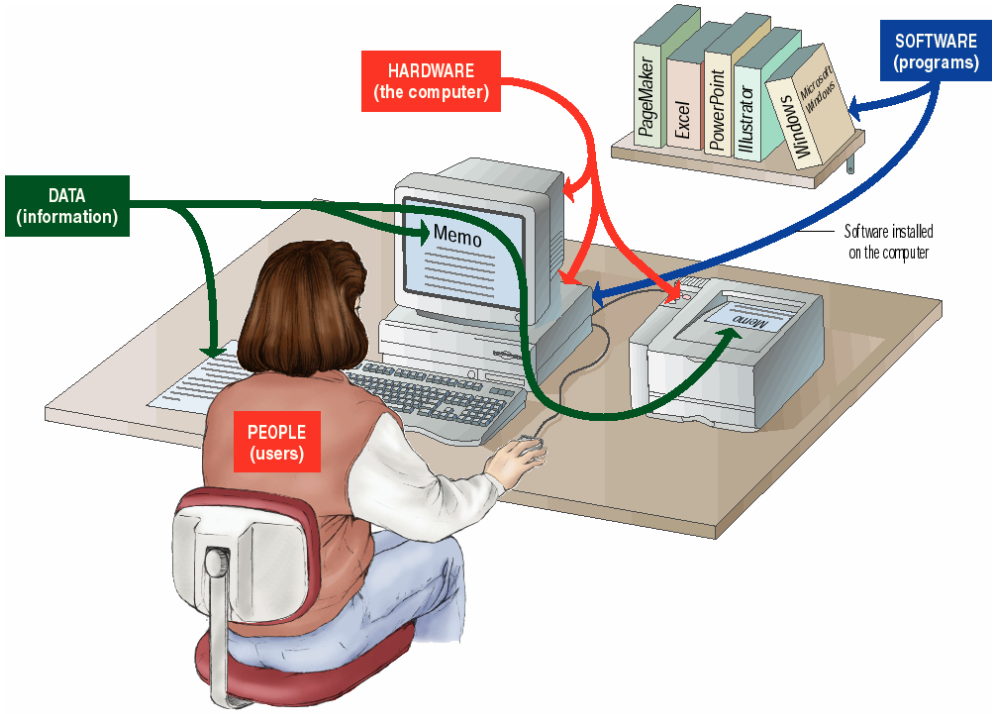
Introduction

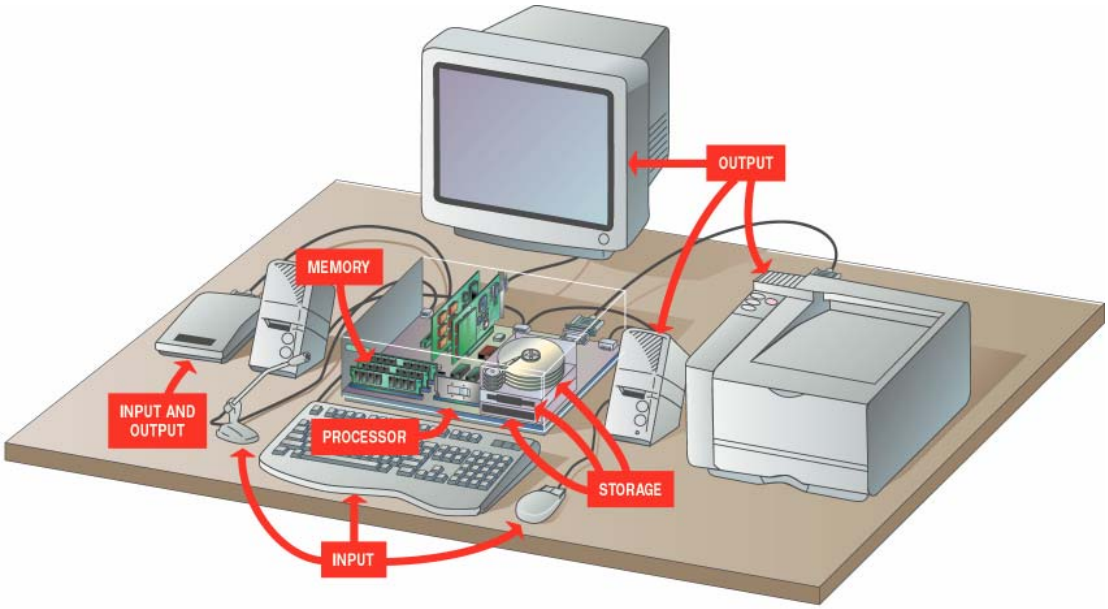
Computer is derived from the Latin word 'Computare' which means 'calculate'. So according to this definition, computer is a machine which can perform calculations at very high speed.

- Basically, computer is defined as programmable machine which computes.
- Computer can be defined as a digital and automatic machine which takes input from the user, process it, stores it if necessary and gives output in the desired form.
- A computer is an electronic device used to process data, converting the data into information that is useful to the people.
- Computer is an electronic machine that can accept data: process it according to a set of predefined instructions and then gives the results.
  The main characteristics of a computer are:
    - It responds to a specific set of instructions in a well-defined manner.
    - It can execute a prerecorded list of instructions (called program).

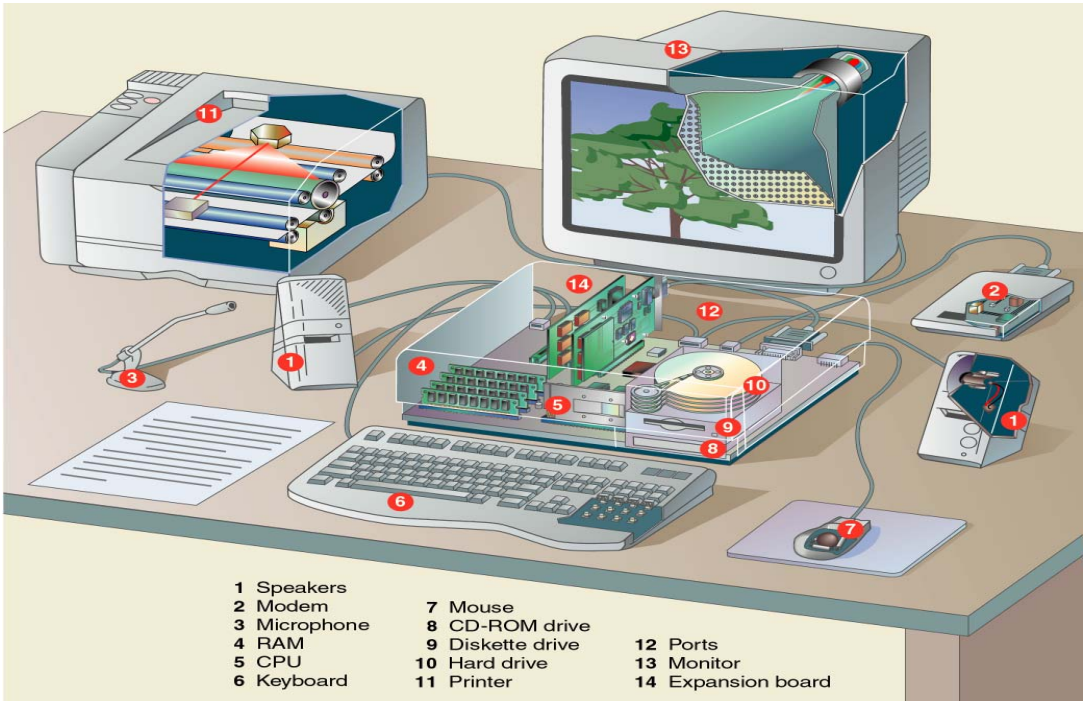


- Computer is a device, which is capable of doing almost all the works which can be programmed by the user.
- Computer can do jobs with 100% accuracy and in a very fast speed in comparison to any other devices or man.
- It is possible to show and do things, which are impossible for a man.
- Computer provides faster and cheaper communication with the use of internet.
- It can perform almost all the works but for that purpose man must provide program and hardware.

Computer System



- The computer system consist of the following five components
  - Processor
  - Memory
  - Input Device
  - Output Device
  - Storage
- The procedure that transforms raw data into useful information is called processing. To perform this transformation, the computer uses two components : the processor and memory
- **Processor** – is the brain of the computer. It organizes and carries out instructions that come from either the user or the software. Microprocessor (chips) which are made up of silicon chips. CPU refers to a computer's processor.
- **Memory** – is like an electronic scratch pad inside the computer. When you launch a program it is loaded into and run from memory. Data used by the program is also loaded into memory for fast access. Common type of memory are RAM(Random Access Memory) and ROM (Read Only Memory)
- Computer would be useless if they did not provide interaction with users.
- **Input devices** – are those devices that accept data and instruction from the user or from another computer system (such as a computer on the internet). Examples are keyboard, mouse, joysticks, touch pads, scanners, digital camera, microphones etc.
- **Output devices** – are those devices that return processed data, back to the user or to another computer system. Examples are monitor, printers, speakers etc.
- **Storage** – is used to hold data. Allows a computer to permanently store large amounts of data. Common mass storage devices are disk drives, CD- drives and tape drives.



Terms used in Computer system

- **Hardware** – The mechanical devices that make up the computer are called hardware. Hardware is any part of the computer that you can touch. Hardware consists of interconnected electronic devices that you can use to control the computer's operation, input and output.
- **Software** – is a set of electronic instructions consisting of complex codes (also known as programs) that make the computer perform tasks. In other word, software tells the computer what to do. Some programs exist primarily for the computer's use and help the computer perform and manage its own tasks. Other types of programs exist primarily for the user and enable the computer to perform tasks.
- **Human ware** – people who operates the computer is known as human ware or users.
- **Firmware** – is a program or information written in ROM permanently by the manufacturer during the manufacturing of computers.
- **Data** – consists of raw facts, which the computer stores and reads in the form of numbers. The computer manipulates data according to the instructions contained in the software and then forwards it for use by people or another computer. Data can consists of letters, numbers, sounds or images however the computer converts it to numbers within the computer, data is organized into files.
- **A computer file** is simply a set of data or program instructions that has been given a name. A file that the user can open and use is often called a documents.
- **Program** – programs are the collection of many commands or instructions together in sequence and in logical way. A program is written for some specific purpose.
- **Information (Solutions)** – it is the collection of data in systematic way, so that it carries specific meaning when presented.

Type Of Computers

Computers can be generally classified by size and power as follows, though there is considerable overlap:

- **Personal computer:** A small, single-user computer based on a microprocessor.
- **Workstation:** A powerful, single-user computer. A workstation is like a personal computer, but it has a more powerful microprocessor and, in general, a higher-quality monitor.
- **Minicomputer:** A multi-user computer capable of supporting up to hundreds of users simultaneously.
- **Mainframe**: A powerful multi-user computer capable of supporting many hundreds or thousands of users simultaneously.
- **Supercomputer:** An extremely fast computer that can perform hundreds of millions of instructions per second.

Characteristics of Computer (Features)

1. **Speed, size and cost**
    - The speed of a computer is directly linked with the technology used to build it.
        - ENIAC → uses vacuum tubes
            - Speeds in milliseconds
            - 150 squares meters
            - Costs millions of dollars
        - Transistor
            - Speeds in microseconds
            - Size and Price are reduced
        - IC (Integrated Circuit)
            - Tens of millions of operations per seconds
            - Size 0.25 square cm
            - The cost was also reduced because of the enhancement in the technology
    - With the development in the computer technology the speed is going on increasing, the size and cost are decreasing.

2. **Accuracy and Reliability**
    - Computer can do a lot of work without any mistake and tiredness
    - The output of the computer is only as reliable as the instructions (the program) used and the data supplied
    - Almost all the computer errors are because of errors in programming or because of invalid data fed to the computer.

3. **Vast Storage Capacity**
   - A computer system can store and retrieve massive amounts of data.
   - Computer's storage can be divided as primary storage and secondary storage.

4. **Automatic**
   - Computer is an automatic machine.
   - Everything that is given to computer are processed and done by computer automatically to the instruction provided.

5. **Diligent**
   - The ability of computer to perform a work repeatedly again and again without getting tired and bored is called diligence.

6. **Versatile**
   - A computer can perform more than one work having different characteristics.

7. **Electronic**
   - Computer totally depends on electricity. All its parts especially memory, processor are electrical devices and most of the computer parts are made up of electronic circuits therefore, computer is a electronic device.

8. **Non – Intelligent**
   - Computer can't do simple of the simple work, if it is not given input in terms of data, instruction or program by the user.

9. **Word Length**
   - A digital computer operates on binary digits – 0 and 1. It can understand information only in binary digits (bits). The number of bits that a computer can process at a time in parallel is called word length. Commonly used word lengths are 8, 16, 32 or 64 bits. Word length is the measure of the computing power of a computer.

Computer Uses:

- Computer are used almost in every field that you can think
- Computer or IT is finding wide applications in industries, hospitals, research labs, offices, domestic gadgets and for personal use.
- Today, computer – based information and control system are performing a variety of important functions in several areas. Such as Business, customer services, education, research, entertainment, government, home, medical, industries, engineering, office automation system, transportation system, etc.

Limitations of computer

The computer can outperform human beings in speed, memory and accuracy but still the computer has limitations. There are following limitations of a computer.

Programmed by human:
Though computer is programmed to work efficiently, fast and accurately but it is programmed by human beings to do so. Without a program, computer is nothing. A program is a set of instructions. Computer only follows these instructions. If the instructions are not accurate the working of computer will not accurate.

Thinking:
The computer can not think itself. The concept of artificial intelligence shows that the computer can think. But still this concept is dependent on set of instructions provided by the human beings.

Self Care:
A Computer can not care itself like a human. A computer is dependent still to human beings for this purpose.

Retrieval of memory:
A computer can retrieve data very fast but this technique is linear. A human being's mind does not follow this rule. A human mind can think randomly which a computer machine can not.

Feelings:
One of the main limits in the computer is of feeling. A computer can not feel about some like a human. A computer can not meet human in respect of relations.

Human can feel, think and caring but a computer machine itself can not.

Chapter 2: Classification Of Digital Computers

Computer Systems are classified as Microcomputers, Minicomputers, Mainframes and Supercomputers.

1. Micro Computer

- Are the smallest computer systems on the basis of size
- Are called micro computer because microprocessor is used as its CPU which are very small
- Are also called PC(Personal Computers) or home computers
- Smallest are laptop, notebook and palmtop computers.
- Examples: IBM Pentium PC, Apple/Macintosh etc

Characteristics:

- Smallest in term of size
- Speed and cost is also less as compared with other super, mainframe and mini computers.
- Since a single user system is used, storage devices and memory are smaller size.

Microcomputers are of two types: Personal Computers and Workstations

1.1 Personal Computers (PCs)

It can be defined as a small, relatively inexpensive computer designed for an individual user. In price, personal computers range anywhere from a few hundred pounds to over five thousand pounds. All are based on the microprocessor technology that enables manufacturers to put an entire CPU on one chip. PCs are used for word processing, accounting, desktop publishing, and for running spreadsheet and database management applications. At home, the most popular use for personal computers is for playing games and recently for surfing the Internet.

Personal computers first appeared in the late 1970s. One of the first and most popular personal computers was the Apple II, introduced in 1977 by Apple Computer. During the late 1970s and early 1980s, new models and competing operating systems seemed to appear daily.

1.2 Workstation

It is a type of computer used for engineering applications, desktop publishing, software development, and other types of applications that require a moderate amount of computing power and relatively high quality graphics capabilities. Workstations generally come with a large, high-resolution graphics screen, at large amount of RAM, built-in network support, and a graphical user interface. The most common operating systems for workstations are UNIX and Windows NT. Like personal computers, most workstations are single-user computers. However, workstations are typically linked together to form a local-area network, although they can also be used as stand-alone systems. The most powerful workstations are called supermicros.

N.B.: In networking, workstation refers to any computer connected to a local-area network. It could be a workstation or a personal computer.

1.3 Portable Computers

Computers are becoming smaller yet more powerful. Portable computer are gaining rapid popularity and can be easily carried around. There are three categories of portable computers viz. **Laptops or Notebook PCs, Subnotebooks and Personal Digital Assisstants.**

Laptop

SubNotebook

PDA

2. Minicomputers

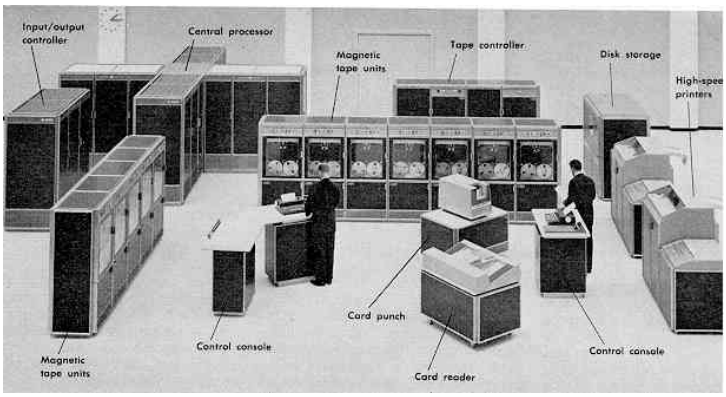
- Are medium sized computers on the basis of size
- A centrally located server or CPU is connected with more than 50 terminals.
- Examples: Prime 9755, Vax 36 etc.

Characteristics:

- Medium size
- More than 50 terminals and large capacity storage devices than micro computers.
- Used for general purpose.
- Used in medium sized organizations and corporation for their database administration.

3. Mainframe Computer

- Are the largest types of computers
- Are used in large organizations like insurance companies, banks where people need frequent access to the same data, which is usually organized into one or more huge databases.



- Examples: IBM 1401, ICL 2950/10 , IBM S/390 etc

Characteristics:

- Very large in size.
- Central processor , central administration
- More than 100 terminals, large capacity storage devices used
- Fastest and more expensive system.
- Used by large agencies and government for large scale data processing.

4. Super Computer

- Are the most sophisticated and powerful computers.
- They are large in size
- These systems are built to process he amount of data and the fastest supercomputer can perform more than 1 trillion calculations per second.
- Some super computers are Cray T90, Super Cray, Cyber 205 and Super SXI.
- These can house thousand of processor
- These speed and power make supercomputers ideal for handling large and highly complex problems that require extreme calculating power.
- Used in weather forecasting, nuclear fusion, study of DNA structures.
- Can cost tens of millions of dollars and consume enough electricity to power dozen of homes.
- They are often housed in protective rooms with special cooling systems, power protection and other security features.
- Because of their size and cost, super computers are relatively rare, used only by large corporations, universities and government agencies that can afford them.
- Super computing resources are often shared to give researchers access to these precious machines.

5. Network Computers

- Is a less power full version of personal computers, with minimal processing power, memory and storage
- Network computers are designed to be connected to a network, a corporate intranet or to the Internet.
- The Network computers relies on the network for software and data storage and many even use the network's server to perform some processing tasks.
- If you want to use only the Internet, for example, or if your job involves data entry, then you may not need the processing power, memory and storage capacity of a fully equipped PC.

A fast simultaneous look to the different categories of computer is as follows.

Type of computer	Word length (bit)	Speed (insth/sec)	Internal memory(KB)
Super computer	64 and above	Above 1,00,00,000	8,000 to 64,000
Mainframe	32 to 64	10,00,000 to 1,00,00,000	2,000 to 16,000
Minicomputer	16 to 32	5,00,000 to 10,00,000	250 to 2,000
Micro computer	8 to 16	80,000 to 1,00,000	32 to 640

Functions and Components of A Computer

A computer does mainly the following functions:

Receive Input: Accept raw data through various input device like keyboard, mouse
Process Information: perform arithmetic and logical operations on any piece of information
Produce Output: Display information through output devices monitor, printer
Store Information: Store information in storage devices like hard disk, CDs for future reference

All the above listed functions are performed smoothly in presence of both the hardware and the software.

Hardware:

Hardware is a general term that refers to the physical, mechanical and electronic artifacts of a technology which can be touched, seen and felt. They are the devices capable of accepting and storing computer data, executing a systematic sequence of operations on computer data, or producing control outputs. Such devices can perform substantial interpretation, computation, communication, control, or other logical functions.

Software:

Software is a general term used to describe a collection of computer programs, procedures and documentation that perform some tasks on a computer system. They are the programs that enable a computer to perform a specific task. This includes application software such as a word processor, which enables a user to perform a task, and system software such as an operating system, which enables other software to run properly, by interfacing with hardware and with other software.

Central Processing Unit (CPU)

A central processing unit (CPU), or sometimes simply processor, is the component in a digital computer that interprets instructions and processes data contained in computer programs. CPUs provide the fundamental digital computer trait of programmability, and are one of the necessary components found in computers of any era, along with primary storage and input/output facilities.

On large machines, CPUs require one or more printed circuit boards. On personal computers and small workstations, the CPU is housed in a single chip called a microprocessor. Since the 1970's the microprocessor class of CPUs has almost completely overtaken all other CPU implementations.

A CPU has two parts – the Control Unit (CU) and the Arithmetic and Logic Unit (ALU)

Control Unit

The control unit tells the computer system how to carry out a program instruction. It is a typical component of the CPU that implements the microprocessor instruction set. It extracts instructions from memory and decodes and executes them, and sends the necessary signals to the ALU to perform the operation needed. Control Units are either hardwired or micro-programmed.

Arithmetic and Logic Unit (ALU)

The arithmetic and logic unit is the part of a computer that performs all arithmetic computations, such as addition, subtraction, multiplication and division. It also performs the logical operations like comparison between data. Besides these operations some processors also supports operations which check if particular bits are on or off.

Memory

Memory, also known as the primary storage, is the storage point in the computers that holds data for processing, instructions for processing the data (the program) and information (processed data). The content of primary memory is volatile and stored until there is a supply of electricity.

Registers

These are the additional memory locations in the CU and ALU to make processing more efficient. They are the special hi-speed storage areas that hold data and instructions temporarily during processing. The important registers within CPU the are, Program Counter (PC) that keeps track of next instruction to be executed and the Instruction Register(IR), which holds instruction to be decoded by the control unit.

Addresses

The characters of data or instructions in the main memory of the computers are stored in certain locations known as the address designated by a unique number. Each cell in memory has an address, which is used to refer to that cell. To get data from memory, a program gives the address of the cell that holds the data. To put data into memory, a program gives the address of the cell which will hold the data.

How do the CPU and memory work?

1. The control unit recognizes that the program has been loaded into memory and begins to execute the first step of the program.
2. The program tell the user to enter the first number.
3. The user enters 10 from the keyboard. An electronic signal is sent to the CPU.
4. The control unit recognizes this signal and routes the signal to a memory address – 7.
5. After completion of the above instruction, the next instruction tells user to enter another number.
6. The user enters 4 from the keyboard. An electronic signal is sent to the CPU.
7. The control unit recognized this signal and routes the signal to a memory address – 8.
8. The next program instruction is executed – Multiply 1st and 2nd numbers.
9. To execute this instruction, the control unit informs the ALU that two numbers are coming and the ALU is to multiply them. The control unit next sends to the ALU a copy of the contents of addresses 7 (10) and 8 (4).
10. ALU performs the multiplication: 10 x 4= 40
11. The control unit sends a copy of the multiplication result (40) back to memory to address 9.
12. The next program instruction is executed: "Print the result"
13. To execute this instruction, the control unit sends the contents of the address 9 (40) to the monitor.
14. Monitor displays the value 40
15. Final Instruction is executed: "End" The program is complete.

Chapter 6: Memory Units

Introduction

Memory units are the internal storage areas in computer. They are the locations which hold actual data and information either for short time temporarily or for long time permanently. The temporary memory is referred to as main memory and the permanent memory is called auxiliary memory. RAM and ROM are the main memory while secondary storage devices like hard disk, floppy disk, CDs, USB are the auxiliary memory.

Main Memory

- is the workspace for the computer's processor
- CPU needs to have millions of bytes of randomly accessed space where it can quickly read or write programs and data while they are being used.
- its storage is considered temporary because the data and programs will remain there only as long as the computer has electrical power or is not reset.

RAM (Random Access Memory)

- It is a volatile memory and holds data on a temporary basis
- When power is turned off its contents are erased.
- RAM holds programs and data which are currently being used.
- We can randomly (and quickly), directly access any location in memory.
- RAM is used to store:
    - Instruction awaiting to be obeyed
    - Instruction currently being obeyed
    - Data currently being processed
    - Data awaiting output.
- RAM can be assumed as the set of boxes, the boxes are numbered from zero upwards so that each box can be identified and located.
- Each bit of semi-conductor memory is represented by a single cell which may be regarded as Microscopic electronic circuits with two distinguishable stages used to represent 0 and 1.

Types of RAM

DRAM and SRAM

DRAM (Dynamic RAM)

- It is dense, meaning that we can pack a lot of bits into a very small chip and it is inexpensive which makes it affordable for large amount of memory.
- DRAM gets its name from the fact that it must be refreshed frequently. (The term refreshing means recharging the RAM chips with electricity.)
- DRAM chips must be recharged many times each second or they will lose their contents.
- The memory cells in a DRAM chip are tiny capacitors that retain a charge to indicate a bit.
- DRAM must be constantly refreshed or the electrical charges in the individual memory capacitors will drain and the data will be lost.
- The charge slowly leaks from the cells and has to be topped up constantly called "Refreshing".

SRAM (Static RAM)

- It does not need the periodic refresh rates like DRAM.
- Due to design of SRAM, not only are refresh rates unnecessary but SRAM is much faster than DRAM.
- Transistors are used instead of capacitors in SRAM.
- Transistors do not loose their charge.
- SRAM is much faster but lower in density and more expensive.
- The lower in density means that SRAM chips are both physically larger and store many less bit overall.
- Much more expensive that DRAM.

ROM (Read Only Memory)

- is a non-volatile type of memory that can permanently or semi permanently hold data
- is called ROM because it is either impossible or needs a special device to write to.
- contents or data in ROM will remain even if power is turned off.
- is an ideal place to put the computer's startup instructions that is , the software that are required to boots the system (are called firm ware)
- otherwise the processor would have no program in memory to execute when it is powered on.

Types of ROM

- PROM
- EPROM
- EEPROM

PROM (Programmable Read Only Memory)

- It is blank when new and must be programmed with what ever data is necessary
- They are technically preloaded with binary 1s.
- 1MB ROM chip would come with about 1 million bit location each containing 1.
- A blank PROM can be programmed, using a special machine called ROM programmer or ROM burner.
- Each binary 1 bit can be thought of as a fuse that is in fact (un burned).
- Most chip run on 5 volts but when we program a PROM we place a higher voltage normally 12 volt at various address with the chip
- The higher voltage actually blows or burns the fuses at the location we desire thus turning any given 1 into 0.
- PROM chips are often called OTP i.e. One Time Programmable chips because we cannot convert a 0 back into a 1.
- That is they can be programmed once and never erased.

