COMPUTER

ORGANAIZATION

1ST STAGE

COMPUTER ORGANAIZATION

COMPUTER SYSTEM:

Electrical device that accept a large number quantities of data executes complex instruction which direct computer to perform mathematical and logical operations and output the answer sing humanly form.

A COMPUTER:

Is a fast and accurate electronic symbol (or data) manipulating system that's designed and organized to automatically accept and store input data , process them and produce output results.

THE SYSTEM CONCEPT:

The term "system" is used often in many different ways. A system is a group of integrated parts that the common purpose of achieving same objectives. The system has more than one element there is a logical relationship must exist between the parts of the system any system is designed to a accomplish one or more objectives.

A COMPUTER: is a group of integrated parts that have the common purpose of performing the operations called for in the program being executed. It qualifies as a system.

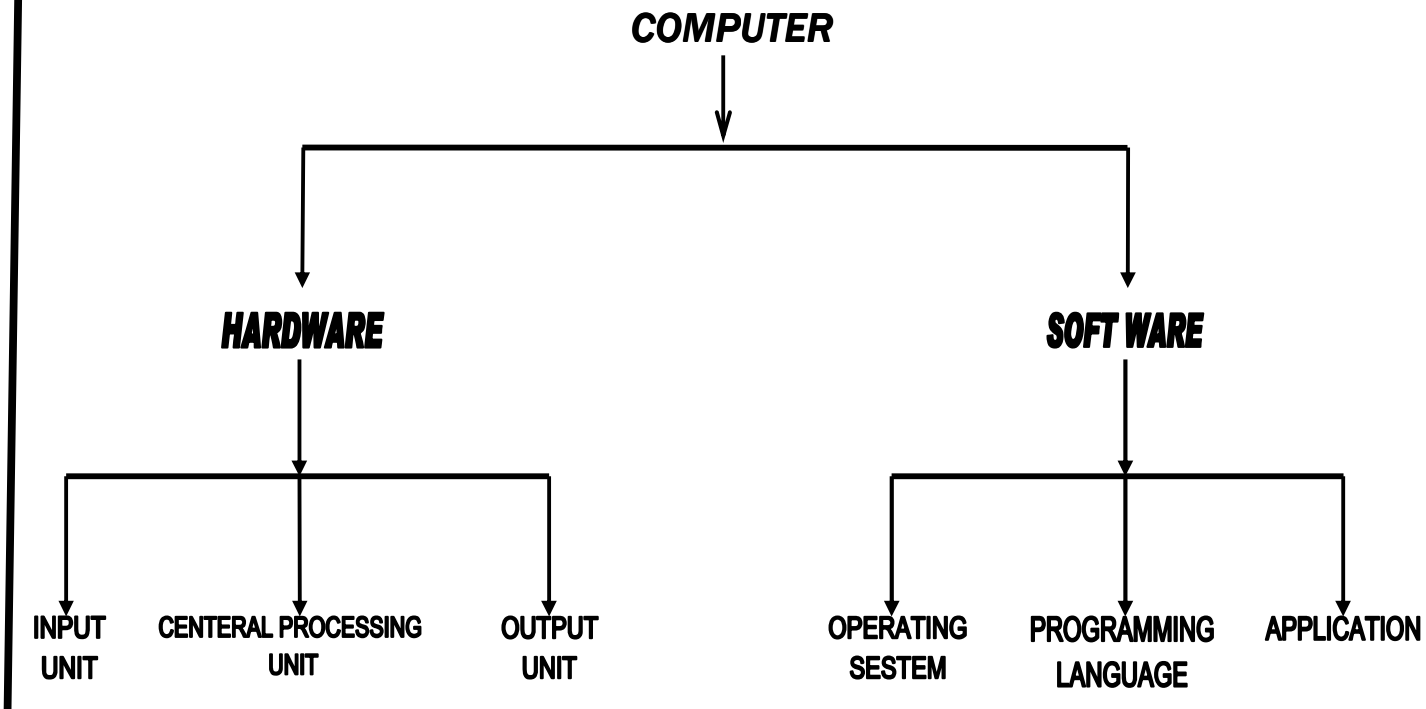
THE PROGRAM: A sequence of instruction describing how to perform a certain task. Or a detailed set of humanly prepared instruction that directs the computer to function in a specific way to produce a desired result.

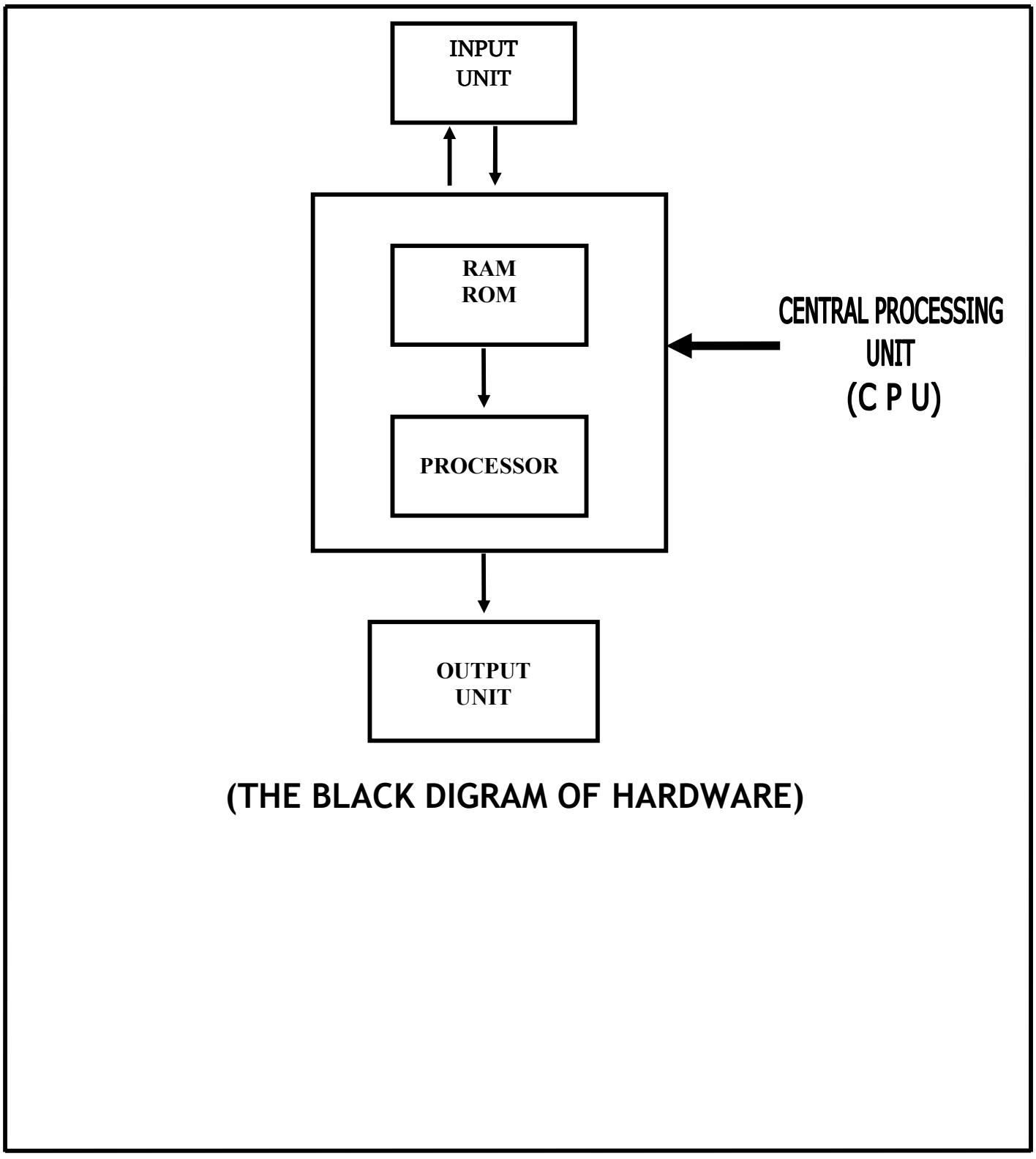
A DIGITAL COMPUTER: is a machine that can solve problems for people by carrying out instruction given to it. Consists of as interconnected system of processors, memories and input/output devices.

INSTRACTIONS: are explicit commands which covers the transfer of information within the computer as well as between the computer and its input and output devices specify the arithmetic and logic operations to be performed.

DATA: are numbers and encoded characters or alphabetic characters or symbols, which are used as operands by the instructions.

ORGANIZATION OF COMPUTER SYSTEM COMPONENTS :





(THE BLACK DIGRAM OF HARDWARE)

PART OF COMPUTER:

There are two main parts of computer system:

1. **hardware(H/W).**
2. **software (S/W).**

HARDWARE(H/W): The physical equipment you can see and touch when using the computer system e.g. Keyboard, mouse, monitor, hard disk , etc.

SOFTWARE: The intangible" control"(programs) that governs the computer e.g. BASIC, FORTRAN, PASCAL, DOS , WINDOWS,……,etc.

INPUT UNIT(DEVICE): accepts data and converts the data into electrical pulses that sent to the CPU.

1. **Keyboard.**
2. **Mouse.**
3. **Floppy disk, compact disk.**
4. **Magnetic Tap.**
5. **Punched chard.**
6. **Scanner.**
7. **Digital Camera.**
8. **Speaker.**

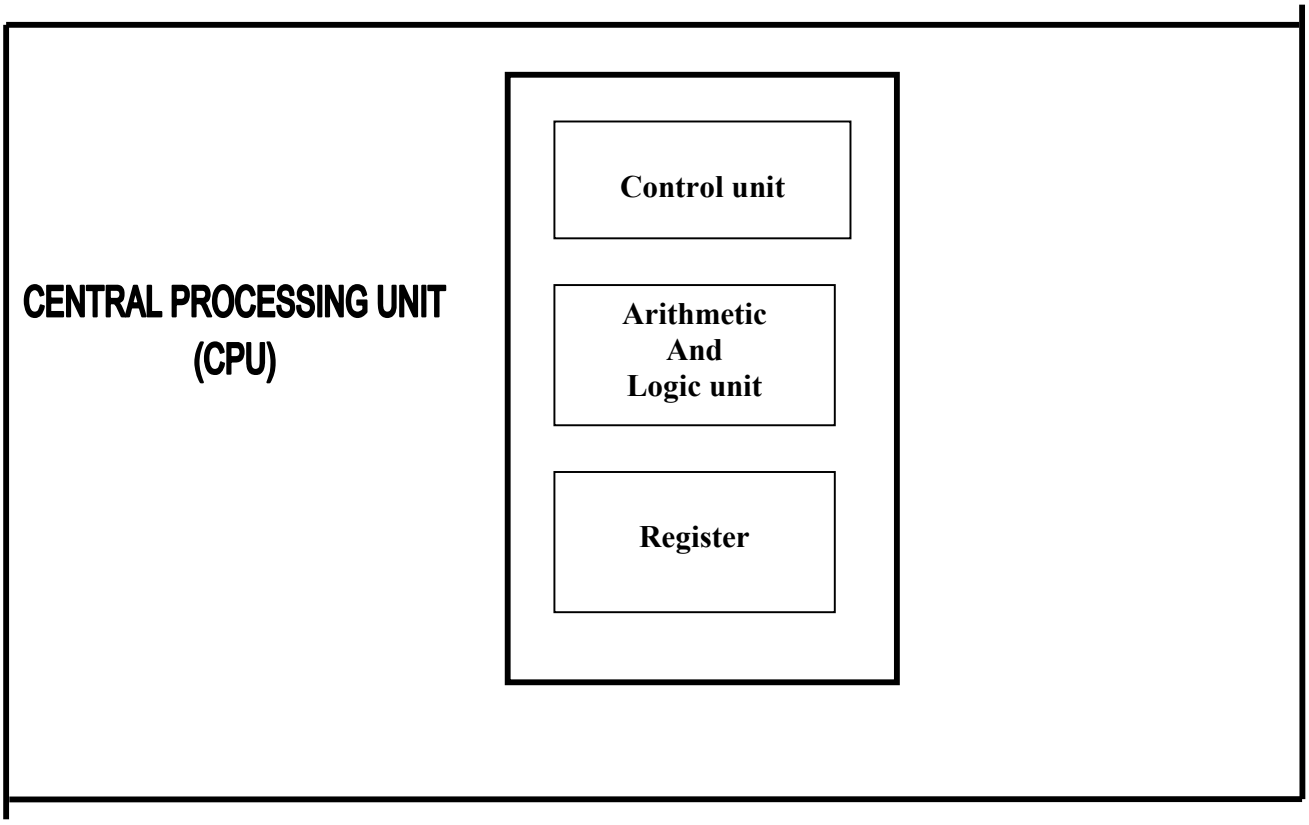
CENTRAL PROCESSING UNIT(CPU):

The (CPU) supervises and controls all of the peripheral equipment(peripheral devices) and performs the arithmetic and logic decisions. The CPU executes a collection of machine instructions that tell the processor to do.
The CPU is the brain of the computer, its functions is to execute programs stored in the main memory by fetching their instructions, examining them, and then exacting them one after another. The CPU consist several parts:

1.Control unit: fetching instruction from main memory to the ALU .

- **Determining their type.**
- **Control the input devices.**
- **Entry and retrieval of information f: (Arithmetic and logic unit).**

2.ALU: (Arithmetic and logic unit).
Performs operations such as addition, sub transfer, AND, OR, …etc, out the instruction.
3.Register: (Small high-speed memory used to store the result and certain control information, each one of then has a certain function.


CENTRAL PROCESSING UNIT
(CPU)
Control unit
Arithmetic
And
Logic unit
Register

OUTPUT UNIT:

Accept electrical signals from the CPU and converts them into new form.

1.Printers.

2.Monitors.

***The computer must be able to do two fundamental things:**

1.Store information.

2.Process the stored information.

***Computer memories are electronic circuits that hold information while it is being processed.**

***Computer processing is controlled by programs, which are nothing more than lists of instruction explaining step-by-step how to process data.**

***The memories can store any kind of information-programs and data.**

***The computer is built from many different integrated parts each part plays either a primary or secondary role. The absence of a primary component means that the computer simply will not function. The a absence of secondary component means that the computer can still perform basic input/output function but will not provide the services of the missing secondary component. All most computers consist of components manufactured by different hardware and software vendors.**

Computer system differs in size and in design. Size very from the smallest microcomputer to minis, mainframes and super computers. And the architecture can very from system that use single arithmetic logic and control sections to those that use multiple sections and thus speed up processing.

FIRST ELECTONIC COMPUTERS:

ENIAC(Electronic Numerical Integrator and Calculator) is usually considered the first operational electronic digital computer product from 1941 to 1946. It's contained 18,000 vacuum tubes, 70,000 registers and 500,000 hard-soldered connections. It weighted 30 tans used 100 kilowatts of electron city and occupied 20-40 foot room. It had a limited amount of storage and un reliable because the vacuum tubes frequently burn out. ENIAC was into 3 limited in another way. It was programmed by plugging wire into 3 wall of plug boards containing over 6,000 a witches. To change the program required resetting switches by re plugging the plug board.

COMPUTER GENERATION:

1.The first generation(Vacuum Tube Systems(1951-1958)

***First generation computers used vacuum tubes to provide electronic circuits.**

***For memory this computer used a magnetic drum, a rotating cylinder whose outer surface could be magnetized.**

***Punched cards were used for input of both data and programs.**

***program instruction were given in machine language which is a code composed entirely of 0's and 1's.**

***These computers were slow, un reliable, expensive, and tedious to program.**

2.The second generation: (Transistor Systems(1958-1964)).

***The second generation of computers begins when transistors replaced vacuum tubes. Transistors were 1/200 the size of a vacuum tube.**

***Generate less heat, were faster and failed less often.**

***Internal memory was composed of tiny magnetic core strung on thin intersection wires.**

***Magnetic tape largely replaced punched cards for input and output.**

***Printers with speed up to 600 lines per minute was developed for output.**

***This generation brought improvements in software, that is, in the programs that direct the computer to perform tasks. One of the important developments unlike machine language a high level programming language uses names and commands that resemble English such as FORTRAN, COBOL.**

***A program called a compiler translates the high-level language program into a machine language program that can be executed by the computer. High level language represented against step forward because they are less detailed, easier to learn, and easier to use for problem solving than machine language.**

***Operating system was invented. It is an efficient program controls the operation of the computer, so the tasks had become too complex and time-sensitive to leave to the computer operator.**

3.The Third generation:(Integrated circuits(1964-1971))(IC)

***Integrated circuits replaced transistor in third generation computers.**

***An integrated circuit is a complex electronic circuit etched on a tiny silicon chip about one-fourth inch square, It is smaller, faster, and more reliable than wiring together separate transistor.**

***Improvement also occurred in the equipment attached to computer, to handle input, output and storage. These are called" peripheral devices".**

***Magnetic if rapid access to data was required.**

***Printers was capable of printing nearly 3000 lines per minute.**

***The television-like cathode ray tube(CRT)was developed to display input and output.**

***Operation system capable of times sharing began to appear during the third generation.**

***Time-sharing allowed many users to use a single computer simultaneously.**

***A new programming language, BASIC(Beginners ALL-purpose Symbolic Instruction Code), was developed. Which is as easily learned language, initially designed for teaching students to program on a time shared computer.**
***In late 1960's another type of computer appeared called(mini computer).**

4.The forth generation(large-scale integration ((1971-)).

