Computer organization

Computer: **- electronic device that accepts input, stores large quantities of data, execute complex instructions which direct it to perform mathematical and logical operations and outputs the answers in a human readable form. (See fig. 1)**

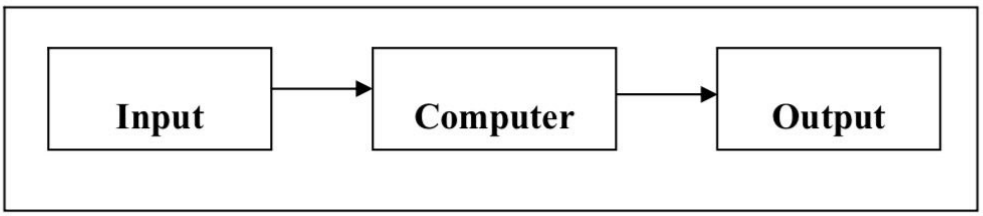


Fig (1) simple model of a computer

Advantages of computer system:

1- Store and retrieve large quantities of data.
2-The speed is faster than in any other form of data processing.
3-A single computer can perform a wide variety of activities as directed by a set of instructions (program).
4-Once data and instructions are fed into the computer, processing is continuous with a minimum of human intervention.
5-Data and programs may be stored inside the computer indefinite and be retrieved quickly.
6- Accuracy is greater than any other system.

Computer structure:

Computer system are made of two main parts: -
1-Hardware: refers to the physical components of the computer such as: -Keyboard, memory, printer…

2-Software: refers to programs, languages, procedures and instructions that make the hardware work for us.

Main components of hardware:

The basic components of a computer system are: (see fig. 2)
1-Input unit
2-Central processing unit: -which consists
a- control unit.
b- Arithmetic and logic unit.
c- Register.
3- Output unit.
4- Memory unit (internal memory).
5- External storage.

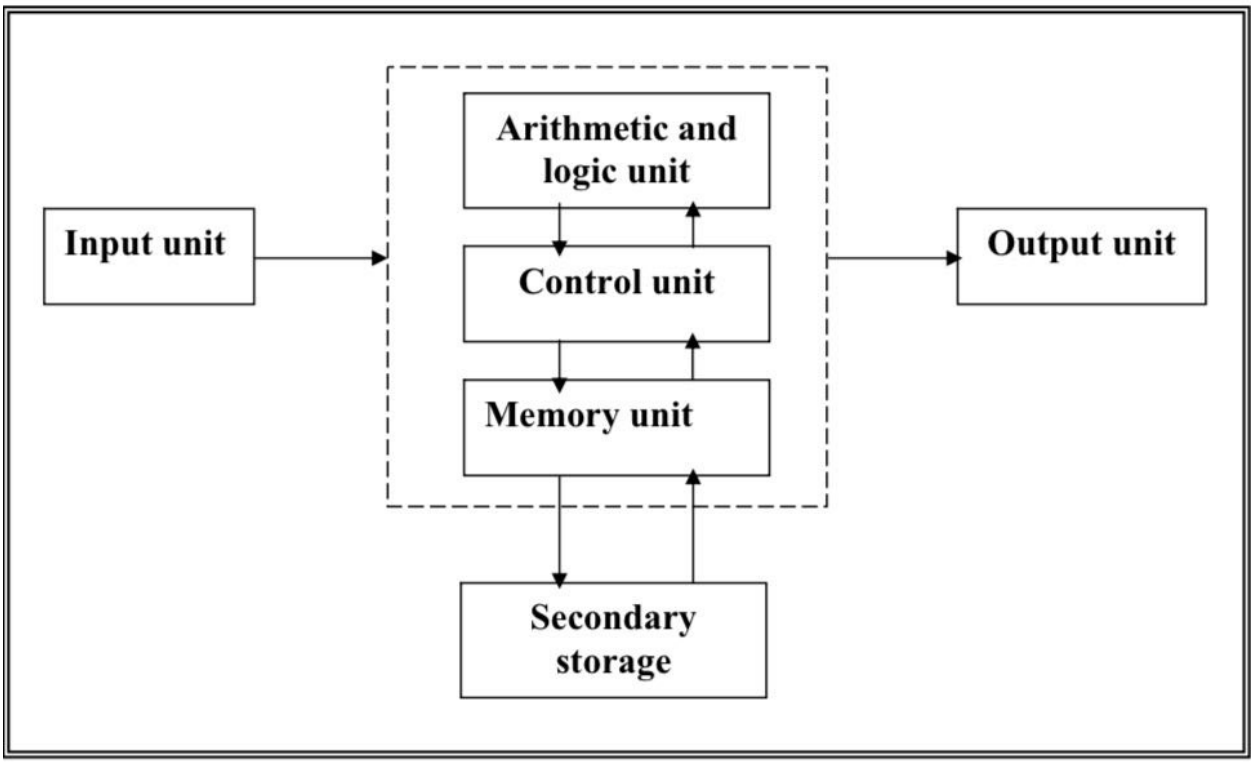


Fig (2) The logical structure of a computer

1- Input unit: - the input unit of a computer system accepts data, convert it into electrical impulses that are sent in to internal memory or to the central processing unit (CPU) where can be processed. Such as Punched cards (old system), Magnetic tape, Floppy disk, keyboard, mouse.