EPROM (Erasable PROM)

- PROM that is erasable.
- EPROM is erased by the exposure to intense UV (Ultra Voilet) light.

- UV light erases the chip by causing a chemical reaction that essentially melts the fuse back together, thus any binary 0s in the chip become 1s and the chip is restored to new condition with binary 1s in all location.

EEPROM (Electrically Erasable PROM)

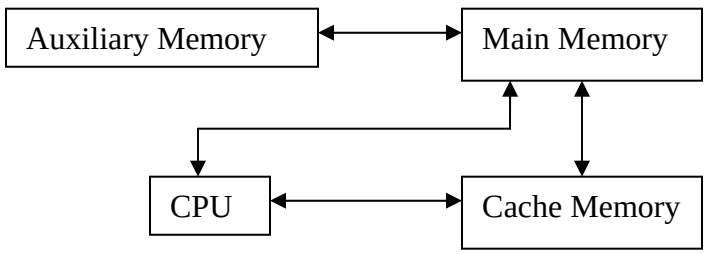
- Can be erased with electrical signals instead of UV light.
- Also known as Flash ROM.
- Are characterized by their capability to be erased and reprogrammed directly in the circuit board in which they are installed with no special equipment required.
- By using EEPROM it is possible to erase and reprogram the ROM in a computer without removing the chip from the System.

FLASH MEMORY

- Special types of EEPROM that can be erased and reprogrammed in blocks instead of 1 byte at ta time.
- Many modern computers have their BIOS stored on a flash memory chip so that it can be easily updated of necessary.
- Also popular in modems because it enables the modem manufacturers to support new protocols as they become standardized.

CACHE MEMORY

- Moving data between RAM and the CPU's register is one of the most time consuming operations a CPU must perform, simply RAM is much slower than the CPU.
- The cache memory is placed between CPU and main memory.
- It is a semiconductor memory similar to RAM except that it is extremely fast compared to normal memory.
- It is a special and high speed memory used to increase the speed of processing by making current program and data available to the CPU at a rapid rate.
- Cache memory is used in computer systems to compensate for the speed difference between main memory access time and processor logic.
- It stores instruction code and data, which are to be currently executed by the CPU.
- It is used to reduce the average access time for instructions and data which are normally stored in the main memory.



- The modern 32- bit and 64 – bit microprocessors operate at a very high speed.

- The memory matching with high – speed microprocessor must be very fast. But very fast memory is very expensive.
- If a fast microprocessor operates with conventional main memory it has to operate with several wait state, this will reduce the speed of the computer.
- A high speed cache memory is used to supply currently needed instructions and date to CPU.
- The main memory stores programs and data which is to be processed by the CPU.
- The currently needed instructions and data of the program are loaded into the cache from the main memory.
- The technique of accessing a cache memory differs from that of the main memory.
- To access main memory the CPU sends an address to it, in response of this the memory sends data contained at the specified memory address.
- On the other hand cache memory used parallel searching of data.
- It first compares the incoming address to the address present in the cache, it the address matches it is said that a "hit" has occurred then the corresponding data is read by the CPU.
- If the address does not match, it is said the a "miss" has occurred when a miss occurs, data is read from the main memory but it also loads a copy of the data to the cache memory so that when the CPU needs the same data or address, it finds it in the cache memory i.e. hit occurs and saves the time needed to load the data from the memory.
- Usually hit ratio is above 90%.
- The hit ratio is defined as the ratio of the number of hits to the total number of read requests sent to the cache by the CPU.
- Cache memory is placed at two or three levels they are called first level cache (L1), second level cache (L2) and third level cache (L3).
- Some microprocessor contains L1, L2, and L3 within the microprocessor.
- Cache within the microprocessor is called internal cache
- Cache outside the processor is called external cache.
- L1 → up to 256 KB built-in
- L2→ 2 MB
- Use of cache memory let the processor work in its actual speed

Chapter 7: Auxiliary Storage Devices

Introduction

Auxiliary storage device, also known as secondary memory is the supplementary memory to the main memory. It is permanent in nature retains its contents when the computer is switched off. It can be used to hold data and programs for future reference and they function as a back up storage media as well. Back ups assist to recover data in cases of accidental erasure, virus infiltration or major system crashes. They are not directly connected to the processor and hence the access time is slower than that of the main memory. The content in it must first be copied into the primary storage RAM for the CPU to process. The most common types of auxiliary storage devices are magnetic tape, hard disks, floppy disks, optical disks etc.

Auxiliary devices can be categorized into two types based on the data access.

1. Sequential Access
2. Random Access

Sequential Access	**Random Access**
Data are accessed sequentially step by step.	Data can be accessed randomly on any location.
Data access time is more as to read a particular piece of data all the data preceding it must be read.	Data access time is less as data on any location can be accessed directly.
Reading data sequentially involves a lower number of seek operations than does random reading; sequential reads deliver a higher rate of throughput	Random reads deliver a lower rate of throughput
Eg. Magnetic Tape, Tape drive	e.g. Magnetic Disks, Floppy Disk, Optical Disk

Magnetic Tape

- is a medium for magnetic recording generally consisting of a thin magnetizable coating on a long and narrow strip of plastic.
- originally developed in Germany, based on the concept of magnetic wire recording.
- device that stores computer data on magnetic tape can be called a tape drive, a tape unit, or a streamer.
- are sequential access device and are slower in performance as their data access time is more.
- are cheap and allow massive amounts (Kbs to Gbs) of data to be stored in computers for long periods of time.
- Modern magnetic tapes for hard disk backup come in cassette form. These are called cartridge tapes
- DAT (Digital Audio Tape) is the latest addition to the magnetic tape, the tape length is 60 or 90 meters, capacity up to 4 GB and data transfer rate 366 KB/sec

Uses

Magnetic tapes are often used to make a copy of hard discs for back-up reasons. This is automatically done overnight on the KLB network and the tapes are kept in a safe place away from the server.

Advantages

Magnetic tape is relatively cheap and tape cassettes can store very large quantities of data (typically 26 GB).

Disadvantages

Accessing data is very slow and you cannot go directly to an item of data on the tape as you can with a disc. It is necessary to start at the beginning of the tape and search for the data as the tape goes past the heads (serial access).

Winchester Disk

- The term Winchester comes from an early type of disk drive developed by IBM that stored 30 MB and had a 30-millisecond access time; so its inventor named it a Winchester in honor of the 30-caliber rifle of the same name.
- They have the same technology of the modern day hard disk with less speed and capacity

Magnetic Disk

- Diskette drive and hard disk drives are the most commonly used storage devices.

Hard Disk	Floppy Disk
1. They are the mass storage device with enormous capacity to store data.	1. They have limited storage capacity upto 1.44 MB.
2. Data access time is less.	2. Data access time is more.
3. Relatively expensive	3. Relatively cheap
4. Are fixed disk and usually built into the computer	4. Are portable.
5. They last long	5. They have a short life.

Hard Disk

- Mass storage random access device that can store GBs of data. As of July 2008, the highest capacity HDDs are 1.5 TB.
- A typical mobile HDD spins at 5,400 rpm, with 7,200 rpm models available for a slight price premium
- The fastest "enterprise" HDDs spin at 10,000 or 15,000 rpm, and can achieve sequential media transfer speeds above 1.6 Gbit/s and a sustained transfer rate up to 125 MBytes/second. Drives running at 10,000 or 15,000 rpm use smaller platters because of air drag and therefore generally have lower capacity than the highest capacity desktop drives.
- Data is stored by magnetizing the surface of flat, circular plates called platters which have a surface that can be magnetized. They constantly rotate at very high speed. A read/write head floats on a cushion of air a fraction of a millimeter above the surface of the disc. The drive is inside a sealed unit because even a speck of dust could cause the heads to crash.
- Programs and data are held on the disc in blocks formed by tracks and sectors. These are created when the hard disc is first formatted and this must take place before the disc can be used. Disc are usually supplied pre-formatted.

Uses:

- The hard disc is usually the main backing storage media for a typical computer or server.

Advantages:

- Stores and retrieves data much faster than a floppy disk or CD-ROM
- Very fast access to data as data seek time is less.
- Data can be read directly from any part of the hard disk. The access speed is about 1000 KB per second.
- Usually fixed inside the computer so cannot get mislaid.
- Cheap on a cost per megabyte compared to other storage media.

Disadvantages:

- Hard disks eventually fail which stops the computer from working.
- Regular 'head' crashes can damage the surface of the disk, leading to loss of data in that sector.
- The disk is fixed inside the computer and cannot easily be transferred to another computer.

Floppy Disk

- A floppy disk is an obsolescent data storage medium that is composed of a disk of thin, flexible magnetic storage medium encased in a square or rectangular plastic shell.
- Floppy disks are read and written by a floppy disk drive
- Invented by IBM, floppy disks in 8-inch, 5¼-inch, and the newest and most common 3½-inch formats enjoyed many years as a popular and ubiquitous form of data storage and exchange, from the mid-1970s to the late 1990s. They have now been superseded by flash and optical storage devices.

Uses:

- Moving files between computers that are not connected through network or communication hardware
- Loading new programs onto a system
- Keeping a back-up of small files.

Advantages:

- They are very cheap to buy and floppy disk drives are very common.

Disadvantages:

- They are easily physically damaged if unprotected and magnetic fields can damage the data.
- They are relatively slow to access because floppy disk rotates far more slowly than hard disks. The access speed is about 36 KB per second.

Two types of Floppy Disk

- 8" inch disk →
- 5.25" inch disk → mini floppy
- 3.5" inch disk → micro floppy
- Also depends upon the density if the disk
    - Density of the disk is measure of the capacity of the disk surface: the higher the density the more closely the iron – oxide particles are placed and the more data the disk can store.
    - Double Density (DD)
    - High Density (HD)
    - Extra High Density (ED)

Disk Capacity Determination

Disk capacity = NT x NS x NB x S

NT → No. of Tracks per surface
NS → No. of Sectors per tracks
NB → No. of Bytes per sectors – 512 bytes
S → No. of Sides

Disk	Type	Tracks	Sectors/Tracks	Sectors	Bytes/Sectors	Total bytes	KB	MB
5.25”	DD	40	9	750	512	368640	360	.36
5.25”	HD	80	15	2400	512	122800	1200	1.2
3.5”	DD	80	9	140	512	737280	720	.7
3.5”	HD	80	18	2880	512	1474560	1440	1.44
3.5”	ED	80	36	5760	512	2949150	2880	2.88

Example:

5.25” DSDD	3.5” DSHD
Capacity = NT x NS x NB x S = 40 x 9 x 512 x 2 = 368640 bytes = 360 KB	Capacity = NT x NS x NB x S = 80 x 18 x 512 x 2 = 1474560 bytes = 1440 KB = 1.44 MB

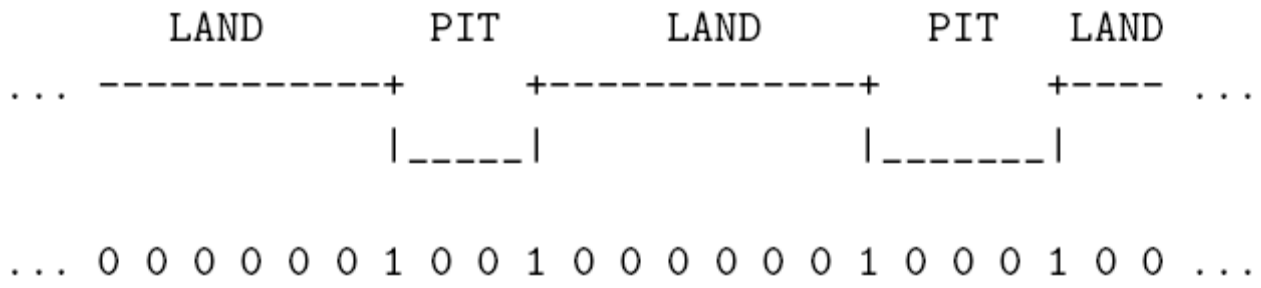
Optical Disk

- Alternatives to magnetic storage systems.
- Most widely used type of optical storage medium is the compact disk (CD), CD – ROM, DVD – ROM, CD – Recordable, CD – Rewritable
- These devices fall into the category of optical storage because they store data on a reflective surface. So it can be read by a beam of laser light.
- A laser uses a concentrated, narrow beam of light, focused and directed with lenses, prisms and mirrors.
- The light focus of the laser beam is possible because all the light is the same wavelength.

CD-ROM (Compact Disk Read Only Memory)

- Is read only optical storage medium
- They are capable of holding above 700MB of data , 74 minutes of audio or video
- Accessing data from a CD-ROM is quite a bit faster than floppy disk but considerably slower than a modern hard disk
- The disk is made of a polycarbonate wafer, 120mm in diameter and 12mm thick with a 15 mm hole in the center.
- The wafer is coated with metallic film, usually an aluminum alloy.
- The aluminum film is the portion of the disk that the CD-ROM drive reads for information.
- The aluminum film is covered by a plastics polycarbonate coating that protects the underlying data.
- CD-ROM is single sided.
- Data is laid out on a CD-ROM disk in a long, continuous spiral that starts at the outer edge and winds inward to the center.
- Data are stored in the form of lands which are flat area on the metal surface and pits, which are depressions or hollows.
- Land reflects the laser light into the sensor (indicating a data bit of 1)
- Pit scatter light (indicating a data bit of 0)
- Reading the information back is a matter of reflecting a lower – powered laser off the aluminum film.
- A receiver or light receptor notes where light is strongly reflected or when it is absent or defused.

- Diffused or absent light is caused by the pits made that is called land.
- Data transfer rate is around 150 KBps , 300KBps now a days 7800KBps



WORM (Write Once Read Many)

- is a data storage technology that allows information to be written to a disk a single time and prevents the drive from erasing the data.
- The discs are intentionally not rewritable, because they are especially intended to store data that the user does not want to erase accidentally.
- Because of this feature, WORM devices have long been used for the archival purposes of organizations such as government agencies or large enterprises.
- The discs have varied in size from 5.25 to 14 inches wide, in varying formats ranging from 140MB to more than 3 GB.

EO disks (Erasable Optical Disks)

- Data in EO disks can be erased and loaded with new data just like the magnetic disk
- eg. CD RW, DVD RW, Magneto Optical Disk

Magneto Optical Disk

- Incorporates the combined features of magnetic disk and CD-ROMs
- They can be read and written into and are portable as well.
- Storage capacity more than 200 megabytes
- Data access speed is faster than floppies and CD-ROMs but not as fast as hard disks

Chapter 8: Input Devices

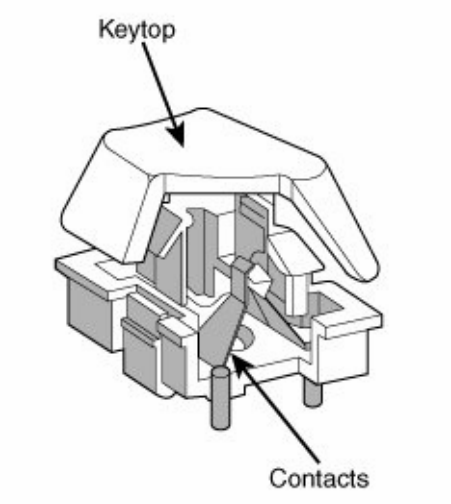
Introduction

- are the hardware parts that accept data and instructions from the user
- It enables you to input information and commands into the computers.
- convert input data and instructions into suitable binary form (such as ASCII) which can be accepted by the computer.
- The commonly used input devices are keyboard, mouse, scanner, light pen, graphic tablet, joystick, trackball, touch screen, microphone, digital tablets etc.

Keyboard

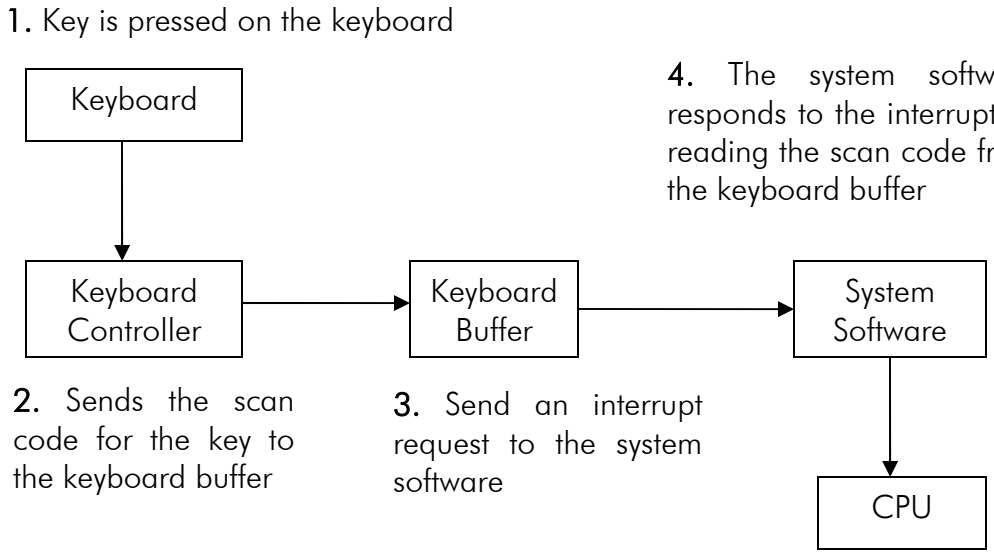
- Is the most common way to enter text and data into a computer
- Standard layout is basically like old typewriter keyboard (called a QWERTY keyboard)
- The most commonly used keyboards are
    - 101 – Key enhanced keyboard, 104 – key windows keyboard.
    - 82 – Key Apple standard keyboard and 108- key Apple extended keyboard.
    - It contains alphabets (A to Z or a to z), digits (0 to 9), special characters (!, @,#,$,%,^,&,*,<,>,? etc) and some control keys.
- There are five key groups:
    - Alphanumeric keys
        - Letters of the alphabets
        - Numbers and symbols
        - Caps lock, tab, backspace and enter key do special functions but they are part of the alphanumeric key group.
    - Modifier Key group
        - Modify what happens when you press another key
        - Shift changes letter keys to upper case
        - Shift makes the number keys produce special symbols
        - Ctrl and alt used in combination with other keys change what that key does
    - Numeric Key Pad
        - Looks like a calculator keyboard
        - Used to enter numbers and operation symbols
        - Num lock forces keypad to enter numbers which is the normal default.
    - Function Keys
        - Middle of top row
        - Labeled F1 to F12
        - Could be assigned specific commands by the current application or operating system (or software dependent)
    - Cursor Movement keys
        - Direct movement of on-screen cursor
        - Up, down, left and right arrow
        - Other keys are insert, home, page up, delete , end and page down
- Special purpose keys are in addition to the five key group are found on keyboards specifically designed for windows operating system
- Start key or windows key

When a key is pressed an electronic signal is produced which is detected by an electronic circuit called keyboard encoder or controller.



The function of an encoder is to detect which key has been pressed and to send a binary code (corresponding to the pressed key) to the computer. The binary code may be an ASCII, EBCDIC or HEX code depending upon the computer.

How the computer accepts input from the keyboard?

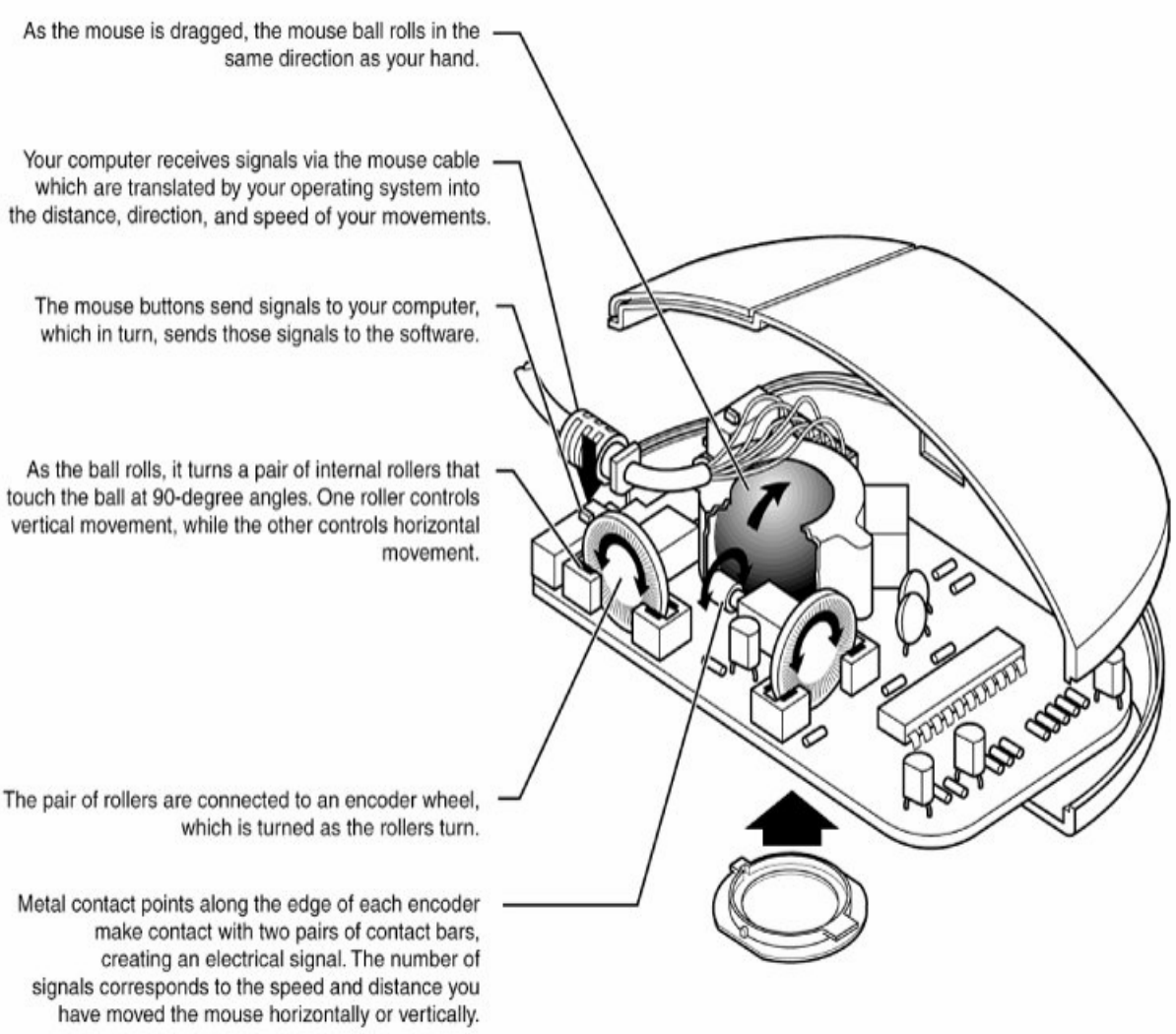


Mouse

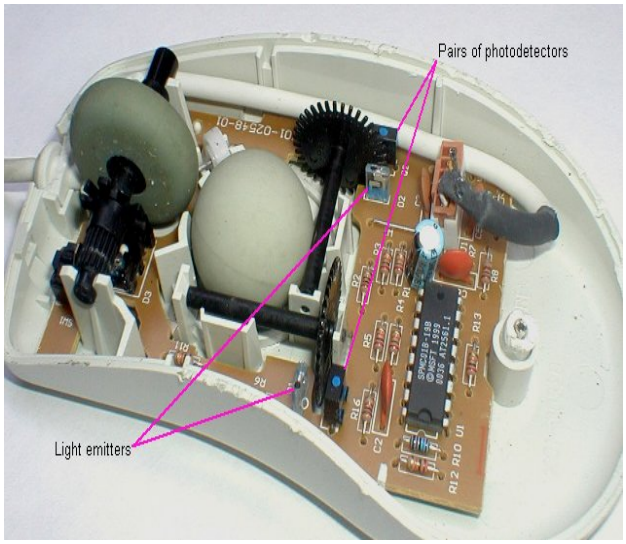
- Is a small hand held devices used to position the cursor on the screen
- Is a kind of pointing device
- Is an input device that rolls around on a flat surface and controls the pointer
- Pointer is an on-screen object, usually an arrow, that is used to select text; access menus; and interact with programs, files or data that appear on the screen.

Mouse Actions:

- Clicking – move pointer to item and click left button one time.
- Double – clicking – move pointer to item and click left button two times quickly.
- Dragging – position mouse over item, click and hold left button as you move the mouse.
- Right Click – move pointer to item and click one time with right button

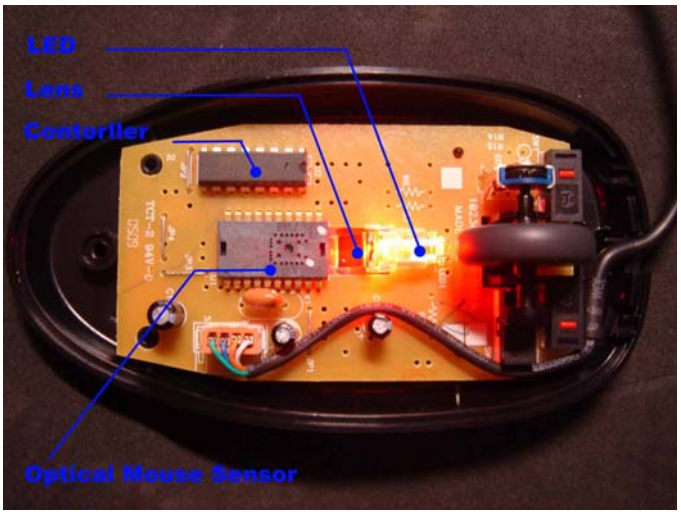


Mechanical Mouse



- a mouse that operates by mechanical means
- a rubber ball rolls as the mouse is moved across a tabletop or mouse pad, and the rubber ball turns vertical and horizontal wheels inside the mouse.
- The wheels, called encoders, have tiny metal contact points on their rims, which touch a contact bar as they turn. The contact bar sends electrical signals to the computer. The location of the mouse is established by how many times the contact points have touched the bars, the direction in which the wheels are turning, and the ratio between the number of signals from the vertical and horizontal encoders. The mechanical mouse is different from the optical mouse, which uses a beam of light to tell where it is.

Optical Mouse



- Introduced in 1999, actually uses a tiny camera to take thousands of pictures every second.
- Is able to work an almost any surface without a mouse pad
- Most optical mice use a small, red light – emitting diode (LED) that bounces light off that surface onto a complementary metal – oxide semiconductor (CMOS) sensor
- In addition to LED, a recent innovation are laser-based optical mice that detect more surface details compared to LED technology
- The results is the ability to use a laser – based optical mouse on even more surface than an LED mouse

Optical mouse has several benefits over track-ball mouse

- No moving parts means less wear and a lower chance of failure
- There's no way for dirt to get inside the mouse and interface with the tracking sensors
- Don't require a special surface such as a mouse pad.

