Subject

Computer Science

For Class XI

Contents

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Chapter 1:

Introduction to Information Technology

Introduction to Computer:

- ➢ A computer is an electronic device that can accept data (input), manipulate data (process), and produce information (output) from the processing.

- ➢ Computers are used today to store, retrieve, process, and transmit data and information of all types.

- ➢ Today, almost all of us in the world make use of computers in one way or the other.

- ➢ It finds applications in various fields of engineering, medicine, commercial, research and others. Not only in these sophisticated areas, but also in our daily lives, computers have become indispensable. They are present everywhere, in all the devices that we use daily like cars, games, washing machines, microwaves etc. and in day to day computations like banking, reservations, electronic mails, internet and many more.

- ➢ The word **computer** is derived from the word **compute.** Compute means to calculate. The computer was originally defined as a super fast calculator. It had the capacity to solve complex arithmetic and scientific problems at very high speed. But nowadays in addition to handling complex arithmetic computations, computers perform many other tasks like accepting, sorting, selecting, moving, comparing various types of information. They also perform arithmetic and logical operations on alphabetic, numeric and other types of information. This information provided by the user to the computer is **data.** The information in one form which is presented to the computer is the input information or **input data.**

- ➢ The set of instructions given to the computer to perform various operations is called as the **computer program.** The process of converting the input data into the required output form with
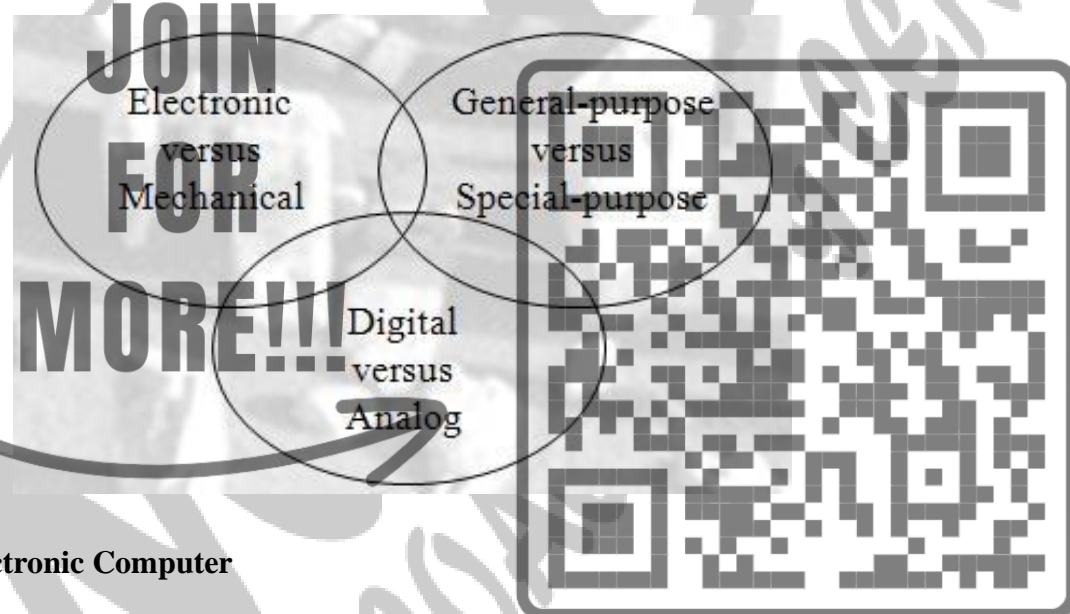
the help of the computer program is called as **data processing.** The computers are therefore also referred to as data processors.

➢ Therefore a computer can now be defined as a fast and accurate data processing system that accepts data, performs various operations on the data, has the capability to store the data and produce the results on the basis of detailed step by step instructions given to it..

Kinds / Types of Computers

➢ Computers can be classified by three sets of characteristics:

Electronic versus Mechanical

General-purpose versus Special-purpose

Digital versus Analog

➢ **Electronic Computer**

- Constructed from transistors and electrical circuits.
- Needs an electrical source to function.

➢ **Mechanical Computer**

- Constructed of a combination of gears, levers and/or springs.
- Produces its own intrinsic energy. (Does not need electricity to function.)

➢ **General-purpose Computer**

- used for a wide variety of applications
- Single user at a time, multiple concurrent users

➢ **Special-purpose Computer**

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- Manufactured to perform a predetermined task or set of tasks.

- used for limited applications by military and scientific research groups

➢ **Analog Computer**

- One that functions in continuously varying quantities.

- Produces or gives results that are also continuously varying.

- Readings on a dial or graphs are obtained as the output, ex. Voltage, temperature; pressure can be measured in this way.

➢ **Digital Computer**

- These are high speed electronic devices. These devices are programmable. They process data by way of mathematical calculations, comparison, sorting etc. They accept input and produce output as discrete signals representing high (on) or low (off) voltage state of electricity. Numbers, alphabets, symbols are all represented as a series of 1s and Os.

- Digital Computers are further classified as General Purpose Digital Computers and Special Purpose Digital Computers. General Purpose computers can be used for any applications like accounts, payroll, data processing etc. Special purpose computers are used for a specific job like those used in automobiles, microwaves etc.

- Another classification of digital computers is done on the basis of their capacity to access memory and size like:

Components of Computers

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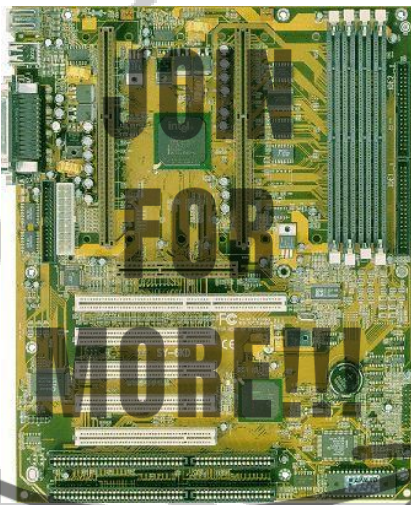
System unit:

- Micro-processor, memory, mother board & power supply, ..

Storage devices:

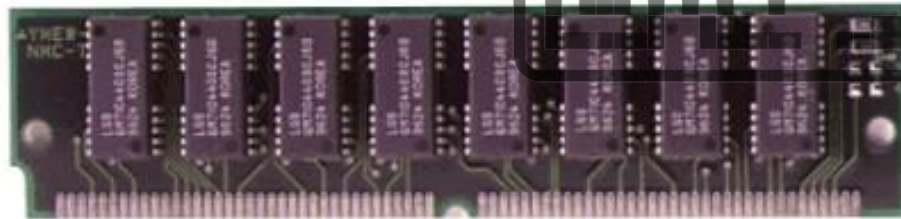- where programs and data are held permanently between sessions: CD-RW, floppy, Hard disk, Zip. ..

Peripherals:

- Monitor, keyboard, mouse, printer, speaker, scanner, camera...
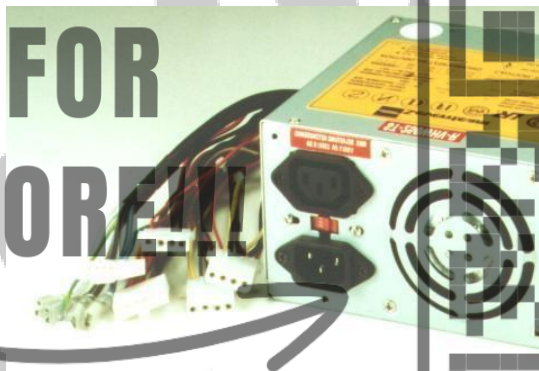

Mother Board

Microprocessor

Memory Chip

HDD (Hard Disk Drive)
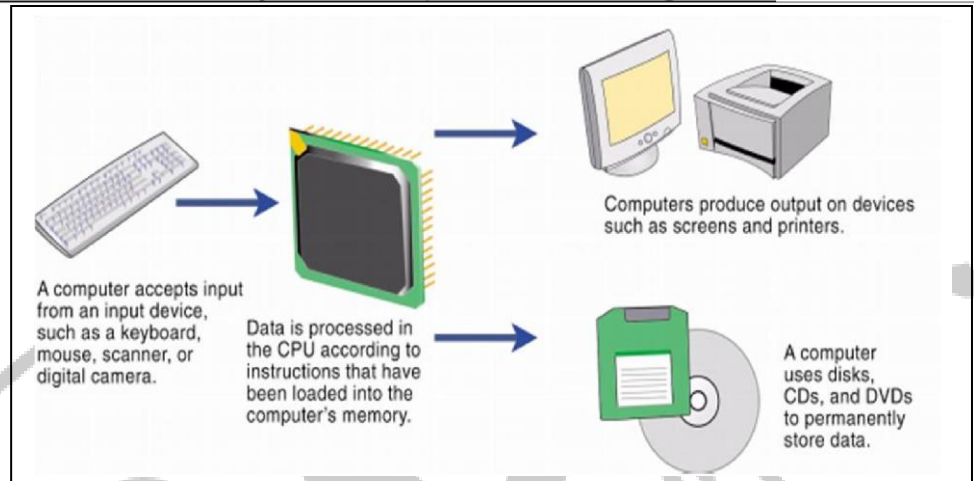
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Power Supply

3

Data Processing Cycle

➤ Computers can perform four general operations, which comprise the data processing cycle.

- Input
- Process
- Output
- Storage

A computer accepts input from an input device, such as a keyboard, mouse, scanner, or digital camera.

Data is processed in the CPU according to instructions that have been loaded into the computer's memory.

Computers produce output on devices such as screens and printers.

A computer uses disks, CDs, and DVDs to permanently store data.

Data and Information

➢ All computer processing requires **data**, which is a collection of raw facts, figures and symbols, such as numbers, words, images, video and sound, given to the computer during the input phase.

➢ Computers manipulate data to create information. **Information** is data that is organized, meaningful, and useful.

➢ During the output Phase, the information that has been created is put into some form, such as a printed report.

➢ The information can also be put in computer storage for future use.

Characteristics of computers (Why Is A Computer So Powerful?)

➢ The ability to perform the information processing cycle with amazing speed.

➢ Reliability (low failure rate).

➢ Accuracy.

➢ Ability to store huge amounts of data and information.

➢ Ability to communicate with other computers.

Computer Science & Information Technology

Computer science

➢ *Computer science* is the study of computers, including both hardware and software design.

- ➤ Computer science is composed of many broad disciplines, including systems analysis & design, application and system software design, programming, artificial intelligence and software engineering.

- ➤ The field encompasses both the theoretical study of *algorithms* and the practical problems involved in implementing them in terms of computer software and hardware.

Information Technology:

- ➤ It can be defined as the use of computer to manage information.

- ➤ It is an industry which deals with the usage of computer hardware and software and networking.

- ➤ IT is a combination of computer and communication technology. It is the transfer of information from one computer to another.

- ➤ The significance of IT can be seen from the fact that it has penetrated almost every aspect of our daily life.

APPLICATIONS OF COMPUTERS

Today computers find widespread applications in all activities of the modern world. Some of the major application areas include:

1. Scientific, Engineering and Research:

This is the major area where computers find vast applications. They are used in areas which require lot of experiments, mathematical calculations, weather forecasting, and complex mathematical and engineering applications. Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) help in designing robotics, automobile manufacturing, automatic process control dev ices etc.

2. Business:

Record keeping, budgets, reports, inventory, payroll, invoicing, accounts are all the areas of business and industry where computers are used to a great extent. Database management is one of the major area where computers are used on a large scale. The areas of application here include banking, airline reservations, etc. where large amounts of data need to be updated, edited, sorted, searched from large databases.

3. Medicine:

Computerized systems are now in widespread use in monitoring patient data like , pulse rate, blood pressure etc. resulting in faster and accurate diagnosis. Modern day medical equipment are highly computerized today. Computers are also widely used in medical research.

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4. Information:

This is the age of information. Television, Satellite communication, Internet, networks are all based on computers. **5. Education:**

The use of computers in education is increasing day by day. The students develop the habit of thinking more logically and are able to formulate problem solving techniques. CDs on a variety of subjects are available to impart education. On line training programs for students are also becoming popular day by day. All the major encyclopedias, dictionaries and books are now available in the digital form and therefore are easily accessible to the student of today. Creativity in drawing, painting, designing, decoration, music etc. can be well developed with computers.

6. Games and Entertainment:

Computer games are popular with children and adults alike. Computers are nowadays also used in entertainment areas like movies, sports, advertising etc.

Advantages of information technology / Impacts of computers:

➤ *Globalization* - IT has brought the world closer together. This means that we can share information quickly and efficiently. The world has developed into a global village due to the help of information technology allowing countries to shares ideas and information with each other.

➤ *Communication* - With the help of information technology, communication has also become cheaper, quicker, and more efficient. We can now communicate with anyone around the globe by simply text messaging them or sending them an email for an almost instantaneous response.

➤ *Cost effectiveness* - Information technology has helped to computerize the business process. This in turn increases productivity which ultimately gives rise to profits.

➤ *Bridging the cultural gap* - Information technology has helped to bridge the cultural gap by helping people from different cultures to communicate with one another, and allow for the exchange of views and ideas.

➤ *More time* - IT has made it possible for businesses to be open 24 x7 all over the globe. This means that a business can be open anytime anywhere, making purchases from different countries easier and more convenient.

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➢ *Creation of new jobs* - Probably the best advantage of information technology is the creation of new and interesting jobs. Computer programmers, Systems analysts, Hardware and Software developers and Web designers are just some of the many new employment opportunities created with the help of IT.

Disadvantages of information technology:

➢ *Unemployment* - It has also crated job redundancies, downsizing and outsourcing. This means that a lot of lower and middle level jobs have been done away with causing more people to become unemployed.

➢ *Privacy* - It has also brought along privacy issues. From cell phone signal interceptions to email hacking, people are now worried about their once private information becoming public knowledge.

➢ *Lack of job security* - Industry experts believe that the internet has made job security a big issue as since technology keeps on changing with each day.

➢ *Dominant culture* - While information technology may have made the world a global village, it has also contributed to one culture dominating another weaker one. For English is becoming the primary mode of communication for business and everything else.

The Advantages of Information Technology in Education

- ➤ Advancements in information and communication technology have benefited education.

- ➤ With more powerful software and applications, along with mobile devices such as laptops becoming more prevalent in the classroom, information technology offers many benefits to all aspects of education.

- ➤ By using information technology, teachers and students are more connected in and out of the classroom.

- ➤ Information technology provides teachers a choice of multimedia, software, applications and devices with which to create more exciting, interactive lessons.

- ➤ Advancements in networking within information technology have connected more institutions and their staffs and students, and therefore made a greater amount of information and resources available.

- ➤ Online courses and web-based training have improved in quality as information and communication technology has advanced.

Classification of Digital Computer

- ➤ Until recently computers were classifieds as o Microcomputers o Minicomputers o Mainframes o Supercomputers

- ➤ Technology, however, has changed and this classification is no more relevant. Today all computers use microprocessors as their CPU.

- ➤ Thus classification is possible only through their mode of use. Based on mode of use we can classify computers as o Palms o Laptop PCs
  - o Desktop PCs and
  - o Workstations

- ➤ Based on interconnected computers, we can classify as o Distributed computers and o Parallel computers
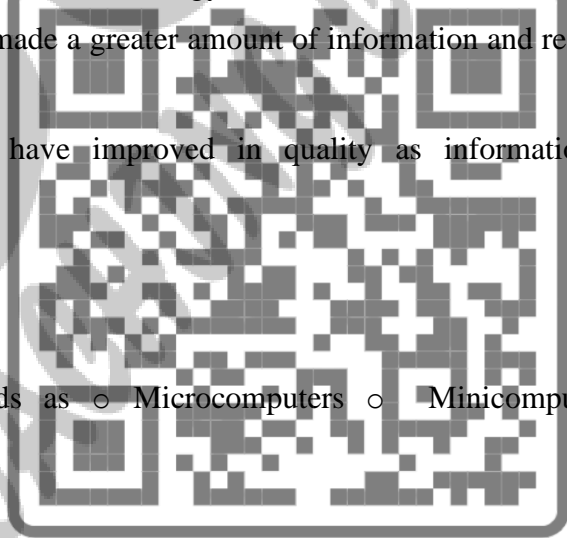
Laptop PCs:

- Laptop PCs (also known as notebook computers) are portable computers.
- They have a keyboard, flat screen liquid crystal display, and a Pentium or Power PC processor.
- They normally run using WINDOWS OS.
- Laptops come with hard disk (around 40 GB), CDROM and floppy disk.
- They should run with batteries and are thus designed to conserve energy by using power efficient chips.

Personal Computers (PCs)

- A small, relatively inexpensive computer designed for an individual user.
- All are based on the microprocessor technology that enables manufacturers to put an entire CPU on one chip.
- Businesses use personal computers 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.
- Today, the world of personal computers is basically divided between Apple Macintoshes and PCs.
- The principal characteristics of personal computers are that they are single-user systems
- Currently, Intel Dual Core is the most popular processor.
- PCs mostly use MS-Windows, WINDOWS –XP.

Supercomputers

- Supercomputers are the fastest computers available at any given time and are normally used to solve problems, which require intensive numerical computations.
- Recently applications of supercomputers have expanded beyond scientific computing; they are now used to analyze large commercial database, produced animated movies and play games such as chess.
- Supercomputers have a large main memory of around 16 GB and a secondary memory of 1000 GB.
- All supercomputers use parallelism to achieve their speed.

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Workstations

- ➢ A type of computer used for engineering applications
- ➢ The most common operating systems for workstations are UNIX and Windows NT.
- ➢ In terms of computing power, workstations lie between personal computers and minicomputers
- ➢ Like personal computers, most workstations are single-user
- ➢ In networking, workstation refers to any computer connected to a local-area network.

Mini computers

- ➢ A mid-sized computer.
- ➢ In size and power, minicomputers lie between workstations and mainframes.
- ➢ But in general, a minicomputer is a multiprocessing system capable of supporting from 4 to about 200 users simultaneously.

Mainframe computers

- ➢ A very large and expensive computer capable of supporting hundreds, or even thousands, of users simultaneously.
- ➢ In some ways, Mainframes are more powerful than supercomputers because they support more simultaneous programs.

Chapter 2:

History & Development of Computers

The Development of the Computer

➢ In fact, the first computers were invented by the Chinese about 2500 years ago. They are called *abacuses* and are still used throughout Asia today.

The Abacus

➢ The abacus, shown in Figure, is a calculator; its first recorded use was circa 500 B.C. The Chinese used it to add, subtract, multiply, and divide.
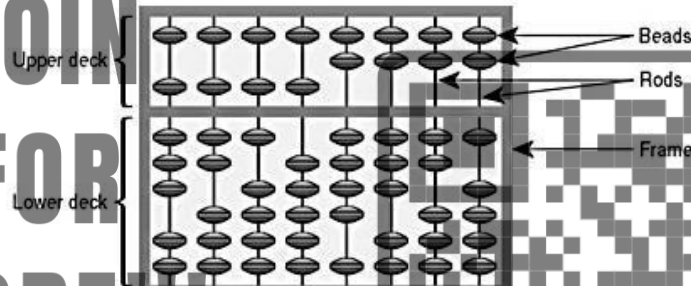
The Analytical Engine (A Pre-Electronic Computer)

➢ The first mechanical computer was the analytical engine, conceived and partially constructed by Charles Babbage in London, England, between 1822 and 1871.

➢ It was designed to receive instructions from punched cards.

Augusta Ada Byron,
Lady Lovelace (1815–1852)

Charles Babbage (1791-1871)

➢ Augusta Ada Byron, the daughter of English poet Lord Byron met Charles Babbage and became fascinated by his machines. Ada was convinced of the potential of Babbage's Analytical Engine

and wrote extensive notes on its design, along with several complex mathematical programs that have led many people to characterize her as the first programmer. In 1980, the U.S. Department of Defense named the programming language Ada in her honor.

The First Electrically Driven Computer

- The first computer designed expressly for data processing on January 8, 1889, by Dr. Herman Hollerith of New York.

- The prototype model of this electrically operated tabulator was built for the U. S. Census Bureau and computed results in the 1890 census.

- Using punched cards containing information submitted by respondents to the census questionnaire, the Hollerith machine made instant tabulations from electrical impulses actuated by each hole. It then printed out the processed data on tape.

- Dr. Hollerith left the Census Bureau in 1896 to establish the Tabulating Machine Company to manufacture and sell his equipment. The company eventually became IBM.

- The 80-column punched card used by the company, shown in Figure, is still known as the Hollerith card.

The Digital Electronic Computer

- John W. Mauchly, who, together with engineer John Presper Eckert, developed the first large-scale digital computer, the Electronic Numerical Integrator and Computer (ENIAC).

- When finally assembled in 1945, ENIAC consisted of 30 separate units, plus power supply and forced-air cooling. It weighed 30 tons, used 19,000 vacuum tubes, 1500 relays, and hundreds of thousands of resistors, capacitors, and inductors. It required 200 kilowatts of electrical power to operate.

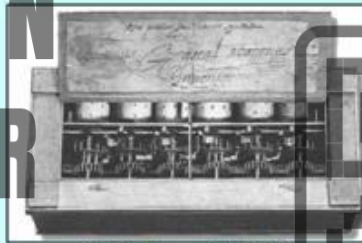- ENIAC is considered the prototype for most of today's computers.
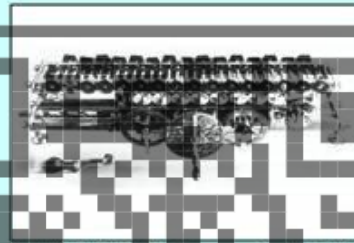
A Brief History of Computing

- Computing history is divided into three ages:
  - o The Dark Ages (2500 BC - 1890 AD)
  - o The Middle Age (1890 – 1942)
  - o The modern Age (1942 – Present)

- Although electronic computers are relatively new, mechanical computers are much older. The abacus goes back almost 4000 years.

