UNIT I INTRODUCTION

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

GENERATIONS OF COMPUTERS

The Zeroth Generation

The term Zeroth generation is used to refer to the period of development of computing, which predated the commercial production and sale of computer equipment. The period might be dated as extending from the mid-1800s. In particular, this period witnessed the emergence of the first electronics digital computers on the ABC, since it was the first to fully implement the idea of the stored program and serial execution of instructions. The development of EDVAC set the stage for the evolution of commercial computing and operating system software. The hardware component technology of this period was electronic vacuum tubes. The actual operation of these early computers took place without be benefit of an operating system. Early programs were written in machine language and each contained code for initiating operation of the computer itself. This system was clearly inefficient and depended on the varying competencies of the individual programmer as operators.

The First Generation, 1951-1956

The first generation marked the beginning of commercial computing. The first generation was characterized by high-speed vacuum tube as the active component technology. Operation continued without the benefit of an operating system for a time. The mode was called "closed shop" and was characterized by the appearance of hired operators who would select the job to be run, initial program load the system, run the user's program, and then select another job, and so forth. Programs began to be written in higher level, procedure-oriented languages, and thus the operator's routine expanded. The operator now selected a job, ran the translation program to assemble or compile the source program, and combined the translated object program along with any existing library programs that the program might need for input to the linking program, loaded and ran the composite linked program, and then handled the next job in a similar fashion. Application programs were run one at a time, and were translated with absolute computer addresses. There was no provision for moving a program to different location in storage for any reason. Similarly, a program bound to specific devices could not be run at all if any of these devices were busy or broken.

At the same time, the development of programming languages was moving away from the basic machine languages; first to assembly language, and later to procedure oriented languages, the most significant being the development of FORTRAN.

The Second Generation, 1956-1964

The second generation of computer hardware was most notably characterized by transistors replacing vacuum tubes as the hardware component technology. In addition, some very important changes in hardware and software architectures occurred during this period. For the most part,

computer systems remained card and tape-oriented systems. Significant use of random access devices, that is, disks, did not appear until towards the end of the second generation. Program processing was, for the most part, provided by large centralized computers operated under mono-programmed batch processing operating systems.

The most significant innovations addressed the problem of excessive central processor delay due to waiting for input/output operations. Recall that programs were executed by processing the machine instructions in a strictly sequential order. As a result, the CPU, with its high speed electronic component, was often forced to wait for completion of I/O operations which involved mechanical devices (card readers and tape drives) that were order of magnitude slower.

These hardware developments led to enhancements of the operating system. I/O and data channel communication and control became functions of the operating system, both to relieve the application programmer from the difficult details of I/O programming and to protect the integrity of the system to provide improved service to users by segmenting jobs and running shorter jobs first (during "prime time") and relegating longer jobs to lower priority or night time runs. System libraries became more widely available and more comprehensive as new utilities and application software components were available to programmers.

The second generation was a period of intense operating system development. Also it was the period for sequential batch processing. Researchers began to experiment with multiprogramming and multiprocessing.

The Third Generation, 1964-1979

The third generation officially began in April 1964 with IBM's announcement of its System/360 family of computers. Hardware technology began to use integrated circuits (ICs) which yielded significant advantages in both speed and economy. Operating System development continued with the introduction and widespread adoption of multiprogramming. This marked first by the appearance of more sophisticated I/O buffering in the form of spooling operating systems. These systems worked by introducing two new systems programs, a system reader to move input jobs from cards to disk, and a system writer to move job output from disk to printer, tape, or cards. The spooling operating system in fact had multiprogramming since more than one program was resident in main storage at the same time. Later this basic idea of multiprogramming was extended to include more than one active user program in memory at time. To accommodate this extension, both the scheduler and the dispatcher were enhanced. In addition, memory management became more sophisticated in order to assure that the program code for each job or at least that part of the code being executed was resident in main storage. Users shared not only the system' hardware but also its software resources and file system disk space.

The third generation was an exciting time, indeed, for the development of both computer hardware and the accompanying operating system. During this period, the topic of operating systems became, in reality, a major element of the discipline of computing.

The Fourth Generation, 1979 - Present

The fourth generation is characterized by the appearance of the personal computer and the workstation. Miniaturization of electronic circuits and components continued and Large Scale Integration (LSI), the component technology of the third generation, was replaced by Very Large Scale Integration (VLSI), which characterizes the fourth generation. However, improvements in

hardware miniaturization and technology have evolved so fast that we now have inexpensive workstation-class computer capable of supporting multiprogramming and time-sharing. Hence the operating systems that supports today's personal computers and workstations look much like those which were available for the minicomputers of the third generation. Examples are Microsoft's DOS for IBM-compatible personal computers and UNIX for workstation. However, many of these desktop computers are now connected as networked or distributed systems. Computers in a networked system each have their operating system augmented with communication capabilities that enable users to remotely log into any system on the network and transfer information among machines that are connected to the network. The machines that make up distributed system operate as a virtual single processor system from the user's point of view; a central operating system controls and makes transparent the location in the system of the particular processor or processors and file systems that are handling any given program.

CLASSIFICATION OF COMPUTERS

There are four classifications of digital computer systems: super-computer, mainframe computer, minicomputer, and microcomputer.

Super-computers are very fast and powerful machines. Their internal architecture enables them to run at the speed of tens of **MIPS** (Million Instructions per Second). Super-computers are very expensive and for this reason are generally not used for CAD applications. Examples of super-computers are: Cray and CDC Cyber 205.

Mainframe computers are built for general computing, directly serving the needs of business and engineering. Although these computing systems are a step below super-computers, they are still very fast and will process information at about 10 MIPS. Mainframe computing systems are located in a centralized computing center with 20-100+ workstations. This type of computer is still very expensive and is not readily found in architectural/interior design offices.

Minicomputers were developed in the 1960's resulting from advances in microchip technology. Smaller and less expensive than mainframe computers, minicomputers run at several MIPS and can support 5 -20 users. CAD usage throughout the 1960's used minicomputers due to their low cost and high performance. Examples of minicomputers are: DEC PDP, VAX 11.

Microcomputers were invented in the 1970's and were generally used for home computing and dedicated data processing workstations. Advances in technology have improved microcomputer capabilities, resulting in the explosive growth of personal computers in industry. In the 1980's many medium and small design firms were finally introduced to CAD as a direct result of the low cost and availability of microcomputers. Examples are: IBM, Compaq, Dell, Gateway, and Apple Macintosh.

The average computer user today uses a microcomputer. These types of computers include PC's, laptops, notebooks, and hand-held computers such as Palm Pilots.