Track Ball

- A trackball is a pointing device consisting of a ball housed in a socket containing sensors to detect rotation of the ball about two axes—like an upside-down mouse with an exposed protruding ball.
- The user rolls the ball with the thumb, fingers, or the palm of the hand to move a cursor.
- Before the advent of the touchpad, small trackballs were common on portable computers, where there may be no desk space on which to run a mouse.
- The trackball was invented by Tom Cranston and Fred Longstaff as part of the Royal Canadian Navy's DATAR system in 1952
- The advantage of track balls over a mouse it that it remains stationary and does not require more space.

Joystick

- Is also a pointing device
- Used to move the cursor position on the screen
- Has spherical ball at its lower end as well as its upper end
- The lower spherical ball moves in a socket
- The joystick can be moved right or left, forward or backward
- The electric circuitry inside the joystick detects and measure the displacement of the joystick from its central position
- Buttons mounted on the stick or elsewhere on the joystick can be pressed to execute commands.
- Mainly used to play games.

Digitizing Tablet

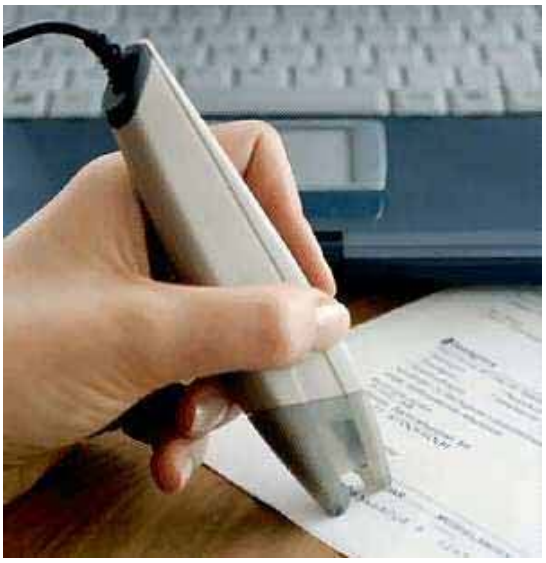
- is an input device that enables a user to enter drawings and sketches into a computer.
- consists of an electronic tablet and a cursor or pen
- A graphics tablet (or digitizing tablet, graphics pad, drawing tablet) is a computer input device that allows one to hand-draw images and graphics, similar to the way one draws images with a pencil and paper. These tablets may also be used to capture data of handwritten signatures.
- A graphics tablet (also called pen pad) consists of a flat surface upon which the user may "draw" an image using an attached stylus, a pen-like drawing apparatus.
- The image generally does not appear on the tablet itself but, rather, is displayed on the computer monitor. Some tablets however, come as a functioning secondary computer screen that you can interact with directly using the stylus.
- Some tablets are intended as a general replacement for a mouse as the primary pointing and navigation device for desktop computers.

Scanners

- is an input device that can read text or illustrations printed on paper and translate the information into a form that the computer can use.
- Using scanner drawings, graphs, photos, text can be stored for computer processing by passing an optical mechanism over the information stored.
- The core component of the scanner is the CCD array (charge couple device).

- CCD is the most common technology for image capturing in scanner. CCD is collection of tiny light sensitive diode which convert photos (light) into electrons (electrical charge)

Scanning process



- The document is placed on the glass plate
- The lamp is used to illuminate the document
- The entire mechanism (mirrors, lens , filter and CCD array) make up the scan head
- The scan head is moved slowly across the document by a belt that is attached to a stepper motor.
- The image of the document is reflected by an angled mirror to another mirror and then reflects the image onto a lens
- The lens focuses the image through a filter on the CCD array
- The lens splits the image into three smaller versions of the original (color filter R, G, B) onto a discrete section of CCD array.

Digital Camera

- is an input device used to input digital images to a computer.
- takes video or still photographs, or both, digitally by recording images via an electronic image sensor.
- can do things film cameras cannot: displaying images on a screen immediately after they are recorded, storing thousands of images on a single small memory device, recording video with sound, and deleting images to free storage space.
- are incorporated into many devices ranging from PDAs and mobile phones (called camera phones) to vehicles. The Hubble Space Telescope and other astronomical devices are essentially specialized digital cameras.

Magnetic Ink Character Reader (MICR)

- allows the computer to recognize characters printed using magnetic ink.
- a character recognition technology adopted mainly by the banking industry to facilitate the processing of cheques.
- ATM cards use a similar technology to access account information and facilitate monetary transaction.

Optical Character Recognition (OCR)

- Optical character recognition, usually abbreviated to OCR, is the mechanical or electronic translation of images of handwritten, typewritten or printed text (usually captured by a scanner) into machine-editable text.
- OCR is used for reading text from paper and translating the images into a form that the computer can manipulate (e.g. into ASCII code)
- Scans the documents and using the photo electric device converts the shape into electric signals.
- These patterns are then compared with the stored patterns of the characters which the reader can recognize
- If a match is found, the character scanned is identified otherwise the document may be rejected by the reader.

OMR (Optical Mark Reader)

- Can sense the presence of a pen or pencil mark
- It is widely used in scoring answers to multiple choice questions.

BCR (Bar Code Reader)

- is an electronic device for reading printed barcodes.
- consists of a light source, a lens and a photo conductor translating optical impulses into electrical ones.
- Is used to extract the information of any product, its description, date of manufacture and expiry and price.

Touch Screen

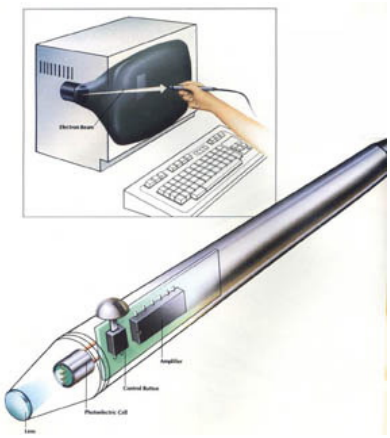
- is a display which can detect the presence and location of a touch within the display area.
- The term generally refers to touch or contact to the display of the device by a finger or hand.
- Touch screens can also sense other passive objects, such as a stylus.
- Until the early 1980s, most consumer touch screens could only sense one point of contact at a time, and few have had the capability to sense how hard one is touching. This is starting to change with the commercialization of multi-touch technology.
- The touch screen has two main attributes.
    - First, it enables one to interact with what is displayed directly on the screen, where it is displayed, rather than indirectly with a mouse or touchpad.

- Secondly, it lets one do so without requiring any intermediate device, again, such as a stylus that needs to be held in the hand. They also play a prominent role in the design of digital appliances such as the personal digital assistant (PDA), satellite navigation devices and mobile phones.

Touch Pad (Track Pad)

- is a pointing device consisting of specialized surface that can translate the motion and position of a user's fingers to a relative position on screen.
- They are a common feature of laptop computers and also used as a substitute for a computer mouse where desk space is scarce.
- Touch pads vary in size but are rarely made larger than 40 square centimeters (about 6 square inches). They can also be found on personal digital assistants (PDAs) and some portable media players.

Light Pen



- A light pen is a computer input device in the form of a light-sensitive wand used in conjunction with the computer's monitor.
- It allows the user to point to displayed objects, or draw on the screen, in a similar way to a touch screen but with greater positional accuracy.
- A light pen can work with any CRT-based display, but not with LCD screens (though Toshiba and Hitachi displayed a similar idea at the "Display 2006" show in Japan), projectors and other display devices.

Chapter 10: Introduction To Computer Software

PRELUDE

Software is a general term used to describe a collection of computer programs, procedures and documentation that perform some tasks on a computer system. They are the programs that enable a computer to perform a specific task. This includes application software such as a word processor, which enables a user to perform a task, and system software such as an operating system, which enables other software to run properly, by interfacing with hardware and with other software.

Firmware: Firmware are software, programs and data that has been permanently written onto read-only memory. Firmware is a combination of software and hardware. ROMs and PROMs that have data or programs recorded on them are firmware.

Software is often divided into two categories.

- ✓ System Software: includes OS and all the utilities that enable the computer to function
- ✓ Application Software: includes programs that do real work for users.
  e.g. Word processors, spreadsheets and DBMS.

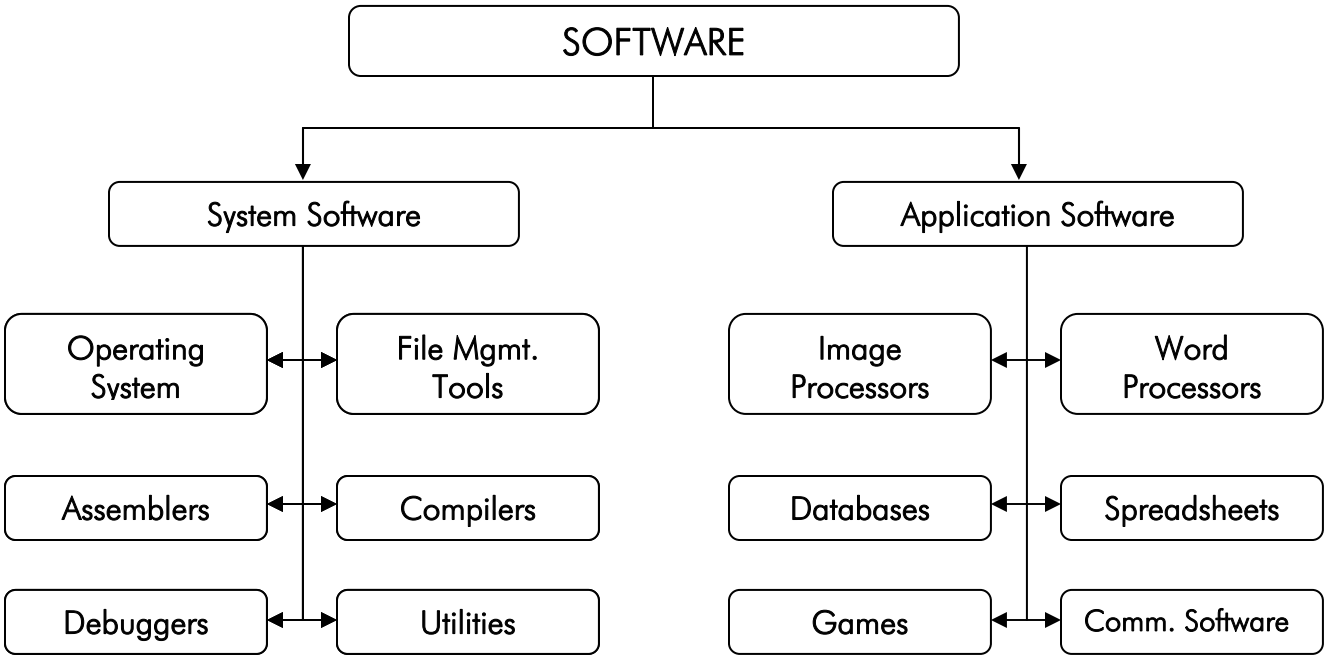


Fig: Software Types

OPERATING SYSTEMS

- ✓ are the most important programs that run on a computer.
- ✓ are the basic building blocks of any computer system that enables the smooth operation of the hardware.
- ✓ act as an interface between the user and the hardware and is responsible for the overall functioning of any computer system
- ✓ e.g. Microsoft Windows, Linux, DOS, Xenix, Mac OS, Unix

UTILITIES

- ✓ program that performs a very specific task usually related to managing system resources
- ✓ used to manage disk drives, printers and other devices attached to the system
- ✓ are small and less complex program ranging from Antivirus to compression utilities

COMPILERS AND INTERPRETERS

Compilers	Interpreters
1. Program that translates source code to object code all at once.	1. Program that translates source code to object code on one to one basis
2. Reports the errors at the end.	2. Reports the errors whenever and wherever encountered.
3. Require some time before an executable program emerges.	3. They can execute a program immediately.
4. Programs produced by compilers run much faster.	4. Programs tend to run slower compared to compilers.

WORD PROCESSORS

- ✓ is an application program that enables to perform word processing functions like create, edit, copy, update, modify and print documents.
- ✓ enables to create a document, store it electronically on a disk, display it on a screen, modify it and print it on a keyboard.
- ✓ its advantage over manual word processing is the editing facility without retyping the entire document.
- ✓ allows to move sections of text from one place to another and also make duplicate copies of the document.
- ✓ e.g. Microsoft Word, WordStar, WordPerfect, AmiPro

SPREADSHEETS

- ✓ is a tabular pad with rows and columns forming a grid where each intersection of row and column is called a cell identified by its cell address.
- ✓ used to create and manipulate spreadsheets electronically.
- ✓ The values in the cells can be interconnected using a formula.
- ✓ E.g. Lotus 123, Microsoft Excel

PRESENTATION GRAPHICS

- ✓ allows user to create highly stylized graphics/images for slide shows and reports.
- ✓ Allows to import data from spreadsheets to create charts and graphs
- ✓ Allows animation and simulation of data
- ✓ e.g. Microsoft Powerpoint, Lotus Freelance Graphics, Harvard Presentation Graphics

DATABASE MANAGEMENT SYSTEM

- ✓ A database is an organized collection of interrelated data used for multiple purposes. It arranges data and information in such a way that any specific piece of information can be easily accessed. e.g. Dictionary, Telephone directory

- ✓ Database management system is a computer program designed to manage a large set of data and run operations on data as requested by the user. It allows a user to create a computerized database, add, change, update, modify, sort, delete or retrieve data from a database. E.g. Computerized Library System, ATM, Railway Reservation
- ✓ Different DBMS support different query language but there is a semi-standardized query language called SQL (Structured Query Language)
- ✓ The commonly used database management tools: MS-Access, Oracle, MySQL, FoxPro, RBase, FoxBase, Omnis, Dbase III, Sybase, Informix

IMAGE PROCESSORS

- ✓ enables to create, edit, add special effect, view, save and print images
- ✓ include paint programs, draw programs and image editors

PRELUDE

- ✓ The operating system is responsible for creating the link between the material resources, the user and the applications (word processor, video game, etc.).
- ✓ When a program wants to access a material resource, it does not need to send specific information to the peripheral device but it simply sends the information to the operating system, which conveys it to the relevant peripheral via its driver.
- ✓ allows the dissociation of programs and hardware, mainly to simplify resource management and offer the user a simplified Man-Machine Interface (MMI) to overcome the complexity of the actual machine.
- ✓ is the infrastructure software component of a computer system responsible for the management and coordination of activities and the sharing of the limited resources of the computer.
- ✓ acts as a host for applications that run on the machine and handle the details of the operation of the hardware.
- ✓ common contemporary OS include Microsoft Windows, Mac OS, Linux and Solaris.
- ✓ the primary purpose of an OS is to maximize the productivity of a system by operating it in the most efficient manner and minimizing the amount of human intervention required.

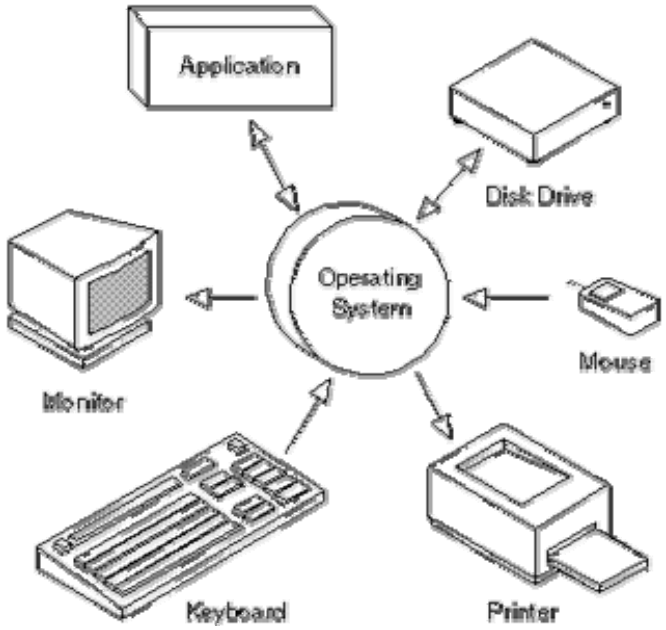


Fig: Operating System Concepts

COMPONENTS OF THE OPERATING SYSTEM

The operating system comprises a set of software packages that can be used to manage interactions with the hardware. The following elements are generally included in this set of software:

- ✓ The **kernel**, which represents the operating system's basic functions such as management of memory, processes, files, main inputs/outputs and communication functionalities.
- ✓ The **shell**, allowing communication with the operating system via a control language, letting the user control the peripherals without knowing the characteristics of the hardware used, management of physical addresses, etc.
- ✓ The **file system**, allowing files to be recorded in a tree structure.

ROLES OF THE OPERATING SYSTEM

The operating system has various roles:

- ✓ **Management of the processor:** The operating system is responsible for managing allocation of the processor between the different programs using a scheduling algorithm. The type of scheduler is totally dependent on the operating system, according to the desired objective.
- ✓ **Management of the random access memory**: The operating system is responsible for managing the memory space allocated to each application and, where relevant, to each user. If there is insufficient physical memory, the operating system can create a memory zone on the hard drive, known as "virtual memory". The virtual memory lets you run applications requiring more memory than there is available RAM on the system. However, this memory is a great deal slower.
- ✓ **Management of input/output:** The operating system allows unification and control of access of programs to material resources via drivers (also known as peripheral administrators or input/output administrators).
- ✓ **Management of execution of applications:** The operating system is responsible for smooth execution of applications by allocating the resources required for them to operate. This means an application that is not responding correctly can be "killed".
- ✓ **Management of authorizations:** The operating system is responsible for security relating to execution of programs by guaranteeing that the resources are used only by programs and users with the relevant authorizations.
- ✓ **File management:** The operating system manages reading and writing in the file system and the user and application file access authorizations.
- ✓ **Information management:** the operating system provides a certain number of indicators that can be used to diagnose the correct operation of the machine.
- ✓ **Job Management:** The OS manages the jobs waiting to be processed. It recognizes the jobs, identifies their priorities, determine whether the required main and secondary memory are available or not and schedules and runs each job at appropriate moment.

CLASSIFICATION OF OPERATING SYSTEM

Operating system can be classified as follows.

- ✓ **Multi-user**
  - o Allow two or more users to run programs at the same time.
  - o Some even permit thousands of concurrent users.
  - o E.g. MVS (Multiple Virtual Storage used in mainframe),UNIX

- ✓ **Multi-processing**
  - o Multi-processing is a technique that involves operating several processors in parallel to obtain a higher calculation power than that obtained using a high-end processor or to increase the availability of the system.
  - o Uses SMP (Symmetric Multiprocessing) in which all processors access the same shared memory.
  - o Enables several programs to run concurrently
  - o A multiprocessor system must be able to manage memory sharing between several processors but also to distribute the work load.

- ✓ Multi-tasking
  - o allows more than one program to run concurrently
  - o only one CPU is involved unlike multiprocessing
  - o two basic types of multitasking
    - ▪ Preemptive
    - ▪ Cooperative
  - o In preemptive multitasking, the operating system parcels out CPU time slices to each program. Preemptive multitasking moves the control of the CPU to the OS, letting each process run for a given amount of time (a time slice) and then switching to another task. This method prevents one process from taking complete control of the system and thereby making it seem as if it is crashed. This method is most common today, implemented by among others OS/2, Win95/98, WinNT, Unix, Linux, BeOS, QNX, OS9 and most mainframe OS. The assignment of CPU time is taken care of by the scheduler.
  - o In cooperative multitasking, each program can control the CPU for as long as it needs it. If a program is not using the CPU, it can allow another program to use it temporarily. This method is not good since it lets one process monopolize the CPU and never let other processes run. This way a program may be unwilling to give away processing power in the fear of another process hogging all CPU-time. (Microsoft Windows 3.x and MultiFinder for Macintosh)

- ✓ Multi-threading
  - o An operating system is known as multi-threaded when several "tasks" (also known as processes) may be run at the same time.
  - o Is the ability of an OS to execute different parts of a program, called threads, simultaneously
  - o The applications consist of a sequence of instructions known as "threads". These threads will be alternately active, on standby, suspended or destroyed, according to the priority accorded to them or may be run simultaneously.

- ✓ Real Time
  - o Real time systems, used mainly in industry, are systems designed to operate in a time-constrained environment.
  - o An RTOS operates reliably according to specific time constraints
  - o An RTOS facilitates the creation of a real-time system, but does not guarantee the final result will be real-time; this requires correct development of the software.
  - o An RTOS provides facilities which, if used properly, guarantee deadlines can be met generally (soft real-time) or deterministically (hard real-time).
  - o An RTOS will typically use specialized scheduling algorithms in order to provide the real-time developer with the tools necessary to produce deterministic behavior in the final system.
  - o An RTOS is valued more for how quickly and/or predictably it can respond to a particular event than for the given amount of work it can perform over time.
  - o
  - o used in industrial robots, spacecraft, industrial control, scientific research equipment, space navigation, rocket launching
  - o e.g. OS-9; RTLinux (RealTime Linux); QNX; VxWorks.

Chapter 12: Programming Language

PRELUDE

- ✓ A programming language is an artificial language designed to express computations that can be performed by a machine, particularly a computer.
- ✓ Programming languages can be used to create programs that specify the behavior of a machine, to express algorithms precisely, or as a mode of human communication.
- ✓ Many programming languages have some form of written specification of their syntax and semantics, since computers require precisely defined instructions. Some are defined by a specification document (for example, an ISO Standard), while others have a dominant implementation (such as Perl).

MACHINE LANGUAGE

- ✓ Sometimes referred to as machine code or object code, machine language is a collection of binary digits or bits that the computer reads and interprets. Machine language is the only language a computer is capable of understanding.
- ✓ machine code is a term for code executed directly by a computer's central processing unit.
- ✓ is the only language understood by a computer based on binary digits 0 and 1.
- ✓ Programming in the machine code is very fast and efficient as the computer can accept the machine code as it is.
- ✓ Is tedious and time consuming for a programmer to program and lacks standard. There is no one standard machine language. Rather, there are machine languages.
- ✓ are machine dependent and technical operations of a computer must be understood.

ASSEMBLY LANGUAGE

- ✓ is a much more readable form of machine language and uses *mnemonic codes* to refer to machine code instructions, rather than simply using the instructions' numeric values.
- ✓ For example, on the Zilog Z80 processor, the machine code 00000101, which causes the CPU to decrement the B processor register, would be represented in assembly language as DEC B.


```
LDA, 7                LET X= 7
LDB, 10               LET Y=10
ADD A,B               LET SUM= X+Y
LD(100),A             PRINT SUM
HALT                  END
```

ADVANTAGES

- ✓ They are moer standardized and easier to use than machine language.
- ✓ They operate very efficiently and convenient to write program.
- ✓ Easier to debug
- ✓ Little more readability as symbolic instructions are used instead of binary sequence.

DISADVANTAGES

- ✓ They are machine dependent and hence not portable.
- ✓ They are not as fast as machine language as an assembler is required for translation.

HIGH LEVEL LANGUAGE

- ✓ simple, clear and easy to understand as it uses English words and mathematical notation.
- ✓ is machine independent and problem oriented
- ✓ less time consuming and efficient compared to other languages
- ✓ e.g. BASIC,C, C++,JAVA

TYPES OF HIGH LEVEL LANGUAGE

1. Procedure Oriented Language (3rd Generation)
2. Problem Oriented Language (4th Generation)
3. Natural Language (5th Generation)

1. PROCEDURE-ORIENTED LANGUAGE

- ✓ general purpose programming language
- ✓ are designed to express the logic and procedure of a problem
- ✓ are flexible and able to solve a variety of a problem
- ✓ e.g. BASIC, COBOL, FORTRAN

Advantage

- ✓ easier to work with as they use English language
- ✓ requires less time to program a problem
- ✓ easier to understand and modify
- ✓ machine independent

Disadvantage

- ✓ Program executes more slowly.
- ✓ The language uses computer resources less efficiently.

2. PROBLEM ORIENTED LANGUAGE

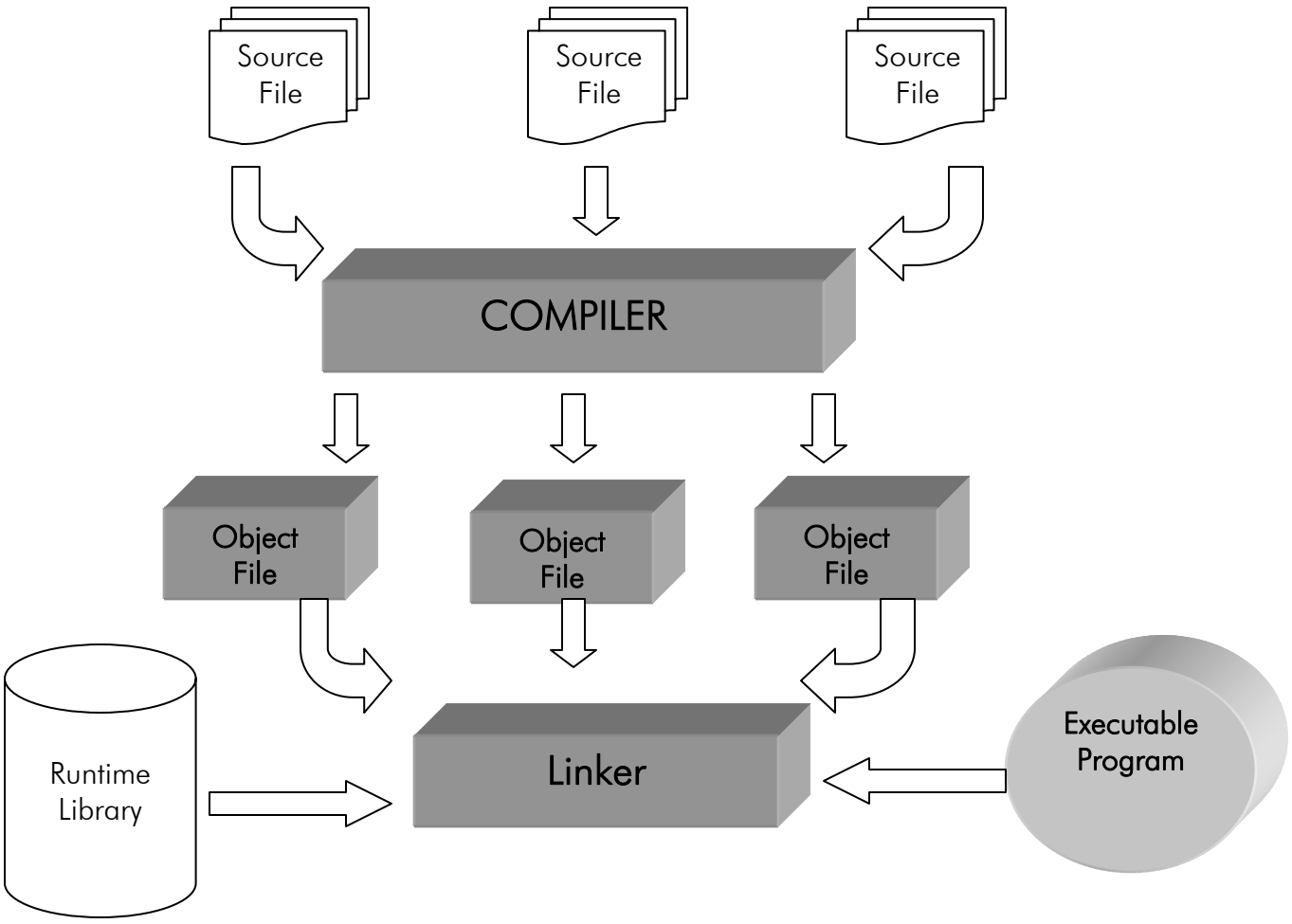
- ✓ are specific purpose programming language
- ✓ used to solve specific problems or design specific applications
- ✓ can be categorized into several kinds of application development tools
  - o **Personal Computer Application Software** – PowerPoint, Excel, dBase
  - o **Query Languages and Report Generators** – QBE, SQL, INQUIRE, INTELLECT
  - o **Decision Support Systems and Financial Planning Languages** – EXPRESS,FCS, IFPS
  - o **Application Generators** – FOCUS,FUSION, PACBASE, TELON,IDEAL

3. NATURAL LANGUAGE

- ✓ are still in developmental stage
- ✓ will have profound effect on areas of AI and Expert Systems.
- ✓ Designed to make connections between humans and computers
- ✓ Designed to train any system and make them learn by experience
- ✓ Popular natural languages : LISP and PROLOG

Procedure Oriented Language	Problem Oriented Language
Intended to use by professional programmers	May be used by non programmers or end users as well
Requires specification of how to perform task.	Requires specification of what task is to be performed and the system determines how to perform the task.
All alternatives must be specified.	Default alternatives are built in; an end user need not specify these alternatives
Code may be difficult to read, understand and maintain	Code is easy to understand and maintain.
Is difficult to learn and debug.	Is easier to learn and debug.
Typically file-oriented.	Typically database oriented.