- In the 17th century, several mechanical computing devices were developed in Europe.

Reconstruction of 1623 Wilhelm Schickard machine (Deutsches Museum, Munich) | Blaise Pascal's 1641 "Pascaline" machine (Musée des Arts et Metiers, Paris) | Gottfried Wilhelm von Leibniz's calculating wheel (ca. 1671) (IBM)

- The most important conceptual breakthroughs, however, came in the early part of the 19th century . . .

The Birth of Modern Computing

- The question of who invented the modern computers is not an easy one, given the competing claims for that achievement.

- In 1939, John Atanasoff and Clifford Barry built a prototype computer at Iowa State and a large machine in 1942.

- The first large-scale computer was the Electronic Numerical Integrator and Computer (ENIAC), completed in 1946 under the direction of J. Presper Eckert and John Mauchly at the Moore School of the University of Pennsylvania.

- Conrad Zuse in Germany and the World War II cryptography team in England also built early computers.

- Other important contributions during the early years include stored-programming concept generally attributed to John von Neumann and the use of switching circuits to implement binary arithmetic proposed by Claude Shannon.

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Computer Generations

Generation	Dates	Technology	Principal New Product
1	1950-1958	Vacuum tubes	Commercial, electronic computer
2	1958-1964	Transistors	Cheaper computers
3	1964-1971	Integrated circuit	Minicomputer
4	1971-199?	LSI and VLSI	Personal computers and workstations
5	199?-20??	Microprocessor?	Personal portable computing devices and parallel processors?

➢ Typically each generation offers the opportunity to create a new class of computers and for new computer companies to be created.

The First Generation:

The first generation computers made use of:

- Vacuum tube technology,
- Punched cards for data input,
- Punched cards and paper tape for output,
- Machine Language for writing programs,
- Magnetic tapes and drums for external storage **The Second Generation:**

In the second generation computers:

- Vacuum tube technology was replaced by transistorized technology,
- Size of the computers started reducing,
- Assembly language started being used in place of machine language,
- Concept of **stored program** emerged, ☐ High level languages were invented.

The Third Generation:

The third generation computers were characterized by:

- Use of Integrated circuits,
- Phenomenal increase in computation speed,
- Substantial reduction in size and power consumption of the machines,
- Use of magnetic tapes and drums for external storage,
- Design-of Operating systems and new higher level languages,

The Fourth Generation:

The general features of the fourth generation computers were:

- Use of Very Large Scale Integration,
- Invention of microcomputers,

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- Introduction of Personal Computers,

- Networking,

- Fourth Generation Languages **The Fifth Generation:**

- Defining the fifth generation computers is somewhat difficult because the fieldis still in its infancy. The computers of tomorrow would be characterized by Artificial Intelligence (At). An example of Al is Expert Systems. Computers could be developed which could think and reason in much the same way as humans. Computers would be able to accept spoken words as input (voice recognition).

- Many advances in the science of computer design and technology are coming together to enable the creation of fifth generation computers. Two such advances are **parallel processing** where many CPUs work as one and advance in **superconductor technology** which allows the flow of electricity with little or no resistance, greatly improving the speed of information flow

Chapter Summary

The following points summarize the main elements of this lesson:

- The concepts that form the basis of computer technology have a long history that stretches back 2500 years.
- Electrically powered computers were first developed in the 1950s and 1960s.
- The "standard" personal computer has undergone several stages of evolution, characterized by improvements to the processor, internal architecture, and types of storage devices.
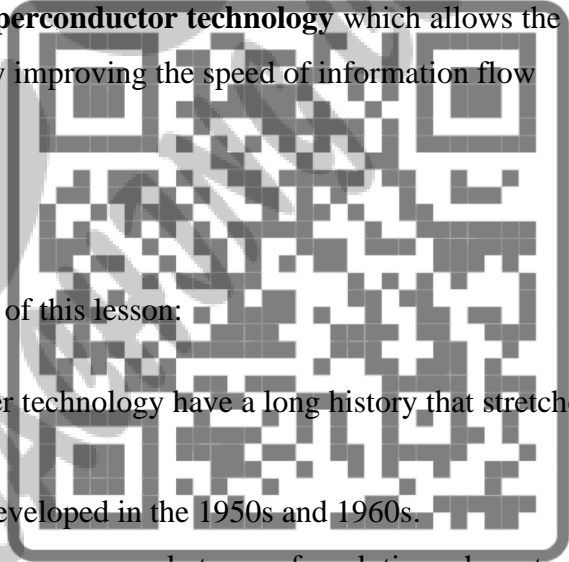
Chapter 3

Digital Computer Systems

The Modern Computer

- ➢ It is constructed of many hardware components connected with wires.
- ➢ Digital computers are made up of four major components:

   • **Central Processing Unit** - ―Brain‖ controls all computer operations, processes information, computes results.

   • **Input units** - Humans interface with the computer through devices like the mouse and keyboard.

   • **Output Units** - The computer displays results to the human through devices like the printer and monitor.

   • **Primary Memory** - Stores programs and other data.
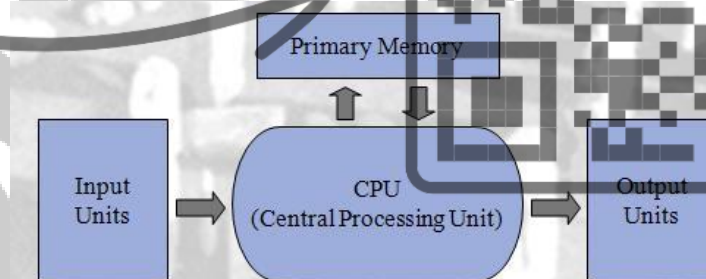
Example:

Word processor (MS-Word):

   Input: Typing your words.

   Processing: Formatting the text (such as justify paragraph and fonts).

   Output: Storing the text and allowing you to retrieve or print it.

Computer Hardware

➢ The term computer hardware refers to the various electronic components that make up a computer.

➢ Some examples include:

- ✓ The Main Computer Box / System Unit
- ✓ Microprocessor
- ✓ Memory
- ✓ Motherboard
- ✓ Modem
- ✓ USB Flash Drive
- ✓ Hard Drive
- ✓ Monitor
- ✓ Keyboard
- ✓ Mouse
- ✓ Speakers
- ✓ Printer

Hardware Components of a computer

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The Main Computer Box/ System Unit

- ➢ The main computer box is the main component of the computer.
- ➢ Houses the components responsible for processing (the CPU and memory)
- ➢ All other computer system devices are linked either directly or indirectly into the system unit housing
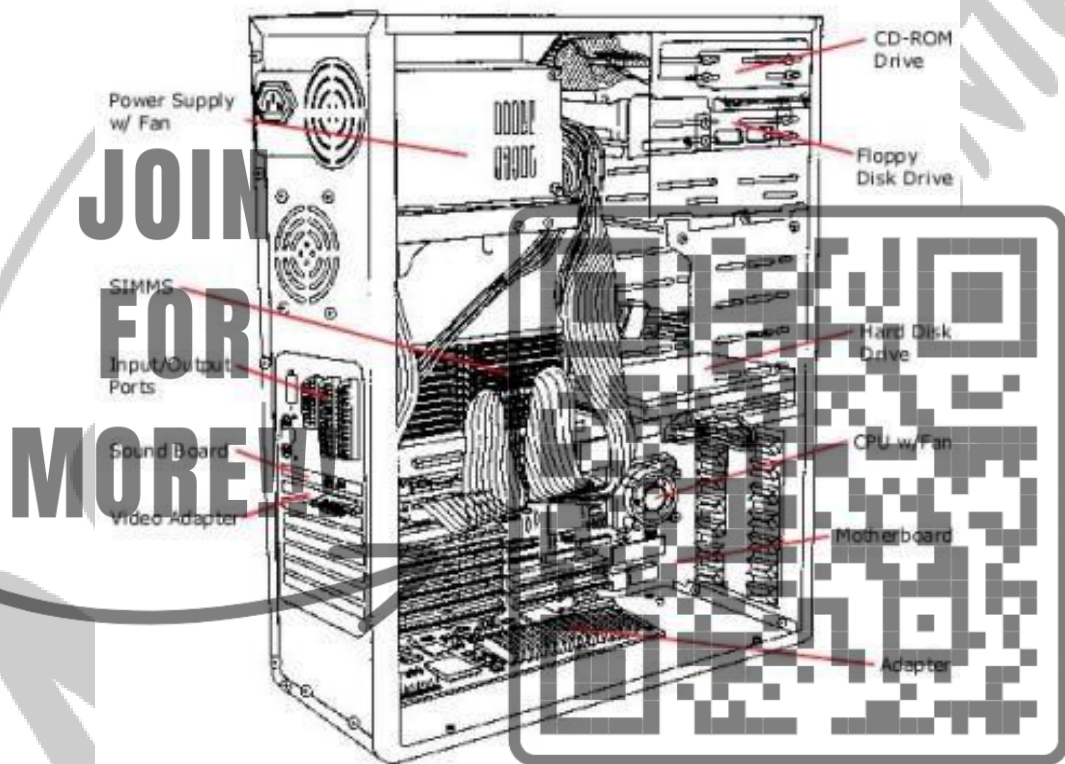
- ➢ The *system unit* is the actual computer; everything else is called a *peripheral* device.

- ➢ It is made of several computer hardware components and subcomponents which include:

  - ✓ **The case** - The outside component which provides protection for the parts inside and provides a fan and power supply which are used to both cool the working parts inside and provide power to them.

  - ✓ **The motherboard** - Hold the following computer hardware subcomponents: ○ Memory, Microprocessor, Video interface card, Sound card, Hard disk & etc

The Central Processing Unit (CPU)

- ➢ Often referred to as the ―brain‖ of the computer.

- ➢ It is the core component of a computer. It executes user's instructions and processes calculations.

- ➢ The CPU controls and co-ordinates various devices in the computer system.

- ➢ Without the CPU, the devices cannot work together and so the computer cannot function.

- ➢ CPU is often etched on a chip and is usually called a microprocessor.

- ➢ A CPU consists of 3 main parts:

   - ✓ Control unit
   - ✓ Arithmetic and logic unit &
   - ✓ Registers

Control Unit

- ▪ The control unit executes the instructions, sends control signals to and receives control signals from peripheral devices.

- ▪ In other words, it controls the whole computer, and directs the entire system to carry out instructions.

Arithmetic and Logic Unit

- ▪ Arithmetic unit: handles arithmetic calculations

- ▪ Logic unit: performs logical calculations and makes judgment like ―if A > B is true‖.

Registers

- ➢ The **Registers** are very fast storage locations inside the processor itself.

- ➢ When the control unit and the arithmetic and logic unit operate, they store the information and instruction temporarily in registers.

- ➢ These registers usually have specialized capabilities for arithmetic, logic, and other operations.

- ➢ Registers are usually fairly small (8, 16, 32, or 64 bits for data, address) ➢ There are many registers including :

   - ✓ **memory address register (MAR)** – holds the address of a location in memory

   - ✓ **memory data register (MDR)** – holds data just read from or written to memory

   - ✓ **program counter (PC)** – holds the address of the next instruction to be fetched

   - ✓ **Instruction register (IR)** – holds the current instruction being executed

- ✓ **general purpose registers** – can be used by programmers
- ✓ **instruction pointer** - which indicates the location (address) of the next instruction to be executed
- ✓ **accumulator** - stores the result of operations performed by the ALU
- ✓ **Memory Buffer Register (MBR)** - This register serves as an interface between the CPU and main memory.

Execution of an Instruction

➢ The diagram shows how the CPU executes an instruction:
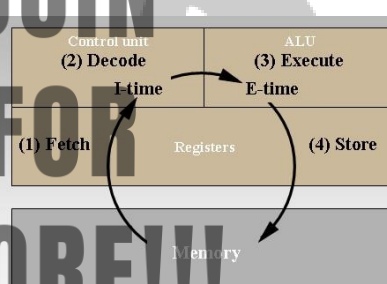
- ✓ **Fetch** – retrieve an instruction from memory, (based on the current instruction pointer value)
- ✓ **Decode** – Put instruction in a form ALU can understand
- ✓ **Execute** – Carry out instruction
- ✓ **Store**: copy results to a register or RAM
➢ Computer execute an instruction during a machine cycle ➢ Machine cycle time is measured in:

  o MIPS (millions of instructions per second)

Clock speed:

➢ Series of electronic pulses produced at a predetermined rate that affects machine cycle time. Often measured in:

  o Megahertz (MHz): millions of cycles per second

  o Gigahertz (GHz): billions of cycles per second

➢ Some computers have more than one processor. This is called **multi-processing**.

➢ The major kinds of digital processors are: CISC & RISC ○ **CISC** stands for Complex Instruction Set Computing

- A computer chip design that places as many microcode instructions into the central processor as possible.

○ **RISC** stands for Reduced Instruction Set Computing

- A computer chip design based on reducing the number of microcode instructions built into a chip to an essential set of common microcode instructions.

Lecture # 10

Motherboard

➢ The motherboard is the main component inside the case. It is a large rectangular board with integrated circuitry that connects the other parts of the computer including the CPU, the RAM, the disk drives (CD, DVD, hard disk, or any others) as well as any peripherals connected via the ports or the expansion slots.
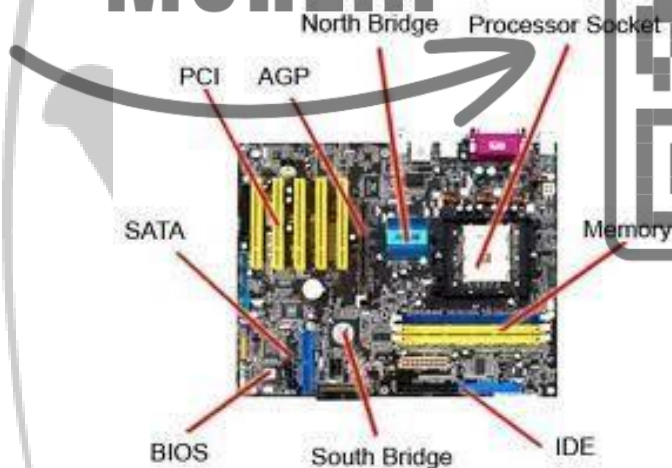
➢ Components directly attached to the motherboard include:

✓ **The central processing unit (CPU)** performs most of the calculations which enable a computer to function. It is usually cooled by a heat sink and fan

✓ **The chip set** mediates communication between the CPU and the other components of the system, including main memory.

✓ **RAM (random-access memory)** stores programs & data.

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- ✓ **The BIOS** includes boot firmware and power management. The Basic Input Output System tasks are handled by operating system drivers.

- ✓ **Internal buses** connect the CPU to various internal components and to expansion cards for graphics and sound.

Bus

- ➢ A bus is a group of electrical conductors (usually wires) running parallel to one another that connect computer components.

- ➢ These conductors can be copper traces on a circuit board or wires in a cable.

- ➢ This is a bus that connects all the internal computer components to the CPU and main memory.

- ➢ **Bus width**: Number of bits a bus can transfer at one time
  - ▪ Usually, they are found in multiples of eight (8, 16, 32, 64, and so on).

- ➢ Information travels on buses as a series of electrical pulses, each pulse representing a one bit or a zero bit.

- ➢ An **internal bus** is a bus inside the processor, moving data, addresses, instructions, and other information between registers and other internal components or units.

- ➢ An **external bus** is a bus outside of the processor (but inside the computer), moving data, addresses, and other information between major components (including cards) inside the computer.

- ➢ Some common kinds of buses are;

  o **Data Bus**: The data bus transfers actual data. For example, a 16-bit bus can transmit 16 bits of data, whereas a 32-bit bus can transmit 32 bits of data. o **Address Bus**: the address bus transfers information about where the data should go. o **Control Bus:** The control bus consists of a set of control signals.

Computer Science XI   [Page # 26]
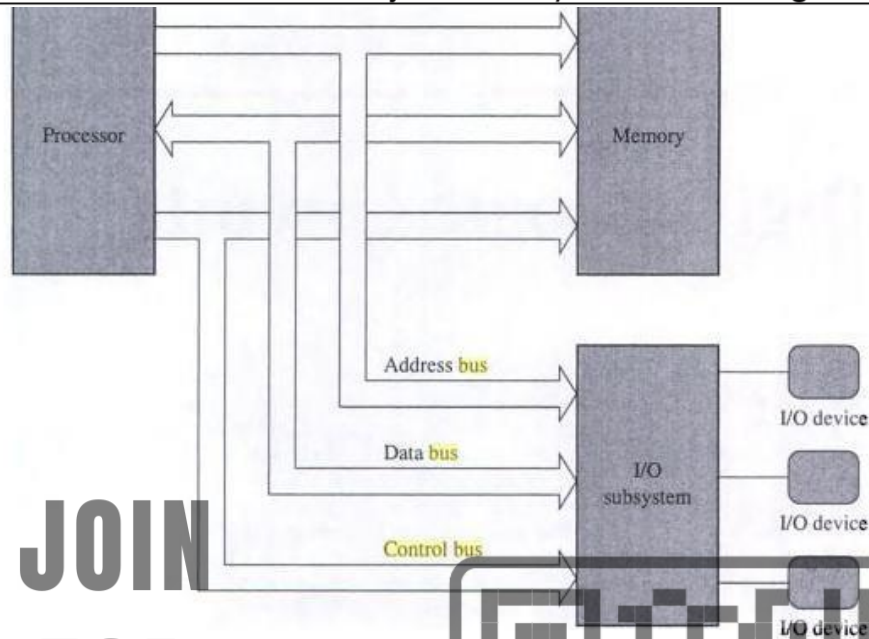
Main / Internal / Primary Memory

➢ Main memory consists of a number of storage locations, each of which is identified by a **unique address**

➢ Located physically close to the CPU, but not on the CPU chip itself.

➢ Rapidly provides data and instructions to the CPU.

➢ Consists of electronic circuits: Extremely fast and expensive.

➢ Types of main memory: There are two types of main memory, **Random Access Memory** (RAM) and **Read Only Memory** (ROM)
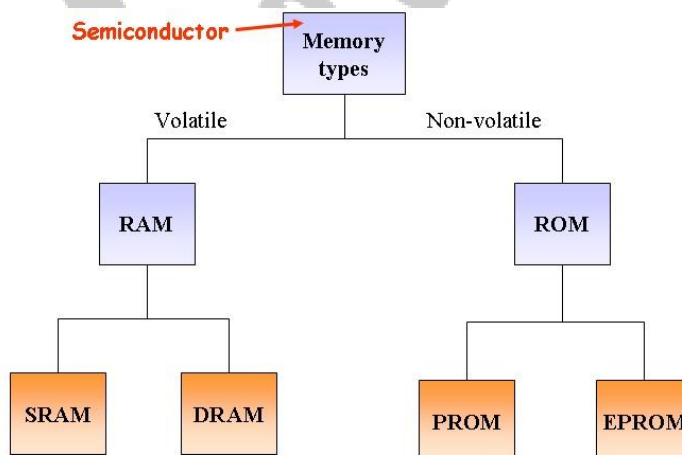
RAM (Random Access Memory)

- ➢ RAM is the basic kind of internal memory.
- ➢ All data in RAM is lost when the computer is switched off
- ➢ It is **direct access** as it can be both written to or read from in any order
- ➢ Programs and data can be stored here for the computer's use.
- ➢ Volatile: All information will be lost once the computer shuts down.
- ➢ RAM is called ―random access‖ because the processor or computer can access *any* location in memory.
- ➢ Most modern RAM is made from integrated circuits.

Types of RAM:

- ✓ **Static RAM**

- o is called static because it will continue to hold and store information even when power is removed.
- o no refreshing, fast but expensive

- ✓ **Dynamic RAM**

- o is called dynamic because it loses all data when power is removed.
- o Transistors and integrated circuits are examples of dynamic memory. It is possible to have battery back up for devices that are normally dynamic to turn them into static memory.
- o Contents are constantly refreshed 1000 times per second o Access time 60 – 70 nanoseconds

- o Types are

  ▪ **Synchronous DRAM (SDRAM)** – faster, works in synch with internal clock ▪ **DRAM, DDRSDRAM** – newer and faster
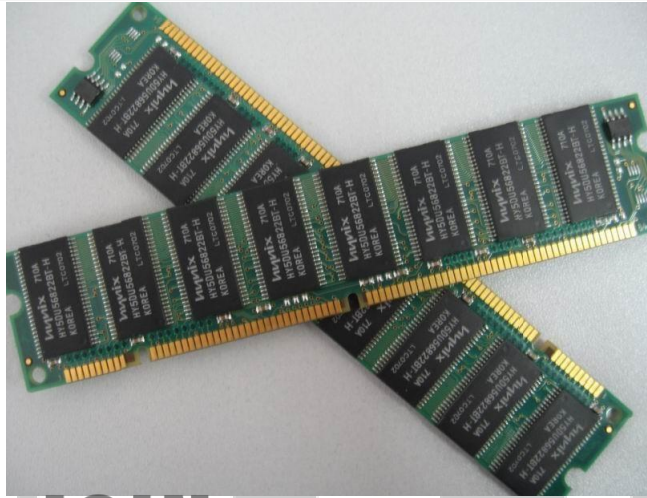
DDR&DDR2 1GB / 2GB RAM Memory Modules

ROM (Read Only Memory)

➢ ROM holds programs and data **permanently** even when computer is switched off

➢ Data can be read by the CPU in any order so ROM is also **direct access**

➢ The contents of ROM are fixed at the time of manufacture

➢ Stores a program called the **bootstrap loader** that helps start up the computer

➢ Access time of between 10 and 50 nanoseconds

➢ ROM is typically used to store things that will never change for the life of the computer, such as low level portions of an operating system.