Larger computers fall into a mini-or mainframe category. A mini-computer is 3-25 times faster than a micro. It is physically larger and has a greater storage capacity.

A mainframe is a larger type of computer and is typically 10-100 times faster than the micro. These computers require a controlled environment both for temperature and humidity. Both the

mini and mainframe computers will support more workstations than will a micro. They also cost a great deal more than the micro running into several hundred thousand dollars for the mainframes.

Processors

The term processor is a sub-system of a data processing system which processes received information after it has been encoded into data by the input sub-system. These data are then processed by the processing sub-system before being sent to the output sub-system where they are decoded back into information. However, in common parlance processor is usually referred to the microprocessor, the brains of the modern day computers.

There are two main types of processors: CISC and RISC.

CISC: A **Complex Instruction Set Computer** (CISC) is a microprocessor Instruction Set Architecture (ISA) in which each instruction can indicate several low-level operations, such as a load from memory, an arithmetic operation, and a memory store, all in a single instruction. The term was coined in contrast to Reduced Instruction Set Computer (RISC).

Examples of CISC processors are the VAX, PDP-11, Motorola 68000 family and the Intel x86/Pentium CPUs.

RISC: Reduced Instruction Set Computing (RISC), is a microprocessor CPU design philosophy that favors a smaller and simpler set of instructions that all take about the same amount of time to execute. Most types of modern microprocessors are RISCs, for instance ARM, DEC Alpha, SPARC, MIPS, and PowerPC.

The microprocessor contains the CPU which is made up of three components--the control unit supervises all that is going on in the computer, the arithmetic/logic unit which performs the math and comparison operation, and temporary memory. Because of the progress in developing better microprocessors, computers are continually evolving into faster and better units.

Notebooks

A laptop computer (also known as notebook computer) is a small mobile personal computer, usually weighing around from 1 to 3 kilograms (2 to 7 pounds). Notebooks smaller than an A4 sheet of paper and weighing around 1 kg are sometimes called sub-notebooks and those weighing around 5 kg a desk note (desktop/notebook). Computers larger than PDAs but smaller than notebooks are also sometimes called "palmtops". Laptops usually run on batteries.

Notebook Processor:

A notebook processor is a CPU optimized for notebook computers. All computing devices require a CPU. One of the main characteristics differentiating notebook processors from other CPUs is low-power consumption.

The notebook processor is becoming an increasing important market segment in the semiconductor industry. Notebook computers are an increasingly popular format of the broader category of mobile computers. The objective of a notebook computer is to provide the performance and functionality of a desktop computer in a portable size and weight. Wireless networking and low power consumption are primary consideration in the choice of a notebook processor.

Integrated Components

Unlike a desktop computer, a notebook has most of the components built-in or integrated into the computer. For desktop systems, determining which computer to buy is generally not based on what type of keyboard or mouse that is available. If you don't like the keyboard or mouse, you can always purchase something else. However, in the case of a notebook computer, the size of the keyboard or type of pointing device may be something that you need to consider unless you intend to use a regular mouse or full-sized keyboard. There are some notebooks that have a keyboard that expands when the notebook is opened which is a nice feature if you find the normal keyboard to be too small. Pointing devices vary from a touch pad to a stick within the keyboard to a roller or track-ball. Most notebooks have the video, sound, and speakers integrated into the computer and some notebooks even have a digital camera built-in which is very handy for video conferencing.

BOOTING:

In computing, booting is a bootstrapping process that starts operating systems when the user turns on a computer system. A boot sequence is the set of operations the computer performs when it is switched on which load an operating system.

Everything that happens between the times the computer switched on and it is ready to accept commands/input from the user is known as *booting*.

The process of reading disk blocks from the starting of the system disk (which contains the Operating System) and executing the code within the bootstrap. This will read further information off the disk to bring the whole operating system online.

Device drivers are contained within the bootstrap code that support all the locally attached peripheral devices and if the computer is connected to a network, the operating system will transfer to the Network Operating system for the "client" to log onto a server

The Process of loading a computer memory with instructions needed for the computer to operate. The process and functions that a computer goes through when it first starts up, ending in the proper and complete loading of the Operating System. The sequence of computer operations from power-up until the system is ready for use

COLD BOOTING:

The cold booting is the situation, when all the computer peripherals are OFF and we start the computer by switching ON the power.

WARM BOOTING:

The warm booting is the situation, when we restart the computer by pressing the RESET button and pressing CTRL+ ALT + DEL keys together.

Graphic User Interface (GUI)
A program interface that takes advantage of the computer's graphics capabilities to make the program easier to use. Well-designed graphical user interfaces can free the user from learning complex command languages. On the other hand, many users find that they work more effectively with a command-driven interface, especially if they already know the command language.

BASIC COMPUTER ORGANIZATION:

A standard fully featured desktop configuration has basically four types of featured devices

1. Input Devices   2. Output Devices 3. Memory 4. Storage Devices
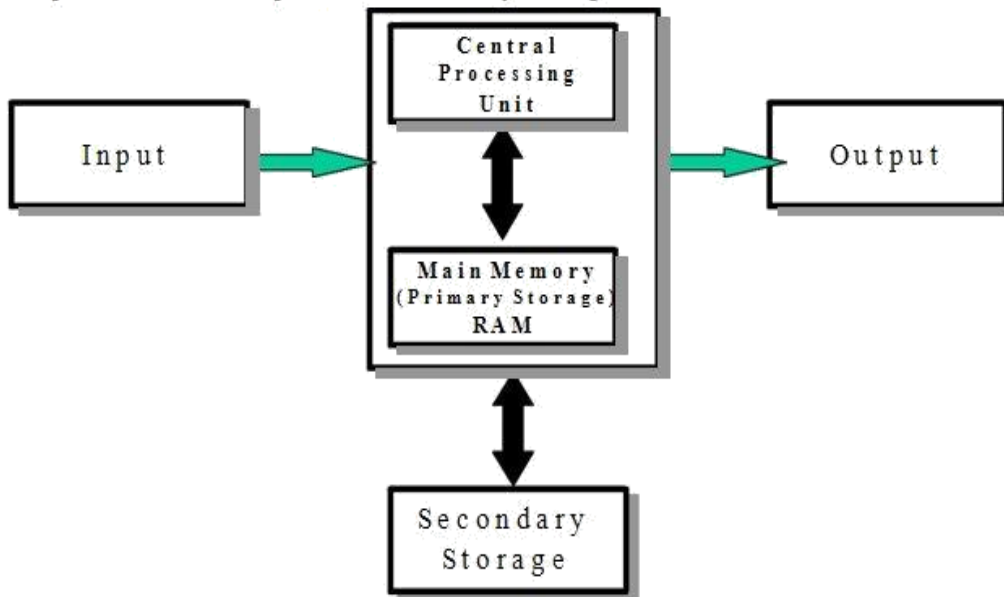
Introduction to CPU