***The beginning of fourth generation computers is not as clear as that of the first three generation.**
***It is coincides with the development of the large-scale integrated circuits(LSI)a single chip that contains thousand of transistor. LSI many more circuits on each silicon chip than was possible on earlier IC.**

large fourth- generation computers(mainframe) can support extensive time-sharing. That is, up to several hundred users may use the computer at the same time, each user feels he or she is the only one using it.
***Timesharing is possible on the smaller computers called minicomputers, but fewer than forty or fifty users can use these computers simultaneously.**
***Programs and peripheral, devices such as disk and printer have grown by leaps and bounds in variety, capability, and sophistication.**

COMPUTER CLASSIFICATION:

Computers are classified according to the type of data they are designed to process.

1. **Analog computers: Analog computers are machine designed to perform arithmetic function upon numbers. Where the numbers are represented by some physical quantity for example. Input which vary with respect to time. And directly apply these inputs to various devices. The out put from the system may be in the form of a graph produce by a plotting. This type of computer does not compute directly with numbers, rather they deal with variable that are measured along scale(also called continuous data). Analog computers is less accurate than digital computers.**

2.Digital computers: The most used type of computers, it operates on discrete data. It operates by directly counting a number(or digit) that represent numbers, letters or other special symbol. They are different in size cost and speed.

3.Hybrid computers: This type of computers combine the features of analog and digital computers.
Also the digital computers can be categorized according to size, cost, and speed, The subclasses of digital computer according to their size are:

I. **Minicomputers: smaller machine is usually called ((minicomputer)) which are reflection on their relatively lower, cost, size, and computer power.**
II. **Microcomputer: very small computer, low in price and costing of only few(VLSI) (very large scale integrated circuit package).**
III. **Main frame computer: also called large computer, are quit different from minicomputers and microcomputers in size, processing power, coasting and the complexity and sophistication of their**

Digital information:

Digital information takes the form of bits(binary digits). A single bit can have one of two states: a zero or low and one or high. The amount of information that can be exchanged used 1 bit only is very limited(ON or OFF, YES or NO, 0 or 1). Using 2 bits, the amount of information is doubled, four different combinations ($_2^2 = 4$) may be obtain with 2 bits as shown below:

Bit no.1	Bit no.2
0	0
1	0
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(Different combinations with 2 bits)

When using 3 bits double the quantity of information yet again with(2^2 =8) different combination as shown below soon.

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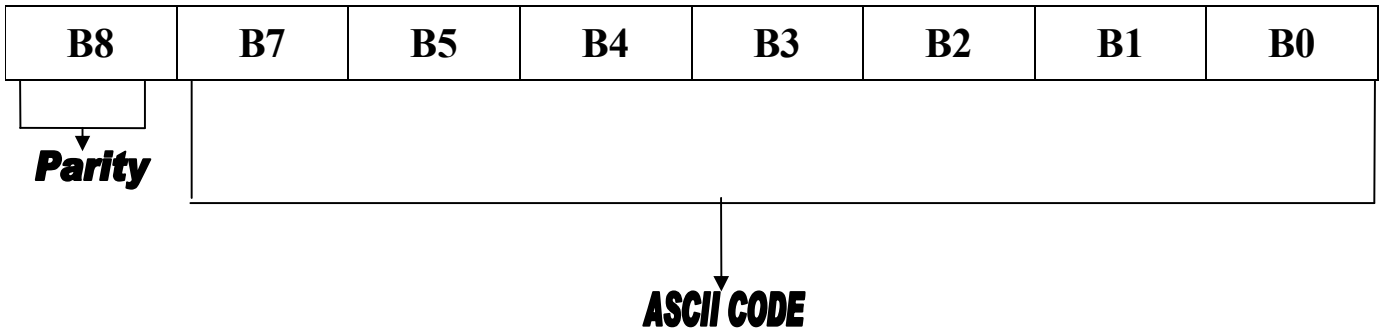

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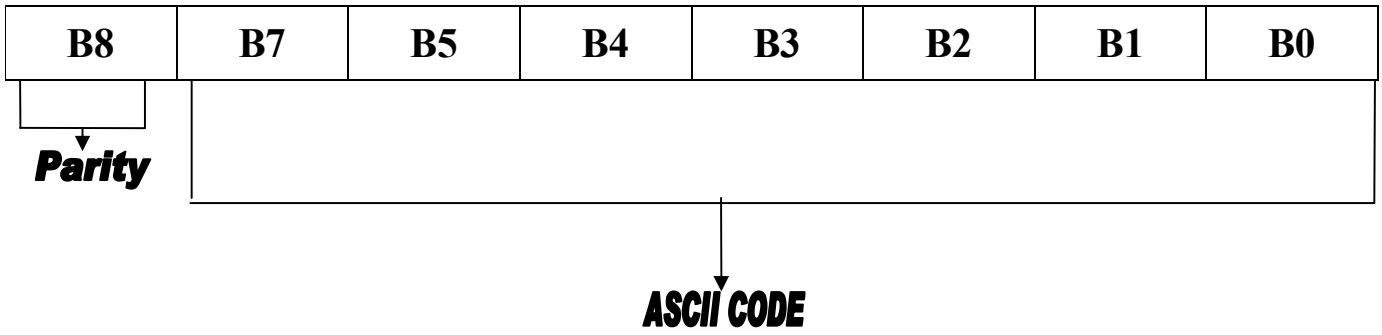

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THE PERSONAL COMPUTER (PC)

The very first PC was the XT (extended Technology).IBM launched it at 12 August 1981.
This was followed a few years later by the AT (Advanced Technology)type using the 80286,80386,80486 and the correct Pentium processors. The development of the PC followed closely upon the development of integrated circuits. The introduction of very large and ultra large scale integration (VLSI and ULSI) which contain the equivalent of a million more transistors pared the way for the manufacture of complete circuits of complex circuits and complete system on a single silicon chip.
Although a computer system may have several external devices connected to it. Such as a printer ,mouse and keyboard ,the essential elements of PCs are the same namely a system unit, a keyboard and a visual display unit (VDU) or monitor. The keyboard provides the user with access to the system unit while the monitor provides a visual display of the textual output of the keyboard as well as information and messages from the system unit.
The system unit contains all the operation of the computer. The component parts of a system unit are:

1. **The power supply.**
2. **Disk drive.**
3. **Expansion or adapter cards.**
4. **The motherboard.**
5. **connectors or ports, which provide access to external devise (printer,mouse,VDU,modem,etc).**

THE POWER SUPPLY

The power supply converts AC mains into the necessary stabilized DC voltage for the motherboard, the keyboard and other elements within the system unit including the expansion cards. The power supply provides +5V,-5V,+12Vand -12V together.

DISK DRIVE:

Disk drives are mass data storage devices. A typical computer employs two types of disk drives: floppy and a hard disk drive. Data is stored on concentric tracks that have been formatted onto plastic (floppy) or metal (hard) disk, which has been load a very thin layer of electromagnetic.

EXPANSION (ADAPTER) CARDS:

Expansion or adapter cards are printed circuit boards,whuch support essential elements such as disk drive and video display or add-on facilities such as CD-ROM, and Modems by simply inserting them into expansion slots on the motherboard.

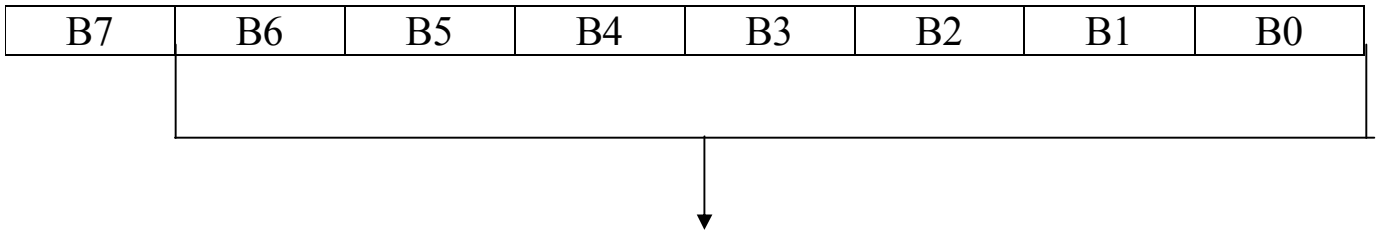
THE MOTHERBOARD:

The motherboard also knows as system board, is The core (main port) of the computer system. It contains all the necessary components (including the processor and other support and logic chips) and circuitry for the operation of the system. A motherboard known by the type of processor it supports, hence a 386(using an 80386 processor) a 486 or a Pentium motherboard. Modern motherboard are designed to support more than one

type of processors ,making it possible to upgrade the system without changing the motherboard.

KEYBOARD:

By for the most common input device is the keyboard. It is standard equipment with every personal computer. Expect for specialized application, such as drawing pictures on the screen, the keyboard is the primary way to communicate with PC. The essential elements of a keyboard are a switch matrix and a keyboard interface encoder chip.
The keyboard encoder is a customized microprocessor with an in-built ROM such as the 8048 or the more recent 8049 or compatibles like the MOTOROLA 6805. The switch matrix consists of a number of horizontal and vertical lines crossing each other. At each crossing a small switch operated by a spring loaded key is located when a key is pressed the switch closes and the relevant horizontal and vertical line are shorted. This is then detected by the keyboard encoder who generates a special 8-bit code known as the scan code. Each key is allocated its own unique scan code defined by the first 7-bit by b0 to b6 as shown below:



(THE KEYBOARD SCAN CODE)

Break :b7=1
Make :b7=0

The eight bit,b7 is used to distinguish between a key-make (b7=0) and a key –release (b7=1). The scan code is entered into an internal for transmission to the computer via a special cable. On the computer side, a keyboard controller ,also known as the keyboard Bios(Basic Input Output

System)chip, receives the serial data stream and coverts it into an appropriate ASCII code. The keyboard controller is an other dedicated processed such as the 8042 or the more modern 8741/8742 with an in-built few kilo bytes of ROM and few hundred bytes of RAM. The characters you type are stored until CPU is ready to accept them.

TYPE OF KEYBOARD:

A poor-quality keyboard can make an other wise reasonable computer hard to deal with. The cheapest keyboard have picture of key-tops drawn on a flat plastic membrane. Membrane keyboard rely on pressure to register each keystroke. They very widely in sensitivity on the most sensitive membrane keyboard you can not rest your fingers lightly on the key to generate the keystroke i.e.

Membrane keyboard are not suitable for extensive typing. Portable personal computers often have compact keyboard. They have less than full-size keys or reduced spacing between keys. Unless you have small hands, you may find it impossible to touch-type on a computer keyboards. Chic let keyboards, have small rectangular keys similar to hand-held calculators. Although chic let keys move up and down a bit, they do not depress as for as standard full-stroke keys. Typing quickly on a chic let keyboard is difficult.

The XT keyboard is containing 83-key and the AT keyboard is contain 84-key which was then followed by the enhanced 101-key or 102-key multifunction keyboard. The enhanced keyboard has a separate numeric keypad. Separate cursor control keys and a set of 12 function keys. The enhanced keyboard is fully programmable by computer software for different layouts to suit different languages.

Many other keys an appear on a keyboard. One of the most important is the control key (usually labeled [CTRL]). It operates just like the shift key

but generates a different type of character code. To get a capital letter you hold down the shift key and type the letter, to get a control-letter you do the same thing except with the control key.

THE CURSOR:

Is a position indicator on the screen, usually it looks like a blinking rectangle or underline. The cursor-movement keys have arrows on their key-tops showing what effect the key has on the cursor.
A particularly useful feature is keyboard buffer, which allows you to continue typing even though the CPU is busy doing other tasks. The character you type are stored until the CPU is ready to accept them. This feature, which is also called type a head, makes slow programs more bearable. You can begin typing a new command or text while the CPU is still working on the last operation .keyboard buffer have room for a limited number of character, from two to twenty or more. Characters in the buffer do not appear on the screen until the CPU has accepted them for processing and has echoed them to the screen. If the buffer becomes full, then the keyboard is likely to beep at you in response to further typing.

KEYBOARD LAYOUT:

The standard layout for type writer keyboard was developed in the last century. The arrangement is known as the QWERTY keyboard. It is named after the order of the keys immediately above where the lift hand normally rests on the keyboard. The QWERTY keyboard was deliberately designed to slow typing in order to prevent the print hammers on early mechanical typewriters from jamming on their way to the paper. This goal quickly become irrelevant with the invention of improvement mechanical typewriters. It is of no concern whatsoever with personal computer. But the QWERTY layout is still used on nearly all personal computer keyboard.

USING THE KEYBOARD:

The main thing to remember when using a computer keyboard is that the keys do not have fixed meanings. On a typewriter hitting the [P] key

will always print a P on the paper. But with a personal computer striking the[P]might display a P on the screen, print a file ,or pull an address out of a list of mailing labels. It all depends on how the program instruction the CPU to interpret the character. Each keyboard has its own quirks. Most personal computer key-boards have repeating keys. This means that pressing a key longer than a second generates a constant stream of characters.

MOUSE:

Since the keyboard is likely to remain the dominant devise for entering text. But many operations on personal computer involve pointing, selecting, or moving items already on the screen. Often you can perform these takes more quickly with a pointing device then with the cursor keys on the keyboard such as the touch screen and the mouse. A mouse is a hand-operated pointing devise. As you drag the mouse across a flat surface, it relays directional information to the computer. Most mice have one or two buttons on top that are used to signal to the computer. A mouse can register very small movement, permitting you to point to individual pixels if necessary. The function of a mouse is to convert a small movement of the mouse into digital signal , which may be interpreted into corresponding movement of a pointer on the screen.

The digital signals may be produced by the rotary movement of a variable resistor in the mechanical type of mouse or the interruption of alight beam by a rotating wheel in the mechanical type.

The monitors :

The video display unit(VDV) or monitor is one of the two principal interfaces between the user and the computer, the other being the keyboard.
Originally employed for monochrome(black and white).

The heart of the display system is the video adapter card which slots in to a PC expansion slot. The video adaptor translates text and graphics instructions into video signals which are fed to the monitor for display. Two types of monitors are in common use in PC's: the raster or CRT (Cathode Ray Tube) and the LCD (Liquid Crystal Display). In the CRT, high speed electrons are emitted by an electron gun. The inside of the screen consist of a large number of very small dots Known as pixels is.

A continuous display is created by refreshing the screen i.e. recreating the image at regular intervals. Each complete scan of the screen is known as a frame. A refresh rate (i.e. a frame frequency) of between 50 and 90 Hz.

The quality of the display id determined by the number of pixels that are available to be scanned by the electron beam. For high quality graphics a large number of pixels must be made available to enable fine details to be reproduced on the screen. A second factor which determines the quality of the video display is the distance between the pixels, known as the dot pitch, given in millimeters. The nearer the pixels are to each other, i.e. the smaller the pitch, the higher is the image quality.

The resolution of a monitor is the total number of pixels available on the screen given as horizontal pixels *vertical pixels.
For example, a monitor with 640 pixels per line(horizontal) and 480 lines(vertical) has a resolution of 640 ×480.

The size of the monitor, which is usually given in Inches, refers to the diagonal measurement of the screen. Thus a 14-inch monitor has a width of 11.2 inches and height of 8.4 in, where:

$$(size)^2 = (11.2)^2 + (8.4)^2 = 125.44 + 70.56 = 196$$
$$\sqrt{196} = 14$$

Given a dot pitch of, say, 0.28 mm and a screen size of, say, 14 inches, the total number of pixels i.e. the screen resolution, may be calculated as follows:

A 14 inches screen with an aspect ratio of 4:3 gives a screen width = 11.2 inches = 284.48 mm and a screen height = 8.4 inches = 231.36 mm .
If the distance between each pixel(dot pitch) = 0.28 mm then the number of horizontal pixels = $\frac{284.48}{0.28}$ **= 1016 , the number of vertical pixels =** $\frac{231.36}{0,28}$ **=**

826
given a resolution of 1016×826 .

A adaptor types:

1- Monochrome display adaptor (MDA)

The MDA is, as its name suggest , a black and white video display system introduced by IBM for the first XT computers. It is used in the text mode only with a resolution of 80×25 .