➢ ROM also has a number of different variations

   o PROM –programmable read only memory

   o EPROM – erasable PROM (ultraviolet ight)

Programmable Read Only Memory (PROM)

➢ Empty of data when manufactured

➢ May be permanently programmed by the user

Erasable Programmable Read Only Memory (EPROM)

➢ Can be programmed, erased and reprogrammed

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- The EPROM chip has a small window on top allowing it to be erased by shining ultra-violet light on it
- After reprogramming the window is covered to prevent new contents being erased ➢ Access time is around 45 – 90 nanoseconds

Cache Memory

- RAM is slow relative to CPU
- Cache memory is similar to RAM but much faster and used to store instructions or data that are most frequently used
- **L1 cache**: within CPU usually 256 KB
- **L2 cache**: on the motherboard 512 –1024 KB

Factors Affecting Processing Speed

- Clock rate of the CPU
- Computer word size
- Bus speed
- Main memory size
- Cache memory size
- instruction set complexity
- Number of processing units
- Pipelining

Chapter 4
Input Output Devices

Input/Output

- ➢ In computing, input/output, or I/O, refers to the communication between an information processing system (such as a computer), and the outside world. Inputs are the signals or data sent to the system, and outputs are the signals or data sent by the system to the outside.
- ➢ Input/Output (I/O) refers to the process of getting information into and out of the computer.

Input/Output Devices

- ➢ Through input and output devices, people provide data and instructions to the computer and receive results from it
- ➢ Most external devices are capable of both input and output (I/O).
- ➢ Some devices are inherently input-only (also called read-only) or inherently output-only (also called write-only).
- ➢ Regardless of whether a device is I/O, read-only, or write-only, external devices can be classified as **block** or **character** devices.

Character Device

- ▪ One that inputs or outputs data in a stream of characters, bytes, or bits.
- ▪ Character devices can further be classified as serial or parallel.
    - ✓ A **serial** device streams data as a series of bits, moving data one bit at a time. Examples of serial devices include keyboards and MODEMs.
    - ✓ A **parallel** device streams data in a small group of bits simultaneously. Usually the group is a single eight-bit byte. Each group usually corresponds to a single character of data. The most common parallel device is a printer.

Block Device

- ▪ Moves large blocks of data at once.
- ▪ This may be physically implemented as a serial or parallel stream of data, but the entire block gets transferred as single packet of data.

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Input Devices

- **Input** devices are devices that bring information into a computer.
- **Digitizing** is the process of taking a visual image, or audio recording and converting it to a binary form for the computer.
- Two categories of input hardware:

  - Those that deal with original data.
  - Those that handle previously stored data.

- The most common types of input devices are: o Keyboards
  - o Point and Click devices (including mouse, tracker balls, touch sensitive pads, joysticks, light pens, touch screens, and graphic tablets)
  - o Readers / scanning devices (including magnetic strip readers, barcode readers, optical character readers/recognition, magnetic ink character readers/recognition, and optical mark readers/recognition)
  - o Punched cards and tape o Sound capture devices (including voice recognition and microphones) o Terminals o Digital imaging devices (including video digitisers, scanners, digital cameras, and web cams)

The Keyboard

- ✓ The keyboard is a mean of interacting with your computer.
- ✓ The most common type of keyboard is the QWERTY keyboard (so called because the top line of letters is q, w, e, r, t, and y.
- ✓ Most of the keys on the keyboard are laid out like the keys on a typewriter.
- ✓ But there are some special keys like Esc (Escape), Ctrl (Control), and Alt (Alternate).
- ✓ There are also some keys across the top of the keyboard labeled F1, F2, F3, and so forth. Those are called the *function keys*, and the exact role they play depends on which program you happen to be using at the moment.
- ✓ Most keyboards also have a *numeric keypad &. Navigation keys*.

The Mouse

- ✓ The mouse translates movement on the desktop into digital information.
- ✓ This information is converted into movement of the cursor on the screen.
- ✓ A mouse has two or three buttons which can be clicked to help the user to select what functions they wish to use.
- ✓ The button on the left is called the *primary (left) mouse button*; the button on the right is called the *secondary (right) mouse button.*
- ✓ Many mice have a small wheel between the two mouse buttons, as illustrated in Figure.
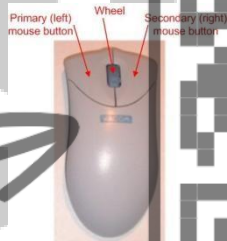
Tracker ball

- ✓ The tracker ball is essentially an upside down mouse.
- ✓ Instead of moving the mouse on the table top, the ball is rotated.
- ✓ This achieves the same result as using a mouse but takes up far less room.

Touch sensitive pad

- ✓ These are most commonly found on laptop computers.
- ✓ A stylus or the user's finger is pressed gently onto the pad, and as it is moved the cursor moves on the screen.

Joystick

- ✓ These are most commonly used to interact with computer games, although they are also used in other circumstances (e.g. on hospital scanners).

- ✓ Like the tracker ball, the movement of the joystick moves the cursor on the screen.

Light pen

- ✓ Light pens are usually used with specialist design software.

- ✓ The light pen works by being touched against the screen.

- ✓ As the pen is moved on the screen, the cursor moves.

Touch screen

- ✓ The touch screen is a special type of screen which is sensitive to touch.

- ✓ Selections can be made by touching the screen.

- ✓ These are particularly useful in banks, building societies, and shops, where customers who are not used to using a keyboard can interact with a computer system.

Scanning Devices / Readers

- ✓ The most common types of reader used include magnetic strip readers, barcode readers, optical character readers/recognition, magnetic ink character readers/recognition, and optical mark readers/recognition).

Magnetic strip readers

- ✓ The most common magnetic tape readers are those used at electronic points of sale (EPOS).

- ✓ These _read' the personal data stored on the magnetic strip of a credit or debit card.

Barcode readers

- ✓ Barcodes are used in shops, libraries, luggage handling, and stock control.
- ✓ The lines on a barcode represent numbers, and can be scanned very quickly using a laser scanner.

Optical character readers/recognition

- ✓ Optical character recognition is a method of inputting text using a scanner.
- ✓ It requires special software to convert the scanned image of each letter into an ASCII (American Standard Code for Information Interchange) code, and it often confuses similar shaped letters and numbers (e.g. S and 5, B and 8).

Magnetic ink character readers/recognition

- ✓ Magnetic ink characters are printed at the bottom of cheques.
- ✓ They are used by banks to identify the bank a customer banks with, the individual branch where their account is held, and the customer's bank account number.
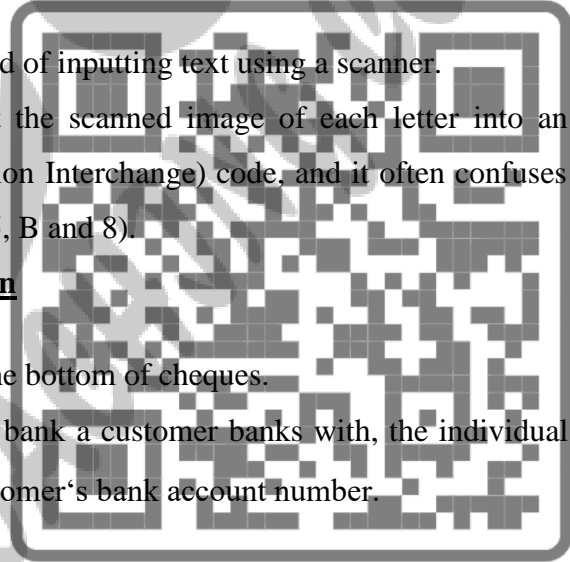
Optical mark readers/recognition

- ✓ Optical mark recognition sense marks made on specially designed forms (e.g. multiple choice answer sheets, lottery cards).
- ✓ OMR is a very cheap, easy and quick to handle system of inputting data, but if a user makes a mistake they are difficult to correct.

Punched cards and tape

- ✓ Punched cards and tape were used by the first computers to store programs and data.
- ✓ They are seldom used today except for clock cards, which records when a person starts and ends work.

Sound capture devices

- ✓ The most common use of sound capture devices involves the use of voice recognition software and microphones.
- ✓ Voice recognition software _remembers' the way a user speaks, and converts their speech into text that appears on screen.

Terminals

- ✓ EPOS (Electronic Point of Sale) and EFTPOS (Electronic Fund Transfer at Point Of Sale) terminals are connected, via secure Internet connections, to the computers of the main banks and credit card companies.
- ✓ EPOS and EFTPOS allow a retailer to transfer the cost of what they have sold to a customer from the customer's credit card or bank account to their own bank account.
- ✓ This is much faster than accepting payment by cheque, and more secure than accepting payment in cash.

Digital imaging devices

✓ These include video digitisers, scanners, digital cameras, and web cams.

Video Digitisers

✓ The video digitiser is a combination of hardware and dedicated software that converts an analogue signal into a digital signal.

✓ This is the basis of most set top boxes that give access to digital television on standard television sets.

✓ It can also be used to _capture' still images from video.

Scanners

✓ Scanners are used to scan text or images so that they can be stored on and manipulated by computer.

✓ The scanner converts the text or image into a digital signal which it sends to the computer.

✓ The user can then decide whether they want to store or manipulate what they have scanned.

Digital cameras

✓ Digital cameras convert the analogue image seen through the camera's lense into a digital signal that can be stored.

✓ Each picture is split up into millions of tiny squares (or pixels), each of which is a different colour.

✓ Each pixel is stored as a _bit' of digital information.

Web cams

- ✓ Web cameras (web cams for short) are small digital cameras which are attached to computers so that still and motion digital images can be _captured' and used.

- ✓ They are often used in conjunction with the Internet so that people can videoconference.

Output Devices

- ➢ An **output device** is any piece of computer hardware equipment used to communicate the results of data processing carried out by an information processing system (such as a computer) to the outside world.

- ➢ There are a number of devices, which produce data in different forms, which includes audio, video or hard copy.

- ➢ Examples of output devices:

  - Screen (Monitor)
  - Printer & Plotter
  - Projector
  - Speaker & Headphone

- ➢ The two output devices more commonly used are the **printer** and the computer **screen**.

  - The printer produces a **hard copy** of your output, and the computer screen produces a **soft copy** of your output.

Monitor

- ➢ A **monitor** or **display** (also called **screen** or **visual display unit**) is an electronic visual display for computers.

- ➢ There are two types of computer monitors available, namely CRT and flat panel.

- ➢ The display device in modern monitors is typically a thin film transistor liquid crystal display (TFT-LCD) thin panel, while older monitors use a cathode ray tube about as deep as the screen size.

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➢ All monitors rely in a video card, which is located on the motherboard to display the information. It is the video card, which processes the data into images, which is eventually displayed on the monitor.

➢ Video cards are also called video display adapters, and graphics cards. Many video cards contain separate processors and dedicated video memory for generating complex graphics quickly without burdening the CPU.

CRT Monitor

➢ The traditional output device of a personal computer has been the CRT (Cathode Ray Tube) monitor.

➢ Just like a television set (an older one, anyway) the CRT monitor contains a large cathode ray tube that uses an electron beam of varying strength to —paint‖ a picture onto the color phosphorescent dots on the inside of the screen.

➢ CRT monitors are heavy and use more electrical power than flat panel displays, but they are preferred by some graphic artists for their accurate color rendition, and preferred by some gamers for faster response to rapidly changing graphics.

➢ Monitor screen size is measured diagonally across the screen, in inches

➢ The resolution of the monitor is the maximum number of pixels it can display horizontally and vertically (such as 800 x 600, or 1024 x 768, or 1600 x 1200).

➢ Pixels (short for picture elements) are the small dots that make of the image displayed on the screen.

➢ The spacing of the screen's tiny phosphor dots is called the dot pitch (dp), typically .28 or .26 (measured in millimeters). A screen with a smaller dot pitch produces sharper images.

CRT monitor

Flat Panel Monitor

- ➤ A flat panel display usually uses an LCD (Liquid Crystal Display) screen to display output from the computer.

- ➤ The LCD consists of several thin layers that polarize the light passing through them.

- ➤ The polarization of one layer, containing long thin molecules called liquid crystals, can be controlled electronically at each pixel, blocking varying amounts of the light to make a pixel lighter or darker.

- ➤ Other types of flat panel technology exist (such as *plasma displays*) but LCDs are most commonly used in computers, especially laptops.

- ➤ Older LCDs had slow response times and low contrast, but active matrix LCD screens have a transparent thin film transistor (TFT) controlling each pixel, so response, contrast, and viewing angle are much improved.

- ➤ Flat panel displays are much lighter and less bulky than CRT monitors, and they consume much less power.

- ➤ They have been more expensive than CRTs in the past, but the price gap is narrowing. You will see many more flat panels in the future.

- ➤ As with CRTs, the display size of a flat panel is expressed in inches, and the resolution is the number of pixels horizontally and vertically on the display.

Flat panel display (LCD)

Video Display Adapter:

- ➤ Today, most systems are sold with a display adapter that connects to a PCI "local bus", supports some Windows accelerator, and provides SVGA resolutions.(The "local bus" means that the CPU can send data to the card at high speed.)

- ➤ The video display adapter is also called the video card or graphics card. It is an expansion card that creates a circuit pathway so that data can travel from the main board to the monitor.

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➢ Elements of the Video Display Adapter:

Resolution: Resolution refers to the number of dots on the screen or pixels. It is expressed as a pair of numbers that give the number of dots on a line (horizontal) and the number of lines (vertical). Four resolutions commonly used today.

- ✓ 640x480 PIXELS (VGA) (images are larger)

- ✓ 800x600 PIXELS (SVGA)

- ✓ 1024x768 PIXELS (SVGA)

- ✓ 1280x1024 PIXELS (SVGA)(images are smaller)

- The smaller the pixels, the clearer and sharper the picture appears on the monitor. Most monitors come with a .28 dot pitch. This is the standard for monitors. Do not buy a monitor if the dot pitch is more than .28. The smaller the dot pitch the better the monitor.

- **Color Depth:** Memory on the video adapter limits the number of colors that can be display at each resolution. If you want to do really high quality photography you need at least 1MB of memory. Multimedia applications with high resolution graphics need at least 2 MB of memory.

  o 4 bits - 16 colors (original VGA) (256K of memory) (very primitive color)

  o 8 bits - 256 colors (SVGA) (good for business and home applications) o 16

  bits - 32 thousand colors (multi-media and desktop publishing) o 24 bits - 16

  Million (Truecolor) (high-end production and desktop publishing and virtual

  environments)More video RAM required.

- **Refresh Rate**: The Refresh Rate determines the speed that the display uses to paint the dots on the screen. The refresh rate requirement of a typical monitor is 70Hz. Simply speaking, refresh rate relates to the number of times a screen is redrawn. In many of the popular Internet browsers you will notice a refresh option or reload. This tells the computer to redraw the screen.

- **Accelerator**: With the invention of the graphics accelerator chip on the video card, the display adapter can draw lines and boxes, scroll text, rotate graphics, make background fills, and also use and manage a mouse pointer, and other pointing devices. Application programs can now send requests and with the help of a Windows Driver routine, the adapter can calculate the bits without the help of the CPU, making the procedure faster.

Printer & Plotter

Printer

- ➢ In computing, a **printer** is a peripheral which produces a text or graphics of documents stored in electronic form, usually on physical print media such as paper or transparencies.
- ➢ Printer takes processed data from the computer to generate a hard copy of the data
- ➢ Many printers are primarily used as local peripherals, and are attached by a printer cable or, in most new printers, a USB cable to a computer which serves as a document source.
- ➢ Some printers, commonly known as *network printers*, have built-in network interfaces, typically wireless or Ethernet based, and can serve as a hard copy device for any user on the network.
- ➢ In addition, a few modern printers can directly interface to electronic media such as memory cards, or to image capture devices such as digital cameras and scanners; some printers are combined with scanners or fax machines in a single unit, and can function as photocopiers.
- ➢ There are three main types of computer printers, namely ink jet, laser printers and dot matrix. Each of this printer type uses a different technology to print the data.

Ink Jet Printer

- ➢ The most common type of printer for home systems is the color ink jet printer.
- ➢ These printers form the image on the page by spraying tiny droplets of ink from the print head.
- ➢ The printer needs several colors of ink (cyan, yellow, magenta, and black) to make color images. Some photo-quality ink jet printers have more colors of ink.
- ➢ Ink jet printers are inexpensive, but the cost of consumables (ink cartridges and special paper) makes them costly to operate in the long run for many purposes.

Laser Printer

- ➢ A laser printer produces good quality images by the same technology that photocopiers use.

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> A drum coated with photosensitive material is charged, then an image is written onto it by a laser (or LEDs) which makes those areas lose the charge. The drum then rolls through toner (tiny plastic particles of pigment) that is attracted to the charged areas of the drum. The toner is then deposited onto the paper, and then fused into the paper with heat.

> Most laser printers are monochrome (one color only, usually black), but more expensive laser printers with multiple color toner cartridges can produce color output.

> Laser printers are faster than ink jet printers. Their speed is rated in pages per minute (ppm).

> Laser printers are more expensive than ink jets, but they are cheaper to run in the long term if you just need good quality black & white pages.

> One of the chief characteristics of laser printers is their resolution -- how many dots per inch (dpi) they lay down. The available resolutions range from 300 dpi at the low end to 1,200 dpi at the high end.

Dot matrix printer

> Dot matrix printers use small electromagnetically activated pins in the print head, and an inked ribbon, to produce images by impact.

> The pin sizes range from 9-24.

> The printhead hits the ink ribbon with one of its many pins causing it to form a letter number or character.

> With the pins hitting the ribbon this printer becomes quite loud.

> These printers are slow and noisy, and are not commonly used for personal computers anymore (but they can print multi-layer forms, which neither ink jet nor laser printers can).

> The ppm (page per minute ranges from 1 to 3 but in new changes in technology its is becoming more and more used in offices today and also can print 3 - 6 ppm plus it is much more quiter. T

> The drawback in most dot matrix printers is the on-roll paper which has a track which feeds it through the printer.

➢ Also in most new dot matrix printers there is a paper feed which allows most forms of paper.

Line printer

➢ The line printer is a form of high speed impact printer in which one line of type is printed at a time.

➢ They are mostly associated with the early days of computing, but the technology is still in use.

➢ Print speeds of 600 to 1200 lines-per-minute (approximately 10 to 20 pages per minute) were common.

Classification of Printers:

➢ Printers are also classified by the following characteristics:

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

- **Speed**: Measured in characters per second (cps) or pages per minute (ppm), the speed of printers varies widely. Dot-matrix printers can print up to 500 cps, and laser printers range from about 4 to 20 text pages per minute.

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

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

- **Fonts** : Some printers, notably dot-matrix printers, are limited to one or a few fonts. In contrast, laser and ink-jet printers are capable of printing an almost unlimited variety of fonts.

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Plotter

- Plotters, like printers, create a hard copy rendition of a digitally rendered design.
- The design is sent to a plotter through a graphics card and the image is created using a pen.
- In simple words, plotters basically draw an image using a series of straight lines.
- This computer output device is used with engineering applications. **Projector**

- It is a hardware device, with which an image like a computer screen is projected onto a flat screen.
- Image data is sent to the video card, by the computer which is then translated into a video image and sent to the projector.
- A projector is often used in meetings or to make presentations, because they allow for a large image to be shown, with which the display is available for a large audience.

Speaker & Headphone

Speaker

- **Computer speaker**, or **multimedia speaker** is a hardware device, that is connected to a computer's sound card, which outputs sound generated by the card.
- Audio data generated by the computer is sent to the audio card that is located in the expansion slot.
- The card translates the data into audio signals, which are then sent to either the speakers or headphones.
- They often have a low-power internal amplifier.
- The standard audio connection is a 3.5 mm (approximately 1/8 inch) stereo jack plug often color coded lime green (following the PC 99 standard) for computer sound cards.
- There are also USB speakers which are powered from the 5 volts at 500 milliamps provided by the USB port, allowing about 2.5 watts of output power.
- Computer speakers range widely in quality and in price
- Some computer displays have rather basic speakers built-in. Laptops come with integrated speakers.

Headphone

➢ **Headphones** are a pair of small loudspeakers, or less commonly a single speaker, held close to a user's ears and connected to a signal source such as an audio amplifier, radio, CD player or portable Media Player.

➢ They are also known as **stereophones**, **headsets** or, colloquially, **cans**.

➢ The in-ear versions are known as **earphones** or **earbuds**.

➢ In the context of telecommunication, the term headset is used to describe a combination of headphone and microphone used for two-way communication, for example with a telephone.

Connecting Hardware to the computer:

• Hardware needs access through some general input/output connection.

✓ **Port**: The pathway for data to go into and out of the computer from external devices such as keyboards.

• There are many standard ports as well as custom electronic ports designed for special purposes.

• Ports follow standards that define their use.

  o SCSI, USB: Multiple peripheral devices (chain). o RS-232, IDE: Individual peripheral devices.

- Hardware needs software on the computer that can service the device.

✓ **Device driver**: Software addition to the operating system that will allow the computer to communicate with a particular device.

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Chapter 5
Storage Devices

Storage Devices

➢ **Storage** or **memory** device refers to computer component and recording media that retain digital data. Data storage is one of the core functions and fundamental components of computers.

➢ Storage devices hold information, when computer is off. These devices are also called secondary storage devices.

➢ Two processes / functions are performed on these devices:

Writing data   Reading data

➢ They operate just like a filing cabinet.

➢ The information is stored on these devices are used to perform tasks.

➢ The information can be as simple as data, or more complex application programs that will enhance your work.

➢ Examples of the devices include the hard drives, floppy drives, tape drives, CD-ROM drives, and zip drives.