- CPU (Central Processing Unit)
- The Arithmetic / Logic Unit (ALU)
- The Control Unit
- Memory
- Main
- External
- Input / Output Devices
- The System Bus

CPU Operation
The fundamental operation of most CPUs
- To execute a sequence of stored instructions called a program.
- The program is represented by a series of numbers that are kept in some kind of computer memory.
- There are four steps that nearly all CPUs use in their operation: fetch, decode, execute, and write back.
- **Fetch:**
  1. Retrieving an instruction from program memory.
  2. The location in program memory is determined by a program counter (PC)
  3. After an instruction is fetched, the PC is incremented by the length of the instruction word in terms of memory units.
- **Decode :**
  o The instruction is broken up into parts that have significance to other portions of the CPU.
  o The way in which the numerical instruction value is interpreted is defined by the CPU's instruction set architecture (ISA).
  o Opcode, indicates which operation to perform.

- o The remaining parts of the number usually provide information required for that instruction, such as operands for an addition operation.
- o Such operands may be given as a constant value or as a place to locate a value: a register or a memory address, as determined by some addressing mode.
  - ▪ **Execute :**
    - o During this step, various portions of the CPU are connected so they can perform the desired operation.
    - o If, for instance, an addition operation was requested, an arithmetic logic unit (ALU) will be connected to a set of inputs and a set of outputs.
    - o The inputs provide the numbers to be added, and the outputs will contain the final sum.
    - o If the addition operation produces a result too large for the CPU to handle, an arithmetic overflow flag in a flags register may also be set.
  - ▪ **Write back :**
    - o Simply "writes back" the results of the execute step to some form of memory.
    - o Very often the results are written to some internal CPU register for quick access by subsequent instructions.
    - o In other cases results may be written to slower, but cheaper and larger, main memory.
    - o Some types of instructions manipulate the program counter rather than directly produce result data.

Input Devices

Anything that feeds the data into the computer. This data can be in alpha-numeric form which needs to be keyed-in or in its very basic natural form i.e. hear, smell, touch, see; taste & the sixth sense …feel?

Typical input devices are:		
1. Keyboard	2.	Mouse
3. Joystick	4.	Digitizing Tablet
5. Touch Sensitive Screen	6.	Light Pen
		Digital Stills
7. Space Mouse	8.	Camera
		Optical Mark
9. Magnetic Ink Character	10.	Reader
Recognition (MICR)		(OMR)
11. Image Scanner	12.	Bar Codes
13. Magnetic Reader	14.	Smart Cards
15. Voice Data Entry	16.	Sound Capture
17. Video Capture		

The **Keyboard** is the standard data input and operator control device for a computer. It consists of the standard QWERTY layout with a numeric keypad and additional function keys for control purposes.

The Mouse is a popular input device. You move it across the desk and its movement is shown on the screen by a marker known as a 'cursor'. You will need to click the buttons at the top of the mouse to select an option.

Track ball looks like a mouse, as the roller is on the top with selection buttons on the side. It is also a pointing device used to move the cursor and works like a mouse. For moving the cursor in a particular direction, the user spins the ball in that direction. It is sometimes considered better than a mouse, because it requires little arm movement and less desktop space. It is generally used with Portable computers.

Magnetic Ink Character Recognition (MICR) is used to recognize the magnetically charged characters, mainly found on bank cheques. The magnetically charged characters are written by special ink called magnetic ink. MICR device reads the patterns of these characters and compares them with special patterns stored in memory. Using MICR device, a large volume of cheques can be processed in a day. MICR is widely used by the banking industry for the processing of cheques.

The **joystick** is a rotary lever. Similar to an aircraft's control stick, it enables you to move within the screen's environment, and is widely used in the computer games industry.

A **Digitising Tablet** is a pointing device that facilitates the accurate input of drawings and designs. A drawing can be placed directly on the tablet, and the user traces outlines or inputs coordinate positions with a hand-held stylus.

A **Touch Sensitive Screen** is a pointing device that enables the user to interact with the computer by touching the screen. There are three types of Touch Screens: *pressure-sensitive, capacitive surface and light beam.*

A **Light Pen** is a pointing device shaped like a pen and is connected to a VDU. The tip of the light pen contains a light-sensitive element which, when placed against the screen, detects the light from the screen enabling the computer to identify the location of the pen on the screen. Light pens have the advantage of 'drawing' directly onto the screen, but this can become uncomfortable, and they are not as accurate as digitising tablets.

The **Space mouse** is different from a normal mouse as it has an X axis, a Y axis and a Z axis. It can be used for developing and moving around 3-D environments.

Digital Stills Cameras capture an image which is stored in memory within the camera. When the memory is full it can be erased and further images captured. The digital images can then be downloaded from the camera to a computer where they can be displayed, manipulated or printed.

The **Optical Mark Reader (OMR)** can read information in the form of numbers or letters and put it into the computer. The marks have to be precisely located as in multiple choice test papers.

Scanners allow information such as a photo or text to be input into a computer. Scanners are usually either A4 size (flatbed), or hand-held to scan a much smaller area. If text is to be scanned, you would use an Optical Character Recognition (OCR) program to recognise the printed text and then convert it to a digital text file that can be accessed using a computer.

A **Bar Code** is a pattern printed in lines of differing thickness. The system gives fast and error-free entry of information into the computer. You might have seen bar codes on goods in supermarkets, in libraries and on magazines. Bar codes provide a quick method of recording the sale of items.

Card Reader This input device reads a **magnetic strip** on a card. Handy for security reasons, it provides quick identification of the card's owner. This method is used to run bank cash points or to provide quick identification of people entering buildings.

Smart Card This input device stores data in **a microprocessor embedded in the card**. This allows information, which can be updated, to be stored on the card. This method is used in store cards which accumulate points for the purchaser, and to store phone numbers for cellular phones.

Output Devices

Output devices display information in a way that you can you can understand. The most common output device is a monitor. It looks a lot a like a TV and houses the computer screen. The monitor allows you to 'see' what you and the computer are doing together.

Brief of Output Device

Output devices are pieces of equipment that are used to get information or any other response out from computer. These devices display information that has been held or generated within a computer. Output devices display information in a way that you can understand. The most common output device is a monitor.