THE COMPILATION PROCESS



Chapter 14: Data Processing

PRELUDE

- ✓ Data processing is any computer process that converts data into information or knowledge.
- ✓ The processing is usually assumed to be automated and running on a computer.
- ✓ Because data are most useful when well-presented and actually informative, data-processing systems are often referred to as information systems to emphasize their practicality.
- ✓ Data-processing systems typically manipulate raw data into information, and likewise information systems typically take raw data as input to produce information as output.

DATA VERSUS INFORMATION

- ✓ Data are plain facts. When data are processed, organized, structured or presented in a given context so as to make them useful, they are called Information.
- ✓ Data themselves are fairly useless. But when these data are interpreted and processed to determine its true meaning, they become useful and can be called Information.
- ✓ Data are assembled in a set order or format for further processing to produce a meaningful result that may support an existing theory or hypothesis or even help to formulate a new one.

Computer data is processed in two fundamental ways:

i. File Processing
ii. Database processing

FILE PROCESSING

- ✓ method of processing data in separate files
- ✓ consists of creating, storing, and/or retrieving the contents of a file to or from a recognizable medium, reading from and writing to files.
- ✓ has two types
  - o Sequential File Processing
  - o Direct Access File Processing

Sequential File Processing

- ✓ stores and accesses files in sequence using a tape or a disk storage.
- ✓ Records are sorted before they are processed
- ✓ Used where data can be processed in batches and where a substantial portion of a master file is changed with the processing of each batch.

Direct Access File Processing

- ✓ Data is accessed directly from any location on the disk
- ✓ Indexes are used to track the location of the file randomly.

PROBLEMS WITH FILE PROCESSING

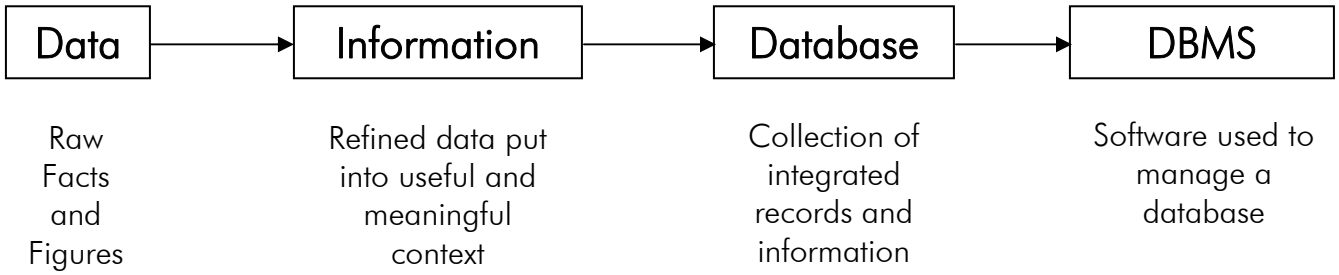
- ✓ Duplication of data leads to wastage of disk space.
- ✓ If the same data is stored in two different places, an update is required in both the places. Otherwise, there would arise a data integrity problem.
- ✓ Difficult to relate records in one file to records in another. [Either a duplicate copy is to be created or a special program (query) is to be prepared to extract the records.]

DATABASE PROCESSING

- ✓ A database is a collection of integrated records which may contain multiple files specifically called tables.
- ✓ Records in the tables are processed by their relationship to one another
- ✓ The DBMS stores and processes the data so that data can be accessed via their relationships to other data.

PRELUDE

- ✓ Information is the refined data, data that have been put into a meaningful and useful context and communicated to a recipient who uses it to make decisions.
- ✓ It involves the communication and reception of intelligence or knowledge.
- ✓ It appraises, notifies, stimulates, reduces uncertainty, reveals additional alternatives or helps in eliminating irrelevant or poor ones and influence individuals and stimulates them to action.
- ✓ Information consists of data, images, text, documents and voice often intertwined but always organized in a meaningful context.



QUALITY OF INFORMATION

1. Accuracy

- ✓ Information should be error free and should clearly reflect the meaning of data on which it is based.
- ✓ It should depict a clear picture to the recipient and may require a graphical presentation rather than tabular structure.
- ✓ Information should be free from biasness without manipulation and distortion.

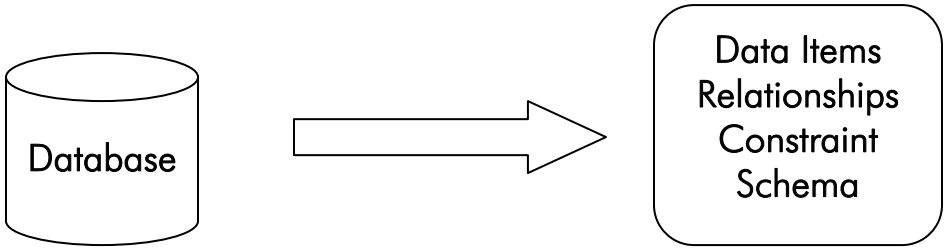
2. Timeliness

- ✓ Timeliness means delivering the information to the recipients with the needed time frame.

3. Relevancy

- ✓ Relevancy means the use of any specific information for a specific person.
- ✓ Information relevant for one person may not be relevant for another.

ELEMENTS OF A DATABASE



TERMS USED IN DATABASE SYSTEM

1. Table
   A table is a part of database with rows and columns where rows are records and columns are fields.
2. File
   A file is a collection of data on disk accessed by a unique name.
3. Record
   A record is a group of related fields of information treated as a unit, an entity. Each row in a table is a record.
4. Fields
   The fields of a record contain the data items, attribute of the entity. The field has its length and data type.
5. Primary Key
   A primary key is a unique field that identifies the records in a table. It is the key that prevents redundant data as no duplicate value possible.
6. Entity
   An entity is a "thing" or "object" in the real world that is distinguishable from all other objects. e.g. each person in an enterprise is an entity.
7. Attribute (Fields)
   The individual properties of the entity, about which data is recorded are its attribute. e.g. the attributes of Report (Entity) will include "Roll No.", "SName", "Class", "Subject1", "Subject2", "Total"
8. Relationship
   A relationship is an association among several entities.

DRAWBACKS OF OLDER DATABASE SYSTEMS

- Encoded Data (data hard-coded in the application)
- Interdependence between programs and data files
- Data repetition or redundancy
- Data inconsistency (Irregularity)
- Ad hoc (Unplanned/Informal) representation of relationships
- Ad hoc data management techniques
- Lack of data security mechanisms
- Non uniform back-up and recovery methods

DATABASE AND ITS IMPORTANCE

A database is a structured collection of records or data that is stored in a computer system. In order for a database to be truly functional, it must not only store large amounts of records well, but be accessed easily. In addition, new information and changes should also be fairly easy to input. In order to have a highly efficient database system, you need to incorporate a program that manages the queries and information stored on the system called the Database Management System. Besides these features, all databases that are created should be built with high data integrity and the ability to recover data if hardware fails.

ADVANTAGES OF DATABASE

Data redundancy can be reduced
Data redundancy refers to the repetition of data in multiple places. This wastes the storage spaces. By using a computerized database system, redundancy can be reduced to remarkable amount. Redundancy can be removed using a primary key.

Inconsistency can be avoided
Data becomes inconsistent when there is a redundancy error. When there is same data on two sites and changes are made at one site only without propagating to the next site, data remain inconsistent as the entries regarding the same data do not agree.

Data Sharing
Data in a database can be shared with any existing application.

Standards can be enforced
With the central control of the database, the database administrator can enforce standards.

Security restrictions can be applied
The DBA can ensure the security of data by the use of a proper channel to access data. Authorization checks can be carried out while accessing sensitive data.

Integrity (Accuracy) can be maintained
Integrity of a database refers to it accuracy and precision. A centralized control of the data helps in permitting the administrator to define integrity constraints to the data in database.

Conflicting requirements can be balanced
Knowing the overall requirement as opposed to the individual requirements, the database can be structured to provide an overall service that is best for the organization.

CHARACTERISTICS OF DATA IN A DATABASE

The data in a database should have the following features.

- ✓ **Shared:** Shared among different users and applications
- ✓ **Persistence:** Data in a database exist permanently and has thoroughness.
- ✓ **Validity/Integrity/Correctness:** Data should be correct with respect to the real world entity that they represent.
- ✓ **Security:** Data should be protected from unauthorized users and access.
- ✓ **Consistency:** Whenever more than one data element in a database represents related real-world values, the values should be consistent (regular) with respect to the relationship.
- ✓ **Non-redundant:** No two data items in a database should represent the same real-world entity.

DATABASE MANAGEMENT SYSTEM

- ✓ A DBMS is a software that provides services for accessing a database, while maintaining all the required features of the data.
- ✓ A DBMS is a set of software programs that controls the organization, storage, management, and retrieval of data in a database.
- ✓ It is a set of prewritten programs that are used to store, update and retrieve a Database.
- ✓ The DBMS accepts requests for data from the application program and instructs the operating system to transfer the appropriate data.
- ✓ When a DBMS is used, information systems can be changed much more easily as the organization's information requirements change. New categories of data can be added to the database without disruption to the existing system.

SERVICES OF DBMS

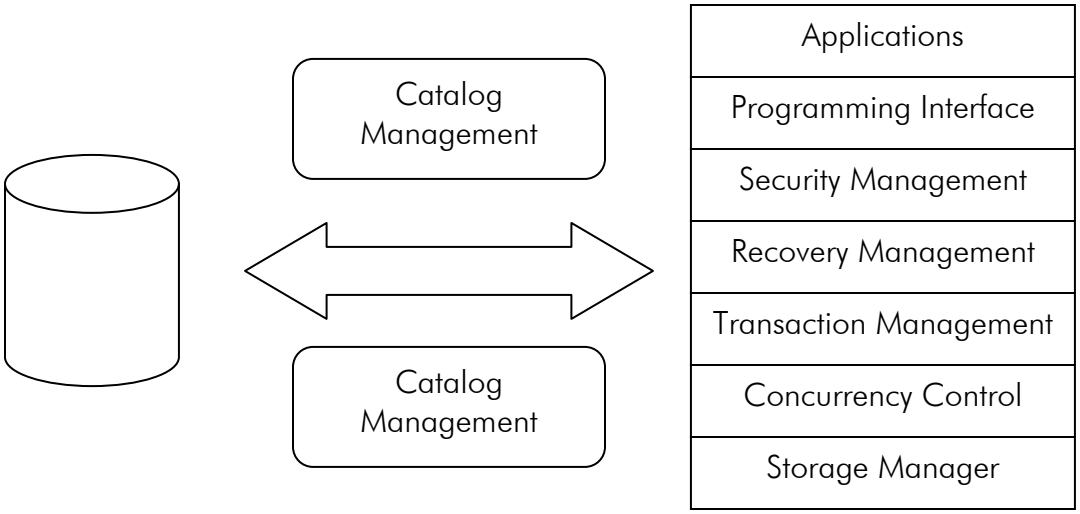


Fig: Services provided by a DBMS

Transaction Processing: A transaction is a sequence of database operations that represents a logical unit of work. It assesses a database and transforms it from one state to another. A transaction can update a record, delete one or modify a set of records. When a DBMS does a "commit", the changes made by the transaction are made permanent. If a user does not want to make the change permanent, he can rollback the transaction and the database will remain in its original state.

Concurrency Management: It is the database management activity of coordinating the actions of database manipulation processes that operates concurrently, access shared data and can potentially interfere with each other. The goal of an ideal concurrency management mechanism is to allow concurrency while maintaining the consistency of the shared data.

Recovery: The objective of recovery in a database is to ensure that the aborted of failed transactions do not create any adverse effect on the database or other transactions. It makes sure that the database is returned to a consistent state after a transaction fails or aborts. Recovery is a very much related to concurrency in the sense that, the more the concurrency, the more is the chance of an aborted transaction affecting many other transactions.

Security: Security refers to the protection of data against unauthorized access. Security mechanisms make sure that only authorized users are given access to the data in the database. The level of access is for each user and the operations that each user can perform on the data will be monitored and controlled by the DBMS depending on the access privileges of the users.

Language Interface: The DBMS provides support languages used for the definition and manipulation of the data in the database. By providing language support for data definition and manipulation the DBMS create an environment where the users can do their jobs without worrying about the physical implementation.

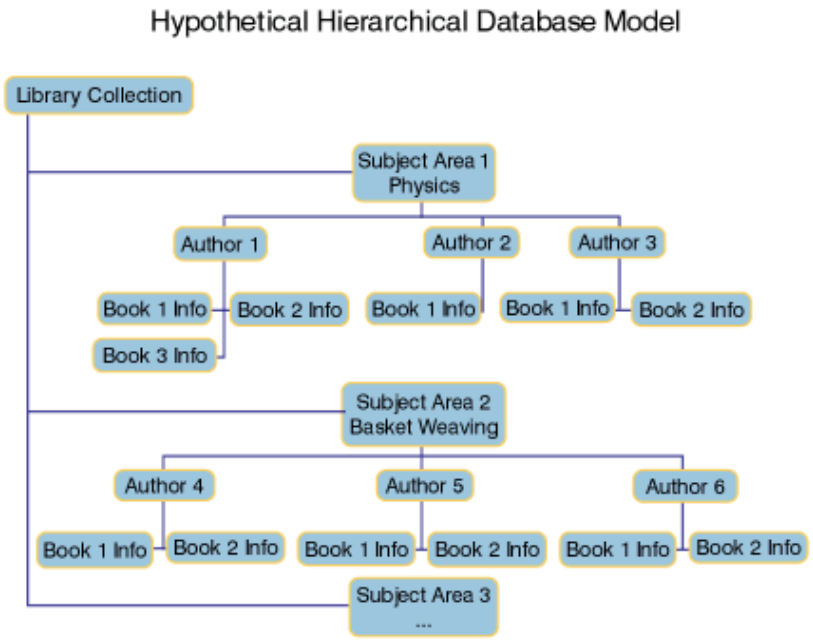
Data Catalog: Data catalog or Data Dictionary is a system database that contains the descriptions of data in the database (metadata). It contains information about data, relationship, constraints and the entire schema that organize these features into unified database. It also gives the information about the structure of the database.

Storage Management: The DBMS provides a mechanism for the management of permanent storage of the data.

DATABASE MODELS

Hierarchical Model

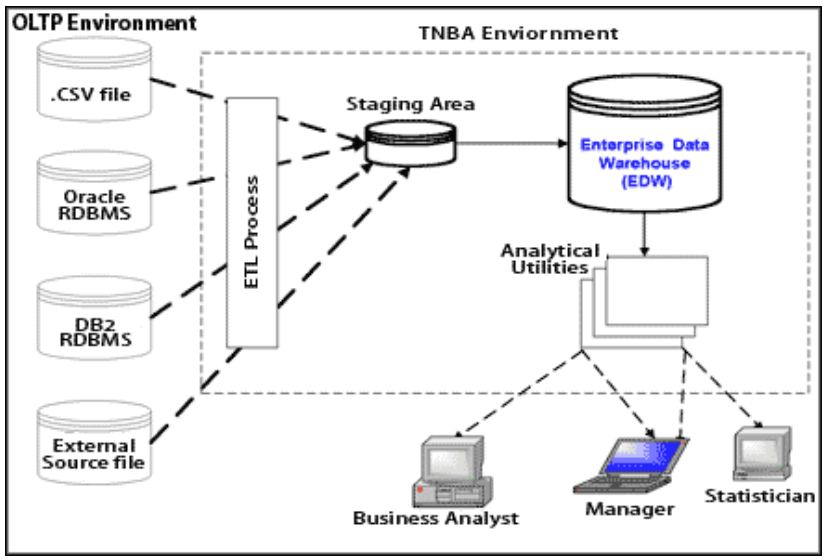
The hierarchical data model organizes data in a tree structure. There is a hierarchy of parent and child data segments. This structure implies that a record can have repeating information, generally in the child data segments. Data is a series of records, which have a set of field values attached to it. It collects all the instances of a specific record together as a record type. These record types are the equivalent of tables in the relational model, and with the individual records being the equivalent of rows. To create links between these record types, the hierarchical model uses Parent Child Relationships. These are a 1:N mapping between record types. This is done by using trees, like set theory used in the relational model, "borrowed" from maths.



For example, an organization might store information about an employee, such as name, employee number, department, salary. The organization might also store information about an employee's children, such as name and date of birth. The employee and children data forms a hierarchy, where the employee data represents the parent segment and the children data represents the child segment. If an employee has three children, then there would be three child segments associated

with one employee segment. In a hierarchical database the parent-child relationship is one to many. This restricts a child segment to having only one parent segment.

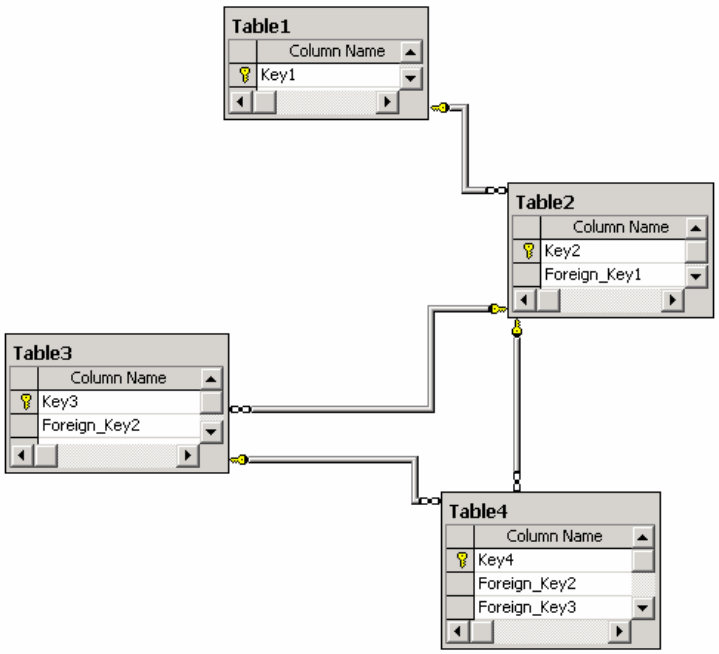
Network Model



The popularity of the network data model coincided with the popularity of the hierarchical data model. Some data were more naturally modeled with more than one parent per child. So, the network model permitted the modeling of many-to-many relationships in data. In 1971, the Conference on Data Systems Languages (CODASYL) formally defined the network model. The basic data modeling construct in the network model is the set construct. A set consists of an owner record type, a set name, and a member record type. A member record type can have that role in more than one set, hence the multiparent concept is supported. An owner record type can also be a member or owner in another set. The data model is a simple network, and link and intersection record types (called junction records by IDMS) may exist, as well as sets between them. Thus, the complete network of relationships is represented by several pairwise sets; in each set some (one) record type is owner (at the tail of the network arrow) and one or more record types are members (at the head of the relationship arrow). Usually, a set defines a 1:M relationship, although 1:1 is permitted. The CODASYL network model is based on mathematical set theory.

Relational Model

Developed by E.F. Codd, a relational database allows the definition of data structures, storage and retrieval operations and integrity constraints. In such a database the data and relations between them are organized in tables. A table is a collection of records and each record in a table contains the same fields.



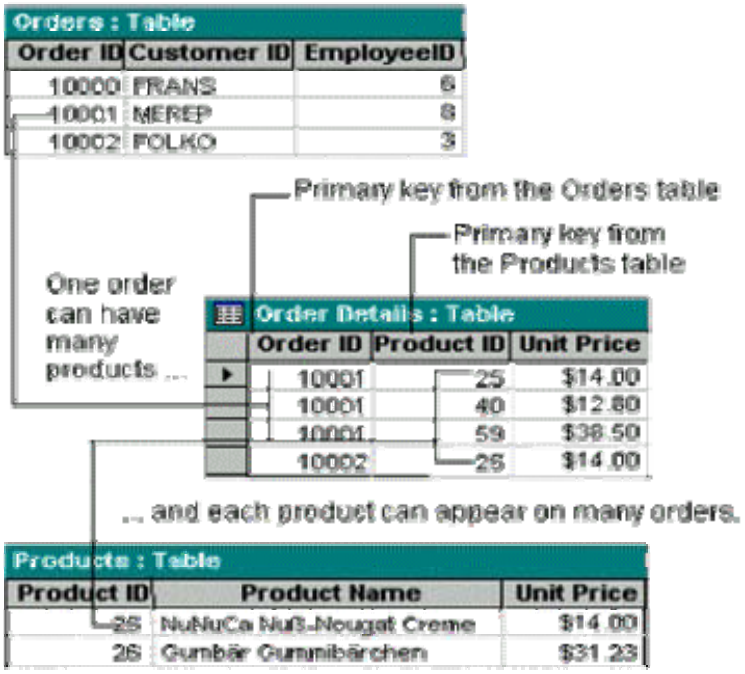
Properties of Relational Tables:

- Values Are Atomic
- Each Row is Unique
- Column Values Are of the Same Kind
- The Sequence of Columns is Insignificant
- The Sequence of Rows is Insignificant
- Each Column Has a Unique Name

Certain fields may be designated as keys, which mean that searches for specific values of that field will use indexing to speed them up. Where fields in two different tables take values from the same set, a join operation can be performed to select related records in the two tables by matching values in those fields. Often, but not always, the fields will have the same name in both tables. For example, an "orders" table might contain (customer-ID, product-code) pairs and a "products" table might contain (product-code, price) pairs so to calculate a given customer's bill you would sum the prices of all products ordered by that customer by joining on the product-code fields of the two tables. This can be extended to joining multiple tables on multiple fields. Because these relationships are only specified at retrieval time, relational databases are classed as dynamic database management system. The RELATIONAL database model is based on the Relational Algebra.

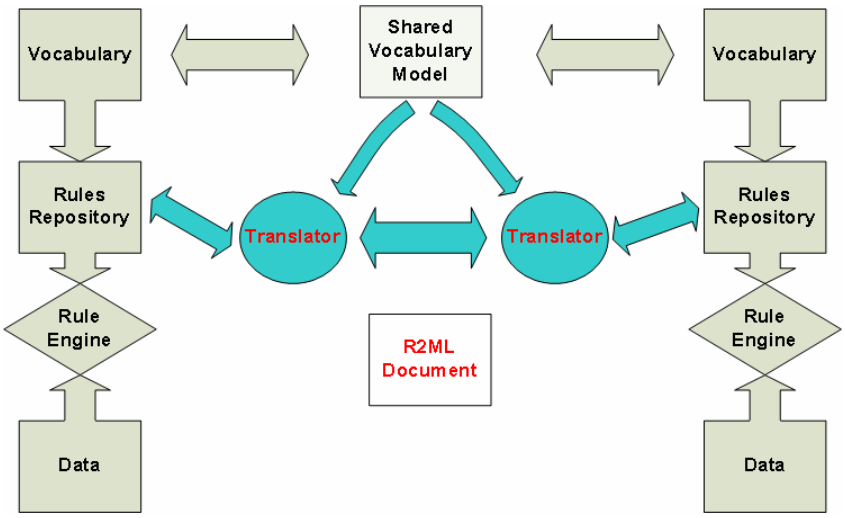
Object-Oriented Model

Object oriented DBMS add database functionality to object programming languages. They bring much more than persistent storage of programming language objects. Object oriented DBMS extends the semantics of the C++, Smalltalk and Java object programming languages to provide full-featured database programming capability, while retaining native language compatibility. A major benefit of this approach is the unification of the application and database development into a seamless data model and language environment. As a result, applications require less code, use more natural data modeling, and code bases are easier to maintain. Object developers can write complete database applications with a modest amount of additional effort.



In contrast to a relational DBMS where a complex data structure must be flattened out to fit into tables or joined together from those tables to form the in-memory structure, object DBMSs have no performance overhead to store or retrieve a web or hierarchy of interrelated objects. This one-to-one mapping of object programming language objects to database objects has two benefits over other storage approaches: it provides higher performance management of objects, and it enables better management of the complex interrelationships between objects. This makes object DBMSs better suited to support applications such as financial portfolio risk analysis systems, telecommunications service applications, World Wide Web document structures, design and manufacturing systems, and hospital patient record systems, which have complex relationships between data.

Deductive/Inference Model



A deductive model stores as little data as possible but compensates by maintaining rules that allow new data combinations to be created when needed. A deductive database system is a database system which can make deductions based on rules and facts stored in the database. Datalog is the language typically used to specify facts, rules and queries in deductive databases. Deductive databases have grown out of the desire to combine logic programming with relational databases to construct systems that support a powerful formalism and are still fast and able to deal with very large datasets. Deductive databases are more expressive than relational databases but less expressive than logic programming systems. Deductive databases have not found widespread adoptions outside academia, but some of their concepts are used in today's relational databases to support the advanced features of more recent SQL standards.