2-Central processing unit (CPU): -

The brain of any computer system is the CPU, which is sometime called "Processor" or "Microprocessor" in personal computer.

The CPU supervises and controls all of the peripheral equipment, perform arithmetic and makes logical decisions. The CPU is responsible for includes the data movement computations and logical operation necessary to convert data into meaningful information.

It is divided into three sections:
2-1. Arithmetic and Logic unit (ALU).
2-2. Control unit.
2-3. Register.

2-1 Arithmetic and Logic unit (ALU): -

Perform the processing of data including arithmetic operations such as addition, subtraction, multiplication, division and logic operations including comparison (ex. A<B) and sorting.

2-2 Control Unit.:-

- Direct and coordinates all units of the computer to execute program steps.
- Direct and coordinates all operations of the computer systems.

<u>These operations include: -</u>
1- Control to the input and output devices.
2- Entry and retrieval of information from memory.
3- Routing of information between the memory and the arithmetic and logic unit.

Control unit automatically coordinates the operation of the entire computer system, although the control unit does not performed any actual processing on the data, It acts as a central nervous system uses to send control signal to other units.

2-3 Register: -

Register are devices capable of storing information, receiving data from other areas within the computer and transferring information as directed by the control unit, it is used for temporary storage of data or instruction and the most important register are: -

a- Program counter (PC): It contains the address of the next instruction to be executed.

b- Instruction Register (IR): It contains the instruction being executed.
c- Address Register (AR): holds the address of memory location.

3- Output unit: -

Output units are instruments of interpretation and communication between human and computer, that let you see (or here) the result of the commands you enter, the most common output device are a display screen (monitor), printer or other device that let you see what he computer has accomplished.

The CPU execute each Instruction in a series of steps: -

1- Fetch the next instruction from memory to IR.
2- Changes the program counter to point to the following instruction.
3- Determine the type of the instruction to be fetched.
4- IF the instruction uses data in memory determines where they are.
5- Fetch the data into the internal CPU register.
6- Execute the instruction.
7- Store the result in the proper place.
8- Go to step 1 to being executing the following instruction.

4- Main Memory units: -

The memory is the part of the computer that holds information (data and Instruction) for processing, main memory also known as primary or internal memory or primary storage, there are two types of main memory are ROM (Read Only Memory) and RAM (Random Access Memory).

The specific function of main memory are to hold (store):

1- All data to be processed.
2- Intermediate result of processing.
3- Final result of processing.

A computer system generally includes two types of storage: -

1- Primary storage
2- Secondary storage

1- Primary storage:-
There are two Primary storage Media

1-1 Magnetic core storage
The second and third generation computers contained primary storage units composed of magnetic cores each core could store one bit when electricity flowed through the wire making up the cores a magnetic field was created the direction of the magnetic field was created the direction of the magnetic field determined which binary state's core represent a magnetic field in one direction indicate an one "1" condition a magnetic field in the other direction indicate an off "0" condition,
So the core Memory stores data magnetically unlike semiconductor memory and operates at lower speed.

1-2 Semiconductors memory
It is a set of electronic circuits that put on the silicon chip. These circuit are often called "gates' because they represent a (1) when current is permitted to flow and a (0) when it is not.
The type of main memory contains a large number of semiconductor storage cells, each capable of storing one bit of information a bit which is a short of binary digit which either 1 or 0 (full or empty).

4-1 Type of main memory:
There is basically two type of memory

4-1-1 Random access memory (RAM):
And also called read/write memory, it is used for storing data and instruction, in this type the stored information will be lost when computers power is turned off so that it is called the volatile memory,

it's used only for temporary storage and the ram can be either dynamic or static.

a- Static RAM: it is a semiconductor memory device in which the stored data will remain permanent stored as long as power is supplied without the need for periodically rewriting the data in to memory.

b- Dynamic RAM: it is a semiconductor memory device in which the stored data will not remain permanent stored even with power is applied unless the data are periodically rewritten in to memory, the later operation is called a refresh operation.

4-1-2 Read only memory (ROM):

Is read only memory which can be read from but not written on so that it is called a non-volatile memory, when the user turn the computer off the content of ROM are not changed, the type of ROM is:

1- Programmable Read Only Memory (PROM):

It is prepared by the maker and can be electrical programmed by the user, it cannot be erased and programmed a gain this means its content can never be changed.

2- Erasable Programmable Read Only Memory (EPROM):

The maker prepares it and can be electrical programmed by the user, it can be erase (deleted) by exposure to ultraviolet light and programmed many times.

3-Electrically alterable Programmable Read Only Memory (EAPROM): read only memory that is electrically reprogrammable.

** The Difference between RAM and ROM: -

RAM	ROM
• Stand for Random- Access Memory	Stand for Read Only Memory
• Read /Write memory	Read Only memory
• Sending data (writing) to RAM Memory address is called destructive Write because the new data erases Whatever was there before.	Sending data to ROM memory address is in effective because the contents of ROM can not be Changed (write not allowed) because this memory for read only.
• Form of primary storage for holding temporary data and instruction.	Form of primary storage for Holding permanent data and instruction.

RAM	ROM
• Volatile: program and data are Erased when the power is off	Permanent: program and data remain intact even power is off.
• Type of RAM is - Static RAM - Dynamic RAM	Type of ROM is - PROM - EPROM - EAPROM

5-Secondary storage (External storage):-
It can be classified into two type:

2-1 Mechanical storage devices: - is punched paper card and punched paper tape, both of this type is less popular now than the past.

