brought from the memory into the processor, which executes the specified operations. Data to be stored are also stored in the memory.

Examples: - Add LOCA, R_0

This instruction adds the operand at memory location LOCA, to operand in register R_0 & places the sum into register. This instruction requires the performance of several steps,

1. First the instruction is fetched from the memory into the processor.
2. The operand at LOCA is fetched and added to the contents of R_0
3. Finally the resulting sum is stored in the register R_0

The preceding add instruction combines a memory access operation with an ALU Operations. In some other type of computers, these two types of operations are performed by separate instructions for performance reasons.

Load LOCA, R1

Add R1, R0

Transfers between the memory and the processor are started by sending the address of the memory location to be accessed to the memory unit and issuing the appropriate control signals. The data are then transferred to or from the memory.

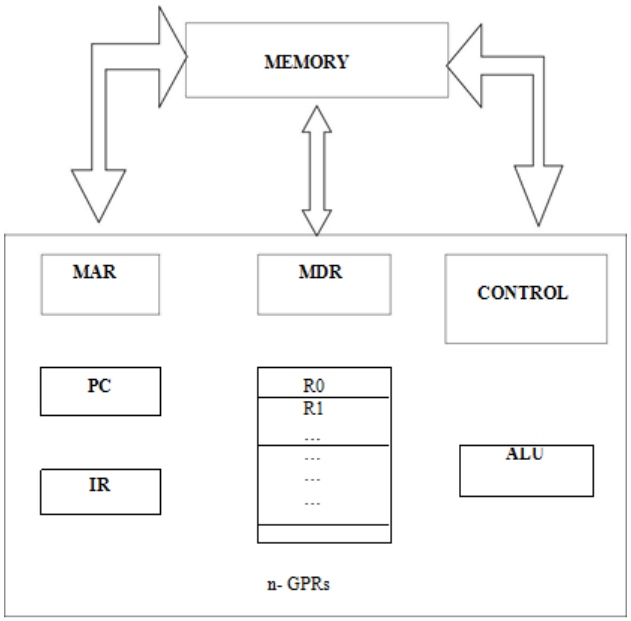


Fig b : Connections between the processor and the memory

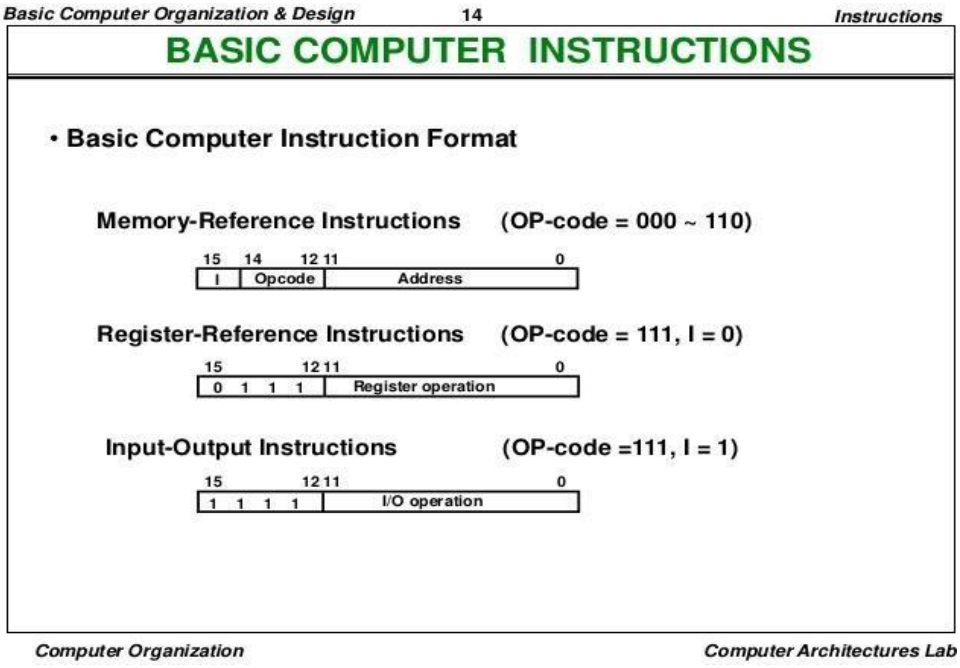
the processor can be connected. In addition to the ALU & the control circuitry, the processor contains a number of registers used for several different purposes

Register:

It is a special, high-speed storage area within the CPU. All data must be represented in a register before it can be processed. For example, if two numbers are to be multiplied, both numbers must be in registers, and the result is also placed in a register. (The register can contain the address of a memory location where data is stored rather than the actual data itself.)