PRELUDE

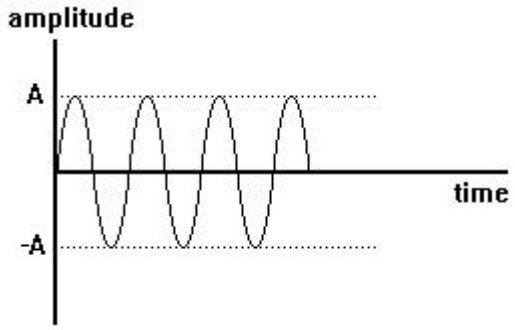
- ✓ refers to all types of data transmission from voice to video.
- ✓ is the transmission of signals over a distance for the purpose of communication.
- ✓ A telecommunication system consists of three basic elements:
  - o a sender that sends information
  - o a transmission medium that carries the information and,
  - o a receiver that receives the information and converts it back into usable information.
- ✓ Telecommunication over a telephone line is called point-to-point communication because it is between one transmitter and one receiver.
- ✓ Telecommunication through radio broadcasts is called broadcast communication because it is between one powerful transmitter and numerous receivers.

The information carrying signals are divided into two broad classes;

- ✓ Analog
- ✓ Digital

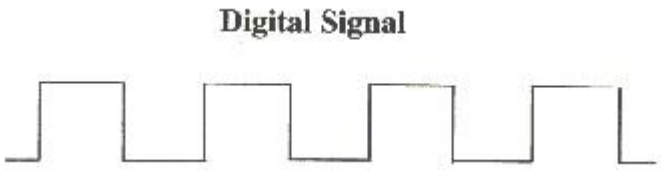
ANALOG SIGNALS

- ✓ Analog signals are continuous electrical signals that vary in time.
- ✓ Analog systems are very tolerant to noise, make good use of bandwidth, and are easy to manipulate mathematically.
- ✓ analog signals require hardware receivers and transmitters that are designed to perfectly fit the particular transmission. While working on a new system, one needs to completely change your transmitters and receivers if there is a change in analog signal.



DIGITAL SIGNALS

- ✓ A digital signal is a discrete signal. It is depicted as discontinuous values of voltage.
- ✓ A digital signal has the following characteristics:
  - o Holds a fixed value for a specific length of time
  - o Has sharp, abrupt changes
  - o A preset number of values allowed



- ✓ Digital signals are intolerant to noise, and digital signals can be completely corrupted in the presence of excess noise. In digital signals, noise could cause a 1 to be interpreted as a 0 and vice versa, which makes the received data different than the original data.
- ✓ Imagine if the army transmitted a position coordinate to a missile digitally, and a single bit was received in error? This single bit error could cause a missile to miss its target by miles. Luckily, there are systems in place to prevent this sort of scenario, such as checksums and CRCs, which tell the receiver when a bit has been corrupted and ask the transmitter to resend the data. The primary benefit of digital signals is that they can be handled by simple,

standardized receivers and transmitters, and the signal can be then dealt with in software (which is comparatively cheap to change).

MODULATION

- ✓ is the process, or results of the process, whereby some characteristic of one signal is varied in accordance with another signal. The modulated signal is called the carrier.
- ✓ Is the process of changing some characteristics of the carrier wave (high frequency wave used to carry the signals) is modulation.
- ✓ The carrier may be modulated in three fundamental ways: by varying the amplitude, called amplitude modulation; by varying the frequency, called frequency modulation; by varying the phase, called phase modulation.
- ✓ A device that performs modulation is known as a modulator and a device that performs the inverse operation of modulation is known as a demodulator (sometimes detector or demod). A device that can do both operations is a modem (short for "Modulator-Demodulator").

WHY MODULATION?

Modulation is necessary in communication due to the following reasons.

- ✓ **Antenna Length**: In order to transmit a wave efficiently, the length of the transmitting antenna should be nearly equal to the wavelength of the wave. So, for transmitting audio wave of very high wavelength, very long antennas are required which is practically impossible.
- ✓ **Operation Range**: The energy of a wave depends upon its frequency. The greater the frequency of the wave, the greater the energy possessed by it. As the audio signal frequencies are small, they cannot be transmitted over long distance.
- ✓ **Wireless Communiation:** At audio frequencies, radiation is not practical because the efficiency of radiation is poor at low frequencies. Hence, wireless communcation would be impractical in such case.

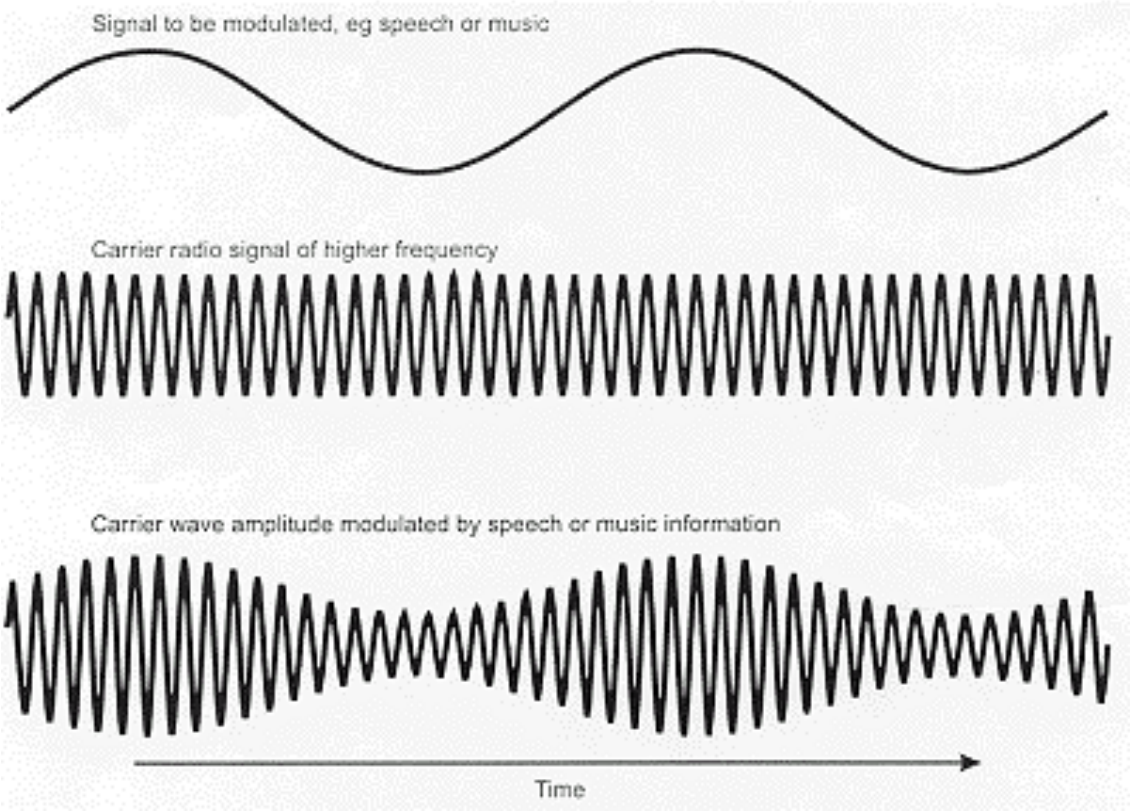
The only practical solution for the above problems is to modulate a high frequency carrier wave with the audio signal and permit the transmission to occur at this high frequency.

TYPES OF MODULATION

1. Amplitude Modulation (AM)
2. Frequency Modulation (FM)
3. Phase Modualtion (PM)

1. Amplitude Modulation (AM)

- ✓ When the amplitude of the high frequency carrier wave is changed in accordance with the intensity of the signal it is called amplitude modulation.
- ✓ The amplitude of the carrier wave changes according to the intensity of the signal.
- ✓ The amplitude variations of the carrier wave is at the signal frequency
- ✓ The frequency of the amplitude moduated wave remains the same - carrier frequency.
- ✓ The depth of modulation is defined by a modulation factor. It determines the extent to which the amplitude of the carrier wave is changed.
- ✓ AM radio ranges from 535 to 1705kHz



Limitations of Amplitude Modulation

- ✓ **Noise Reception:** In an AM wave, the signal is in the amplitude variations of the carrier. Practically, all natural and human voices consist of electrical amplitude disturbances. A radio receiver can't distinguish between amplitude vibrations that represent noise and those that contain the desired signal, reception is generally noisy.
- ✓ **Small Operting Range:** Due to low frequency of amplitude modulation, transmitters employing this method have a small operating range.
- ✓ **Lack of audio quality:** In order to attain high-fidelity reception all audio frequencies upto 15 KHz must be reproduced. This necessitates bandwidth of 30 KHz, but AM broadcasting stations are assigned bandwidth of only 10KHz to minimize interference from adjacent broadcating stations. This means that the highest modulating frequency can be 5 KHz, which is hardly sufficient to reproduce the signal properly.

2. Frequency Modulation (FM)

- ✓ Frequency modulation conveys information over a carrier wave by varying its frequency and the amplitude of the carrier remains constant.
- ✓ The FM radio band goes from 88 to 108 MHz

Advantages

- It gives noiseless reception. Noise is a form of amplitude vibration and FM receivers reject such signals.
- Operating range is quite large.
- It gives high-fidelity (quality) reception
- The efficiency of transmission is very high.

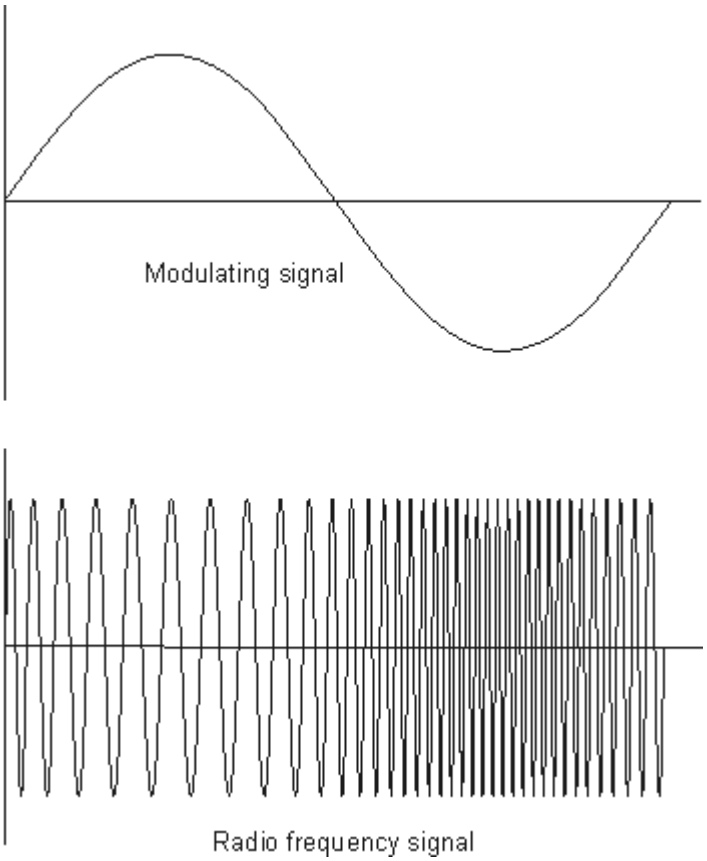


Fig: Frequency Modulation

3. Phase Modulation

- ✓ Phase modulation is the change in the carrier phase angle.
- ✓ The phase angle cannot change without affecting a change in frequency. Hence, it is taken as a second form of frequency modulation.

MODEMS

- ✓ Modem is a device that modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information.
- ✓ The goal is to produce a signal that can be transmitted easily and decoded to reproduce the original digital data.
- ✓ Modems can be used over any means of transmitting analog signals, from driven diodes to radio.
- ✓ Modems are generally classified by the amount of data they can send in a given time, normally measured in bits per second, or "bps". They can also be classified by Baud, the number of times the modem changes its signal state per second.

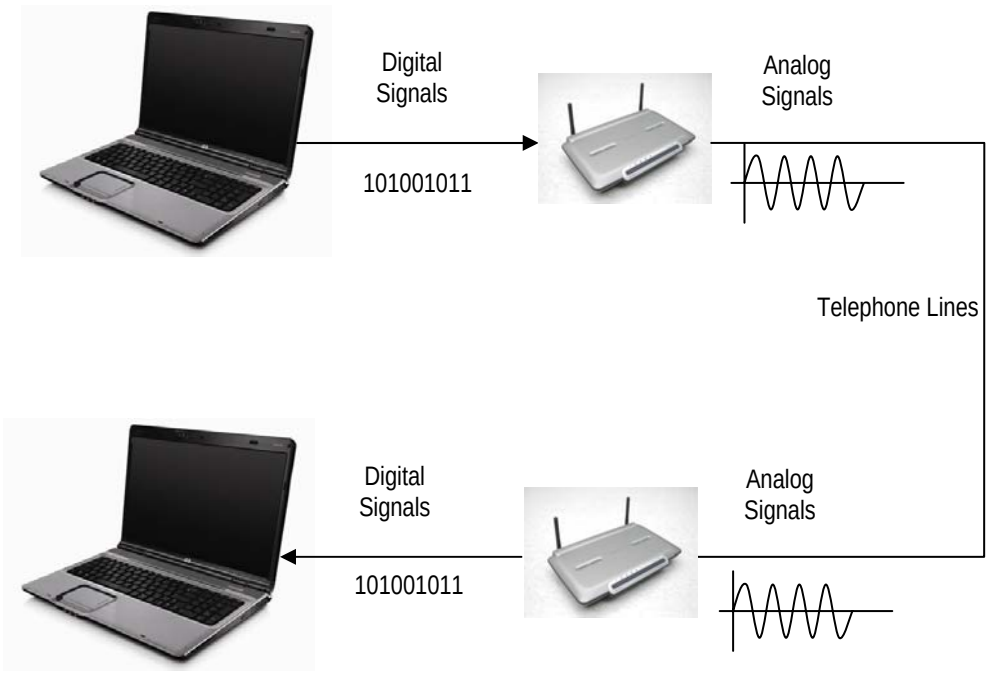


Fig: How MODEM Works

Transfer Speeds

- ✓ Measured in bps (bits per second)
- ✓ General MODEM used for internet connection are 14.4 kbps modems
- ✓ 28.8 kbps, 33.6 kpbs, 56 kbps modems are available in the market.

PRELUDE

INTERNET

- ✓ A worldwide network of computers that can be accessed via the TPL computer network. The Internet allows local computer users to find and use information resources on computers of other academic institutions, research institutes, private companies, government agencies and individuals.

FEATURES OF INTERNET

- ✓ Geographic Distribution
- ✓ Near Light Speed
- ✓ Universal Access
- ✓ The Digital Advantage
- ✓ Freedom Of Speech
- ✓ Ease Of Use
- ✓ Universal Access
- ✓ Search Capabilities
- ✓ Usenet/Newsgroups Features
- ✓ Group Communications
- ✓ IRC Features
- ✓ Distributed Real-Time Communications
- ✓ Emergency Assistance
- ✓ Virtual Space
- ✓ One-to-many communication.

INTERNET PROTOCOLS

- ✓ A protocol is the set of standard rules for data representation, signaling, authentication and error detection required to send information over a communications channel.
- ✓ Protocols for digital computer network communication have features intended to ensure reliable interchange of data over an imperfect communication channel.

TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL (TCP/IP)

- ✓ is the protocol used in the Internet.
- ✓ has to major components: TCP and IP
- ✓ The IP does the following works.
  - o Envelops and addresses the data
  - o Enables the network to read the envelope and forward the data to its destination.
  - o Defines how much data can fit in a single envelope (a packet)
- ✓ The TCP does the following works.
  - o Breaks data up into packets that the network can handle efficiently
  - o Verifies whether all the packets have arrived at their destination
  - o "Reassembles" the data

- ✓ The IP protocol deals only with packets whereas TCP enables two hosts to establish a connection and exchange streams of data. TCP guarantees delivery of data and also guarantees that packets will be delivered in the same order in which they were sent.

FILE TRANSFER PROTOCOL (FTP)

- ✓ File Transfer Protocol (FTP) is a network protocol used to transfer data from one computer to another through a network such as the Internet.
- ✓ used for exchanging and manipulating files over a TCP computer network. An FTP client may connect to an FTP server to manipulate files on that server.
- ✓ Works on the client/server principal.
- ✓ FTP sites are typically used for uploading and downloading files to a central server computer, for the sake of file distribution.
- ✓ In order to download and upload files to an FTP site, we need to connect using special FTP software. Files can be transferred and stored on computers called FTP servers. To access these files, an FTP client program is used.
- ✓ Files on FTP servers are often compressed which deceases the size and enables more files to be stored on the server. It also makes file transfer time shorter.

HYPERTEXT TRANSFER PROTOCOL (HTTP)

- ✓ set of rules that governs the transfer of hypertext between two or more computers.
- ✓ The information of WWW is available through HTTP
- ✓ HTTP is a request/response standard between a client and a server. A client is the end-user; the server is the web site.
- ✓ HTTP is based on the client server principal. HTTP allows client to establish a connection with the server and make a request. The server accepts the connection initiated by the client and sends back a response. An HTTP request identifies the resource that the client is interested in and tells the server what action to take on the resource.
- ✓ The client making a HTTP request—using a web browser is referred to as the user agent. The responding server—which stores or creates resources such as HTML files and images—is called the origin server. In between the user agent and origin server may be several intermediaries, such as proxies, gateways, and tunnels. HTTP is not constrained to using TCP/IP and its supporting layers, although this is its most popular application on the Internet. Indeed HTTP can be "implemented on top of any other protocol on the Internet, or on other networks. HTTP only presumes a reliable transport; any protocol that provides such guarantees can be used."
- ✓ Typically, an HTTP client initiates a request. It establishes a Transmission Control Protocol (TCP) connection to a particular port on a host (port 80 by default). An HTTP server listening on that port waits for the client to send a request message. Upon receiving the request, the server sends back a status line, such as "HTTP/1.1 200 OK", and a message of its own, the body of which is perhaps the requested resource, an error message, or some other information.

TELNET

- ✓ Telnet is a protocol that enables one computer to connect to another computer and such control is referred to as remote login.
- ✓ The user's computer which initiates the connection is referred to as the local computer and the machine being connection to, which accepts the connection is referred to as the remote, host computer.
- ✓ Once connected, the user has full control over the remote host during the telnet session.

GOPHER

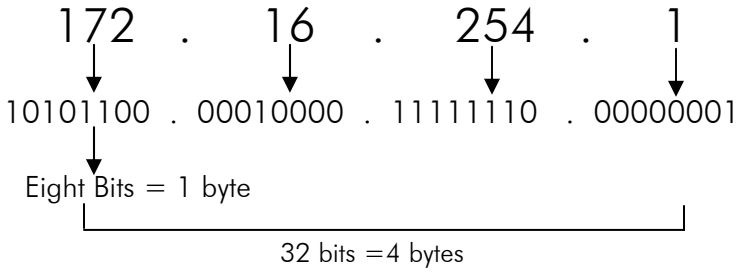
- ✓ is a protocol designed to search, retrieve and display documents from remote sites on the Internet.
- ✓ It is also possible to initiate online-connections with other systems via Gopher.
- ✓ Information accessible via Gopher is stored in Gopher servers. These servers do not just contain files, directories and searchable databases but also reference to other servers.
- ✓ To retrieve and search this information, one needs to run a Gopher client application like TurboGopher.
- ✓ Gopher was created as a piece of software to utilize some of the services that were becoming available on the Internet. It was designed to work with a variety of different Internet stand alone service.
- ✓ Gopher works on the following Internet tools and systems
  - o Search local WAIS (Wide Area Information Service) indices; query remote WAIS servers and funnel the results to Gopher clients
  - o Query remote FTP sites and funnel the results to Gopher clients.
  - o Be queried by WWW clients either using built in Gopher querying or using native HTTP querying.

WIDE AREA INFORMATION SERVICE (WAIS)

- ✓ is an internet search tool that is based on Z39.50 standard. This standard describes a protocol, for computer to computer information retrieval.
- ✓ A WAIS client program enables the user's computer to contact a WAIS server, submit a search query and receive a response to that query.
- ✓ WAIS has the capability of simultaneously searching in more than one database.

INTERNET ADDRESSING

- ✓ is the systematic way to identify people, computers and internet resources.
- ✓ An Internet Protocol (IP) address is a numerical identification (logical address) that is assigned to devices participating in a computer network utilizing the Internet Protocol for communication between its nodes. Although IP addresses are stored as binary numbers, they are usually displayed in human-readable notations, such as 208.77.188.166 (for IPv4), and 2001:db8:0:1234:0:567:1:1 (for IPv6).
- ✓ The role of the IP address has been characterized as follows: "A name indicates what we seek. An address indicates where it is. A route indicates how to get there."
- ✓ Consists of four sections separated by periods. Each section contains a number ranging from 0 to 255.
- ✓ IPv4 uses 32-bit (4-byte) addresses, which limits the address space to 4,294,967,296 (2^{32}) possible unique addresses where the address size was increased from 32 to 128 bits (16 bytes) in IPV6



- ✓ The IP addresses have the following characteristics in common.
  - o IP addresses are unique
  - o No two machines can have the same IP number.
  - o IP addresses are also global and standardized.
  - o All machines connected to the Internet agree to use the same scheme for establishing an address.

DOMAIN NAME

- ✓ A domain name is a way to identify and lcoate computer connected to the internet. No two organizations have the same domain name.
- ✓ A domain name usually has two parts separated by periods called dot.
- ✓ E.g. Microsoft.com, intel.com
- ✓ The last portion of the domain name is the top level domain name which describes the type of the organization.
  - o Com – commercial entities
  - o Edu – education institutions
  - o Net – organization directly involved in Internet operations
  - o Org – organizations
  - o Gov- government entities
  - o Mil – military entites
  - o Country code- np for Nepal, uk- United Kingdom, Fr- France
- ✓ Each domain name corresponds to an IP address.
- ✓ The DNS server is responsible for translation of domain names to IP address.

ELECTRONIC MAIL

- ✓ Electronic mail is a method of creating, transmitting, or storing primarily text-based human communications with digital communications systems.
- ✓ Modern e-mail systems are based on a store-and-forward model in which e-mail computer server systems, accept, forward, or store messages on behalf of users, who only connect to the e-mail infrastructure with their personal computer or other network-enabled device for the duration of message transmission or retrieval to or from their designated server.

URL

- ✓ A Uniform Resource Locator specifies where an identified resource is available and the mechanism for retrieving it. In popular language, a URL is also referred to as a Web address.
- ✓ URL represents a standardized addressing scheme for Internet resources and helps the users to locate these resources by indicating exactly where they are.

WWW

- ✓ The World Wide Web begun in 1992 by MIT professor Tim Berners-Lee working at the European Organization for Nuclear Research (CERN) in Geneva, Switzerland.
- ✓ He developed a programming language called HTML on which the web is based. Early web pages contained only text but due to rapid development in technology, the pages now contain pictures and multimedia elements as well.

- ✓ The World Wide Web (commonly abbreviated as "the Web") is a system of interlinked hypertext documents accessed via the Internet.
- ✓ WWW is the universe of information available via HTTP.
- ✓ With a Web browser, one can view Web pages that may contain text, images, videos, and other multimedia and navigate between them using hyperlinks.
- ✓ The WWW is used as a market place, art gallery, library, community center, school or whatever the authors create.
- ✓ The WWW and HTTP
  - o allow you to create "links" from one of information to another
  - o can incorporate references to sounds, graphics, movies, animations and simulations.
  - o Communicate with other Internet protocols such as FTP, Gopher and Telnet

WEB PAGES AND HTML

- ✓ A web page is single unit information often called a document that is available via the WWW.
- ✓ A web page is a resource of information that is suitable for the World Wide Web and can be accessed through a web browser. This information is usually in HTML format, and may provide navigation to other web pages via hypertext links.
- ✓ Web pages may be retrieved from a local computer or from a remote web server. The web server may restrict access only to a private network, e.g. a corporate intranet, or it may publish pages on the World Wide Web. Web pages are requested and served from web servers using Hypertext Transfer Protocol (HTTP).
- ✓ Web pages may consist of files of static text stored within the web server's file system (static web pages), or the web server may construct the (X)HTML for each web page when it is requested by a browser (dynamic web pages). Client-side scripting can make web pages more responsive to user input once in the client browser.
- ✓ HTML stands for hypertext Markup language which consists of standardized codes or tags that are used to define the structure of information on a web page. These codes enable web pages to have many features including bold text, italics, headings, lists, tables, forms and frames.

HTML TAGS

- ✓ HTML Tags is a set of Code to identify the different parts of a document so that a web browser will know how to display it.
- ✓ The HTML is enclosed within the angle brackets <>.
- ✓ HTML tags may be paired or unpaired.
  - o Paired tag : Tags with a closing tag [ ]
  - o Unpaired tag: tags without closing tag [
 <hr>]

WEB BROWSERS

- ✓ is an application software that acts as an interface between the user and the inner-workings of the WWW
- ✓ is a software application which enables a user to display and interact with text, images, videos, music, games and other information typically located on a Web page at a Web site on the World Wide Web or a local area network.

- ✓ Web browsers format HTML information for display, so the appearance of a Web page may differ between browsers.
- ✓ Web browsers are the most-commonly-used type of HTTP user agent. Although browsers are typically used to access the World Wide Web, they can also be used to access information provided by Web servers in private networks or content in file systems.
- ✓ E.g. Microsoft Internet Explorer, Mozilla Firefox, Netspace Navigator, Opera, Maxthon etc.

SEARCHING THE WEB

- ✓ The web is the information superhighway and finding information on the web can be done using two approaches: browsing through subject trees and hierarchies (web index) and keyword searching using the search engine.

WEB INDEX

- ✓ is designed to assist users in locating information on the WWW. Web indexes are also referred to as catalogs or directories.
- ✓ A web index collects and organizes resources available via the WWW.
- ✓ Indexes may be alphabetic or topic based moving from general to specific

SEARCH ENGINE

- ✓ is an interactive tool to help the user locate information avaliable via the WWW.
- ✓ is a tool designed to search for information on the WWW. Information may consist of web pages, images, information and other types of files. Some search engines also mine data available in newsbooks, databases, or open directories. Unlike Web directories, which are maintained by human editors, search engines operate algorithmically or are a mixture of algorithmic and human input.
- ✓ are the databases that contain thousands of resources and return the desired and possible results based on the query of the user.