2-2 Magnetic storage devices: - In personal computer system , external storage store information as magnetic spots on oxidizer surfaces because the magnetic spots do not need constant supply of power to refresh themselves, since 1 bit represented by magnetized spot and 0 is represented by the absence of magnetized spot.

A magnetic devises can be classified into:
2-2-1 sequential storage media.
2-2-2 directs storage media.
2-2-1 Sequential storage media as the magnetic tape in old computer system.

2-2-2 directs storage media as the magnetic hard disk, magnetic floppy disk, and flash memories.

1- Magnetic Hard Dick: A magnetic hard disk is a circular plate constructed of metal or plastic coated with magnetic material. Often both sides of the disk are used and several disks may be stacked on one spindle with read\write heads available on each surface. All disks rotate to together at high speed and are not stopped or started for access purpose. Bits are stored in the magnetized in sports along concentric circles called tracks. The minimum quantity of information which can be transferred is a sector. A magnetic hard disk is organized or formatting into tracks and sectors. Each track is divided into a number of sectors, and each track and sector has physical address that is used by the operating system to locate particular data record. Hard disks typically have from a few hundred to thousands of tracks. There are a constant number of tracks/sectors, with outer sectors using more surface area than the inner sectors. The

arrangement of tracks and sectors on a disk is known as the format, shown in down hard disk scheme.

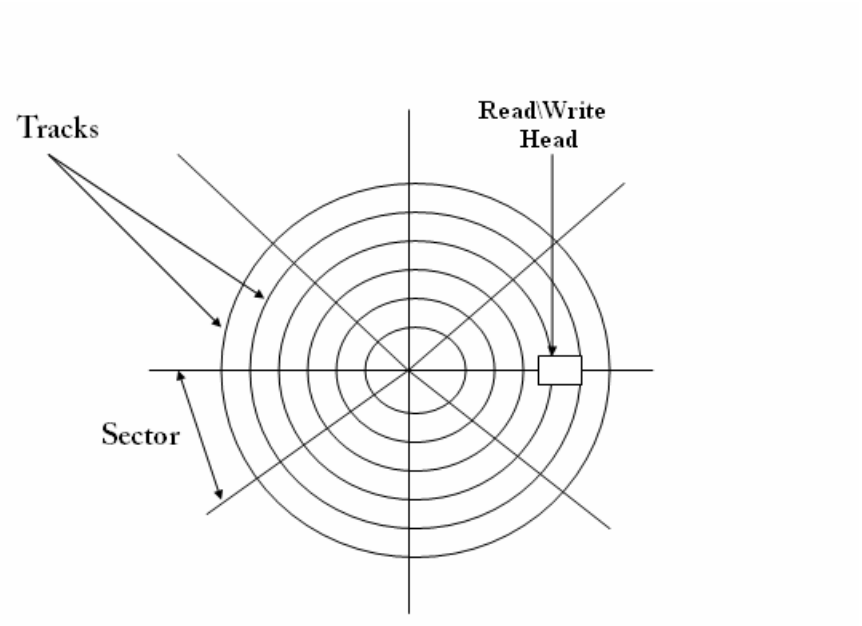


Fig (3) Hard Disk

*** Hard Disk Performance: Several basic parameters determine the performance of a given hard disk drive.**
A seek operation is the movement of the read/write head to the desired track.

a- Seek Time: A seek time is the movement of the read\write head to the desired track. The seek time is the average time for this operation to be performed. Typically, hard disk drives have an average seek time of several milliseconds, depending on the particular drive.

b- Latency Time: The latency period is the time takes for the desired sector to spin under the head once the head is positioned over the desired track. Latency time depend on the constant rotational speed of the disk.

• The sums of average seek time and the average latency time is the access time for the disk drive.

2- Magnetic Floppy disk: The floppy disk is an older technology and derives its name because it is made of a flexible polyester material with a magnetic coating on both sides. The early floppy disks were 5.25 inch in diameter and were packaged in semi flexible jacket. Current floppy disks or diskettes are 3.5 inches in diameter and are encased in a rigid plastic jacket. A magnetic floppy disks transport consists of the electrical, mechanical, and electric components to provide the parts and control mechanism for a magnetic floppy disks unit.
The floppy disks itself is a strip of plastic coated with a magnetic recording medium. Bits are recorded as magnetic spots on the floppy disk along several tracks. Read\write heads are mounted one in each track so that data can be recorded and read as a sequence of characters. Magnetic floppy disks units can be stopped, started to move forward or in reverse, or can be rewound.

3- Flash Memories: Flash memories are high-density read\write memories (high-density translates into large bit storage capacity) that are nonvolatile, which means that data can be stored indefinitely without power they are sometimes used in place of floppy or small. Capacity hard disk drives in portable computers.

High-density means that along number of cells can be packed into a given surface area on a chip, the higher density, the more bits that can be stored on a given size chip. This high density is achieved in flash memories with a storage cell that consists of single floating. A data bit is stored as charge or the absence of charge on the floating gate depending if a 0 or a 1 is stored.