➢ Common Basic Technologies for Storing Binary Information:

  o Electronic / Solid-state
  o Magnetic
  o Optical

➢ **Electronic Technology** o Most expensive of the three forms for storing binary information.

  o A flip-flop circuit has either one electronic status or the other. It is said to flip-flop from one to the other.
  o Electronic circuits come in two forms:
    ▪ Permanent
    ▪ Non-permanent

➢ **Magnetic Technology**

  • Two parts to most of the magnetic forms of information storage:

    – The **medium** that stores the magnetic information.

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- Example: Floppy disk. Tiny spots on the disk are magnetized to represent 0s and 1s.

  – The **device** that can ―read‖ that information from the medium.

  - The drive spins the disk.
  - It has a magnetic sensing arm that moves over the disk.
  - Performs nondestructive reading.

➢ **Optical Technology**

- Uses lasers to ―read‖ the binary information from the medium, usually a disc.

  – Millions of tiny holes are ―burned‖ into the surface of the disc.

  – The holes are interpreted as 1s. The absences of holes are interpreted as 0s.

Four Most Important Characteristics Of Storage Devices:

- Speed and access time
- Cost / Removable versus non-removable
- Capacity
- Type of access

Type of Access

- **Sequential** - The accessing of pieces of information will be in a serial order, one after the other; therefore the time to access a particular piece of information depends upon which piece of information was last accessed. Such characteristic is typical of off-line storage.

- **Random Access** - Any location in storage can be accessed at any moment in approximately the same amount of time. Such characteristic is well suited for primary and secondary storage. Most semiconductor memories and disk drives provide random access.

Storage System Characteristics

➢ Can be internal, external, or remote
➢ Are nonvolatile
➢ Usually use random access; can be sequential

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➢ Logical file representation: The user's view of the way data is stored ○ File: something stored on a storage medium, such as a program, document, or image ○ Filename: name given to a file by the user ○ Folder: named place on a storage medium into which files can be stored

➢ Physical file representation: The actual physical way the data is stored on the storage media as viewed by the computer

➢ With magnetic media, such as floppy discs, data is stored magnetically ○ The data (0s and 1s) is represented using different magnetic alignments

➢ Optical media (such as CDs and DVDs) store data optically using laser beams ○ Data can be permanently burned on the disc ○ Rewritable optical media can be erased and rewritten

➢ Some storage systems combine magnetic and optical technology ➢ Others like flash memory represent data using electrons

A CD/DVD drive is usually assigned a letter after the hard drive (such as D, if there isn't a second hard drive).

The letter C is usually assigned to the first hard drive.

The various slots in a built-in flash memory card reader are typically assigned next, such as the letters E, F, G, and H, in this example.

Other letters, beginning with I in this example, would be used for any other storage devices attached to the PC, such as via these FireWire and USB ports.

Magnetic Storage Devices
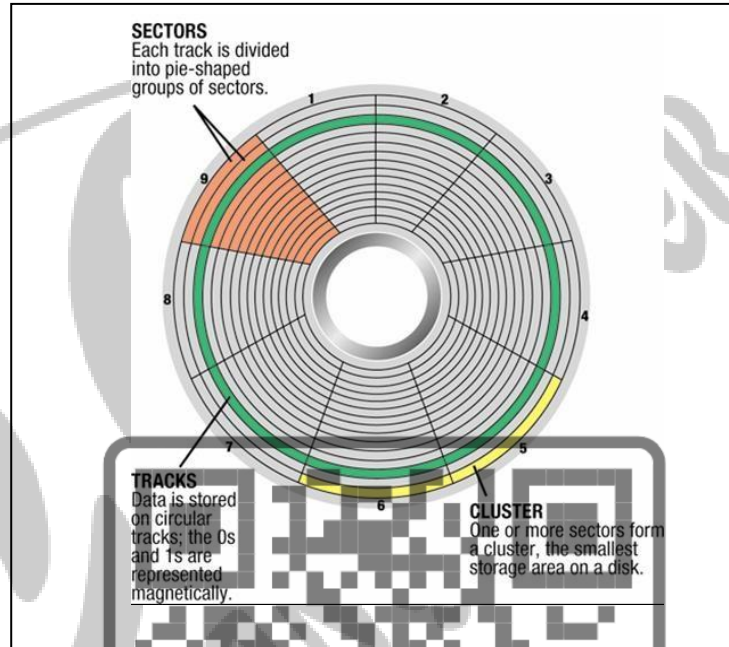
- Magnetic disks: Record data using magnetic spots on disks made of flexible plastic or rigid metal

    – Most widely used storage medium on today's computers (hard drives)

    – Disks are divided into tracks, sectors, and clusters

    – Data written and read using read/write heads

- **Common types**

    – Floppy disks (common removable storage medium in the past; not widely used today)

– Hard disks (included on nearly all PCs today)

– Zip disks (high-capacity magnetic discs that are proprietary)

SECTORS
Each track is divided into pie-shaped groups of sectors.

TRACKS
Data is stored on circular tracks; the 0s and 1s are represented magnetically.

CLUSTER
One or more sectors form a cluster, the smallest storage area on a disk.

FLOPPY DISK
(the actual disk is located inside the hard plastic cover)

FLOPPY DRIVE
(this drive connects to the PC via a USB cable)

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Floppy Disks / Diskettes

➢ Read by floppy drives; sometimes referred to as a legacy drive

➢ Mylar disk, made of flexible plastic, permanently sealed inside a hard plastic cover

➢ Spin at 300 RPM

➢ Takes .2 second to find data

➢ Low capacity, removable magnetic disk

➢ Typically 3 ½ floppy disk holds 1.44 MB

➢ Not widely used today
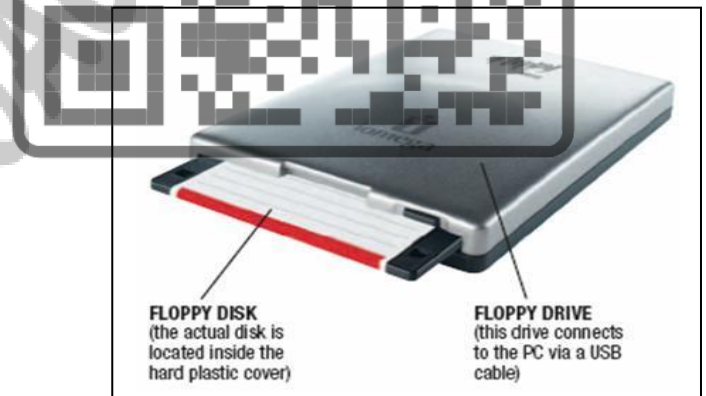
Hard Disks

➢ Primary storage device in a computer

➢ Hard drive: Storage system consisting of one or more metal magnetic discs permanently sealed with an access mechanism inside its drive

➢ Data is stored magnetically

➢ Use thicker, metallic *platters* for storage: Each platter has 2 sides

➢ Several platters, with information recorded magnetically on both surfaces (usually) ➢ Data organization:

o Disks must be formatted before use o Format draws tracks on the disk o Tracks is divided into sectors

- Amount of data a drive can read (e.g., 512 Bytes)

➢ Actuator moves head (end of arm,1/surface) over track (―seek‖), select surface, wait for sector rotate under head, then read or write o ―Cylinder‖: all tracks under heads

➢ Spin between 5,400 to 15,000 RPM

➢ Data found in 9.5 ms or less

➢ Drive capacity greater than 40 GB

➢ Faster than a floppy diskette ➢ HDDs can be:

o Internal: Permanently located inside the system o External: Connected via a USB or FireWire port

o Portable: Designed to transport large amounts of data from one PC to another o Pocket: Very small and portable
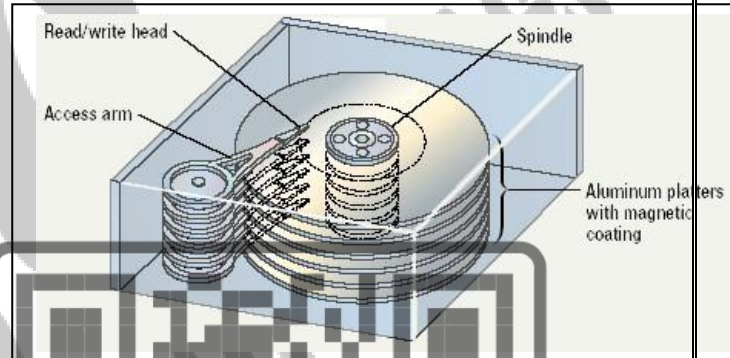
Optical Disks

➢ Optical discs: store data optically (using laser beams) instead of magnetically

➢ Divided into tracks and sectors like magnetic discs but use a single grooved spiral track

➢ Can be read-only, recordable, or rewritable

➢ Permanent storage

➢ Two common types ○ *CD* ○ *DVD*

➢ Conventional CD discs use infrared lasers

➢ DVDs use red lasers

➢ Burning: Recording data onto an optical disc

➢ Pits and lands are used to represent 1s and 0s

➢ Pits can be molded into the disc surface or created by changing the reflectivity of the disc

➢ The transition between a pit and a land represents a 1; no transition represents a 0
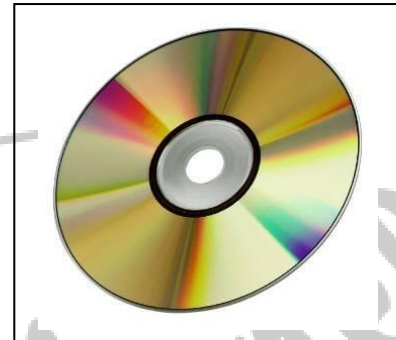
Compact Disc

➢ Optical format

➢ Most software ships on a CD

➢ Read using a laser

➢ From 650 MB to 1 GB capacity

➢ Rotation speeds vary

➢ Types ○ Read only: *CD-ROM* ○ Write once: *CD-R* ○ Rewriteable: *CD-RW* ○ *Picture CDs* and *Photo CDs*

Digital Versatile Disc

➢ *Digital Versatile Disk* or *Digital Video Disk (DVD)*

➢ Similar to CDs, but can store more data

➢ Types ○ Read only: *DVD-ROM* ○ Write once: *DVD+R; DVD-R* ○ Rewritable: *DVD+RW*; *DVD-RW; DVD-RAM*

Other Types of Secondary Storage

Flash memory cards

➢ Widely used in notebook computers

➢ A small card containing flash memory chips and metal contacts to connect the card to the device or reader that it is being used with ○ CompactFlash ○ Secure Digital (SD) ○ Secure Digital High Capacity (SDHC) ○ MultiMedia Card (MMC)

➢ Read by flash memory card reader

Flash memory / USB

USB FLASH DRIVE WITH BACKPACK CLIP

➢ Found in cameras and USB drives

➢ Combination of RAM and ROM

➢ Long term updateable storage

➢ Flash memory drives: Consist of flash memory media and a reader in a single self-contained unit

➢ Typically portable drives that connect via a USB port

➢ Also called USB flash memory drives, thumb drives, jump drives

➢ Come in a variety of appearances **Magnetic Tape**

➢ External storage

➢ Provides *sequential access*

  ▪ Information stored in sequence

  ▪ Slower than disks which provide direct access

➢ *Magnetic tape streamers* or tape cartridges used by both mainframes and microcomputers

➢ Plastic tape with a magnetizable surface that stores data as a series of magnetic spots

➢ Primarily used for backup and archival purposes

➢ Most tapes today are in the form of cartridge tapes

➢ Read from and written to via a tape drive

➢ Tape libraries contain multiple tape drives

Smart cards

➢ Credit cards with a chip

➢ Credit card-sized piece of plastic that contains some computer circuitry (processor, memory, and storage)

➢ Store small amount of data (about 64 KB or less)

➢ Commonly used to store prepaid amounts of digital cash or personal information

➢ Smart card readers are built into or attached to a PC, keyboard, vending machine, or other device

➢ Some smart cards store biometric data

➢ Can be used in conjunction with encryption and other security technologies

Solid-state disks

➢ Large amount of SDRAM

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> ➢ Use flash memory instead of spinning platters and magnetic technology

> ➢ Extremely fast & Volatile storage

> ➢ Require battery backups

Remote storage

> ➢ Using a storage device not directly a part of the PC being used

> ➢ Network storage: Accessible through a local network

> ➢ Online storage: Accessed via the Internet

RAID

> ➢ RAID (redundant arrays of independent discs): Method of storing data on two or more hard drives that work together to do the job of a larger drive o Usually involves recording redundant copies of stored data o Helps to increase fault tolerance

Partitioning and File Systems

> ➢ Partitioning: Enables you to logically divide the physical capacity of a single drive into separate areas, called partitions or logical drives ➢ Used to:
>   o Install more than one operating system
>   o Create a recovery partition o Create a new logical drive for data o
>   Increase efficiency (smaller drives can use smaller cluster sizes)

> ➢ File system: Determines the cluster size, maximum drive size, and maximum file size o FAT, FAT32, and NTFS
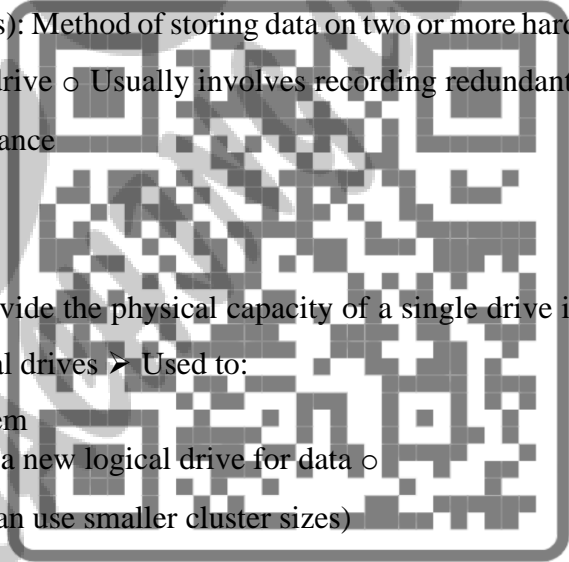
Chapter 6

Computer Software

Computer software

- ➢ **Computer software**, or just **software**, is a collection of computer programs and related data that provide the instructions for telling a computer what to do and how to do it.

- ➢ In other words software is a set of **programs, procedures, algorithms** and its **documentation**.

- ➢ Programs are an ordered sequence / set of instructions, usually written in high-level programming languages

- ➢ Program software performs the function of the program it implements, either by directly providing instructions to the computer hardware or by serving as input to another piece of software.

- ➢ In contrast to hardware, software "cannot be touched".
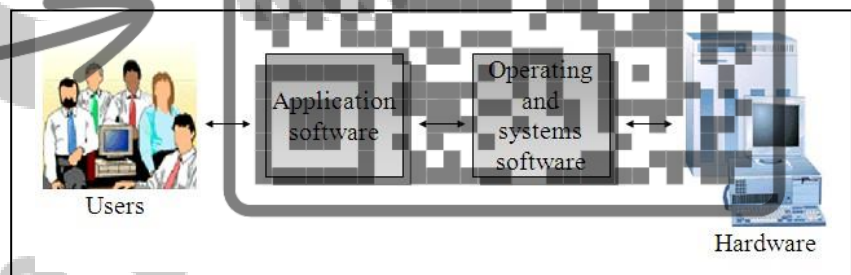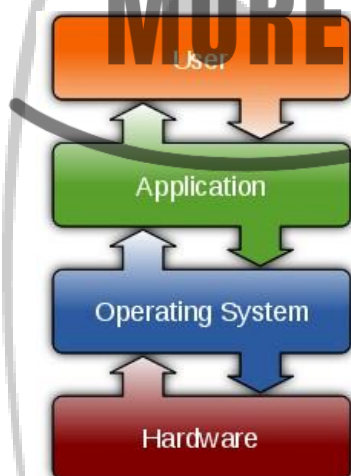
Types of software

- ➢ Practical computer systems divide software systems into three major classes:

  - ▪ System Software

  - ▪ Programming Software

  - ▪ Application Software

System software

- System software provides the basic functions for computer usage and helps run the computer hardware and system.

- It includes a combination of the following:
    - Device drivers
    - Operating systems
    - Utilities

- System software is responsible for managing a variety of independent hardware components, so that they can work together harmoniously.

- Its purpose is to unburden the application software programmer from the often complex details of the particular computer being used, including such accessories as communications devices, printers, device readers, displays and keyboards, and also to partition the computer's resources such as memory and processor time in a safe and stable manner.

Device driver

- In computing, a **device driver** or **software driver** is a computer program allowing higher-level computer programs to interact with a hardware device.

- A driver typically communicates with the device through the computer bus or communications subsystem to which the hardware connects.

- When a calling program invokes a routine in the driver, the driver issues commands to the device.

- Once the device sends data back to the driver, the driver may invoke routines in the original calling program.

- Drivers are hardware-dependent and operating-system-specific.

- A*pplication:* Because of the diversity of modern hardware and operating systems, drivers operate in many different environments.

- Drivers may interface with:

    - printers
    - video adapters
    - network cards
    - sound cards

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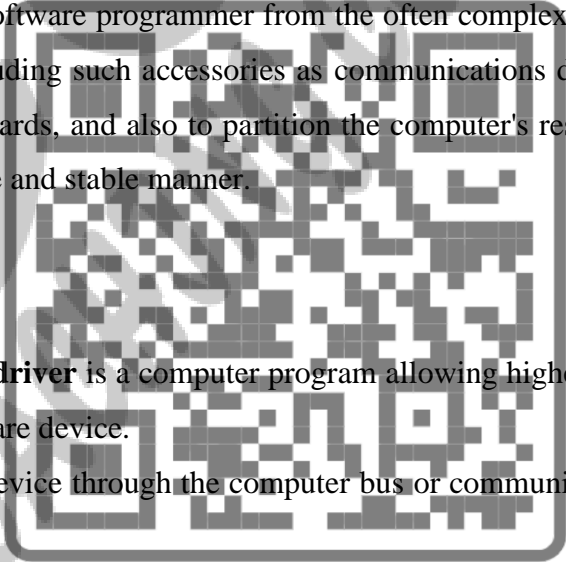
- computer storage devices such as hard disk, CD-ROM and floppy disk buses (ATA, SATA, SCSI)

- image scanners

- digital cameras

Operating system

➢ An **operating system** (**OS**) is a set of programs that manage computer hardware resources and provide common services for application software.

➢ The operating system is the most important type of system software in a computer system.

➢ A user cannot run an application program on the computer without an operating system, unless the application program is self booting.

➢ For hardware functions such as input and output and memory allocation, the operating system acts as an intermediary between application programs and the computer hardware.

➢ Operating systems are found on almost any device that contains a computer—from cellular phones and video game consoles to supercomputers and web servers.

➢ Examples of popular modern operating systems include Unix, and Microsoft Windows.

➢ Operating systems can be classified as follows:

- **Multi-user :** Allows two or more users to run programs at the same time. Some operating systems permit hundreds or even thousands of concurrent users.

- **Single-user:** Single-user operating systems, as opposed to a multi-user operating system, are usable by a single user at a time.

- **Multiprocessing :** Supports running a program on more than one CPU.

- **Multitasking :** Allows more than one program to run concurrently.

- **Single-tasking:** When only a single program is allowed to run at a time, the system is grouped under a single-tasking system.

- **Multithreading :** Allows different parts of a single program to run concurrently.

- **Real time:** Responds to input instantly. The main objective of real-time operating systems is their quick and predictable response to events.

- **Distributed:** manages a group of independent computers and makes them appear to be a single computer.

- **Embedded:** Embedded operating systems are designed to be used in embedded computer systems.

Operating System Functions

- Perform common computer hardware functions
- Provide a user interface
- Provide a degree of hardware independence
- Manage system memory
- Provide networking capability
- Control access to system resources
- Manage files
- Program Execution
- Handling Input/Output Operations
- Information and Resource Protection

User Interface

➢ A function of the operating system that allows individuals to access and command the computer

- **Command-based user interface:**
  - A particular user interface that requires text commands be given to the computer to perform basic activities
  - E.g., unix, DOS
- **Graphical user interface (GUI)**
  - A user interface that uses pictures (icons) and menus displayed on the screen to send commands to the computer system
  - E.g. Windows, MAC OS

Popular Operating Systems

➢ Today, many computers use an operating system that has a graphical user interface (GUI). Microsoft **Windows XP** is a widely used graphical operating system. **DOS** (Disk Operating System) is an older but still widely used operating system that is text-based.

➢ Generally popular operating systems are:

- **Windows XP Professional Edition** - A version used by many businesses on workstations.

It has the ability to become a member of a corporate domain.

- **Windows XP Home Edition** - A lower cost version of Windows XP which is for home use only and should not be used at a business.

- **Windows 2000** - A better version of the Windows NT operating system which works well both at home and as a workstation at a business. It includes technologies which allow hardware to be automatically detected and other enhancements over Windows NT.

- **Windows ME** - A upgraded version from windows 98 but it has been historically plagued with programming errors which may be frustrating for home users.

- **Windows 98** - This was produced in two main versions. The first Windows 98 version was plagued with programming errors but the Windows 98 Second Edition which came out later was much better with many errors resolved.

- **Windows NT** - A version of Windows made specifically for businesses offering better control over workstation capabilities to help network administrators.

- **Windows 95** - The first version of Windows after the older Windows 3.x versions offering a better interface and better library functions for programs.

- **MS-DOS -** (short for Microsoft Disk Operating System) is an operating system for x86based personal computers. It was the main operating system for IBM PC compatible personal computers during the 1980s to the mid 1990s, until it was gradually superseded by operating systems offering a graphical user interface (GUI)

- **Unix** - It is primary used to be a server rather than a workstation and should not be used by anyone who does not understand the system.

- **Linux** - Linux is similar to Unix in operation but it is free. It also should not be used by anyone who does not understand the system and can be difficult to learn.