Types of Output Device

Printing: Plotter, Printer
Sound :   Speakers
Visual :   Monitor

A **Printer** is another common part of a computer system. It takes what you see on the computer screen and prints it on paper. There are two types of printers; Impact Printers and Non-Impact Printers.

Speakers are output devices that allow you to hear sound from your computer. Computer speakers are just like stereo speakers. There are usually two of them and they come in various sizes.

<u>Memory or Primary Storage</u>

Purpose of Storage

The fundamental components of a general-purpose computer are arithmetic and logic unit, control circuitry, storage space, and input/output devices. If storage was removed, the device we had would be a simple calculator instead of a computer. The ability to store instructions that form a computer program, and the information that the instructions manipulate is what makes stored program architecture computers versatile.

- **Primary storage**, or **internal memory**, is computer memory that is accessible to the central processing unit of a computer without the use of computer's input/output channels
- Primary storage, also known as main storage or memory, is the main area in a computer in which data is stored for quick access by the computer's processor.

Primary Storage

Primary storage is directly connected to the central processing unit of the computer. It must be present for the CPU to function correctly, just as in a biological analogy the lungs must be present (for oxygen storage) for the heart to function (to pump and oxygenate the blood). As shown in the diagram, primary storage typically consists of three kinds of storage:

Processors Register

It is the internal to the central processing unit. Registers contain information that the arithmetic and logic unit needs to carry out the current instruction. They are technically the fastest of all forms of computer storage.

Main memory

It contains the programs that are currently being run and the data the programs are operating on. The arithmetic and logic unit can very quickly transfer information between a processor register and locations in main storage, also known as a "memory addresses". In modern computers, electronic solid-state random access memory is used for main storage, and is directly connected to the CPU via a "memory bus" and a "data bus".

Cache memory

It is a special type of internal memory used by many central processing units to increase their performance or "throughput". Some of the information in the main memory is duplicated in the cache memory, which is slightly slower but of much greater capacity than the processor registers, and faster but much smaller than main memory.

Memory

Memory is often used as a shorter synonym for **Random Access Memory (RAM).** This kind of memory is located on one or more microchips that are physically close to the microprocessor in your computer. Most desktop and notebook computers sold today include at least 512 megabytes of RAM (which is really the minimum to be able to install an operating system). They are upgradeable, so you can add more when your computer runs really slowly.

The more RAM you have, the less frequently the computer has to access instructions and data from the more slowly accessed hard disk form of storage. Memory should be distinguished from storage, or the physical medium that holds the much larger amounts of data that won't fit into RAM and may not be immediately needed there.

Storage devices include hard disks, floppy disks, CDROMs, and tape backup systems. The terms auxiliary storage, auxiliary memory, and secondary memory have also been used for this kind of data repository.

RAM is temporary memory and is erased when you turn off your computer, so remember to save your work to a permanent form of storage space like those mentioned above before exiting programs or turning off your computer.

TYPES OF RAM:

There are two types of RAM used in PCs - Dynamic and Static RAM.

Dynamic RAM (DRAM): The information stored in Dynamic RAM has to be refreshed after every few milliseconds otherwise it will get erased. DRAM has higher storage capacity and is cheaper than Static RAM.

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Static RAM (SRAM): The information stored in Static RAM need not be refreshed, but it remains stable as long as power supply is provided. SRAM is costlier but has higher speed than DRAM.

Additional kinds of integrated and quickly accessible memory are **Read Only Memory (ROM),** Programmable ROM (PROM), and Erasable Programmable ROM (EPROM). These are used to keep special programs and data, such as the BIOS, that need to be in your computer all the time. ROM is "built -in" computer memory containing data that normally can only be read, not written to (hence the name read only).

ROM contains the programming that allows your computer to be "booted up" or regenerated each time you turn it on. Unlike a computer's random access memory (RAM), the data in ROM is not lost when the computer power is turned off. The ROM is sustained by a small long life battery in your computer called the CMOS battery. If you ever do the hardware setup procedure with your computer, you effectively will be writing to ROM. It is non volatile, but not suited to storage of large quantities of data because it is expensive to produce. Typically, ROM must also be completely erased before it can be rewritten,

PROM (Programmable Read Only Memory)

A variation of the ROM chip is programmable read only memory. PROM can be programmed to record information using a facility known as PROM-programmer. However once the chip has been programmed the recorded information cannot be changed, i.e. the PROM becomes a ROM and the information can only be read.

EPROM (Erasable Programmable Read Only Memory)

As the name suggests the Erasable Programmable Read Only Memory, information can be erased and the chip programmed a new to record different information using a special PROM-Programmer. When EPROM is in use information can only be read and the information remains on the chip until it is erased.

Storage Devices

The purpose of storage in a computer is to hold data or information and get that data to the CPU as quickly as possible when it is needed. Computers use disks for storage: hard disks that are located inside the computer, and floppy or compact disks that are used externally.

- Computers Method of storing data & information for long term basis i.e. even after PC is switched off.
    - It is non – volatile
    - Can be easily removed and moved & attached to some other device
    - Memory capacity can be extended to a greater extent
    - Cheaper than primary memory

Storage Involves Two Processes
        a) Writing data   b)   Reading data

Floppy Disks

The floppy disk drive (**FDD**) was invented at IBM by Alan Shugart in 1967. The first floppy drives used an 8-inch disk (later called a "**diskette**" as it got smaller), which evolved into the 5.25-inch disk that was used on the first IBM Personal Computer in August 1981. The 5.25-inch disk held 360 kilobytes compared to the 1.44 megabyte capacity of today's 3.5-inch diskette.

The 5.25-inch disks were dubbed "**floppy**" because the diskette packaging was a very **flexible plastic envelope**, unlike the rigid case used to hold today's 3.5-inch diskettes.

By the mid-1980s, the improved designs of the read/write heads, along with improvements in the magnetic recording media, led to the less-flexible, 3.5-inch, 1.44-megabyte (MB) capacity FDD in use today. For a few years, computers had both FDD sizes (3.5-inch and 5.25-inch). But by the mid-1990s, the 5.25-inch version had fallen out of popularity, partly because the diskette's recording surface could easily become contaminated by fingerprints through the open access area.

When you look at a floppy disk, you'll see a plastic case that measures 3 1/2 by 5 inches. Inside that case is a very thin piece of plastic that is coated with microscopic iron particles. This disk is much like the tape inside a video or audio cassette. Basically, a floppy disk drive reads and writes data to a small, circular piece of metal-coated plastic similar to audio cassette tape.