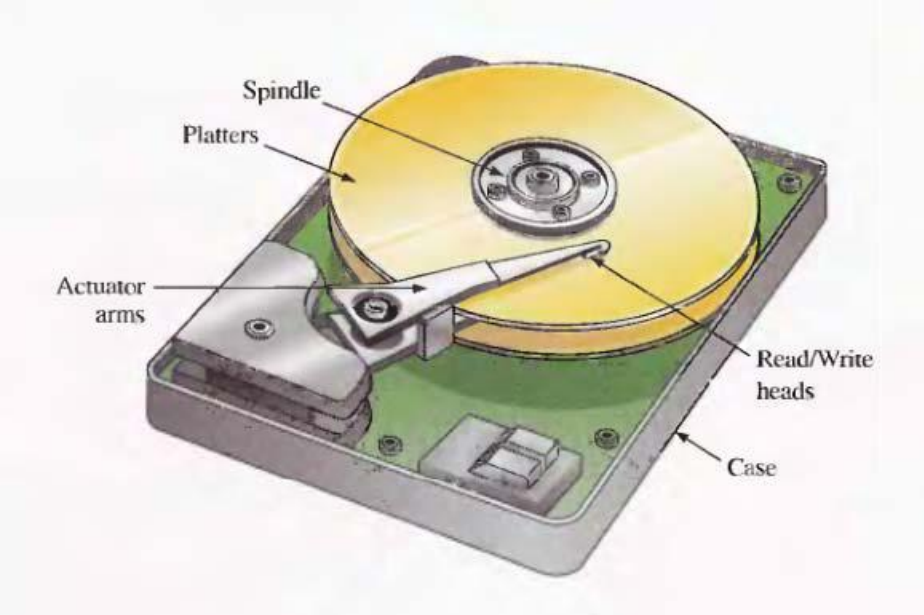


Fig (4) Portions of hard disk drives

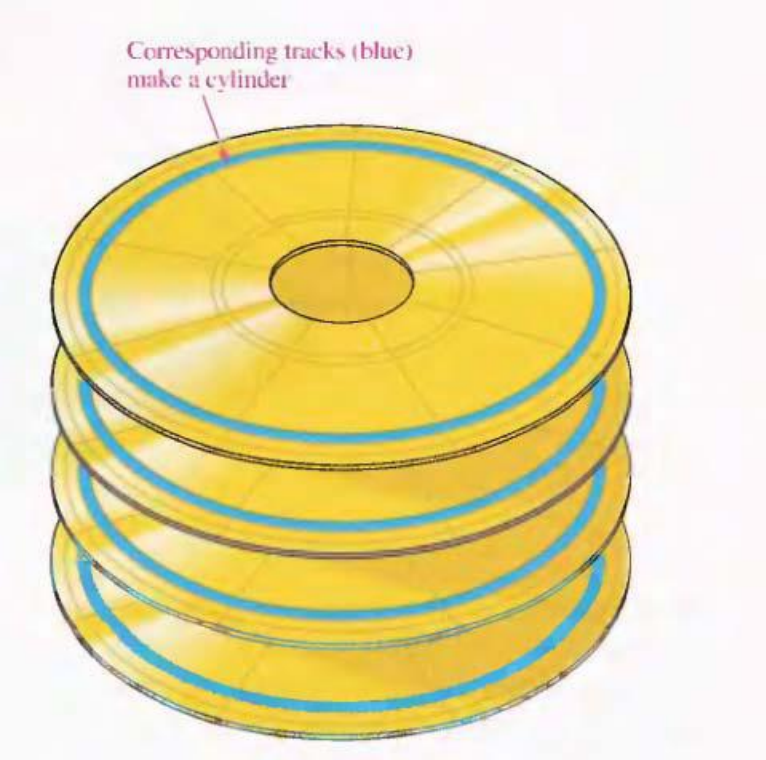


Fig (5) Portions of hard disk

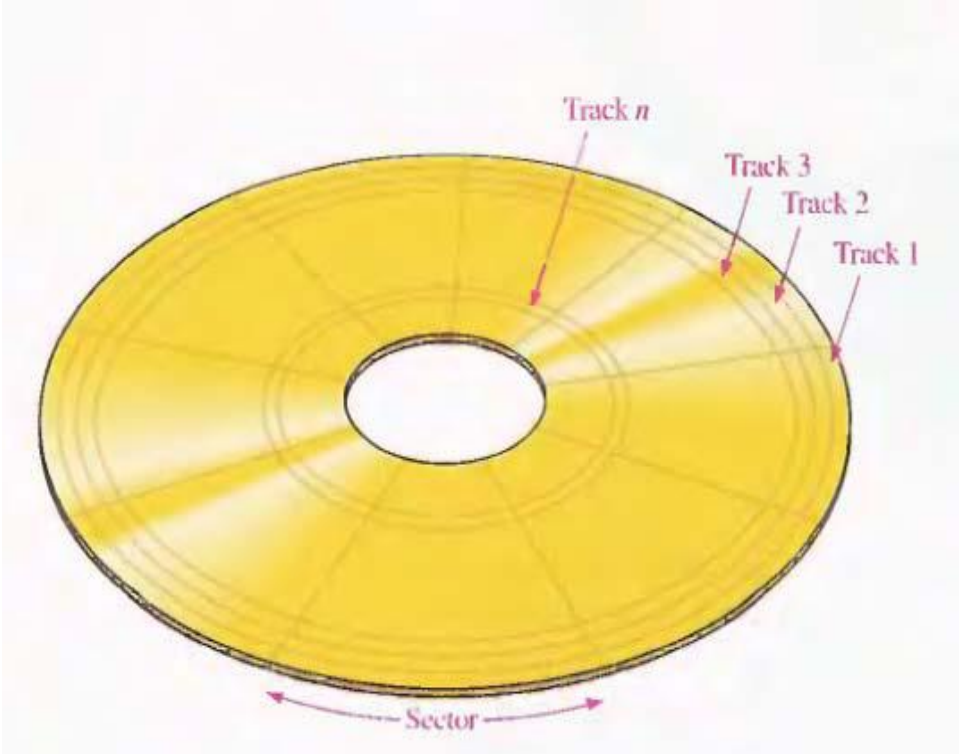


Fig (6) Hard disk

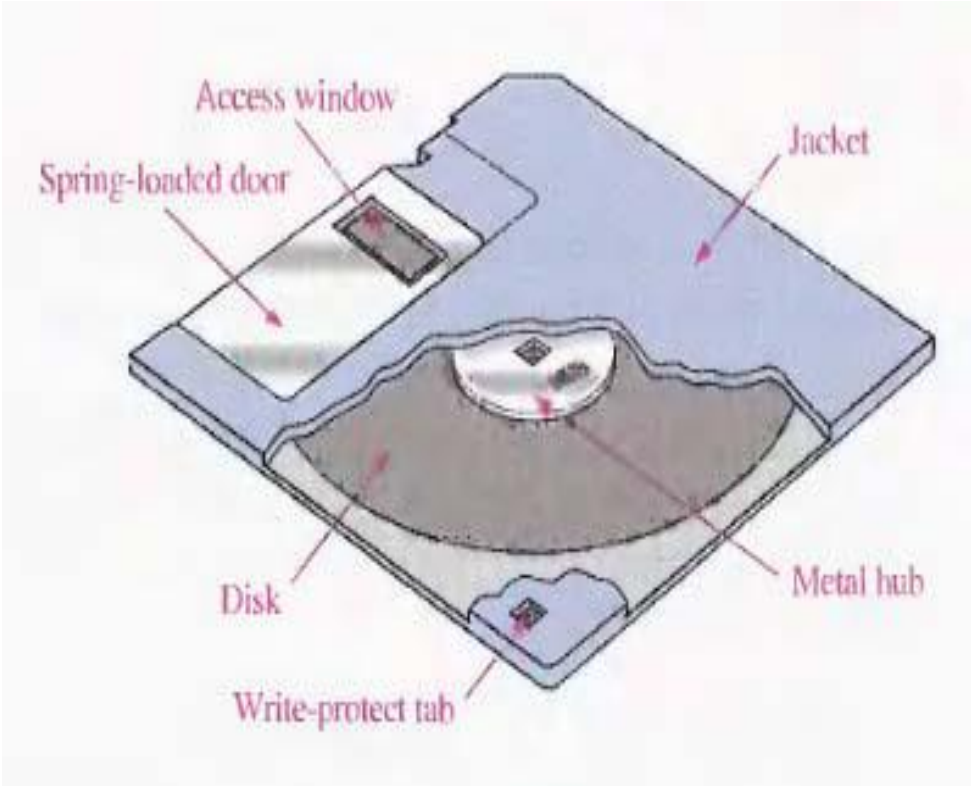


Fig (7) Floppy disk

Definition

1- Operating System:

An operating system is a program that acts as an intermediary between a user of a computer and the computer hardware. The purpose of an operating system is to provide an environment in which a user can execute programs. The primary goal of an operating system is thus to make the computer system convenient to use. A secondary goal is to use the computer hardware in an efficient manner.

An operating system is an important part of almost every computer system. A computer system can be divided roughly into four components: the hardware, the operating system, the applications programs, and the users.

2- Networking:

A network is a set of devices (often referred to as nodes) connected by media links. A node can be a computer, printer, or any other device capable of sending and /or receiving data generated by other nodes on the network. The links connecting the devices are often called communication channels.

Type of the network:

a- LAN (Local Area Network).

b- MAN (Metropolitan Area Network).

c- WAN (Wide Area Network).

3- Internet:

Internet is the world-wide super network of computer networks that links computers around the world.

URL: Each day when we use the Internet to check our mail online, visit a web page or browse an FTP folder, we use our browser. And while there can be a great number of Internet browsers out there, each of them offering different functions and boasting a different

design, one thing that unites all of them is the fact that they are built with a single purpose - to handle URLs.

The URL: Each file available on the World Wide Web can be identified and accessed through its corresponding URL. Standing for Uniform Resource Locator, a URL represents the global web address of documents, including web pages or image files, and programs such as CGI applications or Java applets. Its main mission is to identify the location of a document or a program available on the web and specify the mechanism for accessing it through a web browser.

4-Computer Classification:
1) Computer Classification.
2) Personal Computer.
3) Workstation.
4) Video Game Console.
5) Server.
6) Client.
7) Mainframe computer.
8) Supercomputer.
9) Handheld computer.
10) Smart phone.
11) Portable Media Player.
12) Microcontroller.

5- Integrated Circuit Technologies: They are two types.
a- VLSI: Very large-Scale Integration describe integrated circuits with complexities of form more than 10,000 to 100,000 equivalent gates per chip.