2- Coluor graphics adaptor(CGA)

The CGA was the first graphics-type adaptor from IBM. It has a maximum resolution of 640×200 pixels with two colours only. If the number of colours is increased to four, the resolution is halved to 320×200. In the text mode, it can be programmed to display 40×25 or 80×25 characters with 16 different colours.

3. Hercules graphics card(HGC)

The HGC is another monochrome adaptor. In the text mode, the HGC is the same as the MDA. However, unlike the MDA, it can operate in monochrome graphics mode with a resolution of 720×348 .

4-Enhanced graphics adaptor(EGA)

The EGA provides a maximum resolution of 640×350 pixels with 16 different colours.
The PC's own system Bios only support MDA and CGA cards, EGA incorporates its own video Rom Bios chip Which is mounted on the card with EGA, the size of the character matrix is not predefined by Bios and may be changed by the user.

5- video graphics array(VGA)

The resolution of 640×350 pixels with 256 different colours.

6- super VGA(SVGA)

The SVGA was established as a standard with the introduction of the VESA(Video Electronic Standards ASSOCIATION) buss. A Bios extension was introduced and is used as an interface between the programmer and the adaptor. SVGA is capable of a resolution of up to 1600×1200 and 24-bit colour depth(16,777,216 colours).

PRINTERS:

Printers can be either directly connected to the computer(on-line) or separated from computer(off-line). In the second case the out put information are stored on magnetic disk, for example, and latter on can be printed is available.

(1)Printer can be divided according to the number of character to be printed at the same time:

- **Characters printers.**
- **Line printers.**
- **Page printers.**

(2)Printer can be divided according to the printing speed:

- **Low speed printers: this type can print between(10-500) characters per second e.g. dot-matrix printers, thermal printers, Ink jet printers.**
- **Highest speed printers: this type can print between(300-3000) lines per second e.g. Ink jet printers and laser printer**

(3)printers can be divided according to the way of printing:

- **Impact printers.**
- **Non Impact printers: e.g. Ink jet printer, thermal printer, Laser printer.**

(4) printers can be divided according of the shape of the printed character:

- **Dot matrix printer e.g. 5*7,7*7,9*7,9*9.**
- **Letter quality printers.**

CENTRAL PROCESSING UNIT(CPU):

Computer system is the CPU. It controls the functioning of the other units and processes data.
The CPU is sometimes called the processor, or in the personal computer field called" microprocessor".
Microprocessor:- a single integrated circuit(I.C) that contain all the electronics necessary to follow instruction stored in internal memory. In other words, it contains all the electronics needed to execute a program. The microprocessor calculates(adds, multiplies, numbers, and so on), performs logical operations(compares, numbers, makes, decisions), and controls the transfer of data(moves, information among devices), and timing.

The capacity or size of a microprocessor chip is determined by the number of data bits it can handle. A 4-bit processor has a 4-bit data width and an 8-bit processors are generally employed as dedicated controllers in industrial applications and domestic appliances such as washing machines and TV receivers.
Modern PC's use 32-bit processor such as the 486 and the Pentium. Early generation computers used the 16-bit 80286 and earlier still, the XT computer used the 8-bit 8088 processor.
Microprocessor also differ in the speed with which they execute instruction. CPU speed is indicated by the frequency of the system clock in megahertz(MHz, millions of cycles per second). While the bit width or size determines the quantity of information that may be transferred in any one cycle, the speed determines the number of such transaction per second.

Table bellow consist CPU's microprocessors by PC manufacturers, the yeas they were launched their by size and speed.

CPU	Launched	Bit size	Speed(MHz)
8088	1979	8	5
8086	1978	16	8
80286	1982	16	8-16
80386	1985	32	16-25
80486	1989	32	25-100
Pentium	1993	32	60-200

CPU control-signals:

The number and type of control signals depends on the microprocessor used and the design of the system. Controls signals are normally active low e.g. active when at logic 0. Active low signals are signified by abar(-). The main control; signals of a CPU are as follows.

The clock pulse signal:- A clock pulse is essential requirement for the operation of the processor.

The clock pulse wave form the clock control signal synchronizes the movement of the data around the various element of the system and determines the speed of operation, without which the system comes to a halt.

Read(RD)and write(WR):

The CPU determines the direction of data transfer to or from the microprocessor channel. This is carried out by the read and write control lines. In a READ operation when the CPU is receiving data from memory, the READ line is active allowing data to be transferred to the CPU. In a WRITE operation when the CPU is so riling data to memory, the WEITE line is active enabling data transfer from the CPU to memory.

Interrupts:

When a peripheral device such as a printer, a keyboard or a modem needs attention, a hardware interrupt signal, INTR(interrupt request), sort to the CPU. When such a signals is received, the main program is interrupt temporarily to allow the CPU to deal with the request. After servicing the peripheral device, the CPU returns to the original program at the point where it left it.
In general CPU consists of the following parts:

a) Arithmetic and logic unit(ALU)

Execution of the most operations within a computer(such as arithmetic or logic operation), takes place in the ALU.

EX: consider a typical example, suppose there are two numbers located in the main memory are to be added.

SOL: They are brought into the ALU, where the actual additions is carried out, the sum may then be stored in the memory and from there to an output devices.
Similarly any other arithmetic or logic operations can be performed in a similar way.
In general not all operands in an going computation reside in the main memory, since processors normally contain a number of high-speed

storage elements, called" registers" which may be used for temporary storage of often used operands.

b) Internal-bus structure:

This allows the various parts to communicate with each other. Communication between the internal bus and the external word is accomplished by driver/buffer interface circuits, one of the address lines and another for the data bit.

c) A number of registers:

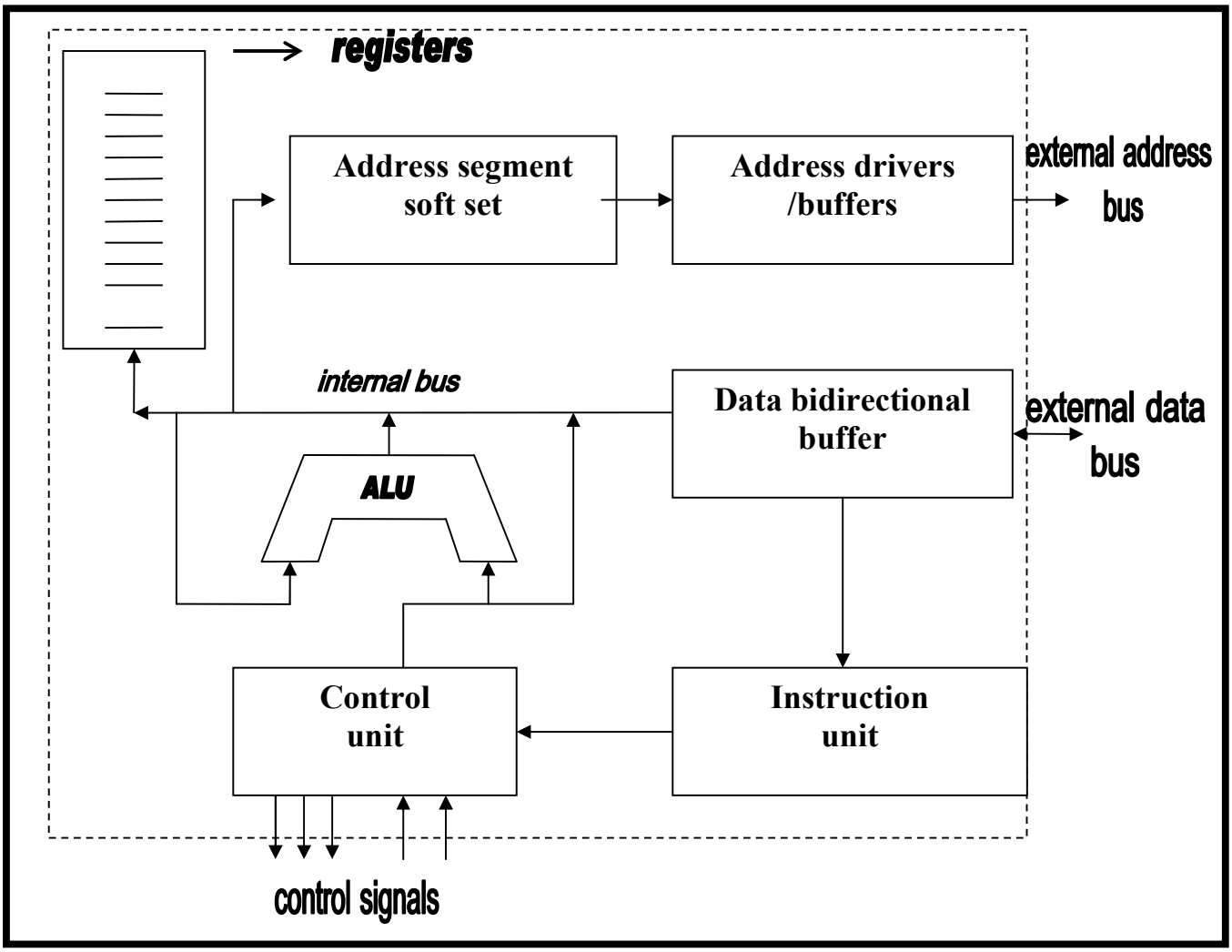
The processor provides a number registers to be used as temporary stores of digital information.

d) Instruction unit:

The instruction unit receives and stores each instruction, decodes it and informs the control unit of all the necessary steps to execute the instruction.

e) Address logic:

The address of a memory location is offset format before an address is sent to the address bus, it must be translated into an absolute(physical) address. This task is carried out by address logic unit.



f) Control unit:

The operation of the previous described (I/O units &ALU) must be coordinated in some organized way, which is the task of a control unit . Although the control unit does not perform any actual processing on the data, it acts as central nervous system used to send control signals to other unit.

The control unit provides the timing and control signals necessary to synchouse the internal operation of the CPU as well as the computer system as a whole.

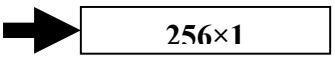
Memory unit:

A computer cannot work with out some form of memory to store programs and routines computer memory is used to store the sequence of instruction and related data which form what is known as a program or routine,. It is also used to store temporary or permanent data used or created by the program.
in running a program, the CPU will need to access the memory store at a rate of between 10 and 50 MHz.
in theory any type of memory store, including a disk drive, can be used provided it is large enough to store the program instructions and associated data. However, because disk drive are extremely slow compared with the speed of the CPU, using them as the main processor memory would make the whole system very slow. The processor will spend more of its time waiting to access the disk drive than carrying out program instructions. For this reason, the main memory where application and other support programs are lauded must have a speed comparable with that of the CPU itself. This means a memory store in the form of integrated circuit or chips. A small amount of memory is also provided by the processor itself.
We consider the internal memory as part of the CPU. This unit is used for storing information (either data or programs), while being used in the computer system. Internal memories are designed for short-term, high – speed access of information. Internal memory also known as primary memory, main memory, or simply memory.

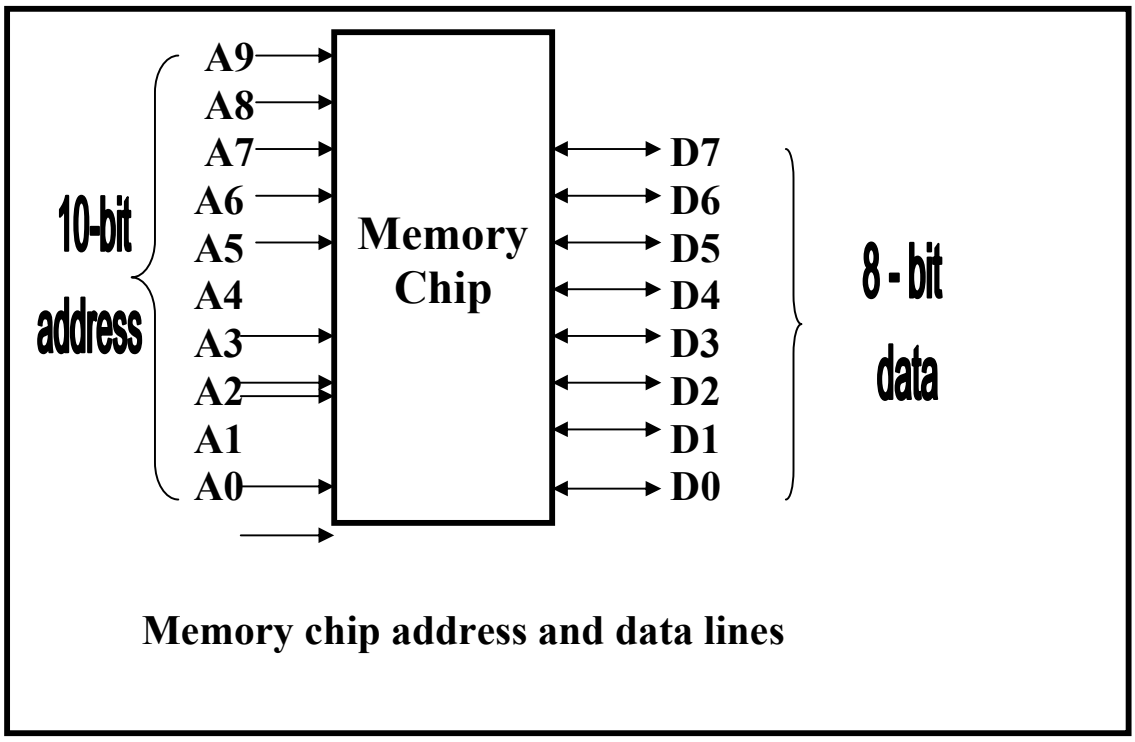
A computer's memory is in constant communication with the CPU, as the program being executed. This type of memory contains a large number of semiconductor storage cells, each capable of storing a one-bit of instruction. A bit which is short of binary digit which is either 1 or 0(either full or empty).
A group of eight bits is called a byte. Since a bite represents only a very small a mount of information,. The usual approach is to deal them in a groups of fixed size. For this purpose, the memory is organized so that a group of n-bits referred to as a word of information and n is called the word size(word length).

Memory chips:

Memory chips have two main properties that determine their application, storage capacity or size and access time or speed.
A memory chip contains a number of locations, each of which stores one or more bits of data known as its bit width. The storage capacity of a memory chip is the product of the number of locations and the bit width. For example, a chip with 512 locations and a 2-bit data width, has a memory size of 512×2=1024 bits.
Since the standard unit of data is a byte(8 bits), the above storage capacity is normally given as 1024/8 =128 bytes.
Total size of the memory banks 256 k byte ×6 = 250 KB.



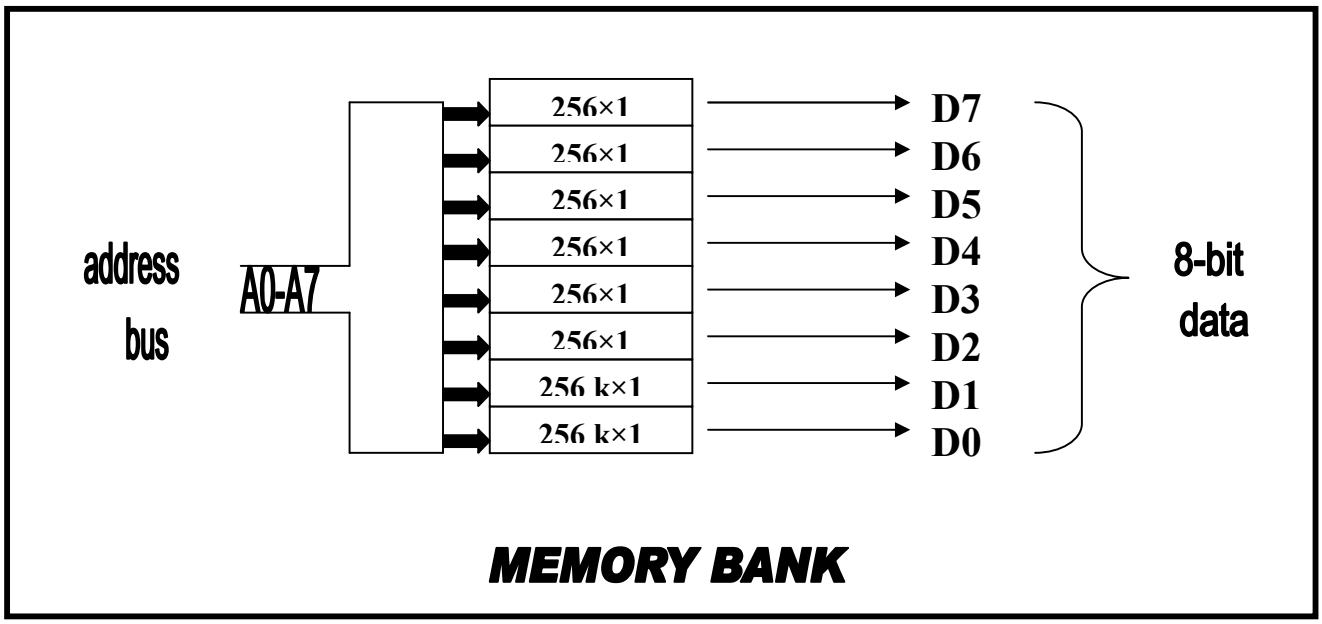
The number of locations may be obtained from the address width of the chip. For example, a chip with 10 address lines has 2^{10} = 1024 or 1 k locations. Given an 8-bit data width, a 10- bit address chip has a memory size of 2^{10} ×8 = 1024×8 = 1k ×1 byte = 1 k byte or 1KB.