At one end of it is a small metal cover with a rectangular hole in it. That cover can be moved aside to show the flexible disk inside. But never touch the inner disk - you could damage the data that is stored on it. On one side of the floppy disk is a place for a label. On the other side is a silver circle with two holes in it. When the disk is inserted into the disk drive, the drive hooks into those holes to spin the circle. This causes the disk inside to spin at about 300 rpm! At the same time, the silver metal cover on the end is pushed aside so that the head in the disk drive can read and write to the disk.

Floppy disks are the smallest type of storage, holding only 1.44MB.

3.5-inch Diskettes (Floppy Disks) features:

- Spin rate: app. 300 revolutions per minute (rpm)
- High density (HD) disks more common today than older, double density (DD)
- disks Storage Capacity of HD disks is 1.44 MB

Floppy Disk Drive Terminology

- **Floppy disk** - Also called diskette. The common size is 3.5 inches.
- **Floppy disk drive** - The electromechanical device that reads and writes floppy disks.
- **Track** - Concentric ring of data on a side of a disk.
- **Sector** - A subset of a track, similar to wedge or a slice of pie.

It consists of a read/write head and a motor rotating the disk at a high speed of about 300 rotations per minute. It can be fitted inside the cabinet of the computer and from outside, the slit where the disk is to be inserted, is visible. When the disk drive is closed after inserting the floppy inside, the monitor catches the disk through the Central of Disk hub, and then it starts rotating.

There are two read/write heads depending upon the floppy being one sided or two sided. The head consists of a read/write coil wound on a ring of magnetic material. During write operation, when the current passes in one direction, through the coil, the disk surface touching the head is magnetized in one direction. For reading the data, the procedure is reverse. I.e. the magnetized spots on the disk touching the read/write head induce the electronic pulses, which are sent to CPU.

The major parts of a FDD include:

- **Read/Write Heads**: Located on both sides of a diskette, they move together on the same assembly. The heads are not directly opposite each other in an effort to prevent interaction between write operations on each of the two media surfaces. The same head is used for reading and writing, while a second, wider head is used for erasing a track just prior to it being written. This allows the data to be written on a wider "clean slate," without interfering with the analog data on an adjacent track.
- **Drive Motor**: A very small spindle motor engages the metal hub at the center of the diskette, spinning it at either 300 or 360 rotations per minute (RPM).
- **Stepper Motor**: This motor makes a precise number of stepped revolutions to move the read/write head assembly to the proper track position. The read/write head assembly is fastened to the stepper motor shaft.

- **Mechanical Frame**: A system of levers that opens the little protective window on the diskette to allow the read/write heads to touch the dual-sided diskette media. An external button allows the
  diskette to be ejected, at which point the spring-loaded protective window on the diskette closes.
  - **Circuit Board**: Contains all of the electronics to handle the data read from or written to the
    diskette. It also controls the stepper-motor control circuits used to move the read/write heads to
    each track, as well as the movement of the read/write heads toward the diskette surface.

Electronic optics check for the presence of an opening in the lower corner of a 3.5-inch

diskette (or a notch in the side of a 5.25-inch diskette) to see if the user wants to prevent

data from being written on it.

Hard Disks

Your computer uses two types of memory: primary memory which is stored on chips located on the motherboard, and secondary memory that is stored in the hard drive. Primary memory

holds all of the essential memory that tells your computer how to be a computer. Secondary memory holds the information that you store in the computer.

Inside the hard disk drive case you will find circular disks that are made from polished steel. On the disks, there are many tracks or cylinders. Within the hard drive, an electronic reading/writing device called the head passes back and forth over the cylinders, reading information from the disk or writing information to it. Hard drives spin at 3600 or more rpm (Revolutions Per Minute) - that means that in one minute, the hard drive spins around over 7200 times!

Optical Storage

- Compact Disk Read-Only Memory (CD-ROM)
- CD-Recordable (CD-R)/CD-Rewritable (CD-RW)
- Digital Video Disk Read-Only Memory (DVD-ROM)
- DVD Recordable (DVD-R/DVD Rewritable (DVD-RW)
- Photo CD

Optical Storage Devices Data is stored on a reflective surface so it can be read by a beam of laser light. Two Kinds of Optical Storage Devices

- CD-ROM (compact disk read-only memory)
- DVD-ROM (digital video disk read-only memory)

Compact Disks

Instead of electromagnetism, CDs use pits (microscopic indentations) and lands (flat surfaces) to store information much the same way floppies and hard disks use magnetic and non-magnetic storage. Inside the CD-Rom is a laser that reflects light off of the surface of the disk to an electric eye. The pattern of reflected light (pit) and no reflected light (land) creates a code that represents data.

CDs usually store about 650MB. This is quite a bit more than the 1.44MB that a floppy disk stores. A DVD or Digital Video Disk holds even more information than a CD, because the DVD can store information on two levels, in smaller pits or sometimes on both sides.

Recordable Optical Technologies

- CD-Recordable (CD-R)
- CD-Rewritable (CD-RW)
- PhotoCD
- DVD-Recordable (DVD-R)
- DVD-RAM

CD ROM - Compact Disc Read Only Memory.
Unlike magnetic storage device which store data on multiple concentric tracks, all CD formats store data on one physical track, which spirals continuously from the center to the outer edge of the recording area. Data resides on the thin aluminum substrate immediately beneath the label.

The data on the CD is recorded as a series of microscopic pits and lands physically embossed on an aluminum substrate. Optical drives use a low power laser to read data from those discs without physical contact between the head and the disc which contributes to the high reliability and permanence of storage device.

To write the data on a CD a higher power laser are used to record the data on a CD. It creates the pits and land on aluminum substrate. The data is stored permanently on the disc. These types of discs are called as WORM (Write Once Read Many). Data written to CD cannot subsequently be deleted or overwritten which can be classified as advantage or disadvantage depending upon the requirement of the user. However if the CD is partially filled then the more data can be added to it later on till it is full. CDs are usually cheap and cost effective in terms of storage capacity and transferring the data.

The CD's were further developed where the data could be deleted and re written. These types of CDs are called as CD Rewritable. These types of discs can be used by deleting the data and making the space for new data. These CD's can be written and rewritten at least 1000 times.

CD ROM Drive

CD ROM drives are so well standardized and have become so ubiquitous that many treat them as commodity items. Although CD ROM drives differ in reliability, which standards they support and numerous other respects, there are two important performance measures.

- ✓ Data transfer rate
- ✓ Average access

Data transfer rate: Data transfer rate means how fast the drive delivers sequential data to the interface. This rate is determined by drive rotation speed, and is rated by a number followed by 'X'. All the other things equal, a 32X drive delivers data twice the speed of a 16X drive. Fast data transfer rate is most important when the drive is used to transfer the large file or many sequential smaller files. For example: Gaming video.