- **Apple Macintosh** - It has a good graphical interface so it is both stable (does not crash often) & easy to learn. One drawback to this system is that it can only be run on Apple produced hardware.
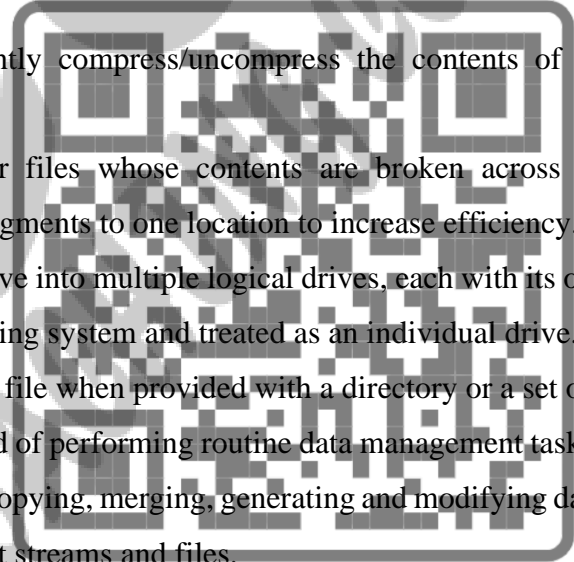
Utility software

- ➢ **Utility software** is system software designed to help analyze, configure, optimize or maintain a computer.

- ➢ A single piece of utility software is usually called a **utility** or **tool**.

- ➢ Utility software usually focuses on how the computer infrastructure (including the computer hardware, operating system, application software and data storage) operates..

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Utility software categories

- **Anti-virus** utilities scan for computer viruses.

- **Backup** utilities can make a copy of all information stored on a disk, and restore either the entire disk (e.g. in an event of disk failure) or selected files (e.g. in an event of accidental deletion).

- **Data compression** utilities output a shorter stream or a smaller file when provided with a stream or file.

- **Disk checkers** can scan the contents of a hard disk to find files or areas that are corrupted in some way

- **Disk cleaners** can find files that are unnecessary to computer operation, or take up considerable amounts of space.

- **Disk compression** utilities can transparently compress/uncompress the contents of a disk, increasing the capacity of the disk.

- **Disk defragmenters** can detect computer files whose contents are broken across several locations on the hard disk, and move the fragments to one location to increase efficiency.

- **Disk partitions** can divide an individual drive into multiple logical drives, each with its own file system which can be mounted by the operating system and treated as an individual drive.

- **Archive** utilities output a stream or a single file when provided with a directory or a set of files.

- **File managers** provide a convenient method of performing routine data management tasks, such as deleting, renaming, cataloging, moving, copying, merging, generating and modifying data sets.

- **Cryptographic** utilities encrypt and decrypt streams and files.

- **Network utilities** analyze the computer's network connectivity, configure network settings, check data transfer or log events.

- **Registry cleaners** clean and optimize the Windows registry by removing old registry keys that are no longer in use.

- **Screensavers** were desired to prevent phosphor burn-in on CRT and plasma computer monitors by blanking the screen or filling it with moving images or patterns when the computer is not in use.

  Contemporary screensavers are used primarily for entertainment or security.

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Programming Software

➢ Programming software usually provides tools to assist a programmer in writing computer programs, and software using different programming languages in a more convenient way.

Programming Languages

➢ Programming languages bridge the gap between human thought processes and computer binary circuitry.

➢ Programming language makes it possible to talk to the computers and ask the computer to perform specific work.

➢ Programming language produces programs which are executed by CPU, and then CPU instructs all the other parts of computers to perform work accordingly.

➢ Each programming language has its own vocabulary and structural rules.

➢ Programmers use these languages to construct programs containing lists of instructions for the computer to perform.

➢ Popular languages include:

- BASIC
- Java
- Visual Basic
- C++

➢ Computers only understand programs in their own machine language. Machine language is the language of 0's and 1's.

➢ It is difficult to write program in machine language so what is the solution to this dilemma? The answer is in what are called high-level languages i.e. Computer programming languages that look like natural language.

➢ All programs written in high level language must be translated before their instructions execution.

➢ Computer languages can be grouped according to which translation process is used to convert the instructions into binary code:

- Assemblers
- Interpreters
- Compilers
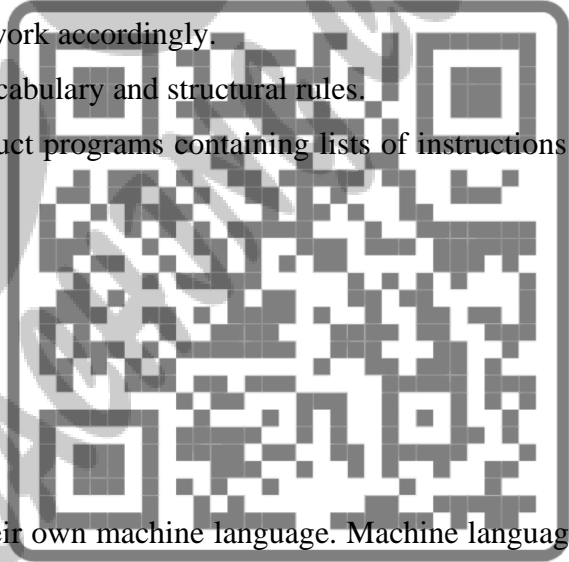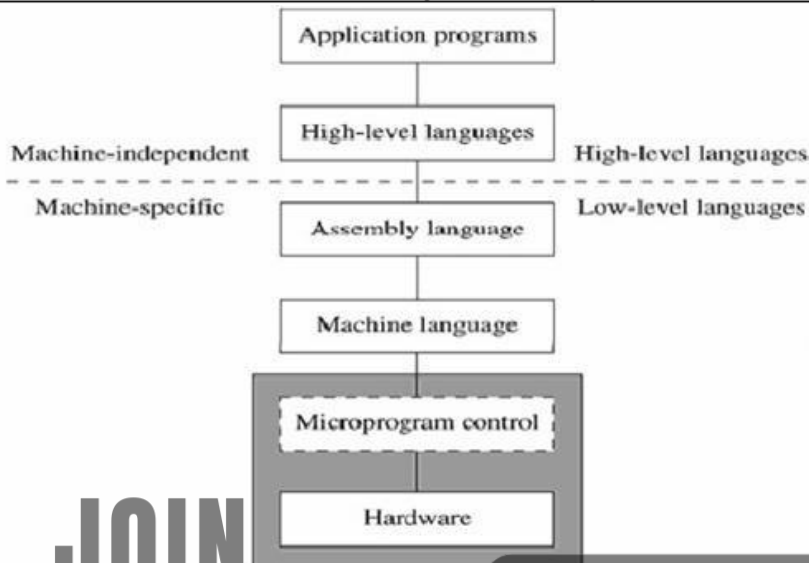
> To see how this was accomplished, let's investigate how programming languages evolved.

- First Generation - Machine Language (code) o **Machine language** programs were made up of instructions written in binary code.

  o This is the ―native‖ language of the computer.

- Second Generation - Assembly Language o **Assembly language** programs are made up of instructions written in mnemonics.

- Third Generation - People-Oriented Programming Languages o **High-level languages**: Use statements that resemble English phrases combined with mathematical terms needed to express the problem or task being programmed.

- Fourth Generation - Non-Procedural Languages o Programming-like systems aimed at simplifying the programmer's task of imparting instructions to a computer.

  o Many are associated with specific application packages.

  - ✓ Query Languages:
  - ✓ Report Writers:
  - ✓ Application Generators:

- Fifth Generation - Natural Languages o **Object-Oriented Languages**: A language that expresses a computer problem as a series of objects a system contains, the behaviors of those objects, and how the objects interact with each other.

Assembler:

> A program used to translate Assembly language programs.

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➢ Produces one line of binary code per original program statement.

– The entire program is assembled before the program is sent to the computer for execution.
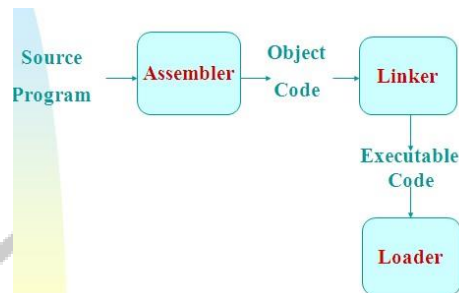
Compiler

➢ A language translator that converts a complete program into machine language (often having a binary form known as object code).

➢ The most common reason for wanting to transform source code is to create an executable program.
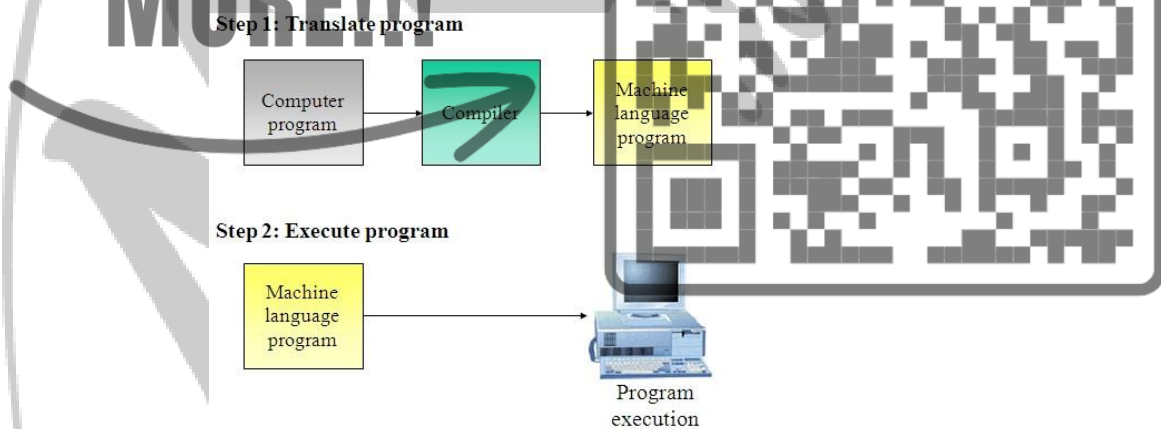
Interpreter

➢ In computer science, an **interpreter** normally means a computer program that executes, i.e. performs, instructions written in a programming language.

➢ translates one program statement at a time into machine code

– An instruction is **fetched** from the original source code.

- The Interpreter checks the single instruction for errors. (If an error is found, translation and execution ceases. Otherwise…) – The instruction is translated into binary code.

- The binary coded instruction is **executed**.

- The fetch and execute process repeats for the entire program
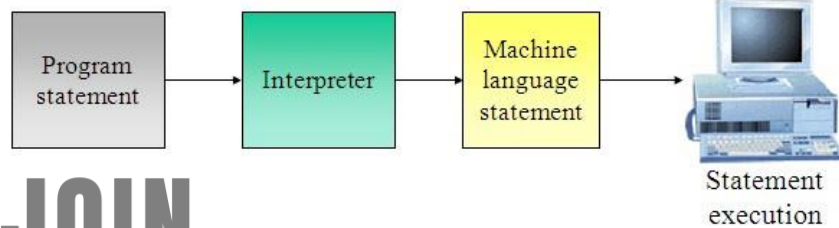
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High-level programming language

- ➢ A programming language such as C, FORTRAN, or Basic that enables a programmer to write programs that are more or less independent of a particular type of computer.

- ➢ Such languages are considered high-level because they are closer to human languages and further from machine languages.

- ➢ The main advantage of high-level languages over low-level languages is that they are easier to read, write, and maintain.

- ➢ The first high-level programming languages were designed in the 1950s.

- ➢ Now there are dozens of different languages, including BASIC, COBOL, C, C++, FORTRAN, LISP, Pascal, and Prolog.

- ➢ Ultimately, programs written in a high-level language must be translated into machine language by a compiler or interpreter.
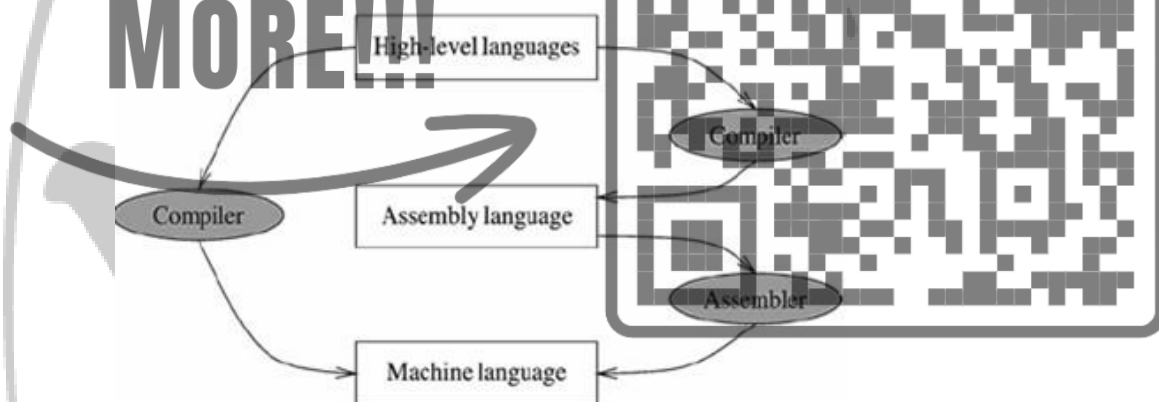
Execution models

There are three models of execution for modern high-level languages:

Interpreted

- ➢ Interpreted languages are read and then executed directly, with no compilation stage.
- ➢ A program called an *interpreter* reads each program line following the program flow, converts it to machine code, and executes it; the machine code is then discarded, to be interpreted anew if the line is executed again.

Compiled

> Compiled languages are transformed into an executable form before running. There are two types of compilation:

- **Machine code generation:** Some compilers compile source code directly into machine code. This is the original mode of compilation, and languages that are directly and completely transformed to machine-native code in this way may be called "truly compiled" languages.

- **Intermediate representations:** When a language is compiled to an intermediate representation, that representation can be optimized or saved for later execution without the need to re-read the source file. When the intermediate representation is saved, it is often represented as byte code. The intermediate representation must then be interpreted or further compiled to execute it.

- **Translated:** A language may be translated into a lower-level programming language for which native code compilers are already widely available. The C programming language is a common target for such translators

Low-level programming language

> Low-level languages are closer to the hardware than high-level programming languages, which are closer to human languages.

> Generally this refers to either machine code or assembly language.

> Low-level languages can be converted to machine code without using a compiler or interpreter, and the resulting code runs directly on the processor.

> A program written in a low-level language can be made to run very fast, and with a very small memory footprint; an equivalent program in a high-level language will be more heavyweight.

> Low-level programming languages are sometimes divided into two categories:

- *first generation (machine code)*

- *second generation* (Assembly Language)

> **Machine code:** *Machine code is the only language a microprocessor can process directly without a previous transformation.*

> **Assembly language:** Assembly language is the most basic programming language available for any processor. With assembly language, a programmer works only with operations implemented directly on the physical CPU. Assembly languages are low- level languages which are translated into machine code by an assembler. Each assembly language instruction corresponds to one

machine language instruction, but assembly language is easier notation for the programmer to use than machine code.

High Level Language Vs Low Level Language:

➢ A high level language is a language for programming computers which does not require detailed knowledge of a specific computer, as a low-level language does.

➢ High-level languages do not have to be written for a particular computer, but must be compiled for the computer they will work with.

➢ High-level languages are closer to human language than low-level languages.

➢ On the other hand, a low level language is a computer programming language that is close to machine language.

➢ Machine language is at the lowest level, because it is the actual binary code of 1s and 0s that the computer understands.

Application software

➢ **Application software**, also known as an **application** or an "**app**", is computer software designed to help the user to perform specific tasks.

➢ Examples include enterprise software, accounting software, office suites, graphics software and media players.

➢ It is a broad category, and encompasses software of many kinds, including the internet browser. This category includes:

- Business software
- Databases
- Educational software
- Mathematical software
- Spreadsheets
- Telecommunications (i.e., the Internet and everything that flows on it)
- Video games
- Word processing

Word Processing

- Word processing was one of the earliest applications for the personal computer in office productivity.

- Microsoft Word is the most widely used word processing software.

- Word processing software is widely used for:

  - writing documents such as letters, memos, reports, books, articles, notes and faxes

  - creating email messages

  - producing agendas and minutes of meetings

  - Generating invoices, statements, referrals and other written material.

- A key advantage of word processing software is that users easily can make changes in documents.

- Word processing software is used because it's easy and functional, allowing you to produce documents that include a range of **fonts** and font **sizes**, **graphics** (pictures), **symbols** and **charts**. A number of proofing tools such as **spelling** and **grammar checkers** are also available.

- It's easy to make changes to existing documents and produce multiple documents that have only slight differences, for instance a **mail merge** where a standard letter is sent to customers with just the customer details changed.

- Industry-standard word processing software packages include Microsoft Word and Corel WordPerfect.

Features of a word processing package

- Professional word processing packages are capable of performing many complicated tasks. Here is a list of some of the features you would expect to find:

  - editing facilities with auto text

  - spelling and grammar checkers

  - cut and paste — text/graphics can be rearranged within the same document or between a number of documents

  - page formatting — layouts, margins, pagination

- character formatting — e.g. bold, underline, italics, etc

- text alignment — e.g. justified centre, left right, full

- centering — vertical/horizontal

- automatic page numbering

- search and replace

- headers and footers

- macros

- tables

- watermark

- some   desktop   publishing capabilities

Microsoft Word

- ➤ **Microsoft Office Word** is a word processor designed by Microsoft.

- ➤ The current versions are Microsoft Office Word 2010 for Windows and Microsoft Office Word 2011 for Mac.

- ➤ Its proprietary DOC format is considered a *de facto* standard, although Word 2007 can also use a new XML-based, Microsoft Office-optimized format called .DOCX

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Spreadsheet

- A **spreadsheet** is a computer application that simulates a paper accounting worksheet.
- Spreadsheet software is probably the second-most used software application on a computer behind word processing.
- Spreadsheets allow a user to quickly calculate numerical data, perform ‗what if' scenarios, represent data with charts and extract and print data quickly.
- Spreadsheets can be used to organise and analyse data, create documents and reports, provide data for mail merges and tables, and create charts.
- In fact they can be used for any numerical or text/graphic based documents.
- It displays multiple cells usually in a two-dimensional matrix or grid consisting of rows and columns.
- Each cell contains alphanumeric text, numeric values or formulas.
- A formula defines how the content of that cell is to be calculated from the contents of any other cell (or combination of cells) each time any cell is updated.
- Spreadsheets are frequently used for financial information because of their ability to re-calculate the entire sheet automatically after a change to a single cell is made.
- Excel now has the largest market share on the Windows and Macintosh platforms.

Features of a spreadsheet package

- All spreadsheets have the same overall features:

    - formulas to perform varying grades of mathematics

    - editing facilities with auto text

    - cut and paste — text/graphics can be rearranged within the same document or between a number of documents

    - page formatting, e.g. columns, margins and page breaks

    - character styling, e.g. bold, underline and italics

    - text alignment, i.e. justified, centre, left, right and full

    - centring — vertical/horizontal
    - automatic page numbering

- search and replace

- Selling-checker/grammar checker/thesaurus

- headers/footers

- sorting facilities

- creating charts to visually represent data

- exporting and importing data easily to database products

- macros

- styles

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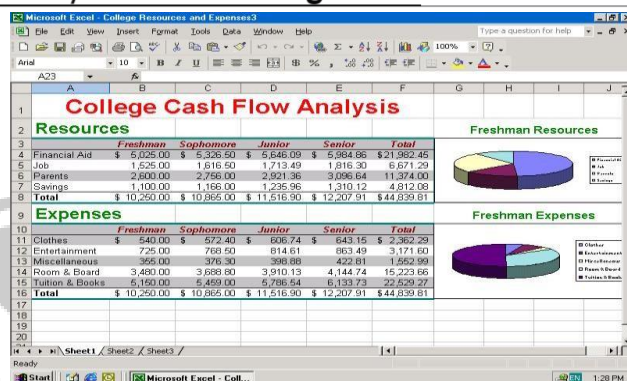
Microsoft Excel

➢ **Microsoft Excel** is a proprietary commercial spreadsheet application written and distributed by Microsoft for Microsoft Windows and Mac OS X.

➢ Excel forms part of Microsoft Office. The current versions are 2010 for Microsoft Windows and 2011 for Mac OS X.

➢ It is available for the Windows and Mac platforms.

➢ Microsoft released the first version of Excel for the Mac in 1985, and the first Windows version in November 1987.

Software Package

➢ A software suite, or collection of related application or utility software

➢ Multiple software programs that work together (or performs similar functions) and is bundled and sold together as a software package.

➢ For example, Microsoft Office includes many software programs that may be used in the office, such as Microsoft Excel, Microsoft Word and Microsoft Access.

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Microsoft Office

- **Microsoft Office** is a non-free commercial office suite of inter-related desktop applications, introduced by Microsoft in 1989.

- Over the years, Office applications have grown substantially closer with shared features such as a common spell checker.

- *Microsoft Office Professional Edition 2007* includes:

    - Word 2007 (word processing)

    - Excel 2007 (spreadsheets)

    - PowerPoint 2007 (presentation graphics)

    - Access 2007 (relational database)

    - Outlook 2007 (email and personal information management)

    - Publisher 2007 (desktop publishing).

Chapter 7

Data Representation

Data Representation

- ➢ Data Representation refers to the methods used internally to represent information stored in a computer.
- ➢ Computers store lots of different types of information:
    - Numbers
    - Text
    - Graphics of many varieties (image, video, animation) ▪ Sound
- ➢ However, ALL types of information stored in a computer are stored internally in the same simple format: a sequence of 0's and 1's.
- ➢ Computers use numeric codes to represent all the information they store.