Memory chip address and data lines

A single chip is usually insufficient to provide the memory requirements of a computer. A number of chips are therefore connected in parallel to form what is known as memory bank. Figure below shows a memory bank consisting of eight 1-bit chips. Each chip has 18 address lines(A0-A17). The total of the bank may be calculated as follows.

Capacity of one chip = 2^{15} ×1 = 256 K × 1 = 156 K bits
Total size of the memory bank = 156 K bits × 8 = 256 KB

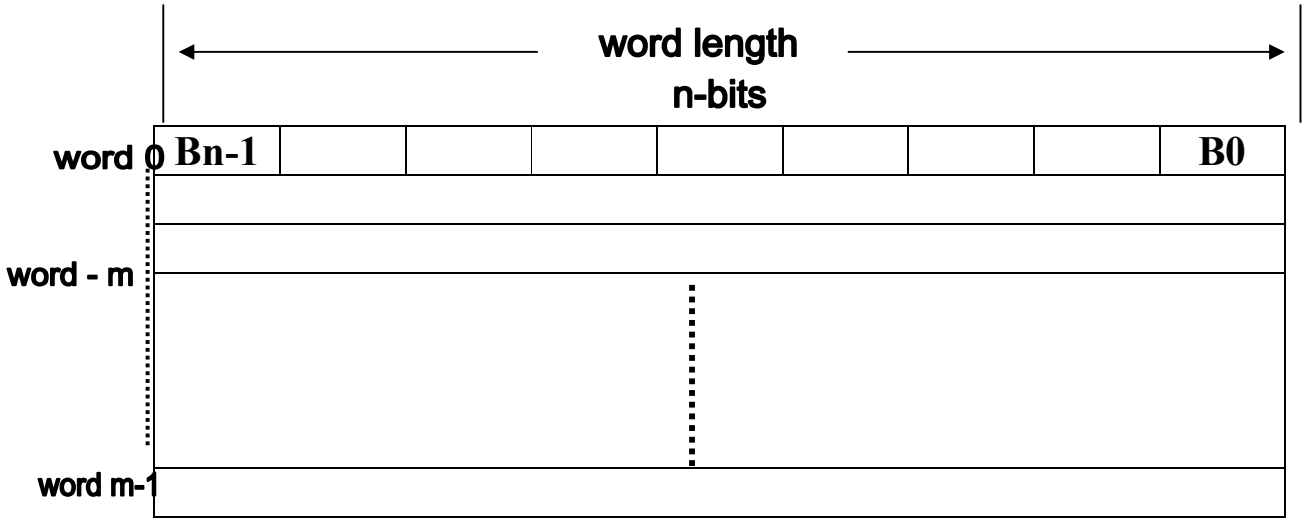


The computer's word size can be expressed in bytes as well as in bits.
For example, a word size of 8-bit is also a word size of one byte, a word size of 16- bit is a word size of two byte. Computers are often described in terms of their word size, such as an 8-bit computer, a 16-bit computer and so on.
For example, a 16-bit computer is one in which the instruction data are stored in memory as 16-bit units, and processed by the CPU in 16-bit units.

The word size also indicates the size of the data. Bus which carries data between the CPU and memory and between the CPU and I/O devices.

To access the memory, to store or retrieve a single word of information, it is necessary to have a unique address. The word address is the number that identifies the location of a word in a memory.

Each word stored in a memory device has a unique address. Address are always expressed as binary number, although hexadecimal and decimal numbers are often used for convenience.



Word address = 2^8 = m –word

"main memory organization"

<u>NOT:</u> the number from 0 to m-1 is used as the address of successive location in memory consisting of m- words.

The second properties of memory chips is access time, access time is the speed with which a location within the memory chip may be made a variable to the data bus. It is defend as the time interval between the instant that an address is sent to the memory chip and the instant that the data stored in to the location appears on the data bus. Access time is given in nanosecond (ns) and varies from 25 ns to the relatively slow 200 ns.

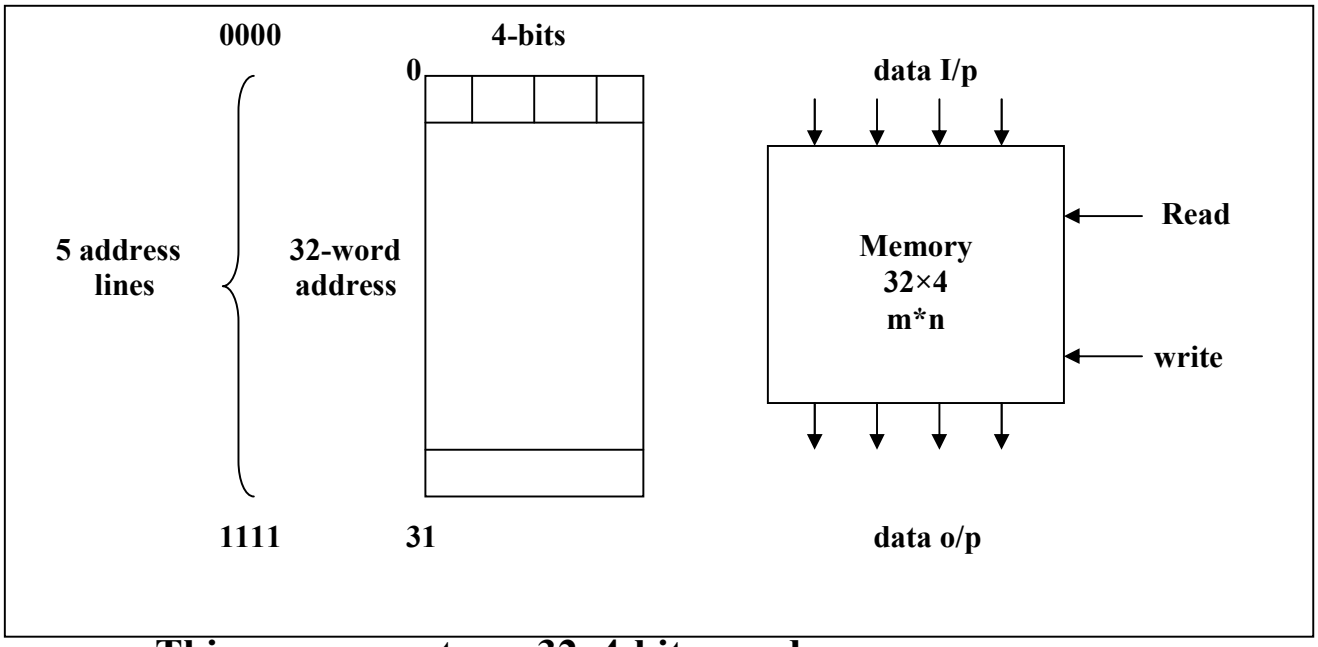
NOTS:

- **The large computer(mainframes) have word-sizes that are usually in the 32-to-64 –bits range.**
- **Mini computers have a word sizes from 8-to-32-bits range.**
- **Microcomputers have a word sizes from 4-to-32-bits range.**

In general a computer with a larger word size, can execute programs of instruction at a fast rate because more data and more instruction are stuffed into one word. The larger word sizes, however, mean more lines making up the data bus, and therefore more interconnections between the CPU and memory and I/O devices.

A more convient unite of measure for memory is that to use kilo byte(KB), means 1024 bytes (2^{10}). A large units called a mega byte (MB), means (2^{10}) KB =2^{20} bytes = 1,048,576 byte.

A more important than a computer's word size is the a mount of memory the computer has, (i.e.) the memory capacity. A memory capacity is a way of specifying how many bits con be stored in a particular memory device or complete memory system.



This memory , stores 32, 4-bits words.

- **The word size is 4-bit therefore there are 4-data I/P lines and 4data O/P lines.**
- **This memory has 32 different words, and therefore has 32 different words, and therefore has 32 different addresses (storage location) from (00000) to(11111). Thus, we need a 5 address I/P lines.**
- **Memory capacity = number of memory storage**

  Location ×size of each word
  = (number of word) × (number of bits per word)
  = m (word)*n(bits)
  = m*n bits

- ❖ **The capacity of memory depends on two parameters, the number of words(m) and the number of bits per word (n).**
- ❖ **Every bit added to the length of address will double the number of words in the memory.**
- ❖ **The increase in the number of bits per bits requires that an increase the length of data I/P and data O/P lines.**

EX:-

A certain memory chip is specified as 2K×8 :

1. **How many words can be stored on this chip?**
2. **What is the words size?**
3. **How many total bits can this chip store?**

SOL:-

1. **2K =2 × 1024 = 2048 words**
2. **The word size is 8-bits (1 byte).**
3. **Capacity = 2048 × 8 = 16,383 bits = 16 KB.**

EX:- A certain memory chip is specified as 2K × 16

1. **How many words can be stored on this chip?**
2. **What is the words size?**
3. **How many total bits can this chip store?**

Solution:-

1. **2K = 2 × 1024 = 2048 words**
2. **The word size is 16-bits(2 byte).**
3. **Capacity = 2048 * 16 = 32,768 =23 KB.**

EX:- Which memory stores the most number of bits:
2M × 8 memory or 2M × 16 memory?

SOL:-

1. **Capacity =(2 × 1024 ×1024) × 8 = 16,777,216 bits.**
2. **Capacity =(2 × 1024 ×1024) ×16= 33,554,432 bits.**

EX:- Which memory stores the most number of bits:
4M × 8 memory or 2M × 16 ?

SOL:-

1. **Capacity = (4 × 1024 ×1024) × 8 =33,554,432 bits.**
2. **Capacity = (2 × 1024 × 1024) ×16= 33,554,432 bits.**

EX:- A certain memory has a capacity of 4K × 8

1. **How many data I/P & data O/P lines?**
2. **How many word address line?**
3. **What is its capacity in byte?**

SOL:-

1. **8 each line:- data I/P lines = data O/P lines =8**

2. 4 × 1024 = 4096 words

thus, there are 4096 memory add nesses

$2^8 = 4096 \longrightarrow 2^8 = 2^{12}$

so X=12 it required a 12 bit address line

3. The capacity = (4 ×1024) × 8= 32,768 bit = 32,769/8 =4096 byte (since 1byte = 8 bit).

EX:- the a certain memory has a capacity of 4K×16

1.How many data I/P & data O/P lines?
2.How many word address lines ?
3.What is its capacity in byte?

SOL:-

1. 16 each one.
   Data I/P lines = data O/P lines = 16
2. 4 × 1024 = 20496 words
   Thus, there are 4096 memory addresses.
   $4096 = 2^{12}$
   its require a 12-bit address line.
3. Capacity = (4 × 1024) × 16 = 65,536 bit
   = 65,536 / 8 = 8.192 byte

Memory unit:

NOTS:-

A computer with memory less than 16 KB is limited to triviable application, because it can execute only small program.
A personal computer must have at least 640 KB memory.

*** instruction and data can be written into or read out under control of the CPU. It is essential to be able to access any words location within the main memory as quickly as possible.**

Memories, where any location can be reached by specifying its address, are called random-access-memories.

The time required to access one word(from memory) is called the memory access-time. That is(i.e.) access time is measured of a memories devices operating speed.

*** The two major types of memory are:-**

1. **read-write or Random-Access-Memory(RAM). It has a variable content , also it is generally used to store the variable data-RAM can also be used to store frequently changed programs and other information.**

RAM allows the computer to store information quickly for later reference, so that(in most personal computer). RAM holds:-

- **The active part of the operating system, the fundamental program that control the operation of the computer.**
- **The application programs being executed(for example a word processing program).**
- **Data used by the application program(for example a letter being written with the word processing program.**

- A representation of the data being presented on the video display.
- Any thing else that is likely to charge frequently (for example the time of the day in the computers a clock).

In RAM, the stored information will be lost when computer power supply is removed(even a short interruption), that is, RAM, is volatile memory .
When –program instruction, reads the data in memory address, it gets a copy of the data. This is called a non destructive read, because the content of the memory address are not changed.
Sending data to a RAM memory address is called a destructive write, because the new data erases whatever was there before RAM can be divided as:-

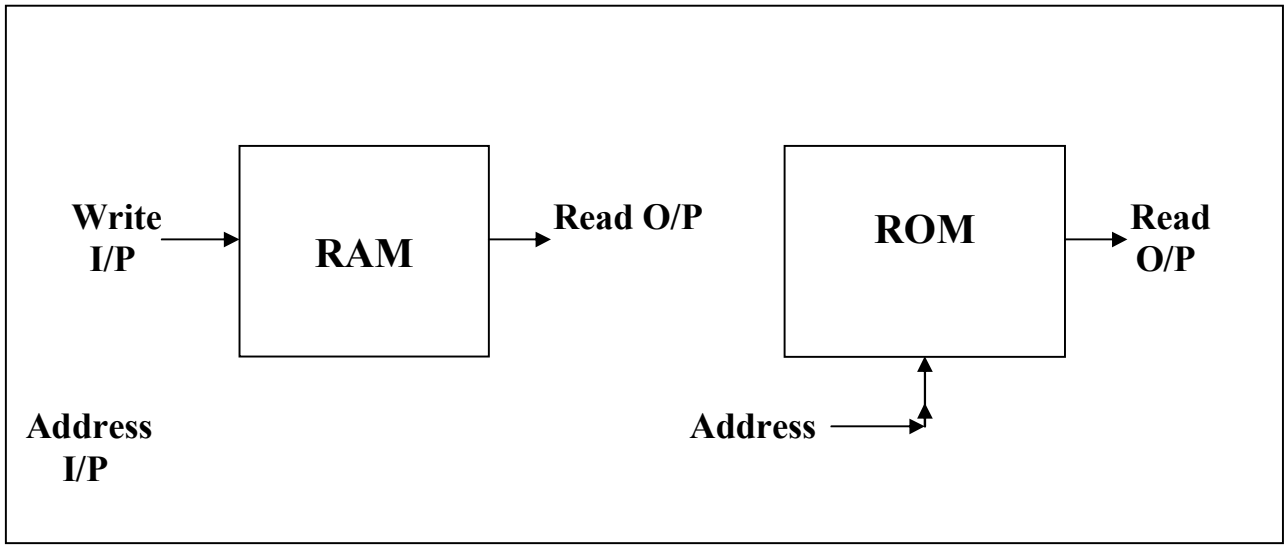
- Static RAM:- semiconductor memory devices in which the stored data will remain permantly stored as long as-power is supplied, without the need for periodically-rewriting the data in to memory.
- Dynamic RAM:- semiconductor memory devices in which the stored data will not remain
  Permantly stored, even with power applied, unless the data are periodically rewritten in to the memory.
  He later operation is called a refresh, operation.

2. Read Only Memory(ROM):- is a non vocative memory, where, the computer off, the contents of ROM are not change. That is the main different between RAM & ROM.