CD ROM drive transfers the data at some integer multiple of this basic 150 KB/s 1X rate. Rather than designating drives by actual KB/s output drive manufacturers use a multiple of the standard 1X rate. For example: a 12X drive transfer data at (12*150KB/s) 1800 KB/s and so on.

The data on a CD is saved on tracks, which spirals from the center of the CD to outer edge. The portions of the tracks towards center are shorter than those towards the edge. Moving the data under the head at a constant rate requires spinning the disc faster as the head moves from the center where there is less data per revolution to the edge where there is more data. Hence the rotation rate of the disc changes as it progresses from inner to outer portions of the disc.

CD Writers
CD recordable and CD rewritable drives are collectively called as CD writers or CD burners. They are essentially CD ROM drives with one difference. They have a more powerful laser that, in addition to reading discs, can record data to special CD media.

Pen Drives / Flash Drives
- Pen Drives / Flash Drives are flash memory storage devices.
- They are faster, portable and have a capability of storing large data.
- It consists of a small printed circuit board with a LED encased in a robust plastic.
- The male type connector is used to connect to the host PC
- They are also used a MP3 players

Printers

Printers are hardware devices that allow you to create a hard copy of a file. Today a printer is a necessary requirement for any home user and business. Allowing individuals to save their work in the format of paper instead of electronically.

Types of Printers

- **Impact printers**
  - In case of Impact printer an inked ribbon exists between the print head and paper ,the head striking the ribbon prints the character.
- **Non Impact Printers**
  - Non Impact printers use techniques other than the mechanical method of head striking the ribbon

Impact printers

Impact printers are basically divided into 2 types
- Serial/Character printers
  - Dot matrix printers
- Daisy wheel printers
  - Line Printers

Non-Impact Printers

Non Impact Printers are divided into 3 categories
- Thermal printers
- Ink jet printers
- Laser printers

Classification
Printers are classified by the following characteristics:

Quality of type: The output produced by printers is said to be either *letter quality* (as good as a typewriter), *near letter quality*, or *draft quality*. Only daisy-wheel, ink-jet, and laser printers produce letter-quality type. Some dot-matrix printers claim letter-quality print, but if you look closely, you can see the difference.

Speed: Measured in characters per second (cps) or pages per minute (ppm), the speed of printers varies widely. Daisy-wheel printers tend to be the slowest, printing about 30 cps. Line printers are fastest (up to 3,000 lines per minute). Dot-matrix printers can print up to 500 cps, and laser printers range from about 4 to 20 text pages per minute.

Impact or non-impact: Impact printers include all printers that work by striking an ink ribbon. Daisy-wheel, dot-matrix, and line printers are impact printers. Non-impact printers include laser printers and ink -jet printers. The important difference between impact and non-impact printers is that impact printers are much noisier.

Graphics: Some printers (daisy-wheel and line printers) can print only text. Other printers can print both text and graphics.

Fonts: Some printers, notably dot-matrix printers, are limited to one or a few fonts. In contrast, laser and ink-jet printers are capable of printing an almost unlimited variety of fonts. Daisy-wheel printers can also print different fonts, but you need to change the daisy wheel, making it difficult to mix fonts in the same document.

Dot Matrix Printers

A dot matrix printer or impact matrix printer refers to a type of computer printer with a print head that runs back and forth on the page and prints by impact, striking an ink-soaked cloth ribbon against the paper, much like a typewriter. Unlike a typewriter or daisy wheel printer, letters are

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drawn out of a dot matrix, and thus, varied fonts and arbitrary graphics can be produced. Because the printing involves mechanical pressure, these printers can create carbon copies and carbonless copies. The standard of print obtained is poor. These printers are cheap to run and relatively fast.

The moving portion of the printer is called the print head, and prints one line of text at a time. Most dot matrix printers have a single vertical line of dot-making equipment on their print heads; others have a few interleaved rows in order to improve dot density. The print head consists of 9 or 24 pins each can move freely within the tube; more the number of pins better are the quality of output. Dot Matrix Printer Characters are formed from a matrix of dots.

The speed is usually 30 - 550 characters per second (cps). These types of printers can print graphs also. They can only print text and graphics, with limited color performance. Impact printers have one of the lowest printing costs per page. These machines can be highly durable, but eventually wear out. Ink invades the guide plate of the print head, causing grit to adhere to it; this grit slowly causes the channels in the guide plate to wear from circles into ovals or slots, providing less and less accurate guidance to the printing wires. After about a million characters, even with tungsten blocks and titanium pawls, the printing becomes too unclear to read.

Daisy Wheel Printer

A daisy wheel printer is a type of computer printer that produces high-quality type, and is often referred to as a letter-quality printer (this in contrast to high-quality dot-matrix printers, capable of near-letter-quality, or NLQ, output). There were also, and still are daisy wheel typewriters, based on the same principle. The DWP is slower the speed range is in 30 to 80 CPS.

The system used a small wheel with each letter printed on it in raised metal or plastic. The printer turns the wheel to line up the proper letter under a single pawl which then strikes the back of the letter and drives it into the paper. In many respects the daisy wheel is similar to a standard typewriter in the way it forms its letters on the page, differing only in the details of the mechanism (daisy wheel vs typebars or the type ball used on IBMs electric typewriters).

Daisy wheel printers were fairly common in the 1980s, but were always less popular than dot matrix printers (ballistic wire printers) due to the latter's ability to print graphics and different fonts. With the introduction of high quality laser printers and inkjet printers in the later 1980s daisy wheel systems quickly disappeared but for the small remaining typewriter market.

Line Printer

The **line printer** is a form of high speed impact printer in which a line of type is printed at a time. The wheels spin at high speed and paper and an inked ribbon are stepped (moved) past the print position. As the desired character for each column passes the print position, a hammer strikes the paper and ribbon causing the desired character to be recorded on the continuous paper. The speed is 300 to 2500 lines per minute (LPM). This technology is still in use in a number of applications. It is usually both faster and less expensive (in total ownership) than laser printers. In printing box labels, medium volume accounting and other large business applications, line printers remain in use

Line printers, as the name implies, print an entire line of text at a time. Two principle designs existed. In *drum printers*, a drum carries the entire character set of the printer repeated in each column that is to be printed. In *chain printers* (also known as *train printers*), the character set is arranged multiple times around a chain that travels horizontally pas the print line. In either case, to print a line, precisely timed hammers strike against the back of the paper at the exact moment that the correct character to be printed is passing in front of the paper. The paper presses forward against a ribbon which then presses against the character form and the impression of the character form is printed onto the paper.