Memory Structure in Computer

Bits

- ➢ A bit is a binary digit, the smallest increment of data on a computer.
- ➢ A bit can hold only one of two values: 0 or 1, corresponding to the electrical values of off or on, respectively.
- ➢ Because bits are so small, you rarely work with information one bit at a time. Bits are usually assembled into a group.

Nibbles

- ➢ A nibble is a collection of four bits. It takes four bits to represent a single BCD (binary coded decimal) or hexadecimal digit.
- ➢ With a nibble we can represent up to 16 distinct values. In the case of hexadecimal numbers the values 0 1 2 3 4 5 6 7 8 9 A B C D E and F are represented with four bits ➢ BCD uses ten different digits (0 1 2 3 4 5 6 7 8 9) and requires four bits.
- ➢ In fact any sixteen distinct values can be represented with a nibble but hexadecimal and BCD digits are the primary items we can represent with a single nibble.

Bytes

- A byte consists of eight bits and is the smallest addressable datum (data item) on the 80x86 microprocessor.

- The bits in a byte are normally numbered from zero to seven using the convention shown below:

- Bit 0 is the low order bit or least significant bit. Bit 7 is the high order bit or most significant bit of the byte.

- Note that a byte also contains exactly two nibbles:
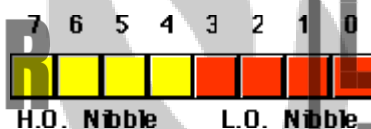
Words

- A word is a group of 16 bits.

- We'll number the bits in a word starting from zero on up to fifteen. The bit numbering appears below:
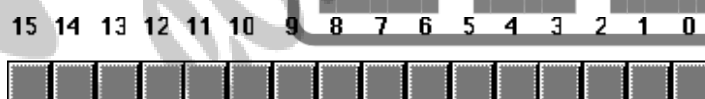
- Notice that a word contains exactly two bytes. Bits 0 through 7 form the low order byte, bits 8 through 15 form the high order byte:
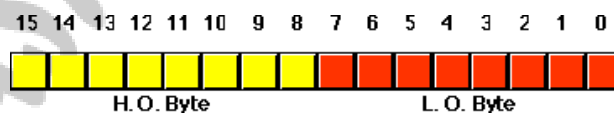
Computer Storage Units:

- Computer Storage and memory is often measured in following units:

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Unit	Equivalent
1 kilobyte (KB)	1,024 bytes
1 megabyte (MB)	1,048,576 bytes or 1,024 KB
1 gigabyte (GB)	1,073,741,824 bytes or 1,024 MB
1 terabyte (TB)	1,099,511,627,776 bytes or 1,024 GB
1 petabyte (PB)	1,125,899,906,842,624 bytes or 1,024 GB

Codes for Data Representation:

➢ Following codes are generally used for data representation in computer:

Binary Coded Decimal (BCD)

▪ Basically, BCD is just a representation of a single number using 4 Bits Binary

▪ Overview of the decimal numbers 0 to 9 and the coherent BCD-numbers in the 8421-Code:

Decimal number	BCD-8421number
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

▪ Although BCD is not suitable for general purpose arithmetic, it is useful in some embedded applications.

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- In 1964, BCD was extended to an 8-bit code, Extended Binary-Coded Decimal Interchange Code (EBCDIC).

- EBCDIC was one of the first widely-used computer codes that supported upper *and* lowercase alphabetic characters, in addition to special characters, such as punctuation and control characters..

ASCII Codes:

- Most computers use ASCII (American Standard Code for Information Interchange) codes to represent text, which makes it possible to transfer data from one computer to another.

- Text can be represented easily by assigning a unique numeric value for each symbol used in the text.

- For example, the widely used ASCII code defines 128 different symbols (all the characters found on a standard keyboard, plus a few extra), and assigns to each a unique numeric code between 0 and 127.

- In ASCII, an "A" is 65," B" is 66, "a" is 97, "b" is 98, and so forth.

- When you save a file as "plain text", it is stored using ASCII.

- ASCII format uses 1 byte per character 1 byte gives only 256 (128 standard and 128 non-standard) possible characters

- The code value for any character can be converted to base 2, so any written message made up of ASCII characters can be converted to a string of 0's and 1's.

- ASCII includes definitions for 128 characters: 33 are non-printing control characters & 95 are printable characters, including the space, which is considered an invisible graphic.

Unicode

- Many of today's systems embrace Unicode, a 16-bit system that can encode the characters of every language in the world.

- The Java programming language and some operating systems now use Unicode as their default character code.

- The Unicode codespace is divided into six parts. The first part is for Western alphabet codes, including English, Greek, and Russian.

Chapter 8: **Data Communication**

Data communication

- ➢ Data communication refers to the transmission of the digital signals over a communication channel between the sender and receiver computers. Communication is possible only with wired and wireless connectivity of the computers with each other.

- ➢ More specifically data communication is the exchange of information from one computer to an other via transmission mediums such as wires, coaxial cables, fiber optics, or radiated electromagnetic waves such as broadcast radio, infrared light, microwaves, and satellites.
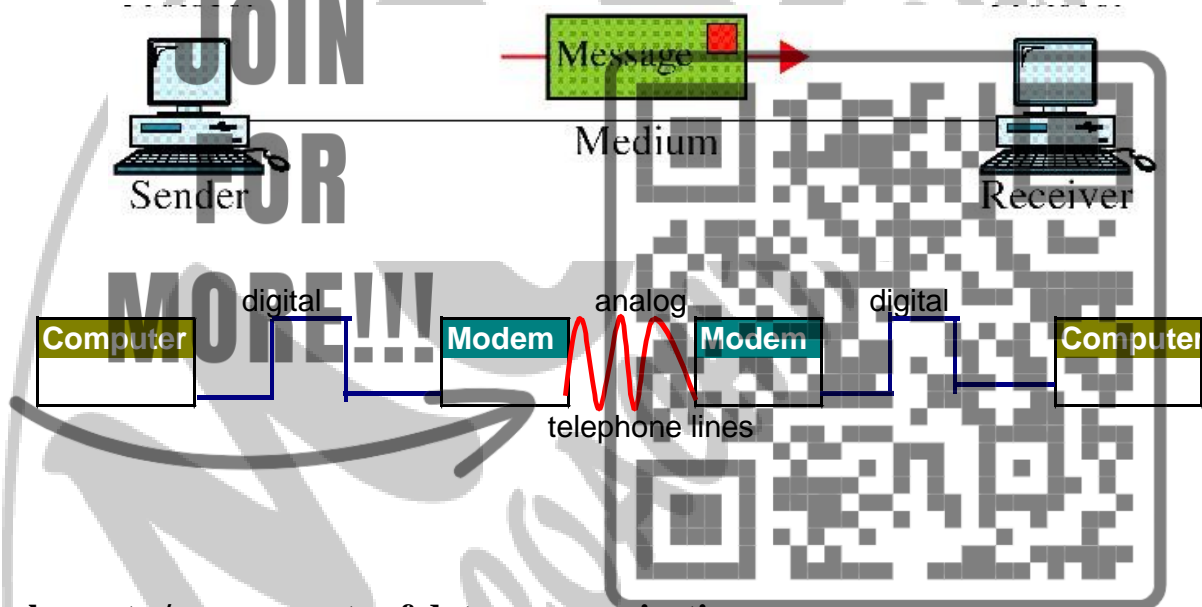
Five elements / components of data communication:

Relationship between the Five Components

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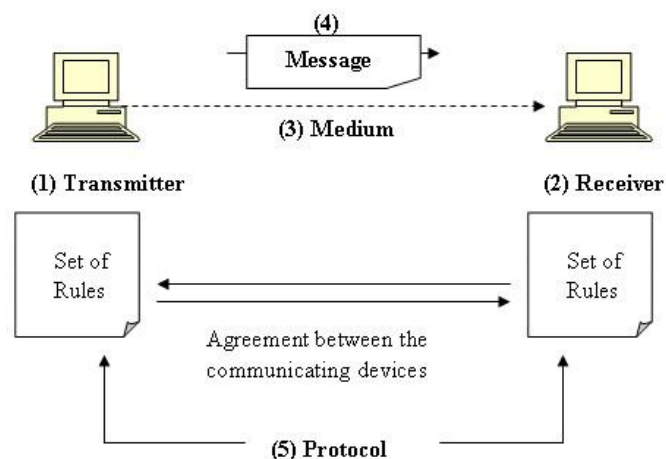
System	Roles of the Components	Example
Transmitter	The device that sends the Message	Computer (workstation)
Receiver	The device that receives the message	Computer (server)
Medium	The channel over which the message is sent	Radio waves, Fiber Optics Cable
Message	The information or data being communicated	Video, Text
Protocol	The set of rules that guides how data is transmitted and encoded and decoded.	TCP/IP

Properties of Transmission

➢ Five basic properties of both the physical and wireless links:

1. Type of signal communicated (analog or digital).

   o **Analog:** Those signals that vary with smooth continuous changes.

      ▪ A continuously changing signal similar to that found on the speaker wires of a highfidelity stereo system.

   o **Digital:** Those signals that vary in steps or jumps from value to value. They are usually in the form of pulses of electrical energy (represent 0s or 1s).
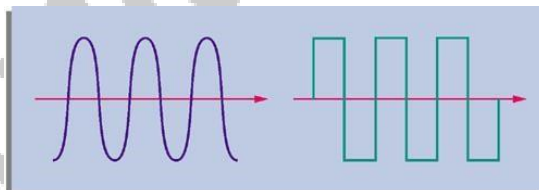
2. The speed at which the signal is transmitted (how fast the data travels).

   o In digital systems: Speed is measured in...

      ▪ **Bits per second** (bps).

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- The number of bits (0's and 1's) that travel down the channel per second.

  - **Baud rate**

- The number of bits that travel down the channel in a given interval.

- The number is given in signal changes per second, not necessarily bits per second.

3. The type of data movement allowed on the channel (one-way, two-way taking turns, two-way simultaneously).

  - **Simplex** transmission - One way transmission.
  - **Half-duplex** transmission - Flows only one way at a time.
  - **Full-duplex** transmission - Two-way transmission at the same time.

4. The method used to transport the data (asynchronous or synchronous transmission).

   o Two types of data transmission, each requiring a different modem.

Asynchronous transmission:

  - Information is sent byte by byte.
  - Cheaper and more commonly used.

Synchronous transmission -

  - Data is sent in large blocks rather than in small pieces.
  - Proceeded by special information, concerning error detection and block size.

5. Single channel (baseband) and multi-channel (broadband) transmission.

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o **Channel** - A path of a signal.

o **Single channel** - Capable of only sending/receiving one signal at a time.

▪ Phone line: Single line = single phone call at a time. o

Multichannel - Capable of more than one channel at a time.

▪ Fiber-optic cable, microwaves, Satellite transmissions.

Transmission Modes/Ways/Methods:

➢ There are three *transmission modes* for transmitting data from one point to another, these are:

1. Simplex
2. Half Duplex
3. full Duplex

▪ **A simplex connection** is a connection in which the data flows in only one direction, from the transmitter to the receiver. This type of connection is useful if the data do not need to flow in both directions (for example, from your computer to the printer or from the mouse to your computer...).

▪ **A half-duplex connection** (sometimes called an *alternating connection* or *semi-duplex*) is a connection in which the data flows in one direction or the other, but not both at the same time. With this type of connection, each end of the connection transmits in turn. This type of connection makes it possible to have bidirectional communications using the full capacity of the line.

▪ **A full-duplex connection** is a connection in which the data flow in both directions simultaneously. Each end of the line can thus transmit and receive at the same time, which means that the bandwidth is divided in two for each direction of data transmission if the same transmission medium is used for both directions of transmission.

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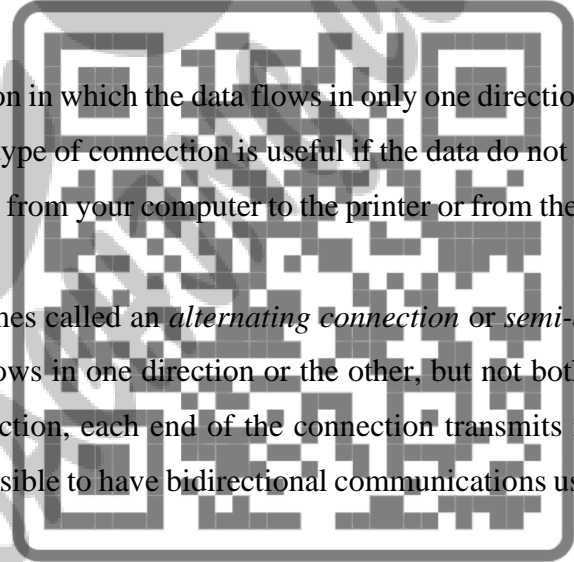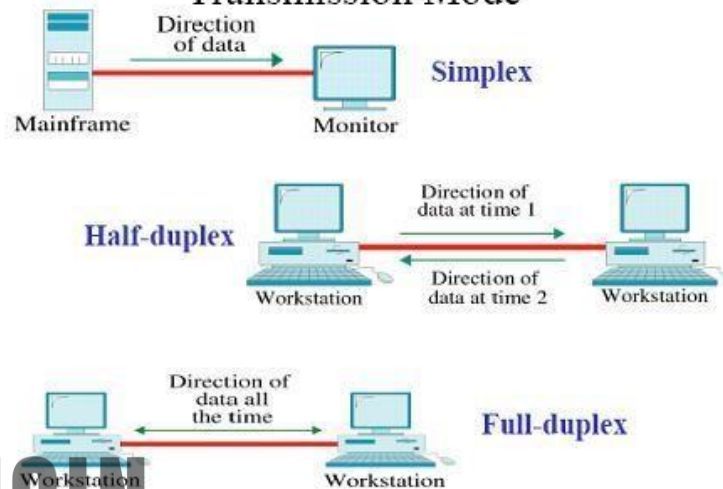
Transmission Mode

Synchronous and asynchronous transmission

Asynchronous Transmission

- **An asynchronous connection**, in which each character is sent at irregular intervals in time (for example a user sending characters entered at the keyboard in real time).

- Each character is preceded by some information indicating the start of character transmission (the transmission start information is called a *START bit*) and ends by sending end-of-transmission information (called *STOP bit*).

Synchronous Transmission

- In a **synchronous connection**, the transmitter and receiver are paced by the same clock.

- The receiver continuously receives the information at the same rate the transmitter sends it.

- In addition, supplementary information is inserted to guarantee that there are no errors during transmission.

The Difference Between Analog And Digital Signals

- **Analog signals** use continuously variable electric currents and voltages to reproduce data being transmitted. Since data is sent using variable currents in an analog system, it is very difficult to remove noise and wave distortions during the transmission. For this reason, analog signals cannot perform high-quality data transmission.

- On the other hand, **digital signals** use binary data strings (0 and 1) to reproduce data being transmitted. Noise and distortions have little effect, making high-quality data transmission possible. The two big advantages of digital technology are:

  - The recording **does not degrade** over time.
  - Groups of numbers can often be **compressed** by finding patterns in them.

Modem (Modulation/Demodulation)

- A Modem converts digital signals into analog signals which can be transmitted over an analog line and transforms incoming analog signals into their digital equivalents.

- The specific technique used to encode the digital bits into analog signals is called "Modulation", their reconversion (analog to digital) to the original signal is called ―Demodulation‖
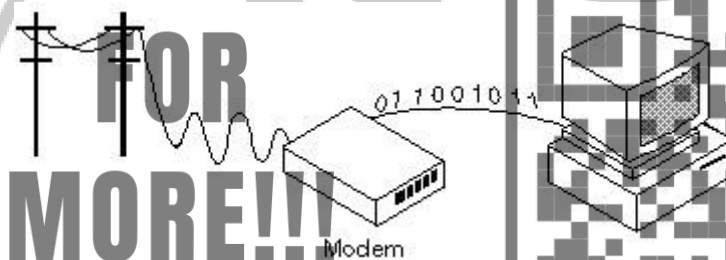
- Modern modems work at 56 thousand bits per second (Kbps) or higher data transfer speeds.

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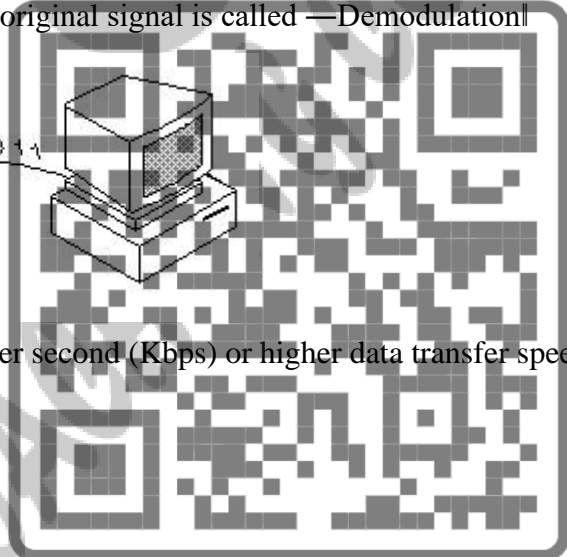
Transmission Media

- ➢ The means through which data is transformed from one place to another is called transmission or communication media.

- ➢ There are two categories of transmission media used in computer communications.
  - ▪ Wired / Bounded / Guided Media
  - ▪ Wireless / Unbounded / Unguided Media

Wired / Bounded / Guided Media:

- ➢ Bounded media are the physical links through which signals are confined to narrow path. These are also called guide media.

- ➢ Bounded media are made up of a external conductor (Usually Copper) bounded by jacket material.

- ➢ They offer high speed, good security and low cast.

- ➢ However, some time they cannot be used due distance communication.

- ➢ Three common types of bounded media are used of the data transmission. These are
  - ▪ Coaxial Cable
  - ▪ Twisted Pairs Cable
  - ▪ Fiber Optics Cable

Coaxial Cable:

- ➢ Coaxial cable is very common & widely used commutation media. For example TV wire is usually coaxial.

- ➢ Coaxial cable gets its name because it contains two conductors that are parallel to each other.

- ➢ The center conductor in the cable is usually copper. The copper can be either a solid wire or stranded martial.

- ➢ Outside this central Conductor is a non-conductive material. It is usually white, plastic material used to separate the inner Conductor form the outer Conductor.

- ➢ The other Conductor is a fine mesh made from Copper. It is used to help shield the cable form EMI.

- ➢ Outside the copper mesh is the final protective cover. (as shown in Fig)
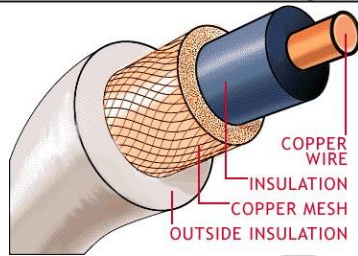
- ➢ The actual data travels through the center conductor in the cable.
- ➢ EMI interference is caught by outer copper mesh. There are different types of coaxial cable vary by gauge & impedance.
- ➢ Gauge is the measure of the cable thickness. It is measured by the Radio grade measurement, or RG number.
- ➢ The high the RG number, the thinner the central conductor core, the lower the number the thicker the core.
- ➢ Here the most common coaxial standards.
    - ▪ 50-Ohm RG-7 or RG-11: used with thick Ethernet.
    - ▪ 50-Ohm RG-58 : used with thin Ethernet
    - ▪ 75-Ohm RG-59 : used with cable television

Characteristics of Coaxial Cable

- ▪ Low cost
- ▪ Easy to install
- ▪ Up to 10Mbps capacity
- ▪ Medium immunity form EMI

Twisted Pair Cable

- ➢ The most popular network cabling is twisted pair.
- ➢ Twisted pair cabling is made of pairs of solid or stranded copper twisted along each other.
- ➢ The twists are done to reduce vulnerly to EMI and cross talk.
- ➢ The number of pairs in the cable depends on the type.
- ➢ UTP cables consist of 2 or 4 pairs of twisted cable. Cable with 2 pair use RJ-11 connector and 4 pair cable use RJ-45 connector
- ➢ There are two types of twisted pairs cabling
    - ▪ Unshielded Twisted Pair (UTP)

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- Shielded Twisted Pair (STP)

.**Characteristics of Twisted Pair**

- low cost
- easy to install
- High speed capacity
- High attenuation
- Effective to EMI
- 100 meter limit
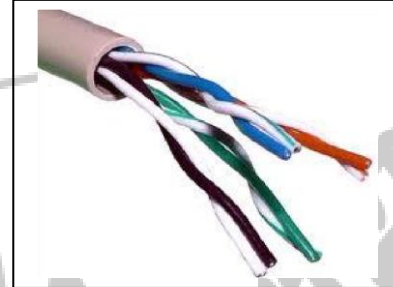
Fiber Optics

➢ Fiber optic cable uses electrical signals to transmit data. It uses light.
➢ A laser at one device sends pulse of light through this cable to other device. These pulses translated into —**1's**‖ and —**0's**‖ at the other end.
➢ In the center of fiber cable is a glass stand or core. The light from the laser moves through this glass to the other device around the internal core is a reflective material known as **Cladding**.
➢ No light escapes the glass core because of this reflective cladding.
➢ Fiber optic cable has bandwidth more than **2 gbps (Gigabytes per Second)**

Characteristics of Fiber Optic Cable:

- Expensive
- Very hard to install
- Capable of extremely high speed
- Extremely low attenuation
- No EMI interference
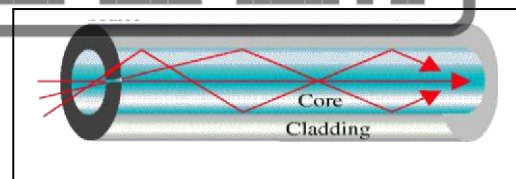
Wireless / Unbounded / Unguided Media

➢ Unguided transmission media are methods that allow the transmission of data without the use of physical means to define the path it takes. Transmission and reception are achieved by means of an antenna.