Sending data to a ROM memory address are:

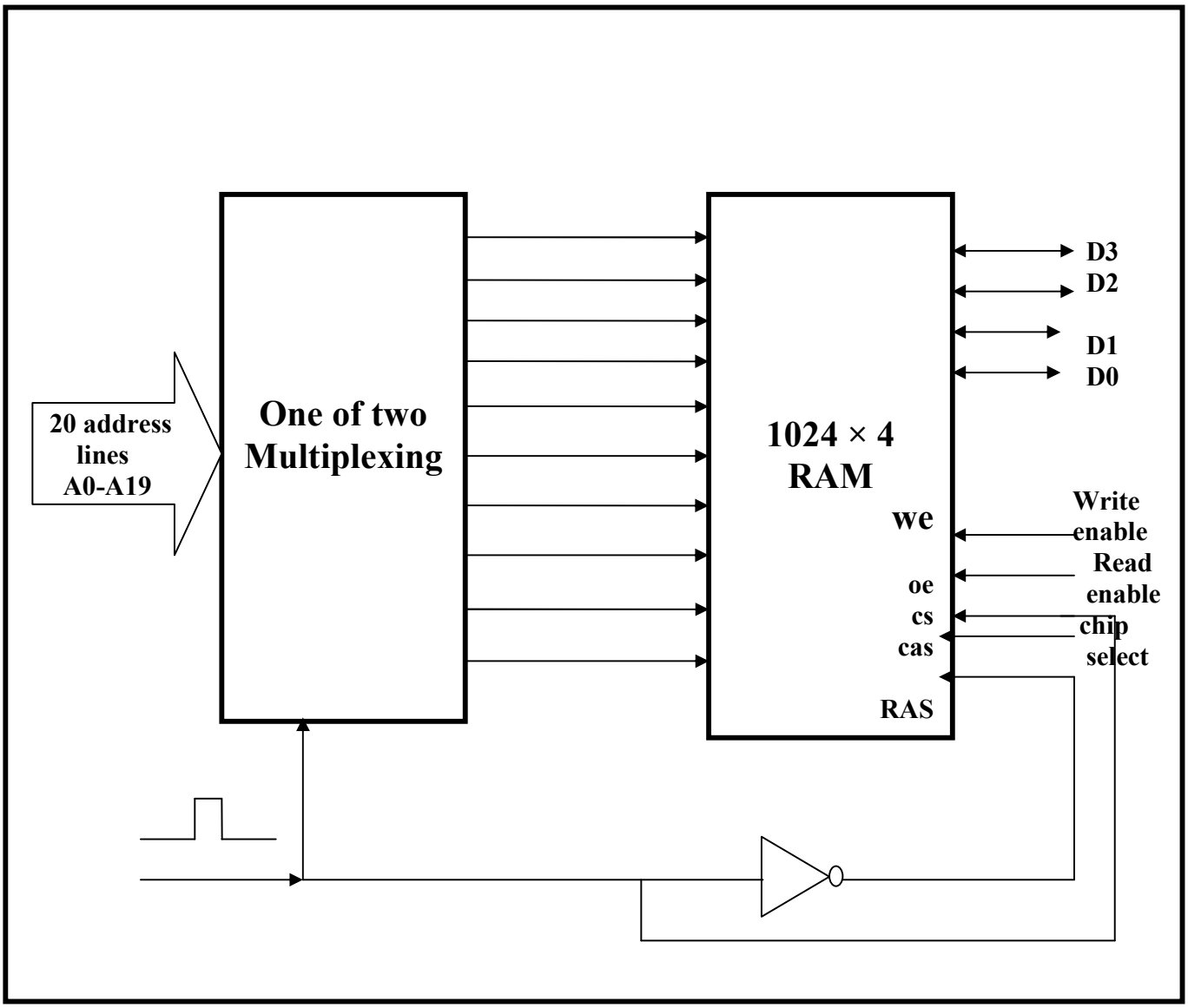
- PROM (programmable ROM): ROM that can be electrically programmed by the user. It can not be erased & programmed.
  PROM can be programmed once with special circuit.

- **EPROM(Erasable programmable ROM): RPM that can be electrically programmed by the user. It can be erased (usually with ultraviolet light) and reprogrammed as often as required.**
- **MPROM(Mask-programmed ROM): ROM that can only be programmed at the factory.**
- **EEPROM(electrically Erasable programmable ROM): ROM that can erased with ultraviolet light.**



Multiplexing:-

Because of the low cost and high density, DRAM devices are used to provide the bulk of computer memory of a few megabyte. The number of address pin required accommodate this size of memory becomes physical-inhibit for manufacturing purpose. To overcomes this problem address multiplexing is employed as show below:-



Multiplexer

The multiplexer received the full 20-bit address from address bus which is then fed to the memory chip is stages. First , Ao-A9 are fed to the address pin. Ic followed by A10-A19 which are fed to the same two special control signals, CAS, the column address st and RAS, the row address strobe, are provided to two halves to two internal latches. The full is then held within the IC long enough to access in the selected location.
There are three control lines all of which are a write enable(WE) which goes low when the

The factors have a major influence on microprocessor power:

1. **how many bits are processed in one operation?**
   This depends on:
   a. **The number of bits processed internally in each operation.**
   b. **The number of bits transferred between the microprocessor and internal memory at once.**

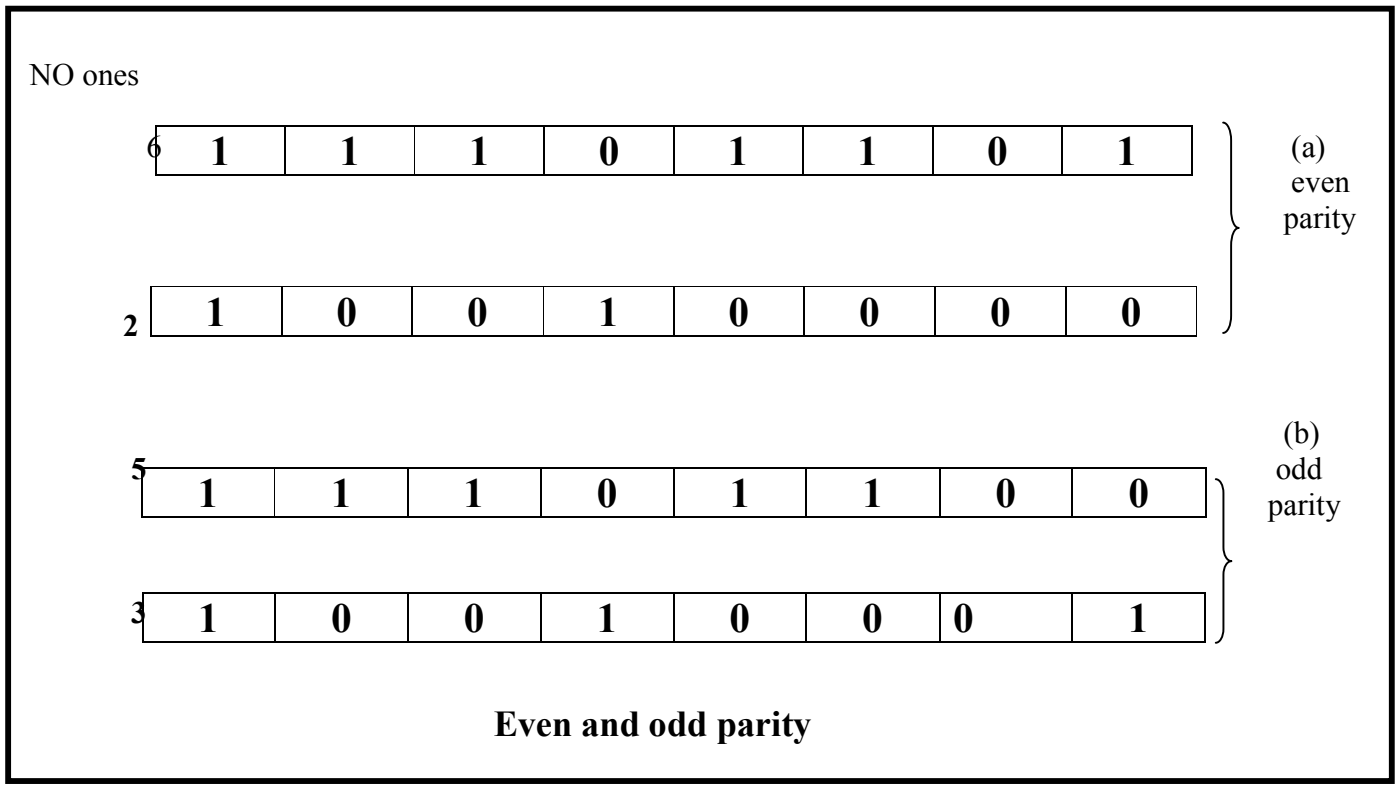
2. **How many operation are in the instruction set and how useful are they?**
3. **How long does it Take to complete an instruction?**
   This depend on:

   a. **The clock rate, which paces all the operation in the CPU. Clock rates are measured in megahertz(MHZ) or millions of cycle per second. For example, a pantium-2 has 433 MHZ clock rate which means there are 433,000,000 ticks (called clocks) of the CPU's clock each second.**
   b. **The number of clocks per instruction. For example , it takes IBM PC 4 clock to transfer one byte from internal memory to the microprocessor, auc it can take more than 100 clocks to multiply two 16-bit number together.**

4. **How much internal memory can the processor manage each word of internal memory needs own unique address, so the length of each memory address limited the maximum amount of internal memory. For example, 16-bit memory to 64 KB, and 20 bit memory address, which limit the internal memory to 1 megabyte(1MB).**

Parity checking:-

A memory bank may include as additional 1-bit chip for parity error checking parity checking involves counting the number of ones an 8-bit data packing and generating an additional ninth bit to indicate whether that count is add or even.
There are two types of parity checking: even and odd. If in an 8-bit word, the number of ones is add, a parity bit at logic 1 is generated to make the number even for "even parity" as shown below:



Even and odd parity

Conversely, a parity bit of 0 is generated to make the number of ones "odd parity". A single parity generator/detector chip they be programmed to generate the parity or check for correct parity. If a wrong parity is detected, the CPU is interrupt by a special non-mask able interrupt(NMI), and a special routine is then execute which display a parity error message on the screen where parity is utilizes, a separate parity chip is used for that purpose. Figure below shows the same memory bank as that shown in figure in(parity -34) with a ninth chip for parity normally, the parity chip can be identified by its size compared with the data chip.

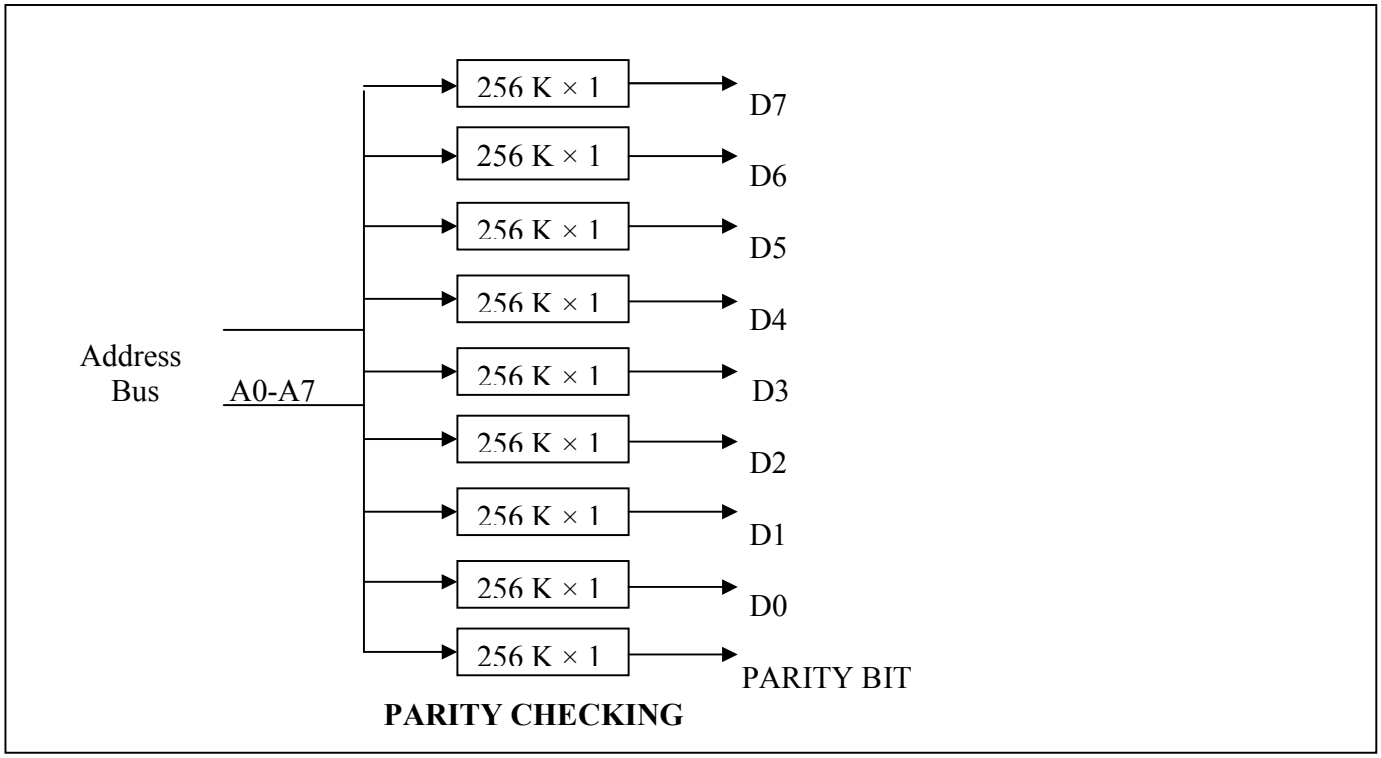
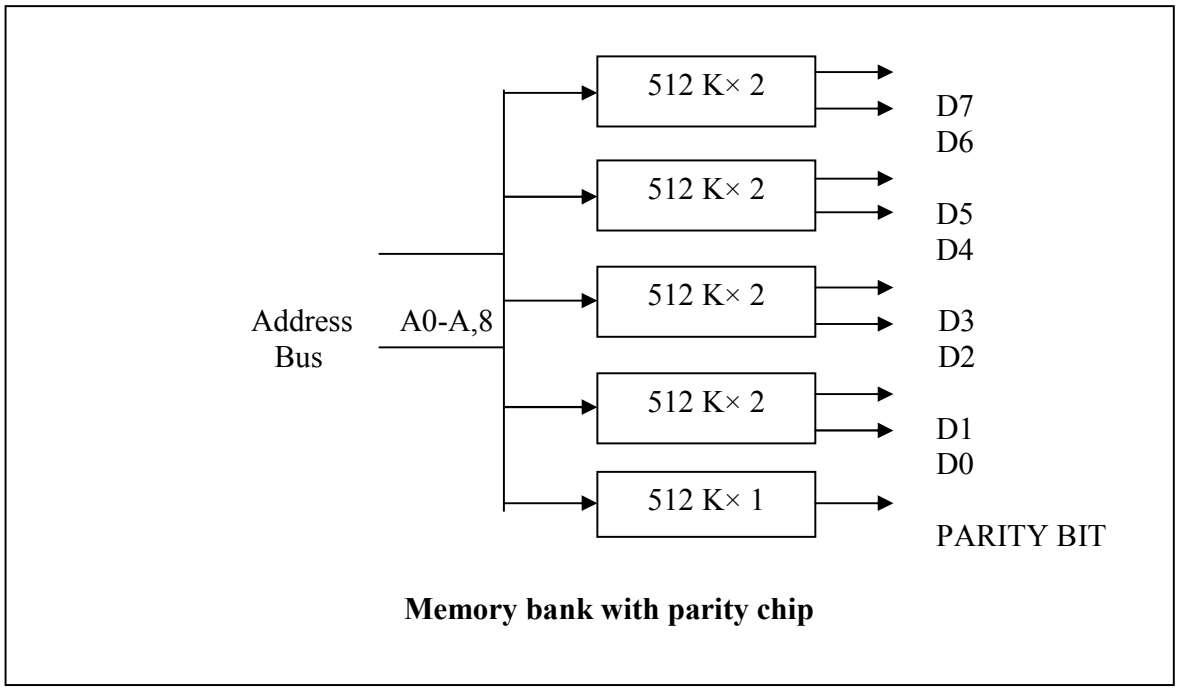


Figure below illustrates a memory bank consisting of four 2-bit chips and one 1-bit chip. The four 2-bit chips provide 1 byte of data and the 1-bit chip provides the associated 1-bit for parity. The capacity of the bank is given by the four 2-bit chip.