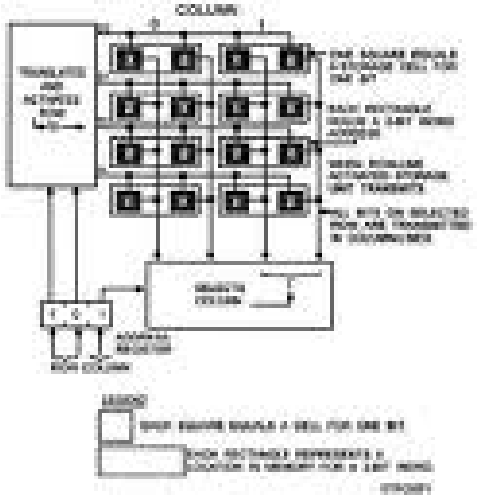
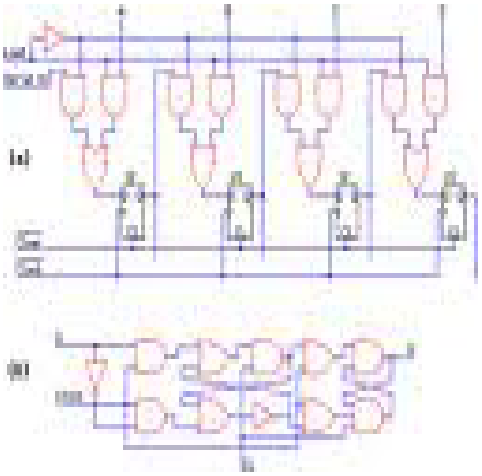


Figure (8) VLSI Circuit

B -MSI: Medium-Scale Integration describe integrated circuits that have from 10 to 100 equivalent gates a chip. They include logic functions such as encoders, decoders, counters, registers, multiplexers, arithmetic, circuits, small memories, and others.



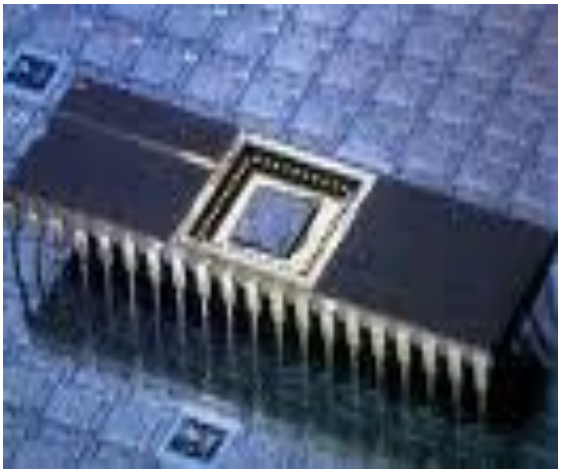


Figure (9) MSI Circuit

6-Translators program: system programming is a set of tools.

a- Mechanical H/W & electronic circuits.

b- S/W (system programming)

6-Translators program: system programming is a set of tools.

a- Mechanical H/W & electronic circuits.

b- S/W (system programming)

• System programming have two purpose:

a- They make a computer easy to use for none expert.

b- They make it possible for the resource of the system to be used efficiently.

• Software:

1- Input /output subroutine.
2- Monitor.
3- Operating system.
4- Assemblers.
5- Microprocessors.
6- Interpreters.
7- Compiler.
8- Linker, Loader.
9- Editors.
10- Debuggers.
11- Database.
12- Communication S/W.

7-language Classification: they are three types:
a- Procedure (using in Pascal language).
b- Functional (using in Prolog language).
c- Object oriented C++ (using in C++ and visual C++ language).

8- Computer architecture: The internal architecture of the 8086 family of microprocessor has changed a lot as part of the evolutionary process from the original 8086 to the 80386. They are implemented with simultaneously operating multiple processing units. Each unit has a dedicated function and they operate at the same time.

The 8086 microprocessor contains just two processing units:
- The bus interface unit and execution unit.
- The 80286 microprocessor contains just four processing unit:
a- Bus unit.
b- Instruction unit.
c- Execution unit.
d- Address unit.

The 80386 microprocessor contains just six functional units:
1- Execution unit.
2- Segment unit.
3- Page unit.
4- Bus unit.
5-Prefetch unit.
6- Decode unit.

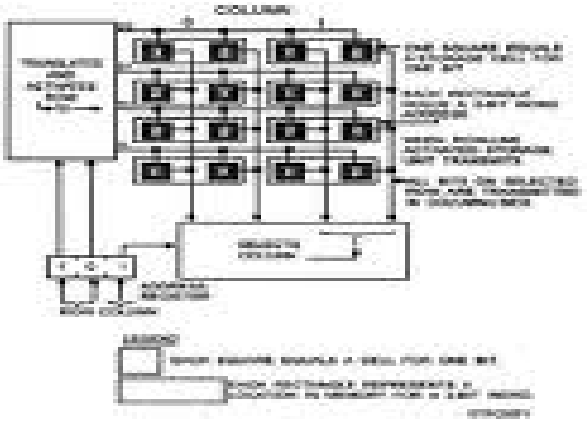
9- Computer generation:
1- The first generation from 1946 to 1958 used electronic valves and frequent breakdowns and a rise in temperature due to the large size and weight. Use complex programming language.

2-The second generation from 1958 to 1964 used transistors instead valves, small size, low coast, and high speed. Use high programming language.