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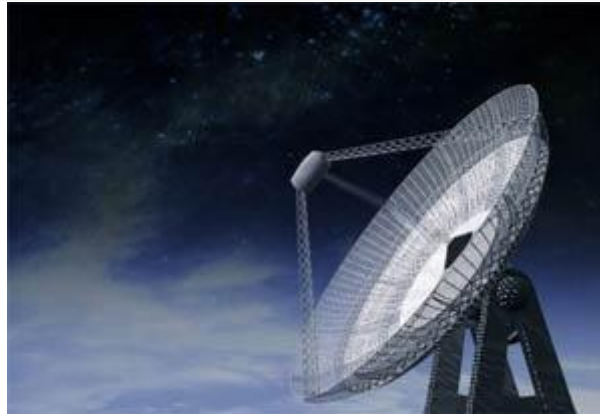
- ➢ Wireless media may carry surface waves or sky waves, either longitudinally or transversely. In both cases, communication is in the form of electromagnetic waves.
- ➢ Unguided media provide a means for transmitting electromagnetic waves but do not guide them; examples are propagation through air, vacuum and seawater. ➢ Three types of unguided media
  - ▪ Satellite
  - ▪ Microwave
  - ▪ Infrared

Terrestrial microwave

- ➢ Terrestrial microwaves use Earth-based transmitter and receiver. The equipment looks similar to satellite dishes. Terrestrial microwaves use low-gigahertz range, which limits all communications to line-of-sight. Path between relay stations spaced approx, 48 km (30 mi) apart.

Communications satellites

- ➢ The satellites use microwave radio as their telecommunications medium which are not deflected by the Earth's atmosphere. The satellites are stationed in space, typically 35,400 km (22,000 mi) above the equator. These Earth-orbiting systems are capable of receiving and relaying voice, data, and TV signals.

Infrared communication

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> Infrared communication can transmit signals between devices within small distances of typically no more than 10 meters. In most cases, line-of-sight propagation is used, which limits the physical positioning of communicating devices.

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Chapter 9: Computer Networking

Computer Network

- ➢ A **computer network**, often simply referred to as a network, is a collection of hardware components and computers interconnected by communication channels that allow sharing of resources and information.

- ➢ A computer network can be two computers connected:

- ➢ A computer network can also consist of, and is usually made for, more than two computers:
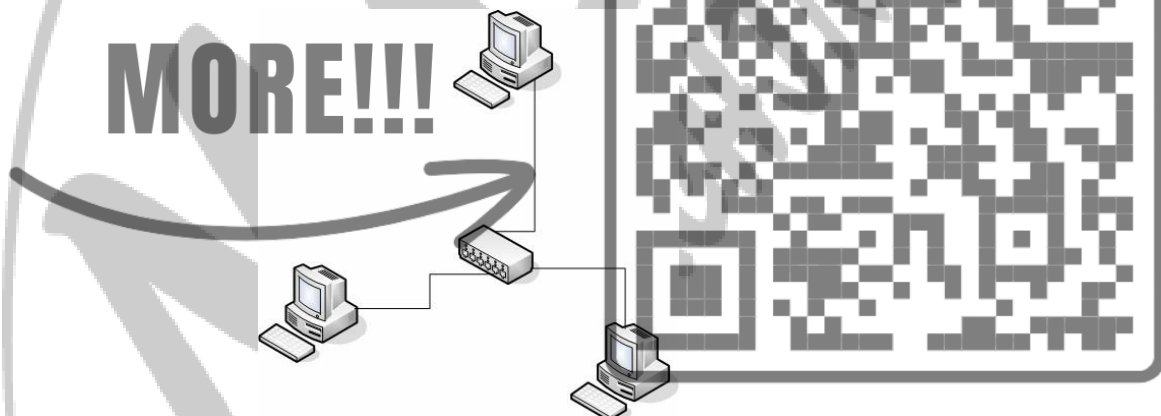
- ➢ Computer network components consist of 2 parts - the items that are to be connected and the equipment that connects them.

- ➢ Each computer or device on the network is a node.

Wireless Networking

- ➢ The term refers to any kind of networking that does not involve cables.

- ➢ The transmission system is usually implemented and administrated via radio waves.

Properties Computer networks / Reasons for networking

➢ **Facilitate communications**: Using a network, people can communicate efficiently and easily via email, instant messaging, chat rooms, telephone, video telephone calls, and video conferencing.

➢ **Share network and computing resources**: In a networked environment, each computer on a network may access and use resources provided by devices on the network, such as printing a document on a shared network printer. The primary purpose of a computer network is to share resources: You can play a CD music from one computer while sitting on another computer

Benefits of using a computer network:

- Cost Effective
- Convenient
- Reliable
- Efficient
- Improves Productivity
- Systematic Backup
- Centralized Information
- Improved Security

Network Performance

➢ *Bandwidth*

- Network media operate across a certain range of frequencies, measured in Hertz (Hz), is known as its bandwidth.

➢ *Speed*

- Speed is measured in megabits per second (Mbps) or Megabytes per second (MBps). The speed depends on the bandwidth, the type of network and the technology used.

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Types of network connections

➢ There are two types of network connections.

- Peer-to-Peer Networking
- Client/Server Networking

Peer-to-Peer Networking

➢ These are also called **Workgroups**.

➢ A peer-to-peer network comprises of 10 or less users and is suitable for small-sized business organizations.

➢ In a peer-to-peer network, each computer holds its files and resources. Other computers can access these resources but a computer that has a particular resource must be turned on for other computers to access the resource it has.

➢ For example, if a printer is connected to computer A and computer B wants to print to that printer, computer A must be turned On.
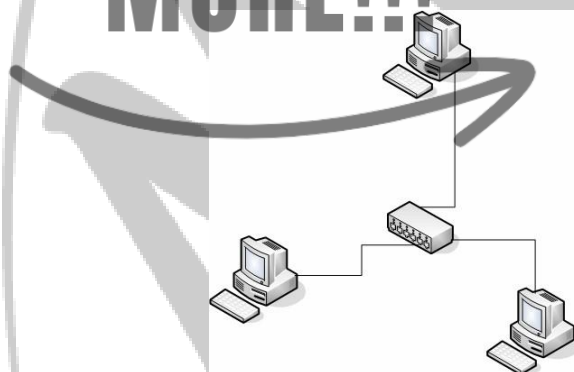
Client/Server Networking

➢ A computer network is referred to as client/server if (at least) one of the computers is used to "serve" other computers referred to as "clients".

➢ They are sometimes referred to as Domains.

➢ This is a centralized model of networking with resources placed on a dedicated machine called Server. There is no user limit as such, as it depends directly on your hardware resources and capacity to support users.
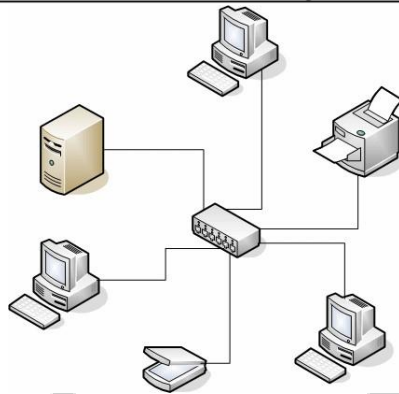
- ➢ Another big advantage of a client/server network is that security is created, managed, and can highly get enforced. To access the network, a person, called a user must provide some credentials, including a username and a password. If the credentials are not valid, the user can be prevented from accessing the network.

- ➢ The client/server type of network also provides many other advantages such as centralized backup, Intranet capability, Internet monitoring, etc.

Categorizing Networks According To Size (Geographical Point of View):

- ➢ From geographical point of view, there are five types of networks.

  - ▪ PAN (Personal Area Network)
  - ▪ LAN (Local Area Network)
  - ▪ MAN (Metropolitan Area Network)
  - ▪ WAN (Wide Area Network)
  - ▪ The Internet

Personal Area Network (PAN)

- ➢ A personal area network (PAN) is a computer network used for communication among computer and different information technological devices close to one person.

- ➢ Some examples of devices that are used in a PAN are personal computers, printers, fax machines, telephones, and even video game consoles.

- ➢ A PAN may include wired and wireless devices.

- ➢ The reach of a PAN typically extends to 10 meters.

➢ A wired PAN is usually constructed with USB and Firewire connections while technologies such as Bluetooth and infrared communication typically form a wireless PAN

Local Area Network (LAN)

➢ A local area network (LAN) is a computer network that connects computers and devices in a limited geographical area such as home, school, computer laboratory or office building.
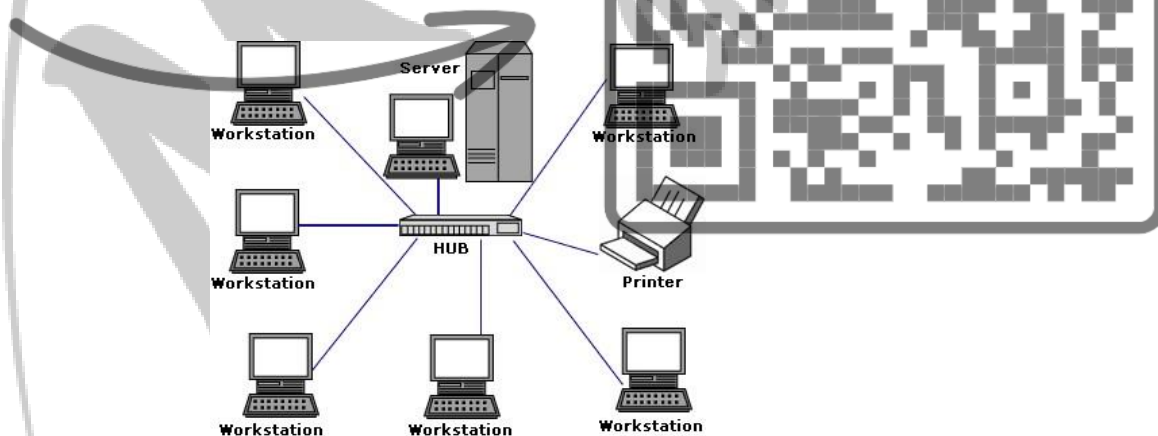
➢ The nodes are linked in a bus, ring, star, tree, or fully connected topology network configuration.

➢ Benefits of LANs:

       o Sharing of hardware resources. o Sharing of

       software and data. o Consolidated

       wiring/cabling. o Simultaneous distribution of

information. ○ More efficient person-to-person communication.

MAN (Metropolitan Area Network)

➢ A Metropolitan area network (MAN) is a large computer network that usually spans a city or a large campus.

.
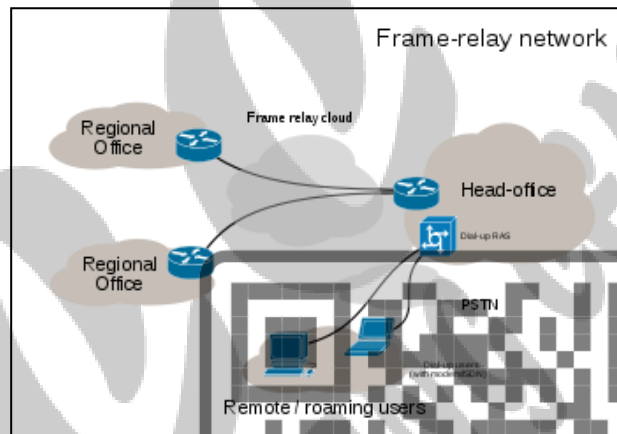
WAN (Wide Area   Network)

➢ A wide area network (WAN) is a computer network that covers a large geographic area such as a city, country, or spans even intercontinental distances.

➢ Internet is one good example of a WAN.

➢ A WAN often uses transmission facilities provided by common carriers, such as telephone companies.

➢ Wide Are Networking connects multiple LANs that are geographically separate.

➢ This can be accomplished by connecting different LANs using services like dedicated leased line, dial-up phone, satellite links and data packet carrier services.

➢ WAN is high speed, long distance communication technology.
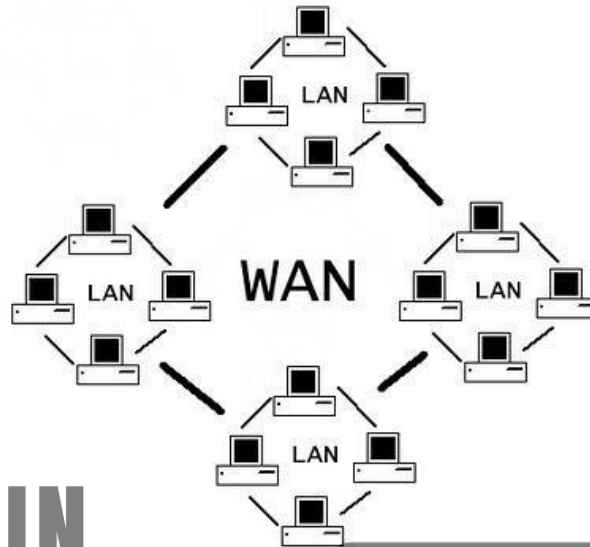
The Internet

➢ The Internet is a global system of interconnected governmental, academic, corporate, public, and private computer networks.

➢ It is based on the networking technologies of the Internet Protocol Suite.

➢ The Internet is also the communications backbone underlying the World Wide Web (WWW).

Summary:

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Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	Local area network
100 m	Building	Local area network
1 km	Campus	Local area network
10 km	City	Metropolitan area network
100 km	Country	Wide area network
1000 km	Continent	Wide area network
10,000 km	Planet	The Internet

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Network Topologies:

- ➢ A network topology is the layout of the interconnections of the nodes of a computer network.
- ➢ The physical organization of networks
- ➢ Physical topology describes the layout of a network media such as copper cable, fiber optic cable, and most popular today is the wireless.
- ➢ While the logical topology is concerned about logical path through the network that data can take from one place to another.
- ➢ The following are basic types of *LAN topology*:

    - Bus
    - Star
    - Ring
    - Tree
    - Mesh
    - Hybrids
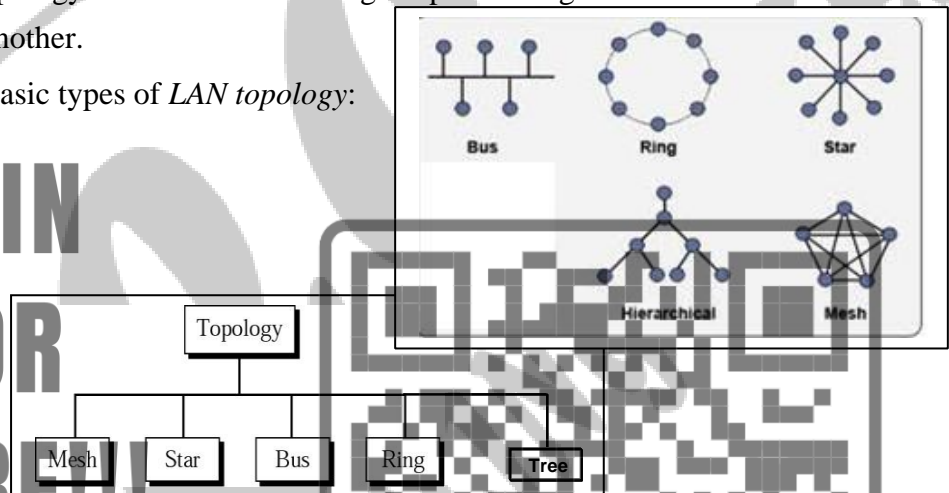
The Bus Topology:

- ➢ The first type of **LAN topology** is the Bus topology and consists of coaxial cable connected to all the computers on the LAN network.
- ➢ All the computer network devices communicate through the same shared bus – so that's why a bus is also a logical topology.
- ➢ LAN Bus topology is very simple and inexpensive to implement, there is only one main trunk.
- ➢ This type of bus LAN topology is not popular today, and it is part of the past ➢ All nodes can detect all messages sent along the bus.

The Ring Topology:

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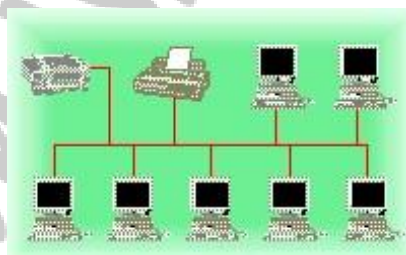
- Computers / Nodes logically communicate in a ring formation, with each node communicating only directly with its upstream and downstream neighbors.
- Actually Ring topology is physically implemented using star topology.
- In a ring topology, access to the network is controlled through a token that is passed from node to node as the arbitration mechanism.
- Each node takes its turn at claiming the token as the token passes from neighbor to neighbor, and when a node possesses the token, it takes its turn to transmit onto the ring.
- A data packet is transferred from one node to the next until it reaches its destination node.
- When the transmitting node is finished, it releases the token to its neighbor, and the process repeats.
- Ring topology is primary used by the Token-Ring networks.

The Star Topology:

- Each node is linked to a centralized point such as a Switch
- The switch handles the repeating or switching the traffic out to the other nodes on the network.
- All messages are routed through the central node, who delivers it to the proper node.
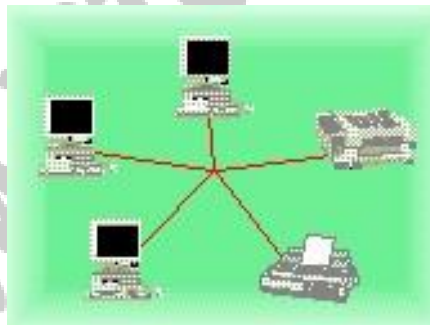
The Tree Topology - (Hierarchical Topology):

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➢ Looks like an upside-down tree where end nodes are linked to interior nodes that allow linking through to another end node.
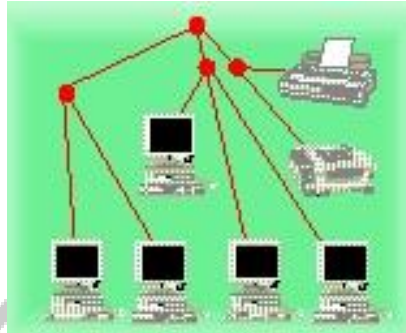
Mesh Topology

➢ Each device has connection to each other devices on the network.

➢ Partial meshes are designed to provide redundancy where it is needed
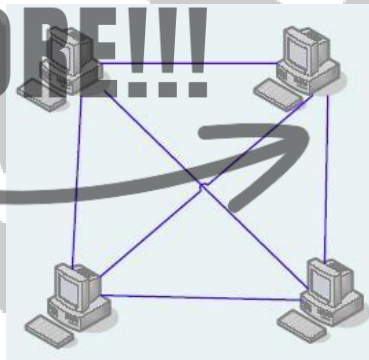
Hybrid Topologies

➢ In large network environment, you can attach Switches one to another to create larger LAN to support more devices.

➢ Hybrid topologies combined the above topologies together to form three popular hybrid topologies: tree, hierarchical star, and star-wireless.

Networks Devices

➢ The following devices connect the members of the network:

- Hub
- Repeater

- Switch
- Bridge
- Gateway
- Router
- NIC Card
- MODEM

Hub

- The hub or network hub connects computers and devices and sends messages and data from any one device to all the others.
- If the desktop computer wants to send data to the laptop and it sends a message to the laptop through the hub, the message will get sent by the hub to all the computers and devices on the network. They need to do work to figure out that the message is not for them.
- Hubs are not used often these days.
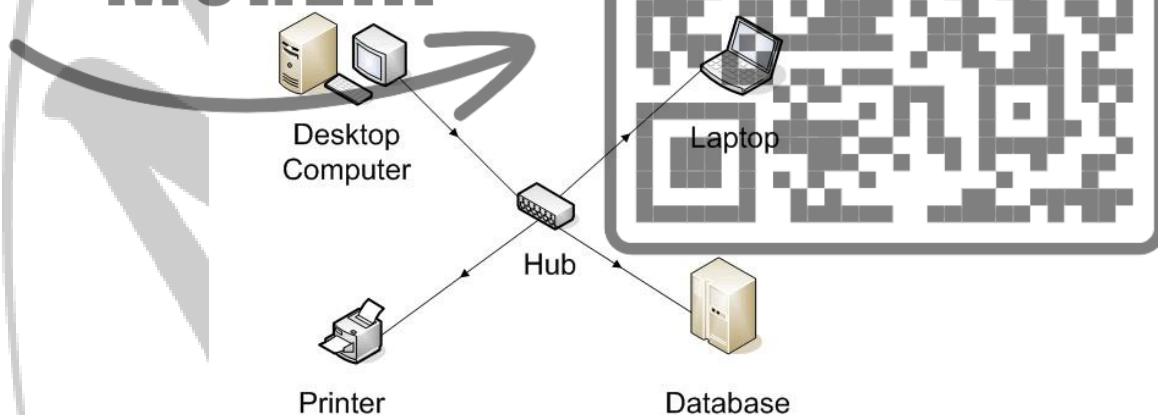
Repeater

- A repeater is an electronic device that receives a signal, cleans it of unnecessary noise, regenerates it, and retransmits it at a higher power level, so that the signal can cover longer distances without degradation.
- In most twisted pair Ethernet configurations, repeaters are required for cable that runs longer than 100 meters.
- A repeater with multiple ports is known as a hub.
- Today, repeaters and hubs have been made mostly obsolete by switches.

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Switch

- The switch connects the computer network components but it is smart about it. It knows the address of each item and so when the desktop computer wants to talk to the laptop, it only sends the message to the laptop and nothing else.