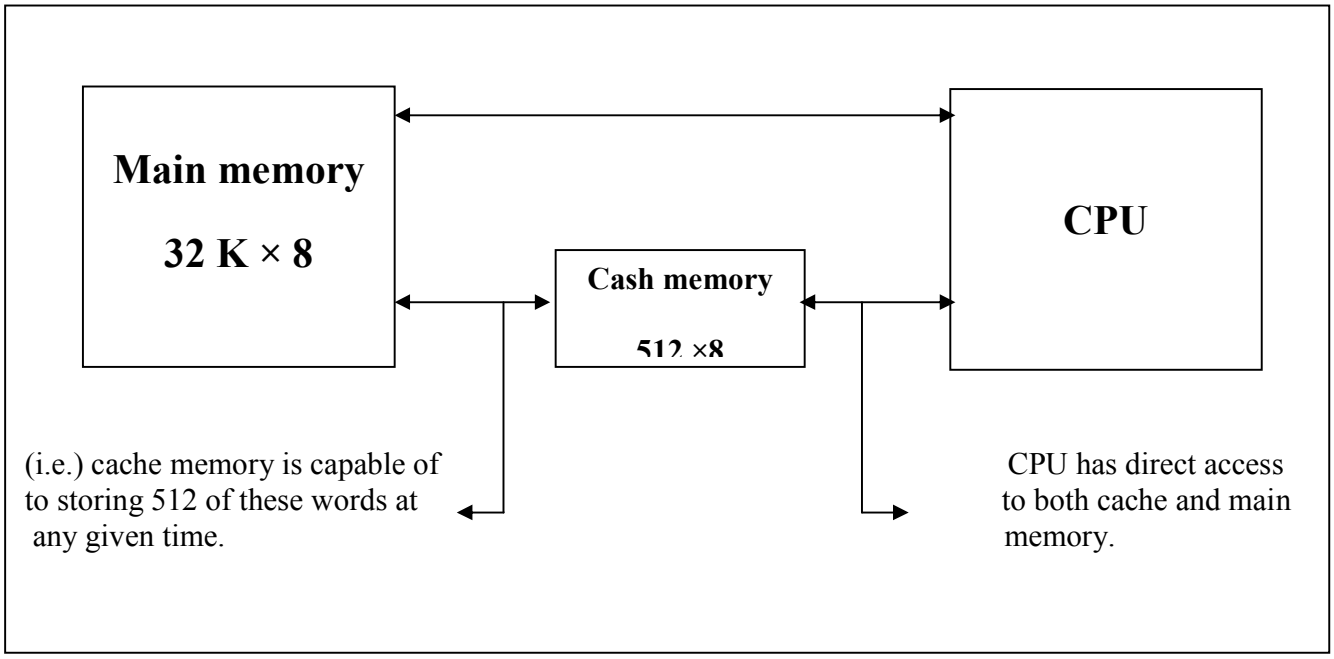
Capacity = 512 K × 2 bits × 4 = 512 K × 8 = 512 KB.



Wait states:- In cases where the speed of the process is faster than the access time of the memory devices, one or more wait states have to be introduced to slow the CPU down. A wait state causes the processor to suspend its activities for one or more clock cycle to allow slower memory to catch up. The number of wait states that are required depends on the speed of systems and the type of CPU used. Some computer system provide automatic wait state detection and setting. Wait state, curtail computer performances drastically. With one wait stat, a PC operates at two-thirds of its potential speed, two wait states cut the performance by half.

Cache memory:- processor is usually faster than main memory access time with the result that result that processing speed is mostly limited by the speed of main memory.
If the average memory access time can be reduced this would reducing , the total exaction time of the program. Normally, this would required that all of the internal memory have an operating speed comparable to that of the CPU in order to achieve maximum system operation

In many system it is not economical to use high-speed memory devices for all of the internal memory. Instead, system designers use a small block of high speed cache memory which might hold, say, 512 words. The cache memory access time is less than access time of main memory by a factor 5 to 10.



This cache memory block is the only block that communicates directly with the CPU at high speed. The fundamental idea of cache memory is that by transferring the most frequently the access program instruction and data from the slower, cheaper internal memory to the expensive fast cache memory when they are needed by the CPU.

By making program & data available at a rapid rate, it is possible to increase the performance rate of the processor.
The bank characteristic of cache memory is it a is fast access time. Therefore, very little or no time must be waited when searching for words in the cache memory. The transformation of data from the main memory to the cache memory is referred to as a mapping proc
Three types of mapping procedures are of particular interest when considering the organization of cache memory are:-

1. **Associative mapping.**
2. **Direct mapping.**
3. **Set associative mapping.**

The only way to avoid wait states as processor speed improves is to use faster memory devices. The most straightforward way of increasing the speed of computer memory is to use fast SRAM chips.
The cost of SRAM chips coupled with their low packing density make their extensive use inhibitive. The use of SRAM devices has to be more targeted and specific to make economic sense. To this end the cache memory technique was introduced.
Motherboard which support cache memory have a set of IC socket holder or a SRAM 160-pin D1MM slot a available, into which SRAM chips or SRAM modules may be inserted as outlined by the manufacture's handbook. Where a SRAM DIMM is used a single package may be used to provide 256 KB or 512 KB cache memory.

The cache memory technique involves the use of a block of few kilobyte(8-512 KB) for fast SRAM to store the contents of the most frequently accessed RAM location and the part of the program that the processor is most likely to call for. The identification of these instruction and data and leading them into the cache memory block is carried out by a

cache controller which continuously updates the content of cache memory as necessary.

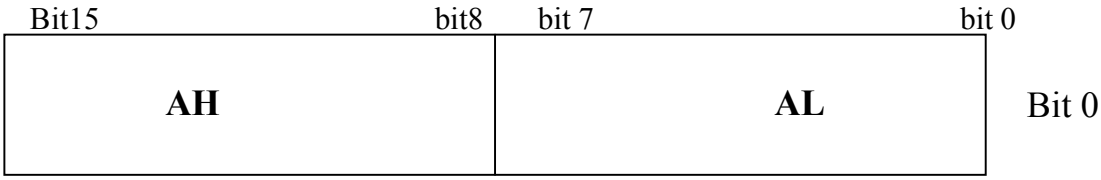
The processor will first a temp to fetch instruction or data from the fast cache memory. If they are not available, wait states will be introduced and he processor will access the slow DRAM location to fetch the desired information with a hit rate(i.e. the likelihood of the processor finding what it wants in cache) as high as 95 percent the net effect is that the system acts as though nearly all its memory is made up of very fast SRAM.

The cache controller has to keep a record of the information copied into cache and where is stored. A small memory known as tag memory is used for this purpose.
A faster and a more affective cache memory was introduces with fourth-generation processors(486-upwards). These processor are built with on-chip internal cache memory known as level one (L1) cache of between 8 and 16 KB with a very fast access time of between 5 and 10 ms

Processor register :-

Processor normally contains number of working-register, which may be used for tern porary storage. The access time to these register are typically 5 to 10 times faster then main memory access time.
Register are memory location within the processor itself instead of in RAM. These register can be accessed much faster than RAM. Register are also specialized memory location. The processor performs arithmetic and logical operations using it register. The processor register are important for system programming because the flow of information between "program and the DOS and BIOS function that call this program occurs through these register.
From a system programming viewpoint, nothing has changed in register since the 8086. this is because the BIOS and DOS were developed in connection with this processor, so they only support this processor's 16-bit register. The 32-bit register of an 80386 and 80486 can not be used in system programming under DOS, we'll discuss only 8088 register, which apply to all later chips.
All register are 16-bit(2 bytes) in size. If all 16-bit of a register contain a 1, the result, which is the decimal number 6553 , is the largest number that can contain any value from 0 to 65535 (FFFFH or 1111111111111111b).
A single 16-bit register and two smaller 8-bit registers.

Common register:- The common register are important for calling DOS and BIOS functions and are used to pass parameters to a particular function that needs these parameters for execution. These register are also influenced by mathematical operation (addition, subtraction, etc., which are the central focus of all software activities at processor level. Register AX,BX,CX and DX have a special position within this set of registers, because they can be divided into two 8-bit register. This means that each of these registers consist of three registers, one big 16-bit register and two small 8-bit register.



8088 register also apply to later processors

the small registers have H(high) and L(low) designators. Occur in such a way the L register contains the lower 8-bit (bit 0throu 7) of the x register, and the H register contains the higher 8-bits(bits 8 through 15) of the AX register. The AH register consists of bits 8-15 and the AL register consists of bits 0-7 of the AX register.
However, the three registers can not be considered independent of each other. For example, 1f bit 3 of the all register is changed, then the value of bit 11 of the AX register also changes automatically. The values change in both the AH and the AX registers.
The value of the AL register remains constant since it is made of bits 0-7 of the AX register (bit 11) of the AX register doesn't belong to it.

This connection between the AX, the AH, and the AL register is also valid for all other common-register and can be expressed mathematically.
You can determine the value of the x register from the values of the H and the L registers, and vice versa. To calculate the value of the x register, multiply the value of the H register by 256 and add the value of the L register.

Example:- The value of the CH register is 10 and the value of the CL register is 118.the value of the CX register results from CH * 256 + CL, which is 10 * 256 +118 =2678.
By specifying register CH or CL, you can read or write an 8-bit data item from or to any memory location. Read or write a 16-bit data item from or to a memory location by specifying register CX.

Flag register:- Besides common register, segment register and the flag register are an important part of system programming. The flag register communicates between consecutive assembly language instruction by storing the status of mathematical and logical operation. For example, after using the carry flag to add two 16-bit registers. A program can determine whether the result is greater than 65,535 and thus present it as a 32-bit number. The sign, zero, and overflow bits perform similar tasks and can be used after two registers have been compared to establish whether the value for the first register is greater than less than or equal to the value of the second register.
Only the carry flag and zero flag are important for system programming from high level languages. Most DOS and BIOS functions use these flags to indicate errors for insufficient memory or unknown filenames.

Address register:- The number of memory locations that a processor can access depends on the width of the address register. Since every memory location is accessed by specifying a unique number or address, the maximum value contained in the address register determines the address space. Earlier microprocessors used a 16-bit address register, which enables users to access addresses from 0 to 65535. this corresponds to the 64 K memory capacity of these processors. To address one megabyte of memory, the address register must be at least 20 bit, wide. At the time 8088 was developed, it was impassible to use a 20-bit address register, so the designers used as alternate way to a chive the 20-bit width. The contents of two different 16-bit numbers are used to from 20-bit address.

Segment register:- one of these 16-bit numbers is contained in a segment register. The 8088 has four segment register. The second number is contained in another register or in a memory location. To form a 20-bit number, the contents of the segment register are shifted left by 4 bits(there by multiplying the value by 16) and the second number is added to the first.

Segment and offset addresses:-

These addresses are the segment address and the offset. The segment address, which is formed by a segment register, indicates the start of a segment of memory when the address is created the offset address is added to the segment address. The offset address indicates the number of the memory location within the segment whose beginning was defined by the segment register. Since the offset address can not be larger than 16 bit, a segment cannot be larger than 65535 bytes(64 K). let's assume the offset address is always 0 and the segment address is also 0 at first. In this case, you received the address of memory location 16. this happens because the segment address is multiplied by 16 when addresses are formed .

If you continue incrementing the segment address. You'll received memory address of 32, 48,64 etc, if the offset address continues to be 0. According to this principle, the maximum memory address is 1 megabyte when the segment reaches 65535 (FFFFH), which is its maximum value. However, if you keep the segment address constant and increment the offset address instead, the segment address will quickly become the base address for a memory segment from which you can reach a total of 65,536 different memory locations. Each memory segment contains 64 K. the offset address represent the distance of the desired memory locations from the beginning of the segment.

Although the in divided memory segment are only 16 bytes apart, the contain 64 K. So they obviously overlap in memory because of this, a memory address, such as 130, can be represent in various ways by using segment and offset addresses.

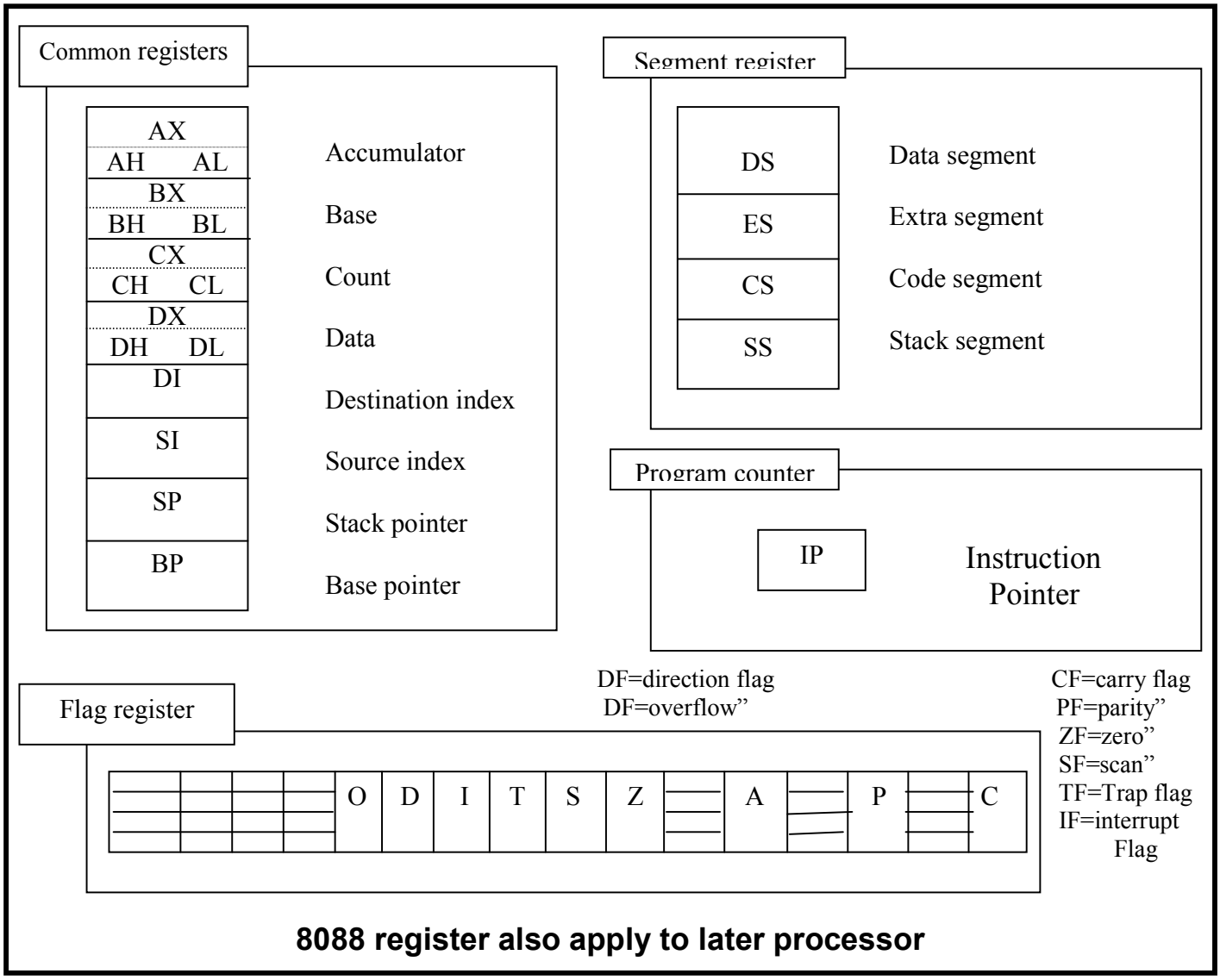
For example, you could specify 0 as the segment address and 130 as the offset address. It's also possible to specify 1 as the segment address and 114 as the offset address or 2 as the segment address and 98 as the offset address, etc. these overlapping segment are easy to use. When you specify an address you can choose the combination of segment address and offset address yourself, you most obtain the desired address by multiplying the segment address by 16 and adding the offset address to it, every thing else is in important.

A segment cannot start at every one of the million or so memory locations. Multiplying the segment register by 16 always produces a segment address that is divisible by 16 (i.e. it's not possible for a segment to begin at memory location 22).

Segment address:-

The segment address result from the combined segment and offset address. This segmented address specifies the exact number of the memory location that should be accessed. Unlike the segmented address, the segment and the offset addresses are relative addresses or relative offset. Combining the segment and offset addresses required special address notation to indicate a memory location's address. This notation consists of the segment address, in four-digit hexadecimal formal, followed by a colon, and the offset .

Register groupings:- As the illustration below shows, registers are divided into four groups: common registers, the program counter , flag register and segment registers.



The different register assignments are designed to duplicate the way in which a program processes data, which is the basic task of a microprocessor.
The disk operating system and the routines stored in ROM use the common registers extensively, especially the AX,BX,CX and DX registers. The contents of the registers tell DOS what tasks it should perform and which data to use for execution.

These registers are affected mainly by mathematical (addition, subtraction, etc. and input/output instruction. They are assigned a special poison within the registers of the 8088 because they can be separated into two 8-bit(1 byte registers). Each common register usually contains three registers address in four-digit hexadecimal format. For example, in this notation a memory location with a segment address of 2000 H and an offset address of AF3H would appear as "2000:0AF3". Because of this notation, you can omit the H suffix from hexadecimal numbers.

The segment register for program execution:-
The 8088 contains four important segment registers for the execution of an assembly language program. These registers contain the basic structure of any program, which consist of a set of instructions(code). Variables and data items are also processed by the program. A structured program keeps the code and data separated from each other while they reside in memory. Assigning code and data their own segments conveniently separates them. These segment registers are as follows:

CS:-the CS(code segment)register uses the IP (instruction pointer) register as the offset address. Then it determines the address at which the next assembly language iv=instruction is located. The IP is also called the program counter. When the processor executes the current instruction, the IP register is automatically incremented to point to the next assembly language instruction. This ensures the instructions are executed in the proper order.