INTERNET RELAY CHAT

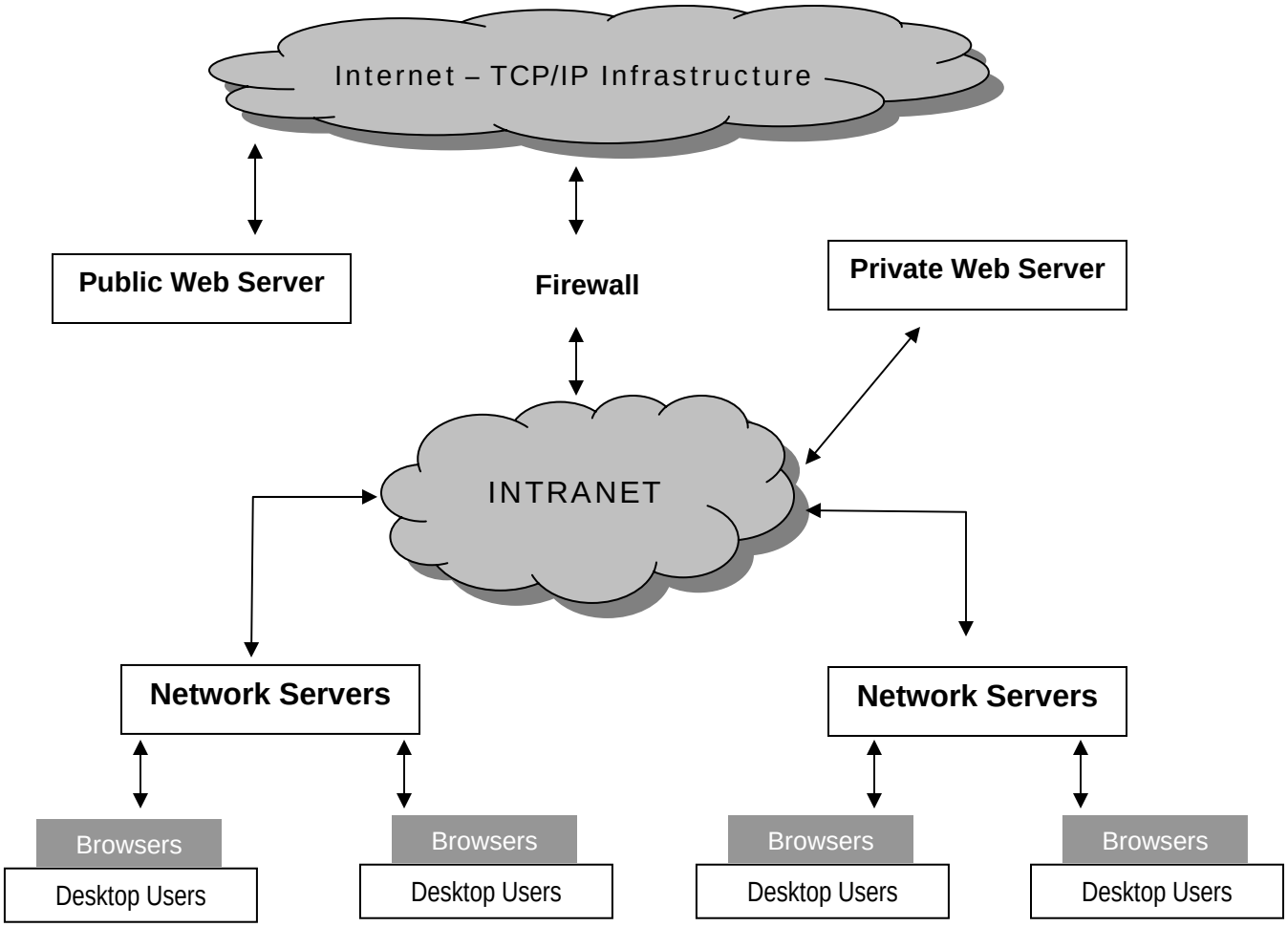
- ✓ is a form of real-time Internet chat or synchronous conferencing.
- ✓ mainly designed for group communication in discussion forums called channels (virtual locations on IRC networks where users talk to one another), but also allows one-to-one communication via private message, as well as chat and data transfers via Direct Client-to-Client.
- ✓ IRC was created by Jarkko Oikarinen in Late August 1988.
- ✓ To take part in an IRC session, a client program is required.

ISP AND ITS FUNCTIONS

- ✓ ISP, also called Internet access provider or IAP is a company that offers its customers access to the Internet.
- ✓ connects to its customers using a data transmission technology appropriate for delivering Internet Protocol datagrams, such as dial-up, DSL, cable modem or dedicated high-speed interconnects.
- ✓ ISPs may provide Internet e-mail accounts to users which allow them to communicate with one another by sending and receiving electronic messages through their ISPs' servers.
- ✓ ISPs may provide other services such as remotely storing data files on behalf of their customers, as well as other services unique to each particular ISP.

PRELUDE

- ✓ An intranet is a private computer network that uses Internet technologies to securely share any part of an organization's information or operational systems with its employees.
- ✓ An intranet is built from the same concepts and technologies used for the Internet, such as client-server computing and TCP/IP.
- ✓ Any of the well known Internet protocols may be found in an intranet, such as HTTP (web services), SMTP (e-mail), and FTP (file transfer).
- ✓ An intranet can be understood as a private version of the Internet, or as a private extension of the Internet confined to an organization.
- ✓ An organization's intranet does not necessarily have to provide access to the Internet. When such access is provided it is usually through a network gateway with a firewall, shielding the intranet from unauthorized external access. The gateway often also implements user authentication, encryption of messages, and often virtual private network (VPN) connectivity for off-site employees to access company information, computing resources and internal communications.
- ✓ When part of an intranet is made accessible to customers and others outside the business, that part becomes part of an extranet. Businesses can send private messages through the public network, using special encryption/decryption and other security safeguards to connect one part of their intranet to another.



CHARACTERISTICS/BENEFITS

- ✓ Workforce productivity: Intranets can also help users to locate and view information faster and use applications relevant to their roles and responsibilities. With the help of a web browser interface, users can access data held in any database the organization wants to make available, anytime and - subject to security provisions - from anywhere within the company workstations, increasing employees' ability to perform their jobs faster, more accurately, and with confidence that they have the right information. It also helps to improve the services provided to the users.
- ✓ Time: With intranets, organizations can make more information available to employees on a "pull" basis (i.e., employees can link to relevant information at a time which suits them) rather than being deluged indiscriminately by emails.
- ✓ Communication: Intranets can serve as powerful tools for communication within an organization. By providing information on the intranet, staffs have the opportunity to keep up-to-date with the strategic focus of the organization.
- ✓ Business operations and management: Intranets are also being used as a platform for developing and deploying applications to support business operations and decisions across the internetworked enterprise.
- ✓ Cost-effective: Users can view information and data via web-browser rather than maintaining physical documents such as procedure manuals, internal phone list and requisition forms.
- ✓ Promote common corporate culture: Every user is viewing the same information within the Intranet.
- ✓ Enhance Collaboration: With information easily accessible by all authorized users, teamwork is enabled.

DRAWBACKS OF INTRANETS

Management concerns	✓ Management fears loss of control ✓ Hidden or unknown complexity and costs ✓ Potential for chaos
Security concerns	✓ Unauthorized access ✓ Abuse of access ✓ Denial of service ✓ Packet Sniffing
Productivity concerns	✓ Overabundance of information ✓ Information overload lowers productivity ✓ Users set up own web pages

- ✓ Performance Limitations: Some applications that have been well optimized for conventional systems create a heavy system workload while migrating them to an Internet platform.

- ✓ Software compatibility problems: It is an evolving technology that requires upgrades and could have software incompatibility problems
- ✓ Security features can be inadequate
- ✓ Inadequate system performance management and poor user support
- ✓ May not scale up adequately
- ✓ Maintaining content can be time consuming
- ✓ Some employees may not have PCs at their desks

DIFFERENCE BETWEEN INTERNET AND INTRANET

Parameter	The Internet	An Intranet
Security	Low (None/Some)	High
Speed	Low/Medium	High
Services	Almost unlimited	Specified by Organization
Access Control	None or limited. Public encouraged to visit.	Account Name and Password. Generally no external (public) access.
Membership	Unlimited. 50 +/- 20 million.	Population of Organization
Reliability	Low	High (Mission Critical)
Control	Low (None)	High

EXTRANET

- ✓ It is a business-to-business intranet that allows limited, controlled, secure access between a company's intranet and designated, authenticated users from remote locations.
- ✓ It is an intranet that allows controlled access by authenticated parties.
- ✓ An extranet can be viewed as part of a company's intranet that is extended to users outside the company
- ✓ As with intranet, access is granted only where one establishes that it is required.
- ✓ User access is controlled by security technologies to protect sensitive material from intrusion.

PRELUDE

- Multimedia describes any application that uses multiple media (graphics, text, animations, audio, and video).
- Multimedia is primarily thought of as any application that uses high-bandwidth media (audio and video) and is most often delivered on CD-ROM.
- Multimedia does not describe the purpose of the application, such as game or a presentation.
- Multimedia also describes electronic media devices used to store and experience multimedia content. Multimedia is similar to traditional mixed media in fine art, but with a broader scope. The term "rich media" is synonymous for interactive multimedia.
- Multimedia comprises of two words “multi” and “media” meaning “many” and “material” through which information may be transmitted.
- Multimedia is the dissemination of computer-controlled information in more than one form that includes the use of text, audio, graphics, animated graphics, video, and motion pictures where every type of information can be represented, stored, transmitted and processed digitally.
- It presents information in a more structured, presentable and understandable manner.

Multimedia System

- Multimedia systems are those computer platforms and software tools that support the interactive uses of text, graphics, animation, audio or motion pictures.
- It is the computer able to handle multiple media, store, digitize, compress, retrieve and decompress the information.
- It includes hardware like CD-ROM, Sound Card such as Sound Blaster or Master Blaster, Microphone, Head Phones, Digital Camera, Speakers, Home Theaters and Multimedia Projectors.

Multimedia Technology

- It is the special computerized technique which helps user by providing methods to combine text, images, and sound or motion pictures.
- It facilitates the user to create, store, edit, delete and copy data.
- Standard file formats are used to create or store multimedia information
- Graphics are stored in .bmp, .jpg, .gif, .tif, .pif, .png formats
- Audio is stored in .wav, .mp3, .wma formats
- Videos and motions pictures are stored in .mpg, .avi, .3gp formats

Software Used In Multimedia

Multimedia is widely used in web, offices, educational presentations, game or business presentation, entertainment, trainings. Hence, programmers or software developers use a variety of software as per the requirement.

- Java (Programming Language)
- Real Audio Or Shock wave (Utilities)
- Active –X of Open Dock
- Windows Media Player
- Flash, Photoshop, Pagemaker, Dreamweaver, 3D-Max, Maya (Graphics, Designing, Editing)

Hardware Used In Multimedia

- High quality display monitors (at least VGA)
- Input device such as mouse, keyboard and scanner
- Voice display facility – sound card, external speakers and a microphone
- Image compression and decompression facility
- Video capture card, mass storage device like CD-ROMs or USB (Universal Serial Bus)
- At least 486 processor with inbuilt math co-processor

Application Areas of Multimedia

- The capability of multimedia technology to handle different type of media makes them suitable for wide range of applications and users.
- It has gained world wide acceptance in almost al the areas of human interest whether it is business, presentation or simulation education or training entertainment, video, graphics, or animations. Some of the areas where multimedia could have direct impact are
  - Video Games
  - Multimedia Presentation
  - Special Effects in Film
  - Public Accessing/Touch Screen Monitors
  - Animated Advertisement
  - Foreign Language Learning
  - Virtual Reality
  - Edutainment
  - Software Training
  - Internet And Interactive Web Pages
  - Office Work
  - Multimedia Server and databases

Virtual Reality

- It is an artificial environment created with computer hardware and software and presented to the user in such a way that it appears real.
- It uses headsets and data gloves.
- It enhances multimedia by supporting real time, interactive three dimensional graphics

Advantages of Multimedia

- It makes teaching learning easier in the classroom
- It makes sharing of views, ideas and thoughts among various people around the world easy.
- It can store the data and information for long time.
- It is very cheap to get the knowledge about the related subject matter in a short time through multimedia.
- It is very easy to use, handle, carry, copy and store data.
- It allows adding audio, video, text and graphics to make the subject matter interactive and attractive.
- It has a wide use in interactive web pages, video conferencing, distance education and seminars.

PRELUDE

- Electronic commerce, commonly known as e-commerce or eCommerce, consists of the buying and selling of products or services over electronic systems such as the Internet and other computer networks.
- The amount of trade conducted electronically has grown extraordinarily since the spread of the Internet. A wide variety of commerce is conducted in this way, spurring and drawing on innovations in electronic funds transfer, supply chain management, Internet marketing, online transaction processing, electronic data interchange (EDI), inventory management systems, and automated data collection systems.
- Modern electronic commerce typically uses the World Wide Web at least at some point in the transaction's lifecycle, although it can encompass a wider range of technologies such as e-mail as well.
- A large percentage of electronic commerce is conducted entirely electronically for virtual items such as access to premium content on a website, but most electronic commerce involves the transportation of physical items in some way. Online retailers are sometimes known as e-tailers and online retail is sometimes known as e-tail. Almost all big retailers have electronic commerce presence on the World Wide Web.
- Electronic commerce that is conducted between businesses is referred to as business-to-business or B2B. B2B can be open to all interested parties (e.g. commodity exchange) or limited to specific, pre-qualified participants (private electronic market). Electronic commerce that is conducted between businesses and consumers, on the other hand, is referred to as business-to-consumer or B2C. This is the type of electronic commerce conducted by companies such as Amazon.com.
- Electronic commerce is generally considered to be the sales aspect of e-business. It also consists of the exchange of data to facilitate the financing and payment aspects of the business transactions.

TYPES OF E-COMMERCE

1. Business to Business
2. Business to Customer
3. Digital Middleman

B2B- BUSINESS TO BUSINESS

- B2B is the selling or buying between companies, wholesale rather than retail.
- B2B involves widening the circle of suppliers (for safety and competition), and of centralizing control (for records and discounts).
- B2B ecommerce is an important part of any online business. Leaving aside the simple transfer of funds, many businesses need some combination of:
    - Credit worthiness assessment.
    - Guarantee of quality and delivery of goods (escrow services).
    - Safeguards against fraud.
    - Fast collection of funds, with ability to vary the collection period.
    - Reporting: approval of sale, invoicing, delivery, payment.
    - Procedures to handle disputes.

B2C - Business to Consumer

- B2C refers to a business communicating with or selling to an individual rather than a company. B2C e-commerce jumped from $11.2 billion in 1998 to $31.2 billion in 1999.
- Doing business online no longer requires a huge investment by retailers as it is through template-based online stores and is delivered over the internet.
- As nearly all online stores require the same functions: catalogues, order baskets, payment processing, content management and member management, it makes sense for those components to be created once and shared by all stores, with each store effectively 'renting' its own copy of the applications.
- Using the latest internet application technology, individual sites can be created within minutes of the retailer selecting a template and supplying graphics such as logos. Typically, retailers will pay only a modest monthly rental charge – and retailers require no specialist hardware or software, other than internet access.
- Anyone who wants to sell products and services over the internet, or who wants customers to be able to research their purchases on the internet, should consider an online store.
- These days, a web site should be a standard part of the promotional and advertising mix for every business, along with other tools such as Yellow Pages, newspaper advertising and signage.

Advantages of B2C E-commerce

- Shopping can be faster and more convenient.
- Offerings and prices can change instantaneously.
- Call centers can be integrated with the website.
- Broadband telecommunications will enhance the buying experience.

Challenges faced by B2C e-commerce

- The two main challenges faced by B2C e-commerce are building traffic and sustaining customer loyalty. Due to the winner-take-all nature of the B2C structure, many smaller firms find it difficult to enter a market and remain competitive. In addition, online shoppers are very price-sensitive and are easily lured away, so acquiring and keeping new customers is difficult.

Digital Middleman

- The digital middleman in e-commerce could be a company that creates a virtual community or portal on the Internet and then gathers several companies together into this community.
- The middleman this promotes this new virtual community to the public.
- Some of these communities are service or product specific and all the companies in the community provide only a specific type of service or product to the visitors.
- The virtual community provides information of the products and services of each company to the visitors allowing them to do comparisons and select the best deal.
- The middleman takes a fee from the companies for each Internet referral.
- Some digital middleman act as **auction houses or flea markets** where sellers put up their advertisements and buyers bid for the items. The digital middleman takes a small commission from each transaction.

ADVANTAGES OF E-BUSINESS APPLICATIONS

Catalog flexibility and Online fast updating

- Direct "link" capabilities to content information and visual displays already existing on other client web site. You can update your E-Catalog anytime, whether it's adding new products, or adjusting prices, without the expense and time of a traditional print catalog.
- Extensive search capabilities by item, corporate name, division name, location, manufacturer, partner, price or any other specified need.

Shrinks the Competition Gap

- Reduced marketing/advertising expenses compete on equal footing with much bigger companies; easily compete on quality, price, and availability.

Unlimited Market Place and Business Access Which Extend Customer Base

- The Internet gives customers the opportunity to browse and shop at their convenience and at their place. They can access your services from home, office, or on the road, 24 hours a day, 7 days a week.
- The Internet allows you to reach people around the world, offering your products to a global customer base.

A 24 Hour Store Reduced Sale Cycle

- Reduce unnecessary phone calls and mailings.

Lower Cost of Doing Business

- Reduce inventory, employees, purchasing costs, order processing costs associated with faxing, phone calls, and data entry, and even eliminate physical stores. Reduce transaction costs.

Eliminate Middlemen

- Sell directly to your customers.

Easier Business Administration

- With right software, store inventory levels, shipping and receiving logs, and other business administration tasks can be automatically stored, categorized and updated in real-time, and accessed on demand.

Frees Your Staff

- Reduce customer service and sales support.

Customers will love it

- Gives customers control of sales process. Builds loyalty.

More Efficient Business Relationships

- Better way to deal with dealers and suppliers.

Workflow automation

- Shipping, real time inventory accounting system which adjusts stock levels and site, location availability instantaneously
- Secured, automated registration verification, account entry and transaction authorization features
- Automated RFP and RTQ features for vendor bid development and selection.
- Banking and accounting features customized for pre-approved third party direct sales, vendor, consignment or internal transfer transactions.

Secure Payment Systems

- Recent advancements in payment technologies allow encrypted, secure payment online.

PRELUDE

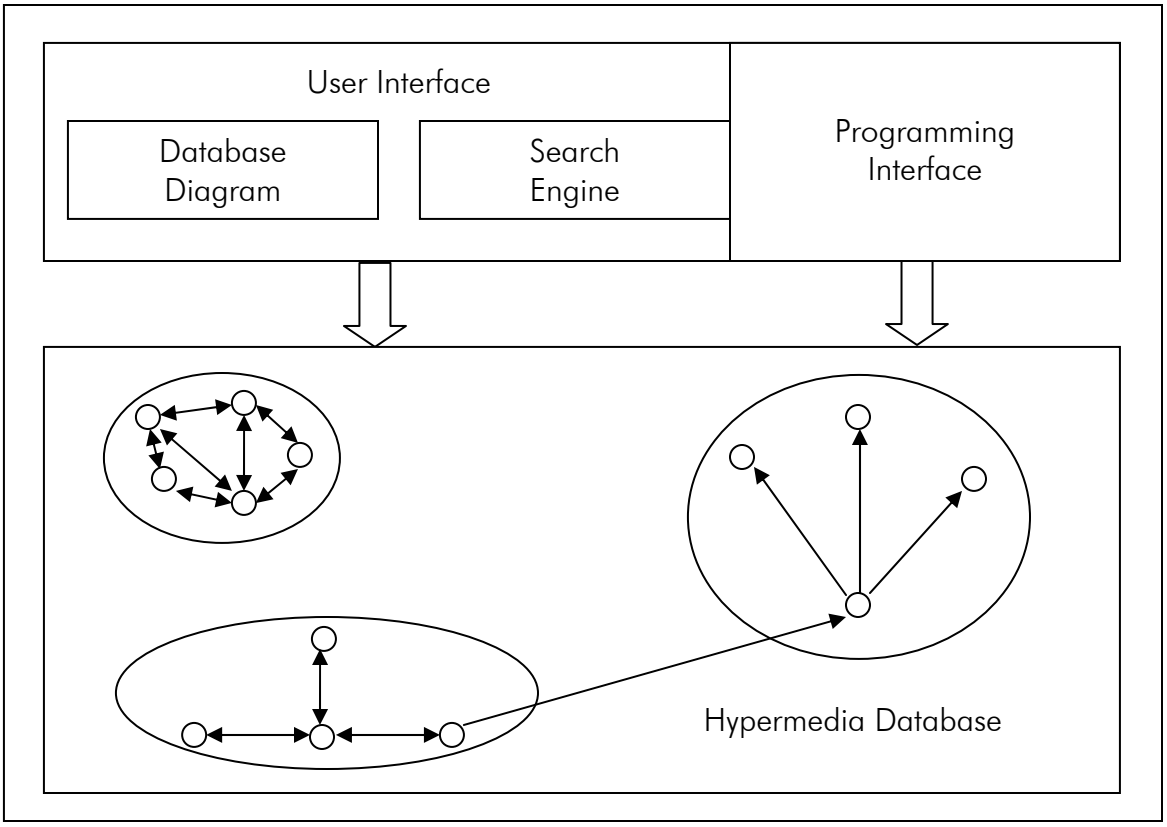
- ✓ Hypermedia is used as a logical extension of the term hypertext in which graphics, audio, video, plain text and hyperlinks intertwine to create a generally non-linear medium of information.
- ✓ It is a network containing several interlinked information units called nodes and the connection between the nodes are called links.
- ✓ It contrasts with the broader term multimedia, which may be used to describe non-interactive linear presentations as well as hypermedia.
- ✓ The World Wide Web is a classic example of hypermedia, whereas a non-interactive cinema presentation is an example of standard multimedia due to the absence of hyperlinks.
- ✓ Most modern hypermedia is delivered via electronic pages from a variety of systems including Media players, web browsers, and stand-alone applications. Audio hypermedia is emerging with voice command devices and voice browsing.
- ✓ Multimedia development software such as Adobe Flash, Adobe Director, Macromedia Authorware, and MatchWare Mediator may be used to create stand-alone hypermedia applications, with emphasis on entertainment content.
- ✓ Some database software such as Visual FoxPro and FileMaker Developer may be used to develop stand-alone hypermedia applications, with emphasis on educational and business content management.
- ✓ Hypermedia applications may also be developed on embedded devices for the mobile using the specification from W3C (World Wide Web Consortium).

CHARACTERISTICS

- ✓ It must be possible to use hypermedia both for writing and reading information.
- ✓ The information comprises non sequential structures and may thus be followed along alternative paths.
- ✓ The information must follow natural association from one information unit to another.
- ✓ The information may be hierarchically structured.
- ✓ Each information unit is presented in a separate on screen window.
- ✓ It must possible to share the information or parts of it among several users.
- ✓ It must be possible to have several people working against the database at the same time.
- ✓ The information resides in a database.

COMPONENTS OF HYPERMEDIA

- ✓ the different components of a hypermedia consists of nodes, links, hyperdocuments, database diagrams, a search engine and a programming interface.
- ✓ The information itself in hypermedia consists of a number of hyperdocuments shown in dotted areas in the figure. The hyperdocuments again are built by a collection of nodes and links. Each hyperdocument comprises an independent, limited topic and each node is an independent information unit. Links handle a natural switch from one node to another thus structuring the hyperdocument.



- ✓ The user's access to information occurs through the user interface which directly goes to the hypermedia base. The user then follows the links from node to node based on the information contained in each node.

- ✓ A database diagram is a graphic overview of the hyperdocument. It allows the user to navigate directly between nodes in the hyperdocument, without following the links.

- ✓ A search engine is a mechanism that allows a user to search directly for information in the hypermedia database. Search engines may find nodes of a certain type or names or nodes containing specific information. Advanced hypermedia systems may have search engines which allow the formulation of direct query in the hyperbase.

- ✓ The programming interface enables the creation of special applications for the existing hypermedia systems. It may also be used to add new features to the system. It may, for example, be used to connect the hypermedia database to more advanced search routines or to link to other applications allowing these to access the information in the hypermedia database.

APPLICATION AREAS OF HYPERMEDIA

- ✓ **Literature Systems:** Different types of literature require organizing the material, as well as references to other liteture. Literature systems lend themselves well to the rich ways of structuring information afforded by hypermedia. Documents are kept together by mean of organization links. This structure may be created by the author,or it may be the original structure of a document which has been converted from printed text to hypermedia. References to other parts of the document and to other documents are handled by reference links. This allows direct references to other documents, if the other document are in the hyperbase.

- ✓ **Publishing:** Compared to traditional printed information media, hypermedia has the advantage of being able to present other information that text and pictures. Information objects such as audio and film may be included in a document. As this publishing is electronic, it will be easier to distribute than traditional printed matter.

- ✓ **Instruction System:** Hypermedia is often employed in interactive instrution systems. The student may move around at will in the information, hopefully learning while jumping from node to node. Instruction systems require the ability to guide the student through the material, creating recommended paths to follow. A simple way to add comments is also required.

- ✓ **Problem Solving Systems:** This types of system is used for inter-group communication. When using hypermedia's opportunites for allowing a number of users to access the same information set, a work group may seek solutions to different issues. Discussions, document sharing, and the ability to let work group members comment on the work of other members are typical features of such systems.

- ✓ **Idea Tools:** A number of experts have argued that the linear structure of traditional documents is inadequate for representing thoughts and ideas. As hypermedia offers a non-linear structure, it may well be an appropriate tool for structuring thoughts and ideas.