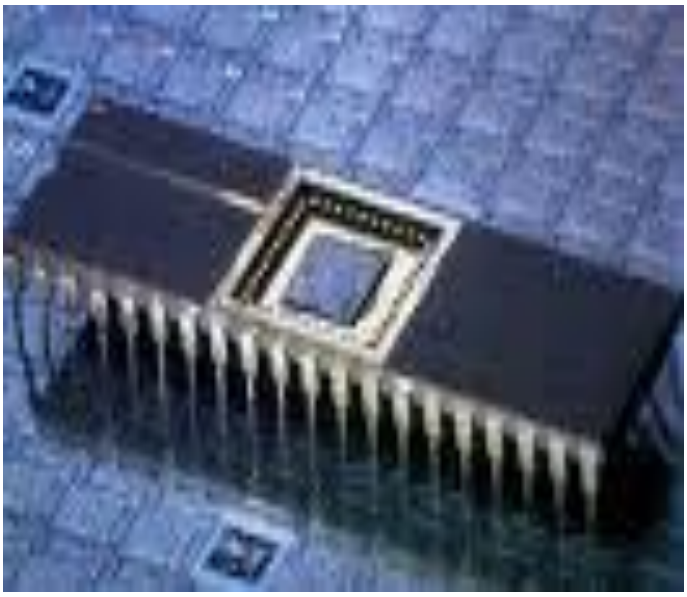
3- The third generation from 1965 to 1970 used complete circuit electronic, high speed, accuracy operations, and uses more users. Use high programming language.

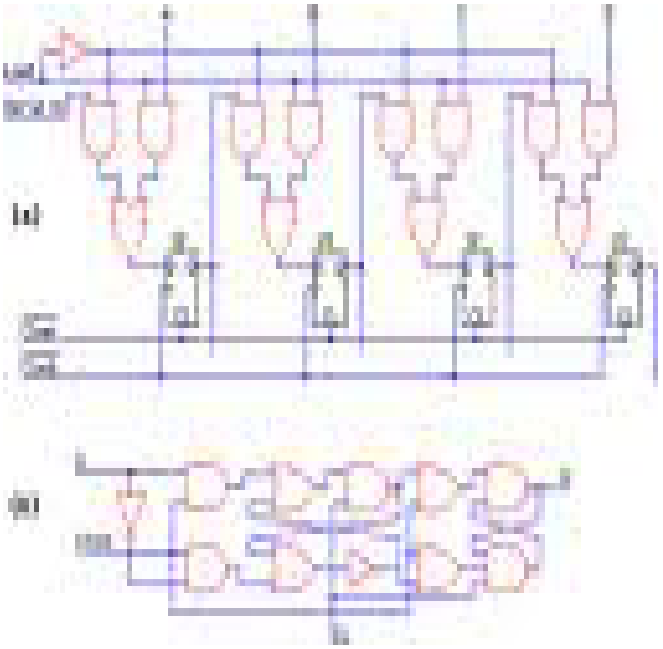
4- The fourth generation from 1971 to 1980 used complete circuit electronic involves large number of transistors, small size, high speed in save data and information.

5- The fifth generation from 1980 to 1997 use complete circuit electronic very large and very high speed. As personal computer (PC), supper computer, and use artificial intelligent.



Circuit VLSI





Circuit MSI

Lectured One

1- Number Systems Operation:

1- Decimal Numbers.

2- Binary Numbers.

3- Octal Numbers.

4- Hexadecimal Numbers.

1- Decimal Numbers: In the decimal number system each of the ten digits (10digits), 0 through 9 (0, 1, 2, 3, 4, 5, 6, 7, 8, and 9).

Decimal weight … …10^4 10^3 10^2 10^1 10^0. 10^{-1} 10^{-2} 10^{-3} ….

Example (1): **$(345)_{10}$**

$300+40+5=10^2*3+10^1*4+10^0*5=345=(345)_{10}$

3 4 5

Example (2): **$23.5=(23.5)_{10}$**

$2*10^1+3*10^0+5*10^{-1}=20+3+0.5=23.5$

Where $10^0=1$

2- Binary Numbers: The binary number system its two digits a base- two system. The two binary digits (bits) are 1 and 0 (1,0).

Binary weight 2^3 2^2 2^1 2^0

Weight value 8 4 2 1

A- Binary – to – Decimal Conversion:

***Binary number 1101101 where $2^0=1$**

1 1 0 1 1 0 1

2^6 2^5 2^4 2^3 2^2 2^1 $2^0=2^6*1+2^5*1+2^4*0+2^3*1+2^2*1+2^1*0+2^0*1$

$=64+32+0+8+4+0+1=96+13=109$ $(109)_{10}$

***The fractional binary number 0.1011 0. 1 0**

1 1

2^{-1} 2^{-2} 2^{-3} 2^{-4} = $1*2^{-1}+ 0*2^{-2}+1*2^{-3}+1*2^{-4}$ =

0.5+0+0.125+0.0625=0.6875 $(0.6875)_{10}$

B- Decimal – to – Binary Conversion:

1- Convert a decimal whole number to binary using the repeated division – by – 2 method.

2- Convert a decimal fraction to binary using the repeated Multiplication – by – 2 method.