The number of registers that a CPU has and the size of each (number of bits) help determine the power and speed of a CPU. For example a 32-bit CPU is one in which each register is 32 bits wide. Therefore, each CPU instruction can manipulate 32 bits of data. In high-level languages, the compiler is responsible for translating high-level operations into low-level operations that access registers.

Instruction Format:



Computer instructions are the basic components of a machine language program. They are also known as *macro operations*, since each one is comprised of sequences of micro operations.

Each instruction initiates a sequence of micro operations that fetch operands from registers or memory, possibly perform arithmetic, logic, or shift operations, and store results in registers or memory.

Instructions are encoded as binary *instruction codes*. Each instruction code contains of a *operation code*, or *opcode*, which designates the overall purpose of the instruction (e.g. add, subtract, move, input, etc.). The number of bits allocated for the opcode determined how many different instructions the architecture supports

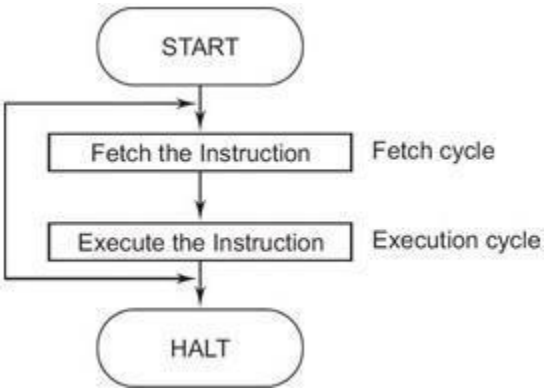
In addition to the opcode, many instructions also contain one or more *operands*, which indicate where in registers or memory the data required for the operation is located. For example, and add instruction requires two operands, and a not instruction requires one.

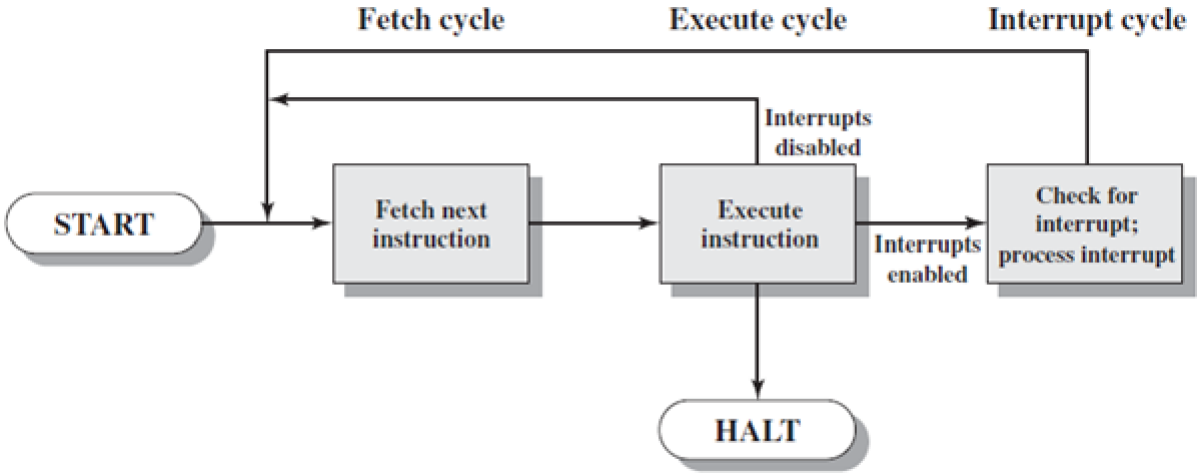
```
 15   12 11       6 5       0
+-----------------------------------+
| Opcode |  Operand   |  Operand  |
+-----------------------------------+
```

The opcode and operands are most often encoded as unsigned binary numbers in order to minimize the number of bits used to store them. For example, a 4-bit opcode encoded as a binary number could represent up to 16 different operations.

The *control unit* is responsible for decoding the opcode and operand bits in the instruction register, and then generating the control signals necessary to drive all other hardware in the CPU to perform the sequence of micro operations that comprise the instruction.

INSTRUCTION CYCLE:





Instruction Cycle with Interrupts