PRELUDE

- ✓ Data warehouse is a repository of an organization's electronically stored data and are designed to facilitate reporting and analysis
- ✓ Also emphasizes on the means to retrieve and analyze data, to extract, transform and load data, and to manage the data dictionary.
- ✓ An expanded definition for data warehousing includes business intelligence tools, tools to extract, transform, and load data into the repository, and tools to manage and retrieve metadata (data about data).
- ✓ In contrast to data, warehouses are operational systems that perform day-to-day transaction processing.
- ✓ A data warehouse is a collection of computer-based information that is critical to successful execution of enterprise initiatives
- ✓ It provides a tool to satisfy the information needs of the employee's at all organizational levels-not just for complex data queries but as a general facility for getting quick, accurate and often insightful information.
- ✓ It is designed so that its users can recognize the information they want and access that information using simple tools.
- ✓ One of the principal reasons for developing a Data Warehouse is to integrate operational data from various sources into a single and consistent architecture that supports analysis and decision making with the enterprise.
- ✓ Some of the applications data warehousing can be used for are:
    - o Credit card churn analysis
    - o Insurance fraud analysis
    - o Call record analysis
    - o Logistics management (part of Supply Chain Management that plans, implements, and controls the efficient, effective, forward, and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements)

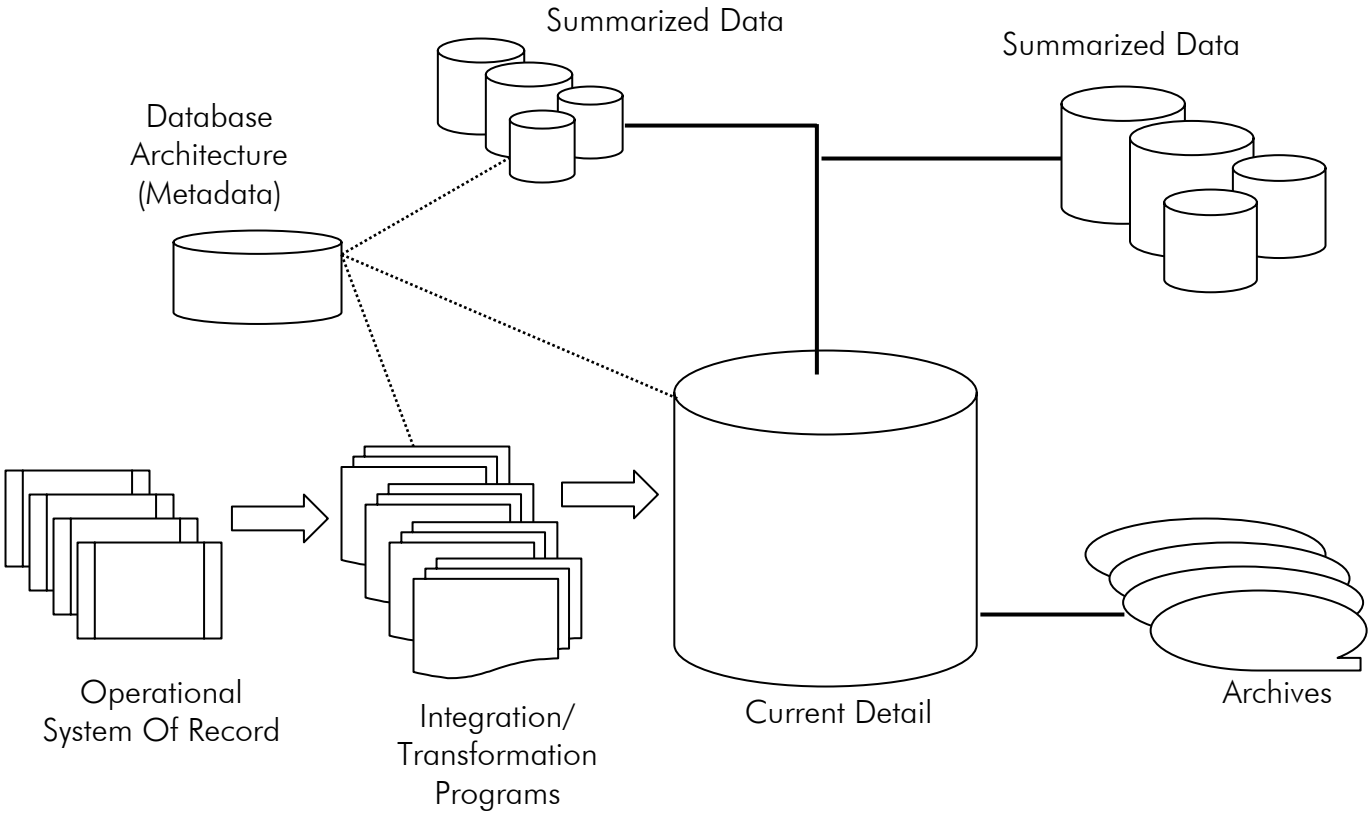
ADVANTAGES

- **More cost effective decision making:** A data warehouse allows reduction of staff and computer resources required to support queries and reports against operational and production database. This typically offers significant savings.
- **Better enterprise intelligence:** Increased quality and flexibility of enterprise analysis arises from the multi-level data structure which guarantees data accuracy and reliability ensuring that a Data Warehouse contains only "trusted" data.
- **Enhanced customer service:** An enterprise can maintain better customer relationships by correlating all customer data via a single Data Warehouse Architecture.
- **Business reengineering:** Allowing unlimited analysis of enterprise information often provides insights to enterprise processes that may yield breakthrough ideas for engineering those processes. Knowing what information is important to an enterprise will provide direction and priority for reengineering efforts.
- A data warehouse provides a common data model for all data of interest regardless of the data's source. This makes it easier to report and analyze information than it would be if

multiple data models were used to retrieve information such as sales invoices, order receipts, general ledger charges, etc.

- Prior to loading data into the data warehouse, inconsistencies are identified and resolved. This greatly simplifies reporting and analysis.
- Information in the data warehouse is under the control of data warehouse users so that, even if the source system data is purged (washed out) over time, the information in the warehouse can be stored safely for extended periods of time.
- Because they are separate from operational systems, data warehouses provide retrieval of data without slowing down operational systems.
- Data warehouses can work in conjunction with and, hence, enhance the value of operational business applications, notably customer relationship management (CRM) systems.
- Data warehouses facilitate decision support system applications such as trend reports (e.g., the items with the most sales in a particular area within the last two years), exception reports, and reports that show actual performance versus goals.

DATA WAREHOUSE COMPONENTS



Components Of A Data Warehouse

The major components of data warehouse are:

- Summarized Data
- Current Details
- Operational System of Record
- Integration/Transformation Programs
- Archives
- Data Warehouse Architecture or Metadata

Summarized Data:

- ✓ Classified into two categories: **lightly summarized** and **highly summarized**
- ✓ Lightly summarized data are the hallmark (trademark) of data warehouse as all enterprise elements do not have the same information requirement. They include less data than the total data stored in current detail.
- ✓ Highly summarized data are primarily for enterprise executives. They come from either the lightly summarized data used by enterprise elements or from current detail. Data volume at this level is much less than other levels.

Current Detail:

- ✓ It is the heart of the data warehouse where the whole bulk of data resides.
- ✓ Comes directly from operational systems of records and may be stored as raw data or as aggregations of raw data.
- ✓ It is the lowest level of data granularity which is typically two to five years old.

Operational System of Record:

- ✓ It is a source of the data that feeds the Data Warehouse.
- ✓ It is necessary for a Data Warehouse to be populated with the highest quality of data that is most timely, accurate, and complete and has the best structural conformance to the Data Warehouse.
- ✓ Often, these data are closest to the source of entry into the production environment. In other cases, a system of record may be containing already summarized data.

Integration/Transformation Programs

- ✓ As operational data items pass from their systems of record to a data warehouse, integration and transformation programs convert them from application-specific data into enterprise data. These integration and transformation programs functions such as:
  - o Reformatting, recalculating or modifying key structures
  - o Adding time elements
  - o Identifying default values
  - o Supplying logic to choose between multiple data sources
  - o Summarizing, tallying and merging data from multiple sources

Archives

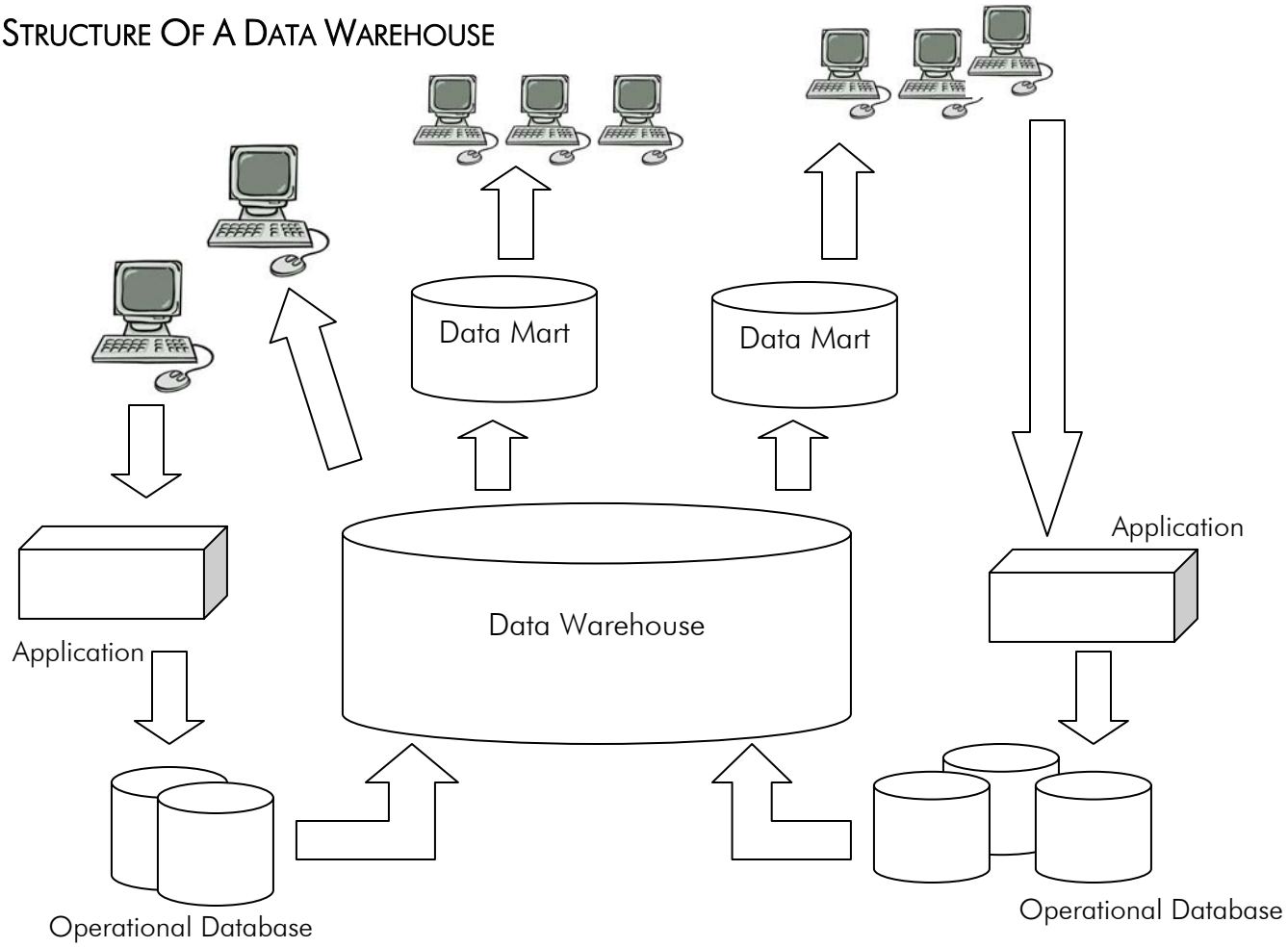
- ✓ Contains old data (normally over two years old) of significant, continuing interest and value to the enterprise.

- ✓ There is usually a massive amount of data stored in the Data Warehouse archives, with a low rate of access.
- ✓ Archives data are most often used for forecasting and trend analysis.
- ✓ Archives not only include old data, they also include the metadata that describes the old data's characteristic.

Metadata:

- ✓ Metadata is "data about other data", of any sort in any media.
- ✓ An item of metadata may describe an individual datum, or content item, or a collection of data including multiple content items and hierarchical levels.
- ✓ Metadata is definitional data that provides information about or documentation of other data managed within an application or environment.
- ✓ Metadata may include descriptive information about the context, quality and condition, or characteristics of the data. It may be recorded with high or low granularity.
- ✓ Data Warehouse developers use it to manage and control Data Warehouse creation and maintenance.
- ✓ For example, metadata would document data about data elements or attributes, (name, size, data type, etc) and data about records or data structures (length, fields, columns, etc) and data about data (where it is located, how it is associated, ownership, etc.).

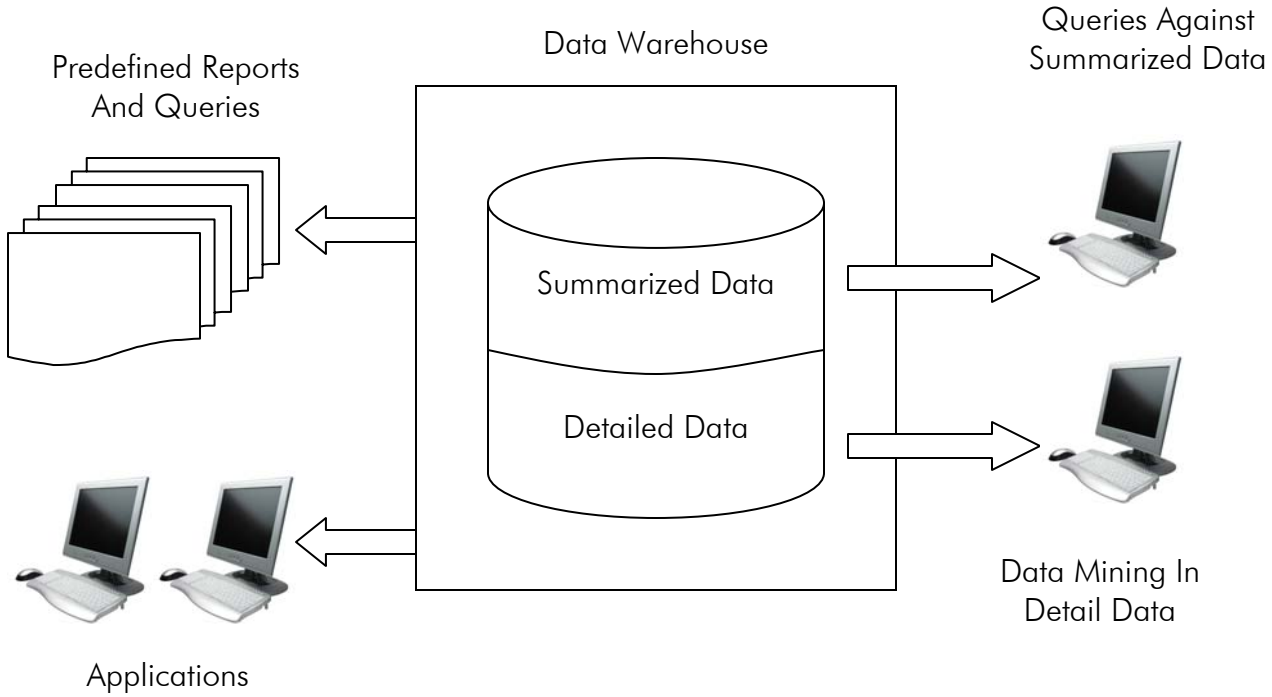
STRUCTURE OF A DATA WAREHOUSE



The structure of Data Warehouse consists of:

- Physical Data Warehouse:
  - ✓ Physical database in which all the data for the Data Warehouse is stored, along with metadata and processing logic for scrubbing, organizing, packaging and processing the detail data.
- Logical Data Warehouse:
  - ✓ It also contains metadata, including enterprise rules and processing logic for scrubbing, organizing, packaging and processing the data but does not contain actual data.
  - ✓ Instead it contains the information necessary to access the data wherever they reside.
  - ✓ This structure is effective only when there is a single source for the data and they are known to be accurate and timely.
- Data Marts:
  - ✓ Data Mart is a subset if an enterprise-wide Data Warehouse, which typically supports an enterprise element (department, region).
  - ✓ As part of an iterative Data Warehouse development process, an enterprise builds a series of physical (or logical) data marts over time and links them via an enterprise-wide logical data warehouse or feeds them from a single physical warehouse.
  - ✓ The data mart is directed at a partition of data (often called a subject area) that is created for the use of a dedicated group of users.
  - ✓ A data mart might, in fact, be a set of denormalized, summarized, or aggregated data.
  - ✓ In most instances, however, the data mart is a physically separate store of data and is resident on separate database server, often a local area network serving a dedicated user group.

USES OF A DATA WAREHOUSE



Standard Reports and Queries

Many users of the data warehouse need to access a set of standard reports and queries and hence it is desirable to periodically produce a set of standard reports that are required by many different users. When these users need a particular report, they can just view the report that has already run the data warehouse system rather than running it themselves. This facility can be particularly useful for reports that take a long time to run.

Queries Against Summarized Data

The summary views in the data warehouse can be object of a large majority of analysis in a data warehouse. These views contain predefined standard business analysis.

Data Mining

Data mining is the process of extracting hidden patterns from data. As more data are gathered, with the amount of data doubling every year, data mining is becoming an increasingly important tool to transform this data into information. It is commonly used in a wide range of profiling practices, such as marketing, fraud detection and scientific discovery. Data mining can be applied to data sets of any size.

PRELUDE

- ✓ Data mining is the process of extracting hidden predictive information from a large database. As more data are gathered, with the amount of data doubling every year, data mining is becoming an increasingly important tool to transform this data into information.
- ✓ It is commonly used in a wide range of profiling practices, such as marketing, fraud detection and scientific discovery. Data mining can be applied to data sets of any size.
- ✓ Data mining tools predict future tends and behaviors, allowing businesses to make proactive, knowledge driven decisions.
- ✓ Data mining sometimes called data or knowledge discovery is the process of analyzing data from different perspectives and summarizing it into useful information.
- ✓ Data mining software is an analytical tool for analyzing data. It allows users to analyze data from many different dimensions, categorize it, and summarize the relationships identified.
- ✓ Technically, data mining is the process of finding correlations or patterns among dozens of fields in large relational databases.

Data mining consists of five major elements:

- ✓ Extract, transform, and load transaction data onto the data warehouse system.
- ✓ Store and manage the data in a multidimensional database system.
- ✓ Provide data access to business analysts and information technology professionals.
- ✓ Analyze the data by application software.
- ✓ Present the data in a useful format, such as a graph or table.

ADVANTAGES OF DATA MINING

- ✓ **Automated prediction of trends and behaviors :**
  - o Data mining automates the process of finding predictive information in large databases. Questions that traditionally required extensive hands-on analysis can now be answered directly from the data, quickly.
- ✓ **Automated Discovery of previously unknown patterns:**
  - o Data mining tools sweep through databases and identify previously hidden patterns in one step.
  - o E.g. – analysis of retail sales data to identify apparently unrelated products that are often purchased together.
- ✓ **Database can be larger in both depth and breadth:**
  - o The databases can have more columns and rows. High performance data mining allows users to explore full depth of a database, without pre-selecting a subset of variables. The data mining database contain larger samples (more rows) as they yield lower estimation errors and variance, and allow users to make conclusion about small but important segments of a population.

Data mining techniques can yield the benefits of automation on existing software and hardware platforms and can be implemented on new systems as existing platforms are upgraded and new products are developed. When data mining tools are implemented on high performance parallel processing systems, they can analyze massive databases in minutes. Faster processing means the users can experiment with more models to understand complex data. High speed makes it practical for users to analyze huge quantities of data. Larger databases, in turn, yield improved predictions.

TECHNOLOGIES USED IN DATA MINING

- ✓ **Artificial Neural Networks:** Non-linear predictive models that learn through training and resemble biological neural networks in structure.

- ✓ **Genetic Algorithms:** Optimization techniques that use processes such as genetic combination, mutation, and natural selection in a design based on the concepts of natural evolution.

- ✓ **Decision Trees:** Tree-shaped structures that represent sets of decisions. These decisions generate rules for the classification of a dataset. Specific decision tree methods include Classification and Regression Trees (CART) and Chi Square Automatic Interaction Detection (CHAID) . CART and CHAID are decision tree techniques used for classification of a dataset. They provide a set of rules that you can apply to a new (unclassified) dataset to predict which records will have a given outcome. CART segments a dataset by creating 2-way splits while CHAID segments using chi square tests to create multi-way splits. CART typically requires less data preparation than CHAID.

- ✓ **Nearest Neighbor Method:** A technique that classifies each record in a dataset based on a combination of the classes of the k record(s) most similar to it in a historical dataset (where k is 1). Sometimes called the k-nearest neighbor technique. It is also called case based reasoning.

- ✓ **Rule Induction:** The extraction of useful if-then rules from data based on statistical significance.

- ✓ **Data Visualization:** The visual interpretation of complex relationships in multidimensional data. Graphics tools are used to illustrate data relationships.

- ✓ **Evolutionary Programming:** This is the most promising branch of data mining at present. The underlying idea of the method is that the system automatically formulates hypothesis about the dependence of the target variable on other variables in the form of programs expressed in an internal programming language.

PRELUDE

- ✓ GIS is a computer based tool for mapping and analyzing things that exist and events that happens earth.
- ✓ GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts.
- ✓ A GIS helps us answer questions and solve problems by looking at your data in a way that is quickly understood and easily shared.
- ✓ A GIS captures, stores, analyzes, manages, and presents data that refers to or is linked to location.
- ✓ It is an information system that integrates, stores, edits, analyzes, shares, and displays geographic information.
- ✓ GIS applications are tools that allow users to create interactive queries (user created searches), analyze spatial information, edit data, maps, and present the results of all these operations.
- ✓ GIS is a computer based information system used to digitally represent and analyze the geographic features present on the Earth' surface and the events taking place on it.
- ✓ "Every object present on the Earth can be geo-referenced", is the fundamental key of associating any database to GIS. Here, term 'database' is a collection of information about things and their relationship to each other, and 'geo-referencing' refers to the location of a layer or coverage in space defined by the co-ordinate referencing system.
- ✓
- ✓ Geographic information science is the science underlying the geographic concepts, applications and systems, taught in degree and GIS Certificate programs at many universities.

APPLICATIONS

Geographic information system technology can be used for

- ❖ Scientific investigations
- ❖ Resource management
- ❖ Asset management
- ❖ Archaeology
- ❖ Environmental impact assessment
- ❖ Urban planning
- ❖ Cartography (Study and practice of making geographical maps)
- ❖ Criminology
- ❖ Geographic history
- ❖ Marketing
- ❖ Logistics

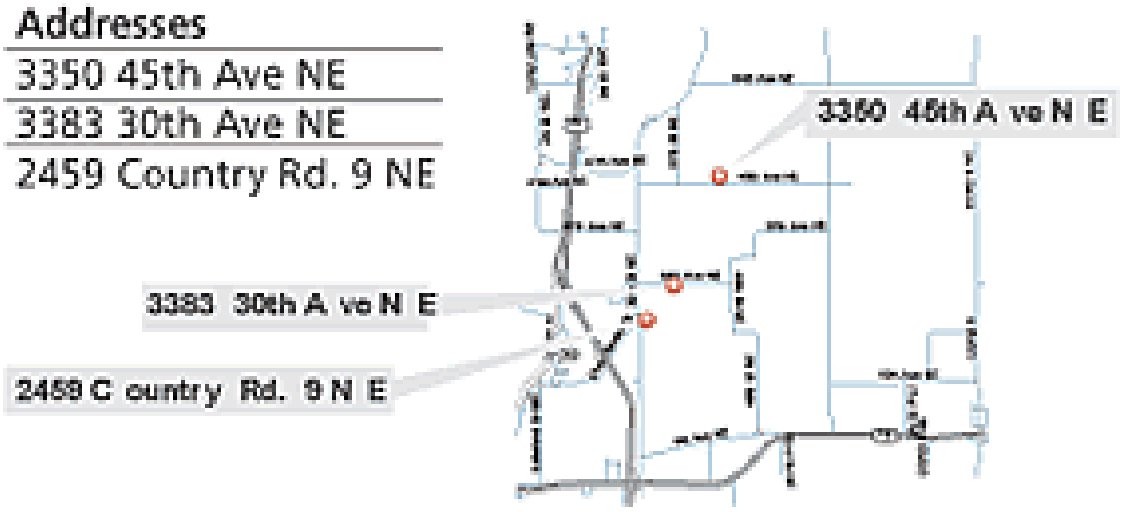
For example, GIS might allow emergency planners to easily calculate emergency response times in the event of a natural disaster, GIS might be used to find wetlands that need protection from pollution, or GIS can be used by a company to site a new business location to take advantage of a previously under-served market.

THREE VIEWS OF A GIS

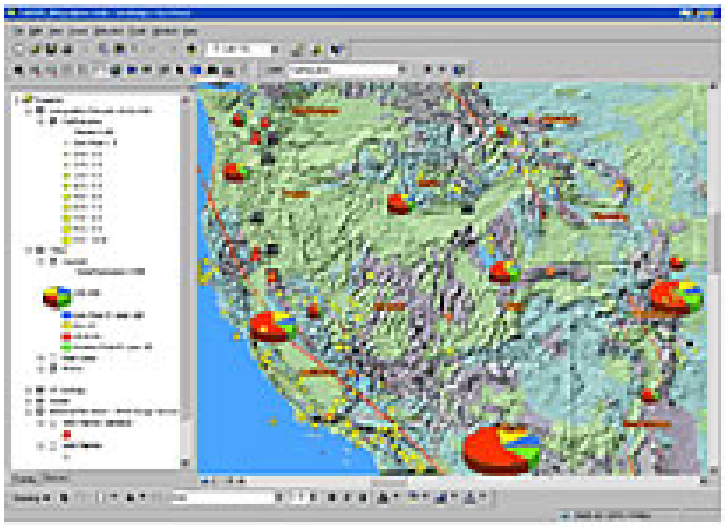
A GIS is most often associated with a map. A map, however, is only one way you can work with geographic data in a GIS, and only one type of product generated by a GIS. A GIS can provide a great deal more problem-solving capabilities than using a simple mapping program or adding data to an online mapping tool (creating a "mash-up").

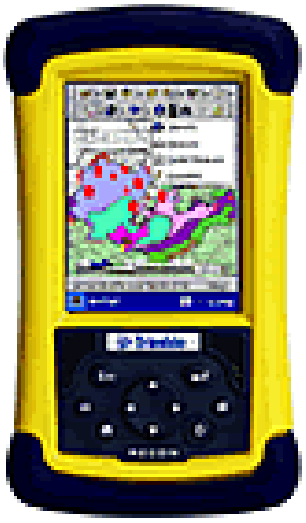
A GIS can be viewed in three ways:

1. The Database View: A GIS is a unique kind of database of the world—a geographic database (geodatabase). It is an "Information System for Geography." Fundamentally, a GIS is based on a structured database that describes the world in geographic terms.