DS:- Like the CS register, the DS(Data segment) register contains the segment address of the data the program accesses(writing or reading data to or from memory). The address is added to the content of the DS register and may be contained in another register or may be contained as part of the current instruction.

SS: The SS (Stack Segment) register specifies the starting address of the stack the stack acts as temporary storage space for some assembly language programs. It allows fast storage and retrieved of data for various instruction.
For example, when the call instruction is executed, the processor placed the return address on the stack. The SS register and either the SP or BP registers from the address that is pushed onto the stack. When accessing the stack, address generation occurs from the SS register in conjunction with the SP or BP register.

ES: The last segment register is the ES(Extra segment) register. It's used by some assembly language instructions to address more than 64 K of data or to transfer data between two different segment of memory.
With the help of the ES register, however, it's possible to leave the DS register on the memory segment of the source area while referencing the target area using the ES memory. The 8088 and its descendants even have assembly language instruction that can copy an entire buffer by assuming, before their execution, the segment address of the start area has been loaded in to the DS register and the segment address of the target area has been loaded into memory or peripheral devices. Both the fetch and execute phases may take more than one cycle to complete depending on the nature of the instruction. When the instruction is completed, the microprocessor then placed the next program address, i.e. the address where the next instruction is stored, on the address bus commencing another fetch and execute cycle and so on.

The booting-up process

The purpose of a PC is to load and run application software such as word processing, computer-aided engineering, windows or games. An application package is designed for a specific operating system such as MS-DOS, ps/2, Unix or windows 95.e.tc. The operating system provides an environment for different software packages to e installed and run. The link between the operating system and the hardware components of the PC is provided by BIOS(Basic input/output system). BIOS is a set of short routines which are stored in a ROM or an EPROM device hence the name ROM BIOS.

The function of BIOS : BIOS routines are stored in a ROM or EPROM chip with memory addresses located in the upper segment of real memory. The number and size of BIOS depend on the manufacturer of the chip and its version, with later versions containing more complex and sophisticated programs. BIOS rotines may be divided in to two categories.

1. **startup routines.**
2. **Basic low level input/output routines.**

The startup routines are initiated when the system is switched on(cold start) or has been reset (warm start). They include such programs as the initial power on self-test(post) and system initialization.

The I/O routines, which include such programs as print routines and disk read/write, are called when the operation system or an application package wishes to carry out these basic tasks, this simplifies application program writing and helps to ensure compatibility of PC's which have different hardware element or configurations. Access to these routines is provided by a system of soft ware interrupts which cause the processor to halt it operation and start a particular BIOS routines. Each interrupt is given a 4-byte values known as vector which its as a pointer to the required routine. Each vector is allocated four memory locations into which BIOS loads the 4-byte value during the start-up routine. Interrupt vectors are

collected into a table, known as an interrupt vector table, which is located in memory locations at the very start of system.

The boot-up process: when a computer system is switched on, a procedure known as boot-up or start-up is initiated by the CPU which a many other things runes BIOS and loads the operating system to get the computer ready for use.

Upon power-up(by turning the mains switch on), the power supply performs a self-test procedure which successful and the corrects roltages are established on its output lines, sends a power good(PG) signed to the timer chip on the motherboard. The timer responds by taking the result control line HIGH to start-up the CPU. The following is the sequence at events that will take place in a typical computer system:

Step1. bootstrap. The CPU searches for starting address FFFF:0000 where first instruction is stored. This instruction, which is a jump instruction, direct the processor to the staring address where BIOS is located. This step is traditionally known as the bootstrap after the notion of the PC pulling itself up by its bootstraps.

Step 2 . post. The first action of bios is to test the system, a routine known as post(power on self-test).

Step 3. initialization. Following a successful self-test, BIOS carries out a system initializing routine.

Step 4.loading the operating system. This involves the BIOS looking for, loading executing two hidden
System files: IO.sys and MSDOS.sys.
The computer is new under the control of the operating system in the guise of IO.sys.

Step 5. loading CONFIG.sys and COMMOND.COM. the operating system takes action to establish the operating environment of the system as specified by the user. Customizing the environment involves, in the first instance, searching the root directory for a file called CONFIG.sys. if one is found, DOS reads and executes all its statement before loading the DOS

kernel, a file called COMMAND.COM. if CONFIG.sys cannot be found, COMMAND.COM is loaded regardless.

The system is now under the control of COMMAND.COM.

STEP 6. loading AUTOEXEL.BAT. the CPU looks for a batch file called AUROEXEL.BAT. if it is present, Dos loads it into memory, executes its commands and displays the DOS prompt. If AUTOEXEL, BAT is not present, DOS will request DATE and TIME, before displaying the DOS prompt.

The system is now ready for DOS commands or application programs.

External storage (memory unit):-

Used for large-term memory storage there internal memory. The most common external storage devices are tape and disk devices. External memory operates at much slower speed than internal memory and it stores programs and data that are not currently being used by the CPU. External storage is also known as secondary storage or auxiliary storage.

External storage is normally the place where a large amount of programs and data are stored permanently, when the power is turned off.

External storage devices can be classified either mechanical or magnetic:-

1. Mechanical storage devices:- are punched paper card, and punched paper tape. Both of these are less popular now than in the past.

2. Magnetic storage devices:- In personal computer systems, external storage units store information as magnetic spots on oxide surfaces. Because the magnetic spots do not need a constant supply of power to " refresh " themselves (as most RAM chip do), external storage units provide nonvolatile storage. Also, external storage is cleaper per unit of storage than the internal memory.

*** The three most common forms of magnetic media used on personal computers systems are:-**

cassette tapes, floppy disk, record again and again. As new information is written, it automatically covers up whatever was there before. To avoid

accident erasure, both cassette tapes and floppy disks can be write-protected.

Top recorders and floppy disk drives will not write on write-protected media.

Most hard disks can not be write protected.

STORAGE DEVICE

1- Cassette types:

Cassette type has been widely used for many years as external storage. It is still used for backing update, because it is quite change. The main disadvantage of cassette tape is that they are sequent-access storage devices. That is, to find information on the tape you must search through the tape sequentially, which means that to read the last item on a tape, you must wind the tape (using cassette recorder) past all the previous items.
The time it takes to begin reading the desired information from a storage device is called the devices access-time, recorder has very poor access-times, because it can take several minutes to get to the right spot on the tape. The rate of which data are read one an information, transfer has began is the data transfer rate, standard cassette tape recorders have an effective data transfer rate between 300 and 1500 bits per second.
For example, at a rate of 500 bits per second, it takes more than five minutes to lead a 16 KB file into internal memory.
The combination of sequential storage and slow data transfer makes cassettes unsuitable for most practical application of personal computer.

2- Floppy Disks:

The must common external storage device for personal computers is the floppy disk. The disk device is the unit that reads and writes on the floppy disk. A typical floppy disk can store a bout 150 KB, 1.2 M byte to about 2.88 M byte of data. Unlike cassette tape devices floppy disk systems are random-access(or Direct-access) storage devices. There read/write heads can move in and out, to quickly access information on any part of the disk.
The amount of information stored on a floppy disk depended on four factors:

1- The number of tracks (concentric circle) of data from the inside to the inside edge of the disk(generally between 40 to 80).
2- The number of sector per track(generally between 8 to 261).each sector per is a pie-shaped wedge of one track. A sector is the smallest unit of information sent between the disk drive and the .
3- The number of bytes stored in each sector(generally between 128 to 512 bytes).
   Double-density disks store twice as many bytes in the same size sector as single-density disk.
4- Whether data is written on one or both sides of the disks, that is, whether storage is single or double-sided.

For example: a single side microfloppy disk has tracks on a single side, each track has as average of 10 sectors, each sectors stores 512 bytes. This give a total storage capacity

$1 \times 80 \times 10 \times 512 = 409{,}600$ byte.
$= 400$ K byte .

In general:- the storage capacity of floppy=
No of sides × No. of tracks × No. of sector/track × storage byte/sector

Ex:- Double-side floppy disk has a number of tracks = 40 and a number of sector = 16 and each sector store 512 by calculate its capacity?

- **capacity** $= 2 \times 40 \times 16 \times 512 = 655{,}360$ byte
  $= 650$ K byte .

Ex:- Double-sided floppy disk has a number of tracks = 40 and number of sector = 16 and each sector 512 bytes.
How many files can be store on this disk, if the average file capacity is 800 bytes?

Sol:- capacity $= 2 \times 40 \times 16 \times 512 = 658{,}360$ byte
$655360/800 \cong$ **891 files.**

The main advantages of floppy disks over tapes foe microcomputer bulk storage are:-

1- **Disks are random access, while tapes are sequential access storage device.**
2- **The disk drive can jump to any location on the disk, where as you must sequence through much data on tape to locate a certain program.**
3- **The access time foe disks is much shorter than the average access time for magnetic tape.**

Note:- there are two types of floppy disks:-
Single sided and Double sided. Also floppy disks can be either single density or Double-density or high density.

Hard disk:-

Hard disk use rigid aluminum platters to support polished oxide recording surface. Like a floppy disk system, a hard disk system is also a random-access storage device. The hard disk is permanently, housed in a sealed disk drive.
The drive spines the rigid disk at high speeds while the precision read/write heads float just above the surface for reading and writting data and programs on the magnetic coating surface.

The standard size for a floppy disk 5,25 inch version, however, a 3,5 inch version is becoming widely used. The hard disk are formatted into tracks and sectors, just like floppy disks, but with higher number of tracks.
Compared with floppy disks:-

1- **Hard disks store much more data per sequence inch of recording surface.**
   - **Typical hard disks used with personal computer have a storage capacity of about 10 k to 9.1 G byte, compare with a capacity of about 150 k to 2.88 M bytes for floppy disks.**

- **Because aluminum platters are less sensitive than floppy disks to variations in variations in temperature and humidity and to mechanical stress.**

This allows the hard drive to have more tracks per redial inch and to write more bits per inch along each track.

2- Hard disks can transfer data faster than floppy disks.(the transfer rate depends on the density of the stored data and the rotational speed of disks. For floppy disk system the maximum transfer, rate is typically between 30.000 and 150.000 characters per second.
For hard disk systems the maximum transfer rate between 200.000 and 2 million character per seconds.

3- Access time are also faster for hard disk than floppy disks. The access time for a hard disk is about 25 to 70 m sec, while the access time for floppy disk is about more than 100 m sec. (whenever, a computer disk is operating its disk (hard disk) is spinning, which means there is no need to wait for the disk to come up to its speed. Because their heads rub against the recording surface when ever the disk is turning, start up time needed to bring a floppy disk to operating speed is about 30 second).
4- Floppy disks are transportable while the hard disk is not transportable.

Hard disks also have several disadvantage:-

1) **They tend to be noisier than floppy disk drivers, because of their constant high speed spinning.**
2) **More important is the high sensitivity of hard disk compared to floppy disk. Hard crashes can be caused by a bent disk or dust inside the drive, or a good thump to the side of the drive. Because hard disks operate on extremely precise mechanical tolerance, they are more sensitive to shack than floppy disks.**
3) **Finally because the hard disk drivers cost much higher than floppy disk drivers, soon the floppy disks become popular among users of small business computer.**

Note:- many micro computer system now use a combination of a hard disk and floppy disk drive. This gives the system the advantage of fast access time and large storage capacity of the hard and the portability of the floppy disks.

 # T = S + L + R

where T = total read time S = seek time L = latency time

R = read time

CD – ROM

Today's most popular storage medium is the CD-ROM. Developers have been adapting many hard drive based software applications to run on the CD-ROM drives. Some applications take advantage of the easy distribution method offered by CD-ROMs while other applications take advantage of the huge amount of storage space and special properties the CD-ROM offers over conventional drives.

When the CD is manufactured, the information to be stored on the CD is pressed into the layer of aluminum in the form of pits(indentations) and lands(elevations) which represent the individual bits. The pits and land are arranged along a single spiral which covers the entire CD, winding from the inside to the out side. Unlike records, CDs start at the inner edge instead of the outer edge.

Because the pits are only 0.6 micron wide (a micron is the equivalent of one millionth of ammeter), the path this spiral are separated by small distance of only 1.6 micron. The track density is almost 16.000 tracks per inch(TPI).

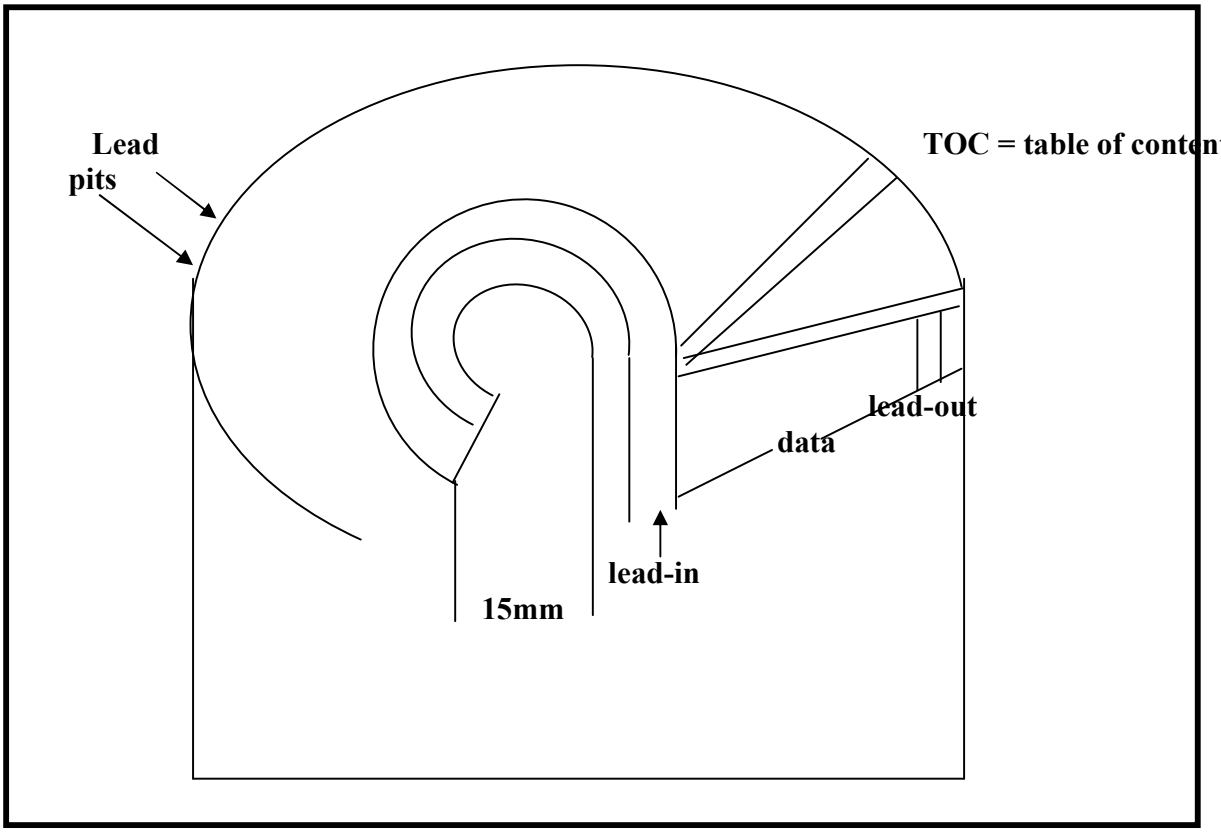
If this spiral were stretched out in a straight line it would be approximately 3.75 miles(6 kilometers) long. It also includes no power than 2 billion pits. Naturally, the laser beam that reads these pits and lands must be correspondingly small.
The scanning beam is approximately one micron in diameter which makes it only a little larger than the wavelength of the light that forms its beam.

How a CD-ROM is organized:-

The recordable surface of a CD-ROM is divided into the following three sections:-

1. **the lead-in.**
2. **the data-in.**
3. **the lead-out**

the lead-in occupies the first four millimeters of the CD's inner edge and contains a type of table of contents.
The lead-in followed by the data area, which can occupy up to 33 millimeters, depending on how much data is on the CD. Finally, the lead-out range marks the and of the data. It follows immediately after the data area and is approximately 1 millimeter wid.