These printers were the fastest of all impact printers and were used for bulk printing in large computer centers. They were virtually never used with personal computers and have now been partly replaced by high-speed laser printers.

Thermal Printers

Direct thermal printers create an image by selectively heating coated paper when the paper passes over the thermal print head. The coating turns black in the areas where it is heated, creating the image. More recently, two-color direct thermal printers have been produced, which allow printing of both red (or another color) and black by heating to different temperatures.

Thermal Printer Characters are formed by heated elements being placed in contact with special heat sensitive paper forming darkened dots when the elements reach a critical temperature. A fax machine uses a thermal printer. Thermal printer paper tends to darken over time due to exposure to sunlight and heat. The standard of print produced is poor. Thermal printers are widely used in battery powered equipment such as portable calculators.

Direct thermal printers are increasingly replacing the dot matrix printer for printing cash register receipts, both because of the higher print speed and substantially quieter operation. In addition, direct thermal printing offers the advantage of having only one consumable - the paper itself. Thus, the technology is well-suited to unattended applications like gas pumps, information kiosks, and the like.

Until about 2000, most fax machines used direct thermal printing, though, now, only the cheapest models use it, the rest having switched to either thermal wax transfer, laser, or ink jet printing to allow plain-paper printouts. Historically, direct thermal paper has suffered from such limitations as sensitivity to heat, abrasion (the coating can be fragile), friction (which can cause heat, thus darkening the paper), light (causing it to fade), and water. However, more modern thermal coating formulations have resulted in exceptional image stability, with text remaining legible for an estimated 50+ years.

Ink-Jet Printers

Inkjet printers spray very small, precise amounts (usually a few picolitres) of ink onto the media. They are the most common type of computer printer for the general consumer due to their low cost, high quality of output, capability of printing in vivid color, and ease of use. It is the most common printer used with home computers and it can print in either black and white or color.

Compared to earlier consumer-oriented printers, ink jets have a number of advantages. They are quieter in operation than impact dot matrix or daisywheel printers. They can print finer, smoother details through higher print head resolution, and many ink jets with photorealistic-quality color printing are widely available. For color applications including photo printing, ink jet methods are dominant.

Laser Printers

A laser printer is a common type of computer printer that produces high quality printing, and is able to produce both text and graphics. The process is very similar to the type of dry process photocopier first produced by Xerox.

Laser Printers use a laser beam and dry powdered ink to produce a fine dot matrix pattern. This method of printing can generate about 4 pages of A4 paper per minute. The standard of print is very good and laser printers can also produce very good quality printed graphic images too.

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SCANNERS:

Technology today is rising to it's heights. For time saving and to have paperless offices we have a need of electronic version of invoice, Material ordering forms, Contract ordering data etc…for filing and database management. Even to automate the process of logging sales data into Excel, a scanner can help one with all of these tasks and more.

A scanner is an optical device that captures images, objects, and documents into a digital format. The image is read as thousands of individual dots, or pixels. It can convert a picture into digital bits of information which are then reassembled by the computer with the help of scanning software. The file of the image can then be enlarged or reduced, stored in a database, or transferred into a word processing or spreadsheet program.

Some of the key considerations for choosing the right scanner for your needs are given below.

 a) How you intend to use the scanner?
 b) Which type of scanner fits the exact usage?
 c) Does one require a Black & White or a Colour quality output?
 d) What is the Price and the Software bundles?

Depending upon the usage and the importance of the business if one would like to have quality photographs or other images, than colour quality will be an important characteristic. With both a black and white and a color quality output the bit depth, resolution and dynamic range are essential to selecting the right scanner for ones need.

Scanner Types:
Scanners create a digital reproduction of an image or document and come in a variety of shapes and sizes designed to perform different types of tasks. There are three types of office scanners usually seen in the market and the functions they serve are as follows:

a) Flatbed
The flatbed scanner consists of its own base with a flat piece of glass and cover just as is found on most copiers. The scanning component of flatbeds runs over the length of the image in order to gather data. Flatbeds are useful when a user needs to scan more than single page documents.

Pages from a book, for example, can easily be scanned without having to copy each page individually first.

Scanning objects is also done by flatbeds. By placing a white sheet of paper over a bouquet of flowers a scanner can reproduce what appears to be a stock photo onscreen.

Flatbeds have large footprint and hence take up a lot of desk thus if space is a concern one may go for an alternative.

b) Sheetfed
Sheetfed scanners are only used if one wants to scan for anything other than sheets of paper. The scanning component of a sheetfed is stationary while the document being scanned passes over it's 'eyes' similar to a fax machine. It is so thin just a couple of inches deep, such that it can easily fit between keyboards and monitor.
Sheetfeds usually work best in conjunction with an automatic document feeder for large projects. Pictures and other documents which are smaller than a full page can also be

scanned using a sheetfed scanner. They have been known to bend pictures and reproduce less than quality images.

c) Slide

There is a need for accurate reproduce of very small images. For such application the resolution required is very sharp and slide types of scanner create a totally different scanner market. Slides are usually inserted into a tray, much like a CD tray on ones computer, and scanned internally. Most slide scanners can only scan slides, though some newer models can also handle negative strips.

Scanner Uses:

A scanner can do far more than simply scan a photograph, and many of its uses could go a long way to helping a small business. Below are indicated some of the applications for the scanner in a business environment.

1) Graphics

Graphic images are an important part of many businesses specially in marketing and sales functions. Scanners, like digital cameras, enable users to convert photographs, slides, and three-dimensional objects into files that can be pasted into a brochure, inserted into a presentation or posted on the Internet. Using accompanying software, these images can be edited, cropped, or manipulated to fit space and size requirements.

2) Data-Entry

Scanners automatically convert the data into digital files using OCR (Optical Character Recognition) software; this would save time and money which one would pay to someone to manually enter the reams of data into the computer. In conjunction with the software, a scanner reads each page and transfers the text to any number of programs. A form letter can be saved to a word processing program, sales figures to a spreadsheet, even a brochure to web-editing software.

3) Digital-Files

One observes that there are numerous papers filed in three-ring binders or different kinds of manual filing in the offices for records. The process of the manual paper flow can be avoided by using scanners of Digital type. Such scanners can help to create electronic filing cabinets for everything from invoices to expense reports. Forms can be reproduced online, and searchable databases can provide relevant information in seconds.

Pointer:
A symbol that appears on the display screen and that you move to select objects and commands. Usually, the pointer appears as a small angled arrow. Text -processing applications, however, use an I-beam pointer that is shaped like a capital I.
Pointing device:
A device, such as a mouse or trackball that enables you to select objects on the display screen.
Icons:
Small pictures that represent commands, files, or windows. By moving the pointer to the icon and pressing a mouse button, you can execute a command or convert the icon into a window. You can also move the icons around the display screen as if they were real objects on your desk.