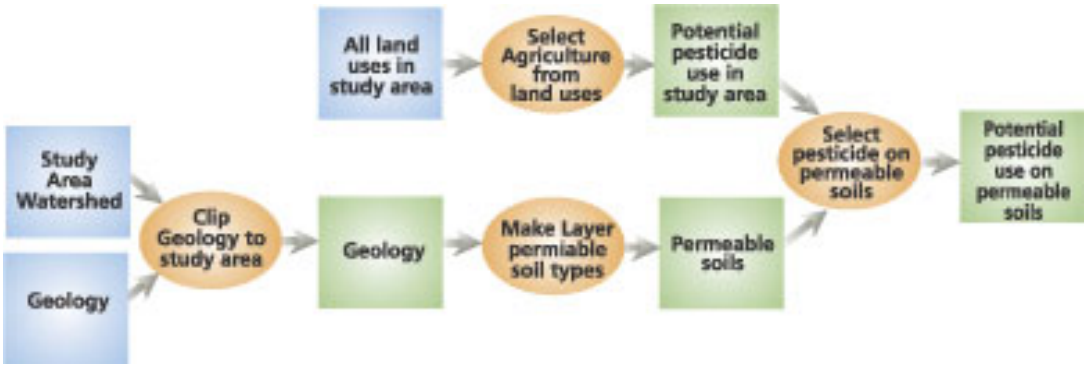


2. The Map View: A GIS is a set of intelligent maps and other views that show features and feature relationships on the earth's surface. Maps of the underlying geographic information can be constructed and used as "windows into the database" to support queries, analysis, and editing of the information.





3. The Model View: A GIS is a set of information transformation tools that derive new geographic datasets from existing datasets. These geoprocessing functions take information from existing datasets, apply analytic functions, and write results into new derived datasets.



COMPONENTS OF GIS

A working GIS integrates five key components: hardware, software, data, people and methods.

Hardware:

Hardware consists of the technical equipment needed to run a GIS including a computer system with enough power to run the software, enough memory to store large amounts of data, and input and output devices such as scanners, digitizers, GPS data loggers, media disks, and printers.

It is the computer on which a GIS operates. Today, GIS software run on a wide range of hardware types, from centralized computer servers to desktop computers used in stand alone or networked configurations.

Software:

GIS software provides the functions and tools need to store, analyze and display geographic information. Key software components are:

- Tools for the input and manipulation of geographic information
- A database management system
- Tools that support geographic query, analysis and visualization
- A graphical user interface for easy access to tools

There are many different GIS software packages available today. All packages must be capable of data input, storage, management, transformation, analysis, and output, but the appearance, methods, resources, and ease of use of the various systems may be very different. Today's software packages are capable of allowing both graphical and descriptive data to be stored in a single database, known as the object-relational model. Before this innovation, the geo-relational model was used. In this model, graphical and descriptive data sets were handled separately. The modern packages usually come with a set of tools that can be customized to the users needs (Lo, 2002).

Common GIS Software: GRASS, Quantum GIS, ILWIS, ARC View, ARC GIS, MapWindow GIS

Data:

Perhaps the most time consuming and costly aspect of initiating a GIS is creating a database. There are several things to consider before acquiring geographic data. It is crucial to check the quality of the data before obtaining it. Errors in the data set can add many unpleasant and costly hours to implementing a GIS and the results and conclusions of the GIS analysis most likely will be wrong. Several guidelines to look at include:

- Lineage – This is a description of the source material from which the data were derived, and the methods of derivation, including all transformations involved in producing the final digital files. This should include all dates of the source material and updates and changes made to it.
- Positional Accuracy – This is the closeness of an entity in an appropriate coordinate system to that entity's true position in the system. The positional accuracy includes measures of the horizontal and vertical accuracy of the features in the data set.
- Attribute Accuracy – An attribute is a fact about some location, set of locations, or features on the surface of the earth. This information often includes measurements of some sort, such as temperature or elevation or a label of a place name. The source of error usually lies within the collection of these facts. It is vital to the analysis aspects of a GIS that this information be accurate.
- Logical Consistency - Deals with the logical rules of structure and attribute rules for spatial data and describes the compatibility of a datum with other data in a data set. There are several different mathematical theories and models used to test logical consistency such as metric and incidence tests, topological and order related tests. These consistency checks should be run at different stages in the handling of spatial data.
- Completeness – This is a check to see if relevant data is missing with regards to the features and the attributes. This could deal with either omission errors or spatial rules such as minimum width or area that may limit the information.

People

The people are the component who actually makes the GIS work. They include a plethora (surplus) of positions including GIS managers, database administrators, application specialists, systems analysts, and programmers. They are responsible for maintenance of the geographic database and provide technical support. People also need to be educated to make decisions on what type of system to use. People associated with a GIS can be categorized into: viewers, general users, and GIS specialists.

- Viewers are the public at large whose only need is to browse a geographic database for referential material. These constitute the largest class of users.
- General Users are people who use GIS to conducting business, performing professional services, and making decisions. They include facility managers, resource managers, planners, scientists, engineers, lawyers and business entrepreneurs.
- GIS specialists are the people who make the GIS work. They include GIS managers, database administrators, application specialists, systems analysts, and programmers. They are responsible for the maintenance of the geographic database and the provision of technical support to the other two classes of users.

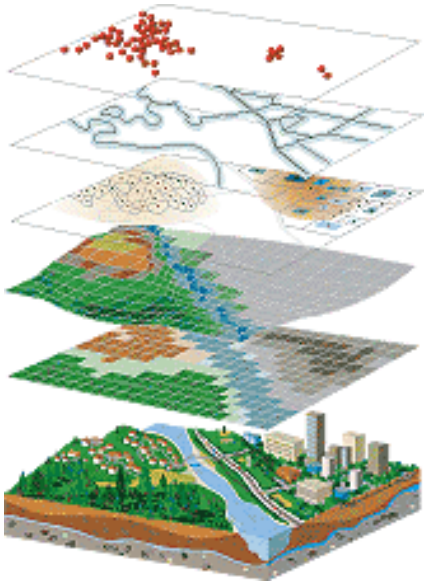
Procedures

A successful GIS operates according to a well-designed plan and business rules, which are the models and operating practices unique to each organization.

- Procedures include how the data will be retrieved, input into the system, stored, managed, transformed, analyzed, and finally presented in a final output.
- The procedures are the steps taken to answer the question that is needed to be resolved. The ability of a GIS to perform spatial analysis and answer these questions is what differentiates this type of system from any other information systems.

The transformation processes includes such tasks as adjusting the coordinate system, setting a projection, correcting any digitized errors in a data set, and converting data from vector to raster or raster to vector.

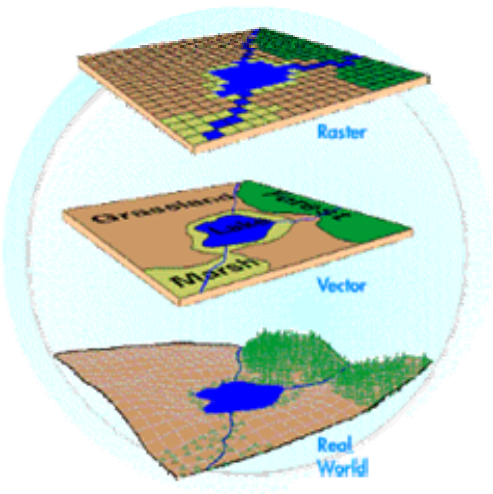
How GIS Works?



How GIS works (y layers)?

GIS store information about the world as a collection of thematic layers that can be linked together by geography. This simple but extremely powerful and versatile concept has proven invaluable for solving many real-world problems from tracking delivery vehicles, to recording details of planning applications, to modeling global atmospheric circulation.

Geographic information contains either an explicit geographic reference, such as a latitude and longitude or national grid coordinate, or an implicit reference such as an address, postal code, census tract name, forest stand identifier, or road name. An automated process called geocoding is used to create explicit geographic references (multiple locations) from implicit references (descriptions such as addresses). These geographic references allow you to locate features, such as a business or forest stand, and events, such as an earthquake, on the earth's surface for analysis.



Vector and Raster Models

Geographic information systems work with two fundamentally different types of geographic models--the "vector" model and the "raster" model. In the vector model, information about points, lines, and polygons is encoded and stored as a collection of x,y coordinates. The location of a point feature, such as a bore hole, can

be described by a single x,y coordinate. Linear features, such as roads and rivers, can be stored as a collection of point coordinates. Polygonal features, such as sales territories and river catchments, can be stored as a closed loop of coordinates.

The vector model is extremely useful for describing discrete features, but less useful for describing continuously varying features such as soil type or accessibility costs for hospitals. The raster model has evolved to model such continuous features. A raster image comprises a collection of grid cells rather like a scanned map or picture. Both the vector and raster models for storing geographic data have unique advantages and disadvantages. Modern GISs are able to handle both models.

DATA FOR GIS

Base Maps: Includes streets and highways; boundaries for census, postal and political areas, rivers, lakes, parks and landmarks and place names.

Business Maps and Data: Includes data related to census/demography, consumer products, financial services, health care, telecommunication, emergency preparedness, crime, advertising, transportation and business establishment.

Environmental Maps and Data: Includes data related to the weather, environmental risk, satellite imagery, topography and natural resources.

General Reference Maps: Includes world and country maps and data

GIS AND RELATED TECHNOLOGIES

GISs are closely related to several other types of information systems, but it is the ability to manipulate and analyze geographic data that sets GIS technology apart. Although there are no hard and fast rules about how to classify information systems, the following discussion should help differentiate GIS from desktop mapping, computer-aided design (CAD), remote sensing, DBMS, and global positioning systems (GPS) technologies.

Desktop Mapping

A desktop mapping system uses the map metaphor (symbol) to organize data and user interaction. The focus of such systems is the creation of maps: the map is the database. Most desktop mapping systems have more limited data management, spatial analysis, and customization capabilities. Desktop mapping systems operate on desktop computers such as PCs, Macintoshes, and smaller UNIX workstations.

CAD

CAD systems evolved to create designs and plans of buildings and infrastructure. This activity required that components of fixed characteristics be assembled to create the whole structure. These systems require few rules to specify how components can be assembled and very limited analytical capabilities. CAD systems have been extended to support maps but typically have limited utility for managing and analyzing large geographic databases.

Remote Sensing and GPS

Remote sensing is the art and science of making measurements of the earth using sensors such as cameras carried on airplanes, GPS receivers, or other devices. These sensors collect data in the form of images and provide specialized capabilities for manipulating, analyzing, and visualizing those images. Lacking strong geographic data management and analytical operations, they cannot be called true GISs.

DBMS

Database management systems specialize in the storage and management of all types of data including geographic data. DBMSs are optimized to store and retrieve data and many GISs rely on them for this purpose. They do not have the analytic and visualization tools common to GIS.

USAGES OF GIS

Perform Geographic Queries and Analysis

The ability of GIS to search databases and perform geographic queries has saved many companies literally millions of dollars. GIS has helped reduce costs by

- Streamlining (reorganizing) customer service.
- Reducing land acquisition costs through better analysis.
- Reducing fleet maintenance costs through better logistics.
- Analyzing data quickly.

Improve Organizational Integration

Many organizations that have implemented a GIS have found that one of its main benefits is improved management of their own organization and resources. Because GISs have the ability to link data sets together by geography, they facilitate interdepartmental information sharing and communication. By creating a shared database, one department can benefit from the work of another - data can be collected once and used many times.

As communication increases among individuals and departments, redundancy is reduced, productivity is enhanced, and overall organizational efficiency is improved. Thus, in a utility company the customer and infrastructure databases can be integrated so that when there is planned maintenance, affected customers can be sent a computer-generated letter.

Make Better Decisions

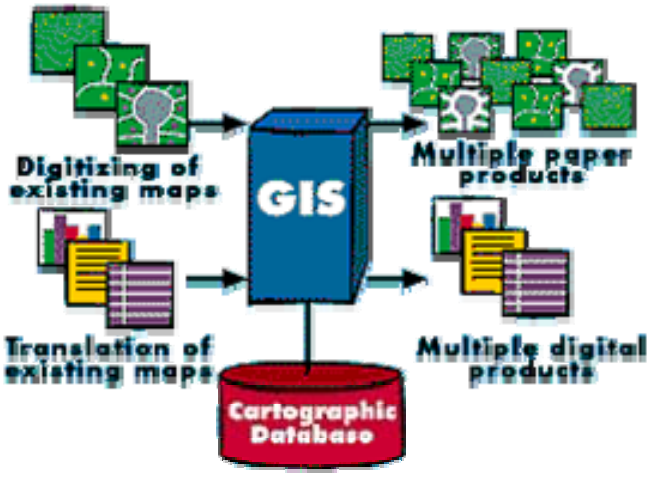
The old adage "better information leads to better decisions" is as true for GIS as it is for other information systems. A GIS, however, is not an automated decision making system but a tool to query, analyze, and map data in support of the decision making process. GIS technology has been used to assist in tasks such as presenting information at planning inquiries, helping resolve territorial disputes and minimize visual intrusion.

GIS can be used to help reach a decision about the location of a new housing development that has minimal environmental impact, is located in a low-risk area, and is close to a population center. The

information can be presented succinctly and clearly in the form of a map and accompanying report, allowing decision makers to focus on the real issues rather than trying to understand the data. Because GIS products can be produced quickly, multiple scenarios can be evaluated efficiently and effectively.

Making Maps

Maps have a special place in GIS. The process of making maps with GIS is much more flexible than are traditional manual or automated cartography approaches. It begins with database creation. Existing paper maps can be digitized and computer-compatible information can be translated into the GIS. The GIS-based cartographic database can be both continuous and scale free. Map products can then be created centered on any location, at any scale, and showing selected information symbolized effectively to highlight specific characteristics.



The characteristics of atlases and map series can be encoded in computer programs and compared with the database at final production time. Digital products for use in other GISs can also be derived by simply copying data from the database. In a large organization, topographic databases can be used as reference frameworks by other departments.

GIS In Everyday Life

Making GIS Data Work for You

- ✓ In today's global community, the more information you have at your fingertips, the easier it is to make an informed decision. In today's high-tech world, information comes in many different ways, from company reports and statistics from down the hall to digital photos and multimedia from across the world.
- ✓ Information can be overwhelming and the need for timely decisions calls not only for innovative ways to access accurate, up-to-the minute information, but also tools to help present the information in useful ways.
- ✓ A geographic information system or GIS allows you to bring all types of data together based on the geographic and locational component of the data.
- ✓ But unlike a static paper map, GIS can display many layers of information that is useful to you.
- ✓ You will be able to integrate, visualize, manage, solve, and present the information in a new way.
- ✓ Relationships between the data will become more apparent and your data will become more valuable.
- ✓ GIS will give you the power to create maps, integrate information, visualize scenarios, solve complicated problems, present powerful ideas, and develop effective solutions like never before.
- ✓ GIS is a tool used by individuals and organizations, schools, governments, and businesses seeking innovative ways to solve their problems.

Computer in Business and Industry

Office Automation System

- Is defined as using computer and communications technology to help people better use and manage information.
- Includes all types of computers, telephones, electronic mail and office machines that use microprocessors of other high- technology components.
- People who use office automation are often called knowledge workers – senior executives, managers, supervisors, analysts, engineers and other white- collar office workers
- These systems keep track of the information originating in various operations throughout the company, such as order processing, accounting, inventory and manufacturing.
- Provides knowledge workers with the information – producing systems to collect, analyze, plan, and control information about the many facets of the business, using text, voice, graphics and video display technology.
- People
- Ergonomics
    - The study of how to create safety, comfort and ease of use for the people who use machines.
    - Office tasks involve a great deal of thinking and decision making so it is different from factory automation.
    - Office systems must be flexible and versatile; moreover they must be designed so any knowledge worker, regardless of background can easily use them.
    - With the advent of computers, ergonomics engineers became particularly interested in office automation systems, furniture and environments for the knowledge workers,
    - Best design of keyboards, set eye fatigue level for monitor and specified desk, seating design.
    - Ergonomics has played a significant role in helping people use technology more effectively.

Office Automation Technologies

- Five primary technologies used in managing information in office automation.
    - Text or written words
    - Data, as in numbers or non- text formats
    - Graphics, including drawings, charts and photographs
    - Audio, as in telephone, voice mail or voice recognition systems
    - Video, such as captured images, videotapes or teleconferencing
- In past these forms of information was created using different technologies.
    - Text – conventional typewriters or word processing
    - Data - such as sales report was provided by central computers
    - Graphs and charts – hand written or creating using slide photography.
- It was not possible to combine all those things.
- Computer made it possible to combine them.
- Computer produces electronic documents, which is self- contained works, conveying information that has been created by a knowledge worker and stored in a computer system.

- Electronic documents can be simple as text file or more complex which contained graphics or even audio and video
- Data, sound and images can all be entered into a computer, stored and translated into the kind of output we need.
- Groupware
- The center of this integration are networking and communication systems

Office Automation Systems

- Uses computer – based systems to provide information to help knowledge workers make decisions that benefit the business.
- Comprise of many subsystems.

Text Management Systems

- Computer system designed to work with the written or typewritten word.
- Includes all kind of typewriters, word processing systems, PCs with word processing, desktop publishing and text editing system.
- Are used for tasks like writing documents simple and complex documents comprise of reports, memos, notices etc.

Business Analysis Systems

- Provides data that, when used with the proper software, helps its users better understand the business environment and make more effective decisions.
- Different software tools for performing analysis are
    - Decision Support System (DSS)
        - Helps the knowledge worker to extract information from the various MIS database and reporting systems, analyze it and then formulate a decision or a strategy for business planning
    - Expert System
        - Is a computer system that can store and retrieve data with special problem solving expertise.
    - Executive Support System
        - Is an information system that consolidates and summaries ongoing transactions with the organization.
        - It provides the management with all the information it requires at all times from internal as well as external sources.

Document Management Systems

- Aid in filing, tracking and managing documents, whether they are paper, computer based, micrographics or purely electronic.

Network and Communication Management Systems

- Includes telephone, electronic mails, voice messaging systems, teleconferencing and fax machines. Pbx (private branch exchange)

Management Information System

- A general term for all automated hardware and software used to provide and maintain information
- is the discipline covering the application of people, technologies, and procedures — collectively called information systems — to solving business problems
- can be any organized combinations people, hardware, software, communications networks, and data resources that collects, transforms and disseminates information in an organization
- The term is commonly used to refer to the group of information management methods tied to the automation or support of human decision making, e.g. Decision Support Systems, Expert systems, and Executive information systems.

Computers in Education and Training

- Influences of IT are also felt in educational system not only in workspace
- Changing the way we learn.
- Economy industry is being changed to information based economy.
- Old education system (factory model)
    - It assumes that all students learn the same way and that all students learn the same things.
    - The teacher's job is to pour facts into students, occasionally checking the level of knowledge in each student.
    - Students are expected to work individually, absorb facts and to spend most of their time sitting quietly listening to the teacher.
- Schools have changed too, but not fast enough to keep pace with the information evolution.
- What should education provide students in this information age?
    - Technological familiarity
    - Literacy
    - Mathematics
    - Culture
    - Communication
    - Learning how to learn

Computer in Education

- Computer Aided Instruction
    - Computers allow students to learn based on the drill and practice principle.
    - The computer based training software allows students to learn at their own pace, in small steps and give feedback about how much they have learn
    - A traditional drill and practice program presents the student wit a question and compares the student's answer with the correct answer. If the answers match, the program offers praise; if the answer does not match , the program offers an explanation and presents another similar problem.
    - The program may keep track of the student responses and provide report on student progress to the teacher.
    - Today most drill and practice programs embed the lessons in animated games, but the underlying principles remain the same.
    - Most CAI programs combine tutorial material with drill and practice questions, in the same way a mathematics textbook alternates explanations with exercise.
    - CAI software is one of the most common types of educational software for three reasons: it is relatively easy and inexpensive to produce, it can easily combined with more traditional educational techniques, and it produces clear, demonstrable results.
    - Advantages
        - Individualized Learning
        - Motivation
        - Confidence
        -

- Programming Tools
  - Seynour Papert developed a computer language called LOGO, so that children could build program computers, rather than the other way round.
  - Children can write LOGO programs as soon as they are enough to read and write a few simple words.
  - Rather than teaching through lessons and tests, LOGO creates environments for learning.
  - Would help children become better at general problem solving and logical thinking.

- Simulation Games
  - Computer can provide an environment that makes learning mathematics, science and the arts as effortless as learning Nepali in Nepal
  - Children learn best through exploration and inventions.
  - Simulations allow students to explore artificial environments, imaginary ot based on reality.
  - Educational simulations are metaphors designed to focus student attention on the most important concepts.
  - Look and the feel of a game, they challenge students to learn through exploration, experimentation and interaction with other students.
  - The students are in control of the learning environment.
  - It is up to the student to find and use information to draw concisions,
  - Students can experience the consequences of their actions without taking real-world risks.
  - Allow students to have experience that wouldn't be possible otherwise.
  -
- Productivity Tools
  - To use computers as tools.
  - Some schools also provide special – purpose tools for classroom use, including:
    - Laboratory sensing hardware and software
    - Collaborative writing groupware
    - Music synthesizers
  - Whether the computer is used as a tutor or a tool, the addition of multimedia adds whole new dimensions to the educational process.
- Computer- Controlled Media
  - Using computer graphics, videodiscs, CD-ROMs and digital media to convey information in a more dynamic form.
  - Depending upon the way these media are used, the student's role might be to observe the presentation, to control the presentation, or to create the presentation
  -
- Presentation Aid
  - Uses computers and multimedia technology to create in-class presentation
    - History - use of different images, videos in class
    - Science – use of 3D graphics and animation program to model different molecules and demonstrate in class
    - Art - illustrate an art history using digital media like CDs.

        - Music – music synthesizer
        - English literature
        -
    - The advantage of computer technology is that the materials can be customized to meet the needs of the class.

- Hypermedia and Interactive Multimedia
    - To get students more involved in the learning process, many teachers use hypermedia and interactive multimedia software that put students in full control.
    - Some are simple tutorials with sound and / or video; others are multimedia reference tools with hypertext cross- references that allow students to jump quickly from topic to topic or change the way the information is displayed.

- Authoring Tools for students
    - Allow students to create their own multimedia presentations.
    - Students are more involved in such type of projects.
    - Promotes the learning process
    -
- Distance learning : virtual Schools
    - Using technology to extend the educational process beyond the wall of the schools.
    - Computers, modems, fax machines, satellite video transmissions, the internet and other communication technologies offer many promising possibilities.
    - Network with other students in other part of the world
    - Handicapped students can do course work without traveling to central sites.
    - Two way video links allow visiting experts to talk to students in outlying classroom and answer their questions in real time.
    - Telecommunication technology is very much important

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Computers in Entertainment, Science, Medicine and Engineering

- Entertainment
  - Computers have now become an integral part of the entertainment industry.
  - Used to create dazzling special effects in movies, editing movies, creating movies using animated cartoon characters,
  - Help in composing, editing, recording and reproducing music and sound effects.
  - In sports to analyze the movements of sportspersons and to find faults in the movements and optimize the movements so that maximum efficiency is achieved.
  - Simulates games to try out different game strategies.

  - Movies
    - Animated movies, special effects
    - With the aid of sophisticated graphics and animation packages the special effects technicians can create the illusion of a locomotive flying through the air or a robot transforming into a human being and so on.
    - In theater – lighting, sound system
    - Improving productivity by automating time consuming, repetitive and monotonous process.
    - Contains many virtual tricks, and treats that could never be accomplished without the aid of computers.
  - Music
    - Any musical composition that we hear goes through a technological process at some point
    - MIDI (Musical Instrumental Digital Interface)
    - Before MIDI, synthesizers could 'note' information to other synthesizers only if they were compatible and very often they were not.
    - Problems with interfacing electronic musical instruments manufactured by different companies.
    - Patch librarian program – small amount of memory which can remember some music
    - Sequencer - memories any thing you play and plays it back on command.
    - Based on pure mathematical methods involving recursion , iteration and complex mathematics.

  - Advertising
    - Has been one of the key factors of growth and success in business
      - Multimedia in advertising and promoting products
      - Utilization of internet.
    - Low cost, animation, computer graphics, sound and videos
  - Art
    - New tools but also a new fine arts medium

        - Capable of transforming art from visual experience to full emotional interaction with the work.

- Medicine
    - Revolutionizing the medical field
    - Performing a wide variety of tasks
    - Used for
        - Everything form diagnosing illnesses and monitoring patients to controlling movements of robotic surgical assistants
        - Used for that vary in complexity from recording of patients history and treatment details to monitoring the patients.
        - A;sp used in automating the hospital management system
        - Automate the billing and other administrative process
        - Digital and imaging technology have helped in better diagnosis
        - Biomedical engineering – development of laboratory and medical equipments that are better and more accurate.
        - Innovative medical applications use small, special purpose computers.
            - Pacemaker
                - an electronic device that is surgically implanted into the patient's heart and chest to regulate heartbeat
            - Cochlear implant
                - An electronic device that is implanted in the inner ear to restore some hearing to a deaf person.
        - Photographs of internal problems such as blood clots and tumors that previously could be seen only during exploratory surgery.
        - Monitoring and automated drug administration
        - MRI (Magnetic Resonance Imaging) – uses radio waves and strong magnetic field to scan a patient's body
        - CT Scan – Computed Tomography Scan
            - A type of imaging scan that shows the internal structure of a person's brain. In diagnosing dementia, CT scans can reveal tumors and small strokes in the brain.
        - Telemedicine – make the life of patients easier and enable them to get high quality medical care irrespective of their physical location.
        - Physical challenged individuals
        - Voice recognition system
        - OCR
        -

- Science
    - Use computers to develop theories, to collect and test data and to exchange information electronically with colleagues around the world.
    - Models of Molecules, space, satellite
    -
- Engineering
- Helps to reduce the cost of design, production and manufacturing.

- EDI (Electronic Data Interchange)
  - EDI is the computer to computer exchange of business documents on a standard formats.
  - These formats look much like standard forms though highly structured.
  - Purpose order format
- CAD/CAM(Computer Aided Design/ Computer Aided Manufacturing)
  - Popular tool for product design
  - Are computer programs or integrated packages for workstation hardware and software that allow the user to draw and easily modify product designs on a computer screen.
  - Major benefits:
    - Graphics capabilities
      - Allows designers to view a product form different perspectives, including three dimensional rotations and various cross sections.
      - Change in scale, change in angle of arc etc
      -
    - Design, storage and retrieval
      - Can store the design characteristics of existing products and components
      - This capabilities not only promotes the use of common components but also reduces the design time
    - Automatic evaluation of specification
      - One of the most Time consuming aspect of design for highly technical products is calculating whether or not product specifications such as strength, heat resistance are satisfied
      - These things can be programmed in CAD model so that if the designer change the design (shapes or materials) these performance characteristics are also recalculated automatically and compared to the product requirements (Computer Aided Engineering)
- Product data management(PDM)
  - To maximize the time – to- market benefits of the concurrent engineering while maintaining control of your data and distributing it automatically to the people who need it, when they need it.
  - The way PDM systems cope with this challenge is that master data is held only once in a secure where its integrity can be assured and all changes to it monitored, controlled and recorded.
  - Some of the benefits are:
    - Reduced time to market
    - Improved design productivity
    - Better use of creativity team skills
    - Data integrity safeguard
    - Better management of Engineering change
    -
- Prototyping

        - Generate computer prototype which can be distributed and tested by actual customers
        -
    - Project management
        - Managing the projects.