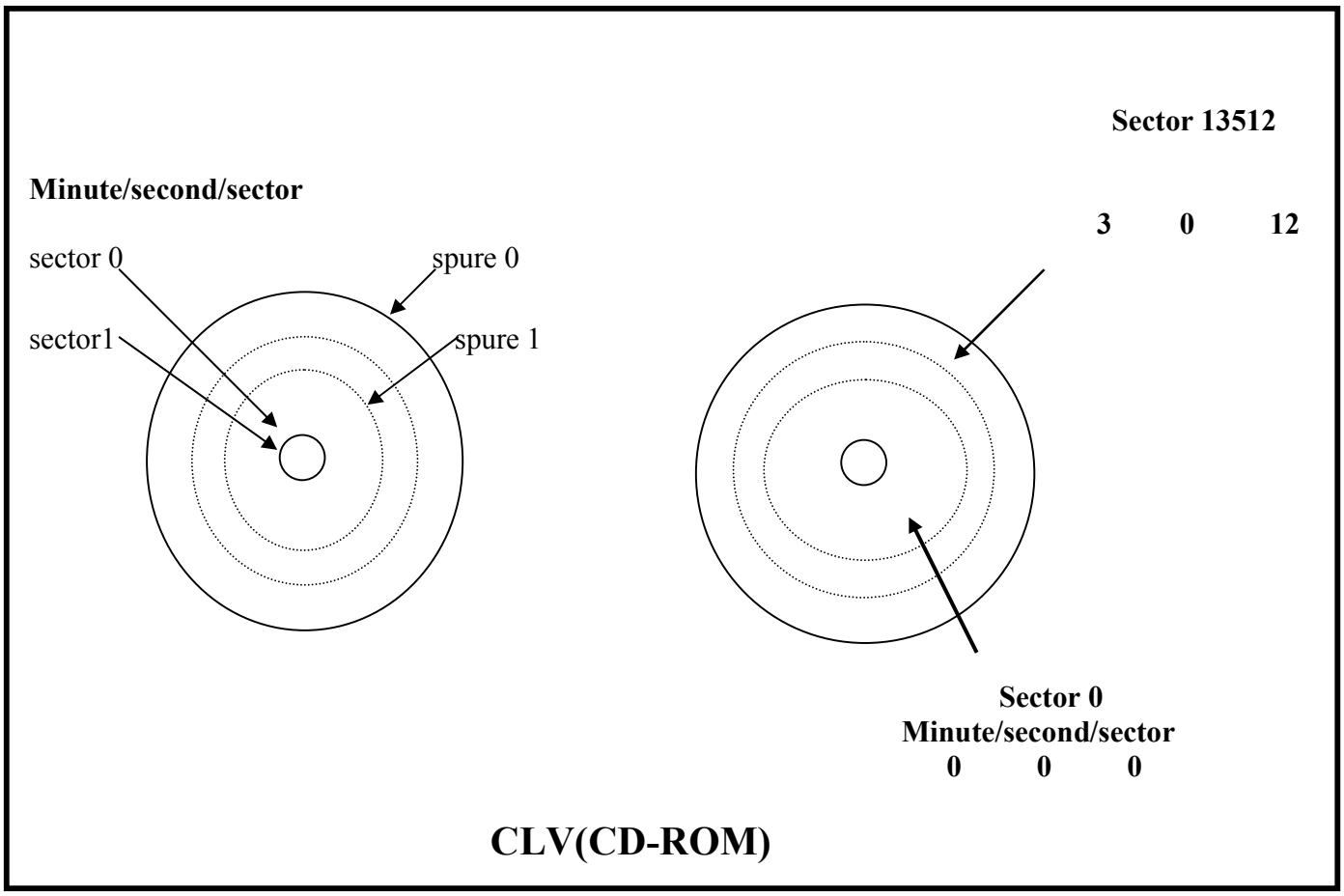
CAV and CLV methods storing data:-

The two methods storing data on rotating mass storage systems are called CAV(Constant Angular Velocity) and CLV((Constant Linear Velocity). Both names refers to the rotation speed of the storage medium.

Hard drives and diskettes that are divided into individual tracks and sectors follow the CAV principle. This is based on constant angular velocity. Regardless of where the read/write head is located above medium the medium always rotates below the read/write head at a constant speed. If the medium, it travels a much shorter course than it would over an outer

track. Today's hard drives take advantage of this factor by packing more sectors into the larger areas of the outer tracks.

Perhaps the most important difference between the CAV method and the CLV procedure is the rotation speed. The rotation aped of the medium doesn't change with CAV. This is true regardless of the read/write head location. The opposite is true with the CLV method used by CD's. the read/write head for CLV always travels a constant distance in a specific unit of time regardless of whether the head is at the inner or outer edge of the CD. However, the rotation speed must be changed based on the position of the head (rotation speed= angular velocity).



CLV(CD-ROM)

Therefore, the rotation speed of the drive increases as the head moves from the inner edge of the medium to it outer edge. This one of the reasons why a CD-ROM drive has significantly slower access times than a hard drive. It must constantly change its rotation speed. The time to speed up and to slow down becomes significant. Also, it's much more difficult to find

a sector a long a 3.75 mile long spiral than it is to find the same sector on a medium which is neatly organized into tracks and sector.

Note:-

Storage capacity of CD-ROM is determined by the number of sectors. CD-Rom storage capacity ranges from 500 MB to 680 MB.

High-level-Language(HLL):-

High-Level-programming language is one type of programming language available. The other type of programming language is known as low-level-language or assembly language.

- High level-language is easier to learn and understood than the assembly language, because high level languages uses names and commands the resemble English, while the assembly language uses mnemonic codes.

- Some of the common high-level-language are:

- **Fortran(Formula Translation) for engineers.**
- **COBOL(Common Business Oriented Language) for business programmer's.**
- **Basic (Beginner's All-purpose symbolic Instruction) Code) for engineer's and scientists.**
- **Pascal.**

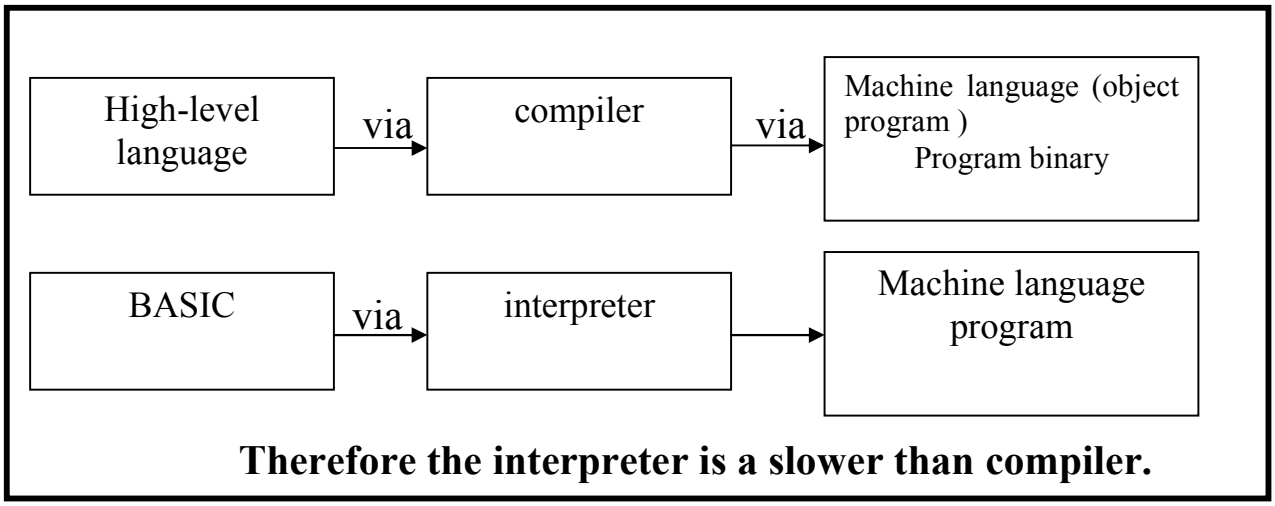
Unlike assembly programs, high-level-languages programs may be used with different makes of computers, while the assembly languages are machine oriented.
Other advantages of high-level-languages are

1) **They are easier to learn than assembly languages.**
2) **They are easier to use for problem solving, than assembly.**
3) **They require less time to write, than assembly.**
4) **They provide better documentation.**
5) **Thy are easier to monition.**

Compiler Translations:-

Naturally, a source program written in a high-level language, must also be translated into a machine usable code, that can be executed by the computer. A translating program that can perform this operation is called" compiler".

The compiler:- converts the entire source high level languages program into a machine language object program, before the program is executed as in FORTRAN.
Another type of translating program called " Interpreter" with the interpreter each statement line is translated and executed immediately(one statement at a time) as with Basic.

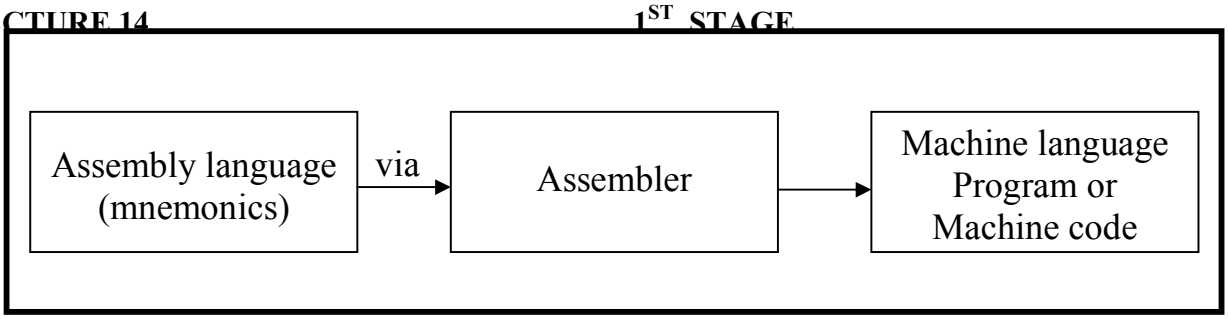


Therefore the interpreter is a slower than compiler.

Assembly language

Assembly language program using instruction abbreviation called mnemonics, such as LD(load), ST(store) and ADD(Add to Accumulator). This is converted to machine language program with a translator called " assembler" .

Assembler:- is a special program that enables assembly language program(some times called source program) into own machine language program(some times called an object code).



Note:- Compilers are similar to assemblers in the fact. That they take the source program and convert(translate) it in to an executable machine language program (object program).

Software

Type of software:-

Software can be divided into two main types:

1- System software.

In general includes all programs designed to help programmers or to control the computer system.

System software includes:

- **Operating system (O.S).**
- **Programming languages(H.L.L&L.L.L).**
- **The language processor translator(interpreter, compiler and Assembler).**
- **Utility (Service) programs.**

2- Application system(software):-

This type of softwares, comprises programs written to performs a specific tasks for the user, and can be divided as:-

- **Application systems:**

  This type of systems are written by a special software houses. e.g. bank systems, salary system, airlines system, information banks.

- **Application programs:**

  This programs direct the computer to accomplish specific activities and it in general small programs and called user programs. e.g. writing a letter using word processor aided design packages.

System software:-

System software has man objectives:-

- **Making it easier for the user to get a job into a computer.**
- **Making it easier for the user to run the job and test it when it is in the computer.**

1- Operating system(O.S):- is asset of inter-related by provided by a computer infect that control the basic operations of the computer(such as loading) and manage the execution of the programs. It also store and retrieves files on disk.

The main parts of an operating system are:

a. Supervisor.
b. Input / output manager.
c. File manager.
d. Command processor.

A. Supervisor: At the heart of all operating systems is the supervisor program, it schedules and coordinates is running. Its supervisor program is loaded in the internal memory, directing and controlling.

B. I/O manager: In general, all data transformed to and form peripheral devices are filtered through the I/O manager. It is insulates the rest of the programs in the computer from the special of the peripheral devices. Foe example the I/O manager might translate the keyboard character codes into the coding system used by the rest of the computer.
With a good O.S, it is possible to add a hard disk or a faster printer to the computer system just by modifying the I/O manager without making any changes to other software).
This is called device independence. An even stronger from of hardware independence, called machine independence (or software portability). Allows application software to be moved from one type of computer system to another without programming changes.

C- File manager:

Any thing on disk is stored in file. Each file has its. Own name and stores one type of information, either program or data. A data file might be a digitized picture, while a program file might be a Basic program or word processor.
Whatever the contents of a file. The file manager takes care of saving, deleting, coping, loading.
As we know data are stored on disks as individual bytes, grouped into sectors, with each sector forming part of a track people think of a data file in logical terms as a letter are stored physically on the disk in tracks and sectors.
The file manager translates between the logical and the physical arrangement of data maintaining a file allocation table (FAT) for each disk.
The file allocation table (FAT) is an index telling where each file is stories.

Another function of the file manager is to format(also called initialize) disk. Formatting a disk involves erasing the disk and giving it an empty file allocation table.
Disk come from the manufacture in blank (or un formatted) condition, files can not be stored on an unformatted disk.
Disk can not be used until it has been formatted, but formatting a disk by mistake erases its content completely.
Therefore formatting should be approached with caution.

e.g. 2.1 hard disk
360 KB 2.88 byte floppy disk

Command processor:-

The command processor communicates between the user and the rest of the operating system. It accepts commands and the user makes sure they are valid, and than takes the appropriate action.

Ex:- **If the ask to copy(file name) and call the new file, the command processor will translate the command and can the request to the file manager. If the disk does not have enough room to store, then the file manager sends a coded error massage, which the command processor might translate to, Insufficient free spare on disk command a aborted.**

Memory Requirements:-

Early 8-bit computer were limited to 64 KB of memory. Every extra byte in the O.S meant there was less room for those microcomputers provided only the bare essentials for controlling the computer.
Most computers must load O.S from the disk into internal memory when they are turned on.
Sequencing the O.S in a small memory is done by breaking the O.S into two pasts, the resident portion and a set of transient utility programs.
The resident part is loaded into memory as soon as the computer is turned on, a process called booting the computer. The resident part always contains the essential routines for controlling the computer and its peripherals.
The essential routines are the operating system supervisor, I/O manager and at least some of the file manager.
The transient utility programs remain on disk until one of the programs is requested.
In some portable computers the entire O.S is permanently stored in Rom. These computers don't to be booted.
Most computers must load a portion of the O.S from the disk into memory. When they are turned on to they immediately look for a system disk(a disk containing the O.S).
If the disk system is not found generally the computer responds with an error massage and unit.
Classification of computer according to system software O.S:-

- **A command line O.S.**
- **A visual O.S.**

Using a command-line operating system :-

When you begin using a personal computer, you will find that the tasks you perform most frequently are

- **Running an application program.**
- **Copying and deleting files and other file operation. This include examing disk to see what is on them and how much space is available.**
- **Formatting new disks, backing up disks, setting the system clock and other maintenance tasks.**

We will explain how to perform these operations on a computer that has a command-line O.S.

A command line O.S accepts command from the keyboard,(i.e) commands are given by typing a line by the user exactly using the key board. Each command is typed anew line. It begins with a keyboard, which is usually a verb such as:

Type, Move, Del(Kill), Normally a keyboard is followed a parameter telling the keyboard what to do.

e.g. a parameter can be a file name.

a key ward and its parameters must be separated by a space.

e.g. The command Del Φ A.B.TXT
keyboard parameter

We will take some examples from a specific operating system. PC-DOS(personal computer disk operating system) which is a slightly modified version of MS-DOS (Microsoft Disk Operating System).

There is another O>S for personal computer known as CP/M(control program for Microcomputer).

All of the version of PC-DOS are up word compatible, in other words, you can upgrade your O.S to the newest version and still use most of the application software written for the older version. Without up word compatibility, up grading to use the new version of the O.S would mean buying a whole newest of application software.

Running programs and giving commands:

When you name a file, you must follow some rigid rules. A file name contains two main parts:
A primary file name, containing one to eight characters and an optical extension with one, two or three characters.
There are some standard conventions for naming files that make it easier to determine what is tored in each file. One convention is that any file ending with extension (xxx.COM) is a machine language programs another is that programs written in Basic end with(xxx.BAS); or written in a Pascal end with (xxx.PAS).
A complete file name begins with the name of the drive storing the file. Disk drives are named by single letter names. On a two-drive floppy disk system the left hand drive is named a and the right hand drive is names B. Thus the file A: MML sys, is store or drive.

Each command begins either with the name of a program file with a keyboard. If it begins with a file name then the O.S loads the file into memory and begins executing the program.

For example, to execute a word in processing program stored on disk as the file named WORD.COM, you type WORD and enter the command by pressing the carriage return key.
If the command begins with a keyboard, then the O.S executes the command. For example, if you type:- Type LETTER.JIM, the file named letter. Jim is displayed on the screen. After completing the command, the O.S shows that it is ready for the next command by displaying a prompt, such as B > or A > . incorrectly typed commands elicit the error massage BAD command or file name; followed by another prompt. Besides that the computer is ready for the next command, the prompt designates the default drive. The default drive is the drive that PC-DOS searches to find a file if it is not told explicitly where the file is stored(the default drive in PC is C:\>).
If the prompt is A > 0 for example, then the PC-DOS will search drive A to find the file named BELL.BAT, but it will search drive B to find the file

B:\>BELL.BAT, you can change the default drive by typing the left of the new default drive followed by a colon.