Desktop:
The area on the display screen where icons are grouped is often referred to as the desktop because the icons are intended to represent real objects on a real desktop.
Windows:

You can divide the screen into different areas. In each window, you can run a different program or display a different file. You can move windows around the display screen, and change their shape and size at will.

Menus:
Most graphical user interfaces let you execute commands by selecting a choice from a menu.

In addition to their visual components, graphical user interfaces also make it easier to move data from one application to another. A true GUI includes standard formats for representing text and graphics. Because the formats are well-defined, different programs that run under a common GUI can share data. This makes it possible, for example, to copy a graph created by a spreadsheet program into a document created by a word processor.

Character User Interface/Text User Interface (CUI/TUI)
Short for Character User Interface or Command-line User Interface, CUI is another name for a command line. Early user interfaces were CUI. That is they could only display the characters defined in the ASCII set. Examples of this type of interface are the command line interfaces provided with DOS 3.3 and early implementations of UNIX and VMS.

This was limiting, but it was the only choice primarily because of 2 hardware constraints. Early CPUs did not have the processing power to manage a GUI. Also, the video controllers and monitors were unable to display the high resolution necessary to implement a GUI.

FUNCTIONS OF CPU:

Process Management

The CPU executes a large number of programs. While its main concern is the execution of user programs, the CPU is also needed for other system activities. These activities are called processes. A process is a program in execution. Typically, a batch job is a process. A time-shared user program is a process. A system task, such as spooling, is also a process. For now, a process may be considered as a job or a time-shared program, but the concept is actually more general.

In general, a process will need certain resources such as CPU time, memory, files, I/O devices, etc., to accomplish its task. These resources are given to the process when it is created. In addition to the various physical and logical resources that a process obtains when it is created, some initialization data (input) may be passed along.

We emphasize that a program by itself is not a process; a program is a passive entity. It is known that two processes may be associated with the same program; they are nevertheless considered two separate execution sequences.

The operating system is responsible for the following activities in connection with processes managed.
- The creation and deletion of both user and system processes
- The suspension and resumption of processes.
- The provision of mechanisms for process synchronization
- The provision of mechanisms for deadlock handling.

Memory Management

Memory is central to the operation of a modern computer system. Memory is a large array of words or bytes, each with its own address. Interaction is achieved through a sequence of reads or writes of specific memory address. The CPU fetches from and

stores in memory. In order for a program to be executed it must be mapped to absolute addresses and loaded in to memory.

In order to improve both the utilization of CPU and the speed of the computer's response to its users, several processes must be kept in memory.

The operating system is responsible for the following activities in connection with memory management.

- Keep track of which parts of memory are currently being used and by whom.

- Decide which processes are to be loaded into memory when memory space becomes available.
- Allocate and de-allocate memory space as needed.

Secondary Storage Management

The main purpose of a computer system is to execute programs. These programs, together with the data they access, must be in main memory during execution. Since the main memory is too small to permanently accommodate all data and program, the computer system must provide secondary storage to backup main memory. Most modem computer systems use disks as the primary on-line storage of information, of both programs and data.

Most programs, like compilers, assemblers, sort routines, editors, formatters, and so on, are stored on the disk until loaded into memory, and then use the disk as both the source and destination of their processing. Hence the proper management of disk storage is of central importance to a computer system.

There are few alternatives. Magnetic tape systems are generally too slow. In addition, they are limited to sequential access. Thus tapes are more suited for storing infrequently used files, where speed is not a primary concern.

The operating system is responsible for the following activities in connection with disk management:
- Free space management
- Storage allocation
- Disk scheduling.

Input Output System
One of the purposes of an operating system is to hide the peculiarities of specific hardware devices from the user. For example, in UNIX, the peculiarities of Input/Output devices are hidden from the bulk of the operating system itself by the INPUT/OUTPUT system. The Input/Output system consists of:

- A buffer caching system
- A general device driver code
- Drivers for specific hardware devices.

Only the device driver knows the peculiarities of a specific device.

File Management

File management is one of the most visible services of an operating system. Computers can store information in several different physical forms; magnetic tape, disk, and drum are the most common forms. Each of these devices has it own characteristics and physical organization. For convenient use of the computer system, the operating system provides a uniform logical view of information storage. The operating system abstracts from the physical properties of its storage devices to define a logical storage unit, the file. Files are mapped, by the operating system, onto physical devices.

A file is a collection of related information defined by its creator. Commonly, files represent programs (both source and object forms) and data. Data files may be numeric, alphabetic or alphanumeric. Files may be free-form, such as text files, or may be rigidly formatted. In general files are a sequence of bits, bytes, lines or records whose meaning is defined by its creator and user. It is a very general concept. The operating system implements the abstract concept of the file by managing mass storage device, such as tapes and disks. Also files are normally organized into directories to ease their use. Finally, when multiple users have access to files, it may be desirable to control by whom and in what ways files may be accessed.

The operating system is responsible for the following activities in connection with file management:

- The creation and deletion of files

- The creation and deletion of directory

- The support of primitives for manipulating files and directories

- The mapping of files onto disk storage.

- Backup of files on stable (non volatile) storage.

Protection System

The various processes in an operating system must be protected from each other's activities. For that purpose, various mechanisms which can be used to ensure that the files, memory segment, CPU and other resources can be operated on only by those processes that have gained proper authorization from the operating system.

Protection refers to a mechanism for controlling the access of programs, processes, or users to the resources defined by a computer controls to be imposed, together with some means of enforcement. An unprotected resource cannot defend against use (or misuse) by an unauthorized or incompetent user.

Networking

A distributed system is a collection of processors that do not share memory or a clock. Instead, each processor has its own local memory, and the processors communicate with each other through various communication lines, such as high speed buses or telephone lines. Distributed systems vary in size and function. They may involve microprocessors, workstations, minicomputers, and large general purpose computer systems.

The processors in the system are connected through a communication network, which can be configured in the number of different ways. The network may be fully or partially connected. The communication network design must consider routing and connection strategies, and the problems of connection and security. A distributed system provides the user with access to the various resources the system maintains. Access to a shared resource allows computation speed-up, data availability, and reliability.

Command Interpreter System

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One of the most important components of an operating system is its command interpreter. The command interpreter is the primary interface between the user and the rest of the system. Many commands are given to the operating system by control statements. When a new job is started in a batch system or when a user logs-in to a time-shared system, a program which reads and interprets control statements is automatically executed.

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