Example (1):

Number $(58)_{10}$ ==== $(111010)_2$

2	**58**	**mod**	**LSB**
2	**29**	**==**	**0**
2	**14**	**==**	**1**
2	**7**	**==**	**0**
2	**3**	**==**	**1**
2	**1**	**==**	**1**
	0	**==**	**1**

MSB

======= (111010)

Example (2):

Number $(0.3125)_{10}$ ====== $(0101)_2$

MSB	**carry**	
		0.3125*2
	0	**0.6250*2**
	1	**0.2500*2**
	0	**0.5000*2**
	1	**0.0000**

LSB

$(0101)_2$

3- ***Octal Numbers:*** The octal number system is composed of eight digits, which are 0, 1, 2, 3, 4, 5, 6, and 7.

To count above 7, begin another column and start over: 10, 11, 12, 13, 14, 15, 16, and 17.

20, 21, 22, 23, 24, 25, 26, and 27.

30, 31, … … … … …37.

A- Octal – to – Decimal conversion: **Weight**

… … 8^3 8^2 8^1 8^0

Octal number 2374 ==== $(1276)_{10}$

xample:

$(2374)_8 = 2*8^3+3*8^2+7*8^1+4*8^0$

$= 2*512+3*64+7*8+4*1$

$= 1024+192+56+4$

$= (1276)_{10}$

B- Decimal – to – Octal Conversion:

Example:

Decimal number $(359)_{10}$ ======= $(547)_8$

8	**359**		**mod LSB**	
8	**44**	**==**	**7**	
8	**5**	**==**	**4**	**==== $(547)_8$**
	0	**==**	**5**	
			MSB	

C- Octal – to – Binary Conversion:

Octal digit can be represented by a 3-bit binary number.

Octal digit binary

0	1	2	3	4	5	6	7
000	001	010	011	100	101	110	111

***Example*s:**

$(25)_8$ $(140)_8$

$(2\ \ 5)_8$ $(1\ \ 4\ \ 0)_8$

$(010101)_2$ $(001100000)_2$

D- Binary – to – Octal Conversion:

Conversion binary number to octal number is start with right – most group of three bits and moving from right to left.

***Example*s:**

$(110101)_2$ $(101111001)_2$

110 101 101 111 001

6 5 5 7 1

$(6\ \ 5)_8$ $(5\ \ 7\ \ 1)_8$

$(65)_8$ $(571)_8$

4- ***Hexadecimal Numbers:*** The hexadecimal number system has a base of sixteen; it is composed of 16 digits and alphabetic characters.

Decimal	Binary	Hexadecimal
0	**0000**	**0**
1	**0001**	**1**
2	**0010**	**2**
3	**0011**	**3**
4	**0100**	**4**
5	**0101**	**5**
6	**0110**	**6**
7	**0111**	**7**
8	**1000**	**8**
9	**1001**	**9**
10	**1010**	**A**
11	**1011**	**B**
12	**1100**	**C**
13	**1101**	**D**
14	**1110**	**E**
15	**1111**	**F**

*A- **Binary – to – Hexadecimal conversion:***

4-bit groups, starting at the right-most bit.

***Example*: $(1100101001010111)_2$ ======= $(CA57)_{16}$**

1100 1010 0101 0111

B- Hexadecimal – to – Binary Conversion:

***Example*: $(10A4)_{16}$ ========= $(1000010100100)_2$**

1 0 A 4

0001 0000 1010 0100

C- *Hexadecimal – to –Decimal Conversion:* **By to method**

*** First method:**

***Example*: $(A85)_{16}$ ==== $(2693)_{10}$**

1- Convert to binary number.

2- Convert from binary number to decimal number.

A 8 5

1010 1000 0101 =

$2^{11}*1+2^{10}*0+2^9*1+2^8*0+2^7*1+2^6*0+2^5*0+2^4*0+2^3*0+2^2*1+2^1*0+2^0*1=$

$2^{11}+2^9+2^7+2^2+2^0=2048+512+128+4+1=2693=(2693)_{10}$

*** Second method:**

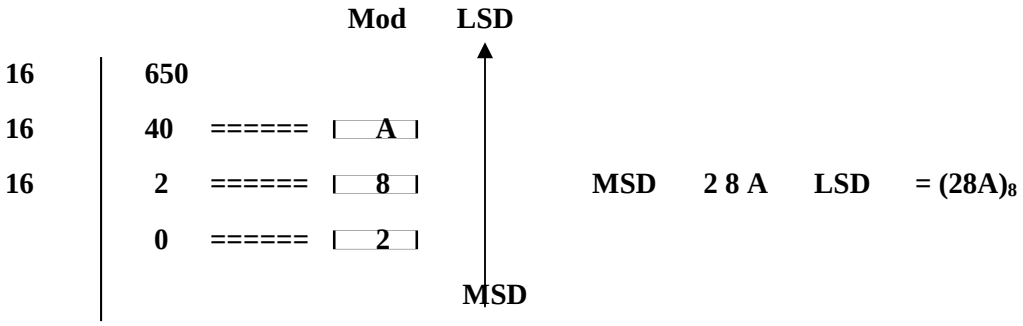
***Example*: $(E5)_{16}$ ======== $(229)_{10}$**

$(E5)_{16}=E*16^1+5*16^0=14*16+5*1=224+5=229=(229)_{10}$

D- *Decimal – to – Hexadecimal Conversion*:

***Example*: Convert the decimal number 650 to hexadecimal by repeated division by 16.**

$(650)_{10}$ ===== $(28A)_{16}$



MSD 2 8 A LSD = $(28A)_8$