- It receives packets from its input link, and then sorts them and transmits them over the proper link that connects to the node addressed

- A switch is distinct from a hub in that it only forwards the frames to the ports involved in the communication rather than all ports connected.
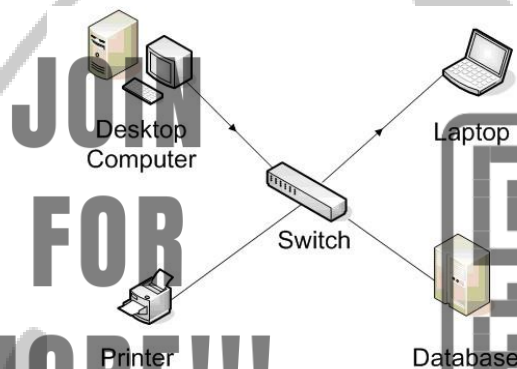
Router

- A router is a device that connects 2 networks.

- A router is an inter-networking device that forwards packets between networks by processing information found in the data gram or packet.

- Routers use routing tables to determine what interface to forward packets.

- It sends network packets in one of many possible directions to get them to their destination.
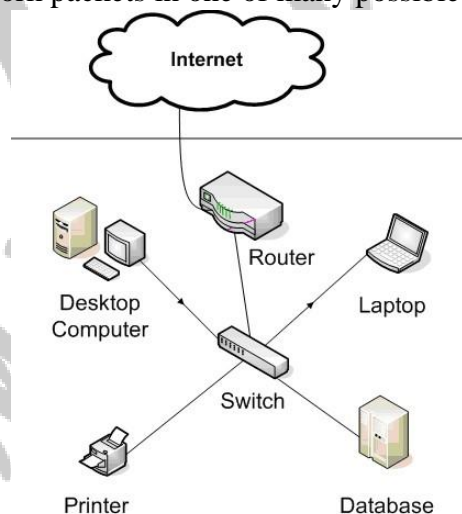
Bridge

- A network bridge connects multiple network segments
- Bridges broadcast to all ports except the port on which the broadcast was received.
- Bridges come in three basic types:
  - Local bridges: Directly connect LANs
  - Remote bridges: Can be used to create a wide area network (WAN) link between LANs.
  - Wireless bridges: Can be used to join LANs or connect remote stations to LANs.

Gateway

- A link between two different networks that have different rules of communication.
- It is usually a computer that acts as a translator between two completely dissimilar systems. Because it is both a translator and a router, it is usually slower than a bridge or router alone.

NIC card

- A network card, network adapter, or NIC (network interface card) is a piece of computer hardware designed to allow computers to physically access a networking medium.
- They come in 2 varieties, wired or wireless. Most modern desktop computers come with a wired NIC and laptops come with both a wired and a wireless NIC.
- Each Ethernet network interface has a unique MAC address which is usually stored in a small memory device on the card, allowing any device to connect to the network without creating an address conflict..

MODEM - MOdulator DEModulator

- Converts computer data to information that can be transmitted via wires (telephone, ISDN, fiber optics, as well as wireless communication).
- Allows communication between computers over long and short distances.
- Outgoing: Converts binary data from computer (digital) into telephone compatible signals (analog).
- Incoming: Converts telephone signal (analog) into binary data for the computer (digital).
- Can be an external or internal device (usually a ―card‖).
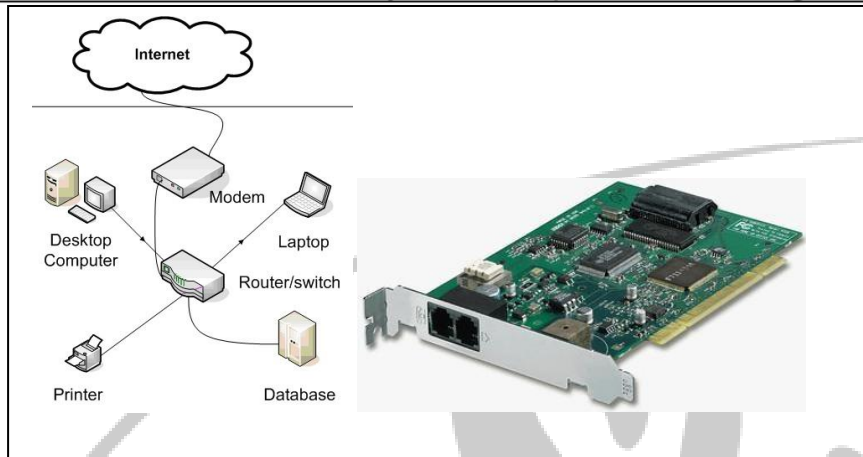
OSI Model

- ➢ OSI: Open System interconnection ○ was created in the 70's by the ISO
- ➢ Comprises of seven layers
- ➢ Reference model: deals with connecting open systems that are; Open for communication with other systems
- ➢ Each layer defines how data is treated and goes through different stages while traveling in network from one place to another.
- ➢ Gives complete picture of information flows within network.
- ➢ All layer are used in end to end systems but only first three layers used in intermediate systems while network communication.

UPPER LAYERS	7	**Application Layer** ✓ Message format, Human-Machine Interfaces
	6	**Presentation Layer** ✓ Coding into 1s and 0s; encryption, compression
	5	**Session Layer** ✓ Authentication, permissions, session restoration
TRANSPORT SERVICE	4	**Transport Layer** ✓ End-to-end error control
	3	**Network Layer** ✓ Network addressing; routing or switching
	2	**Data Link Layer** ✓ Error detection, flow control on physical link
	1	**Physical Layer** ✓ Bit stream: physical medium, method of representing bits

OSI LAYER INTERACTIONS
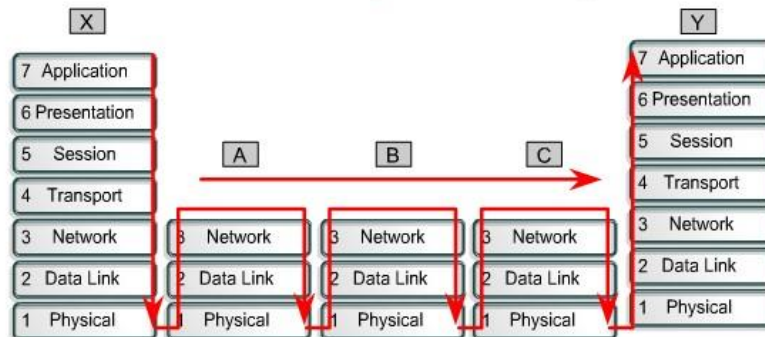
TCP / IP

> ➤ Developed by the US defense advanced research project agency (DARPA) for its packet switched network (ARPANET).

> ➤ Used by the global internet.

> ➤ Like the OSI model, the TCP/IP suite is layered
>   – Because the protocols found at each layer are independent of those at the other layers, a given protocol can be modified without affecting those found at other layers. Layers are: o Application layer. o Host to host or transport layer. o Internet layer. o Network access layer.
>   o Physical layer

TCP/IP Protocol Architecture Model

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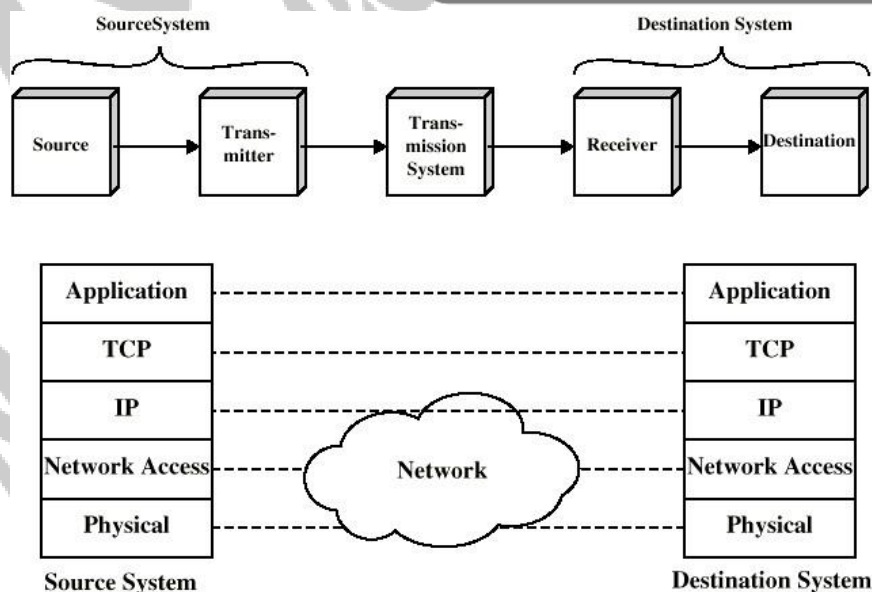
Chapter 10
The Internet

The Internet:

➢ It is the largest network in the world that connects hundreds of thousands of individual networks all over the world.

➢ The popular term for the Internet is the —information highwayǁ.

➢ A world-wide network connecting millions of computer networks for the purpose of exchanging data and communications using special rules of communication.

➢ The word internet is used to describe a network of networks which incorporate a very large and complicated set of equipment.

➢ The Internet is a global system of interconnected governmental, academic, corporate, public, and private computer networks

➢ So the internet is a collection of organizations that provide equipment that support the internet functions and services. The internet connects many corporate and organizational private networks together thus enabling all these organizations to easily communicate.
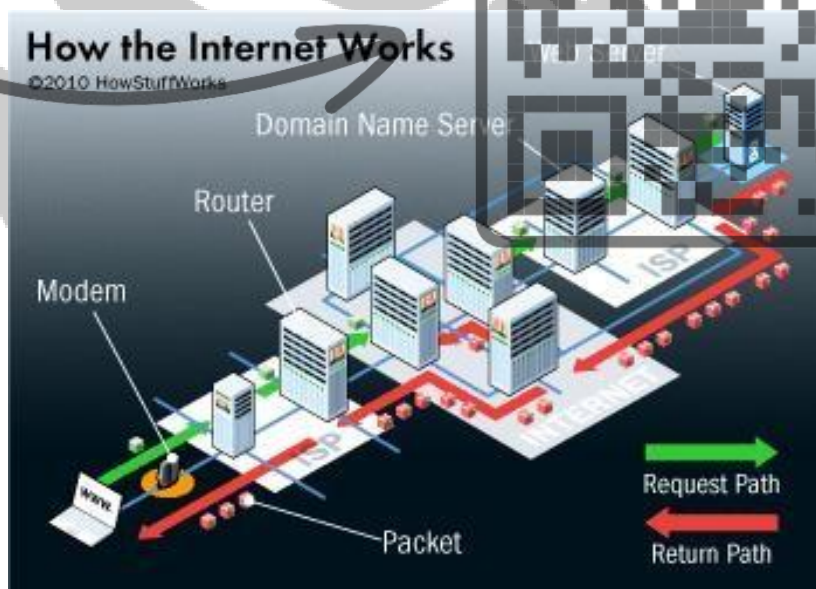
➢ The Internet is referred to as a **packet-switching network**, As the packet travels through the Internet from network to network:

• **Packet**: A unit of information created by the Transfer Control Protocol (TCP) software for transmission over the Internet.

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The uses of the Internet

> - Send e-mail messages.
> - Send (upload) or receive (down load) files between computers.
> - Participate in discussion groups, such as mailing lists and newsgroups.
> - Surfing the web.

Internet Services

> The main services used on the internet include:

- **Web browsing** – Supported by the HTTP protocol, this allows users to view web pages using a web browser.
- **E-mail** - Allows people to send and receive electronic messages.
- **Telnet -** allows remote login to computers
- **FTP** - Allows quick file transmission to remote computers
- **Conferences Online -** An electronic meeting that can take place at the convenience of the participants.
- **IRC (Internet Relay Chat) -** ―Real-time‖ online chat facilities: chat rooms. Communication is accomplished via typing text over a ―channel‖

45

World Wide Web (WWW or the Web)

> The **Web (World Wide Web)** consists of information organized into Web pages containing text and graphic images.

> It contains hypertext links or highlighted keywords and images that lead to related information.

> A collection of linked Web pages that has a common theme or focus is called a **Web site**.

> The main page that all of the pages on a particular Web site are organized around and link back to is called the site's **home page**.

> It allows multimedia information to be accessed and transmitted via the Internet.

- **Multimedia**: Producing different types of information (text, sound, graphics, and/or video) simultaneously.

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- The Web follows the **Hypertext Transfer Protocol (HTTP)**

  - **HTTP**: It is a set of rules implemented in a program. It allows an individual computer to participate with other computers through the Internet. It converts text, visual and audio information into packets to traverse the Internet.

The Internet and Web Tools

- Tools used to make easy access of the Internet possible.
- Tools used to create a web presence.
- **Two tools are listed in this category:**
  - Web Browsers,
  - Search Services, .

Web Browsers

- Most commonly used tool to access the World Wide Web.
- This tool allows accessing all of the multimedia components of Web pages. (support HTTP protocol)
- These tools (programs) allow web pages to be displayed on the computer screen that may include:
  - Text
  - Graphic images, animation and streamed video
  - Sound
  - Three-dimensional virtual reality environments
- The two most widely used web browsers today include Microsoft Explorer, Opera and Mozilla Firefox

Search Engines / Services

- Tools used to help search for specific information on the WWW.
- A program available through WWW browsers that enables the user to search the Internet for information on specific topics.
- There are some web sites, which are used to search information on the web. There are more than 2,500 search services/engines presently on the Web.
- Most search engines take one or more words entered by the user, search the contents of every Web page stored in their databases and display the result. ➢ some popular search engines are:-

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- Google- http://www.google.com
- Infoseek- http://guide.infoseek.com
- Alta Vista – http://www.altavista.digital.com
- Yahoo! – http://www.yahoo.com

Accessing the Internet

➢ Once you have your Internet connection, then you need special software called a browser to access the Web.

➢ Web browsers are used to connect you to remote computers, open and transfer files, display text and images.

➢ When people are browsing of surfing the internet, they usually go from place to place by clicking on links. These links are locations for specific pages (Web Addresses)

➢ The IP address and the domain name each identify a particular computer on the Internet.

➢ However, they do not indicate where a Web page's HTML document resides on that computer.

➢ To identify a Web pages exact location, Web browsers rely on Uniform Resource Locator (URL).

➢ URL is a three-part addressing scheme that tells the Web browser:
  1. Protocol being used such as http or ftp
  2. The domain that the web page is found on. This will point to a specific organization's or company's web server.
  3. The location of the page on the server including the directory path and file name.

Client/Server Structure of the Web

➢ Web is a collection of files that reside on computers, called **Web servers** that are located all over the world and are connected to each other through the Internet.

➢ When you use your Internet connection to become part of the Web, your computer becomes a **Web client** in a worldwide client/server network.

➢ A **Web browser** is the software that you run on your computer to make it work as a web client.

Hypertext Markup Language (HTML)

- The public files on the web servers are ordinary text files, much like the files used by wordprocessing software.

- To allow Web browser software to read them, the text must be formatted according to a generally accepted standard.

- The standard used on the web is Hypertext markup language (HTML).

- HTML uses codes, or tags, to tell the Web browser software how to display the text contained in the document.

Addresses on the Web: IP Addressing

- Each computer on the internet does have a unique identification number, called an IP (Internet Protocol) address.

- The IP addressing system currently in use on the Internet uses a four-part number.

- Each part of the address is a number ranging from 0 to 255, and each part is separated from the previous part by period,

- For example, 106.29.242.17

Domain Name Addressing

- Most web browsers do not use the IP address to locate Web sites and individual pages.

- They use domain name addressing.

- A **domain name** is a unique name associated with a specific IP address by a program that runs on an Internet host computer.

- This program, which coordinates the IP addresses and domain names for all computers attached to it, is called **DNS (Domain Name System) software**.

- The host computer that runs this software is called a **domain name server.**

- For example, the domain name for Karachi University is : www.ku.edu.pk ➢ No other computer on the Internet has the same domain name.

Computer Science XI   [Page # 110]

HTTP

- ➢ The transfer protocol is the set of rules that the computers use to move files from one computer to another on the Internet.

- ➢ The most common transfer protocol used on the Internet is the Hypertext Transfer Protocol (HTTP).

- ➢ Two other protocols that you can use on the Internet are the File Transfer Protocol (FTP) and the Telnet Protocol

Internet Organizations

- ➢ **ISPs (Internet Service Providers):**
  - ▪ A commercial organization with permanent connection to the Internet that sells temporary connections to subscribers.
  - ▪ They provide the connection to the internet for users and also provide routers that direct internet traffic.
  - ▪ Examples: America Online, Microsoft network, AT&T Networks.
- ➢ **Corporations or Web hosting providers:**
  - ▪ They provide the information posted on the internet and virtual data connections to other mail servers.
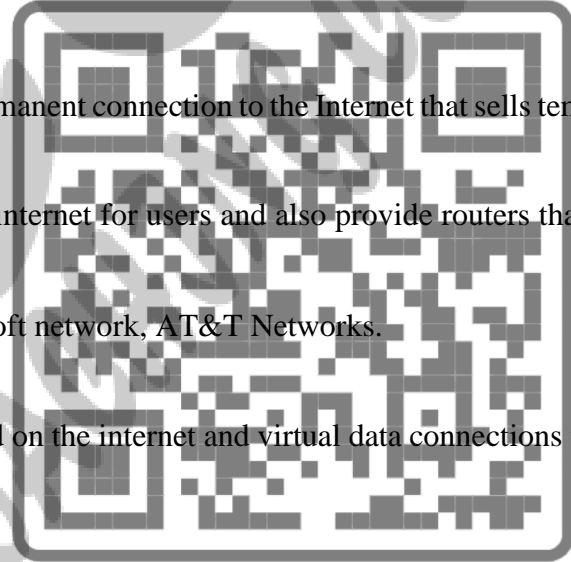
The advantages of Internet

- ➢ Following are the advantages provided by the Internet:
  - ▪ **Information:** The biggest benefit offered by the Internet is information. It functions as a valuable resource of information. You can find any type of information on any subject with the help of the search engines like Yahoo and Google.
  - ▪ **Communication:** The primary goal of the Internet is communication. By sending an e-mail, we can contact a person who is physically present thousand miles away within the fraction of a second's time.
  - ▪ **Entertainment:** Internet functions as a popular medium of entertainment. A wide variety of entertainment including video games, music, movies, chat room, news and others can be accessed through the Internet.

- **E-commerce:** E-commerce is the idea that is implemented for any form of commercial strategy or business transactions that entails transmission of data from one corner of the world to another. E-commerce has become a fantastic option through which you can shop anything.

- **Formation of communities**: Internet helps in formation of communities or forums. Here a number of people can participate in different types of debates and discussions; express their views and gather valuable knowledge.

- **Services:** A variety of services are offered via Internet, for example job searching, online banking, buying movie tickets, hotel reservations and consultation services etc.

The disadvantages of Internet

➢ Following are the disadvantages of Internet:

- **Spamming:** Spamming denotes distribution of unsolicited e-mails in large numbers. They are meaningless and they unnecessarily block the whole system. These activities are treated as illegal.

- **Theft of personal details**: While using the Internet, there is high probability that your personal details like name, address and credit card number may be accessed and used for fraudulent purposes.

- **Virus threat:** Virus is a program that interrupts the usual operation of your personal computer system. PCs linked to the Internet have high probability of virus attacks and as a result of this your hard disk can crash, giving you a lot of trouble.

Chapter 11

Security, Copy Right & The Law

Data protection:

➢ The data stored on a computer is usually far more valuable and important than the computer hardware itself. But it can be easily lost or destroyed.

➢ The loss of data on a computer system may be accidental or deliberate.

➢ The accidental loss occurs due to the following reasons:

- Technical failure of hardware
- Virus attack
- Un authorized access of a computer system

➢ The security of computer hardware and its components is also necessary for the overall protection of data

Computer System Security

➢ In the field of computing, the area of computer system security consists of the provisions and policies, adopted by the administrator to prevent and monitor unauthorized access, misuse, modification of data.

Computer Network Security

➢ Network security is the authorization of access to data in a network, which is controlled by the network administrator.

➢ Users are assigned an ID and password that allows them access to information and programs within their authority.

➢ Network Security covers a variety of computer networks, both public and private that are used in everyday jobs conducting transactions and communications among businesses, government agencies and individuals.

Threats to Computer security:

1. **Denial of Service:** Denial-of-service is meant to disable a computer or a network and can be executed with limited resources. It is one of the most common forms of attacks by hackers and can effectively disable the whole network of an organization. Denial of service attack makes a computer resource unavailable to its intended user.

2. **Trojan Horse:** Trojan horse is common and one of the most potential threats to computer security. They are malicious and security-breaking programs, disguised as something which is considered as non-malicious by the security software. They are a useful tool for hackers who try to break into private networks. Hackers generally attach Trojan horse to a file, which triggers a virus or remotely controlled software, giving the hacker complete control over the computer. Many Trojan Horses are 'key-logger' programs that record every key press on your keyboard and store them in a log file. This log file is then e-mail to the person who sent the Trojan Horse to you in a convert way every time you access the Internet. Everything you type; e-mails, letters, credit card numbers, passwords, phone numbers etc. are all logged and received by the hacker, your privacy is completely compromised.

3. **Viruses:** Viruses are well-known for their destructive nature and the property of replicating themselves. They are basically pieces of computer program codes which are written by hackers and other computer geniuses. In general terms a virus is a program that runs on a system against the owners or user's wishes and knowledge. Viruses have one or more methods they use to spread. Most commonly they will attach a file to an e-mail message and attempt to trick victims into running the attachment. Viruses can increase their chances of spreading to other computers by infecting files on a network file system or a file system that is accessed by other computers.

4. **Worms:** Worms have the ability to replicate themselves, and generally do not require human interactivity to do so. They may be designed to e-mail themselves to other computers. Worms copy themselves from computer to computer rather than file to file like most viruses, and because they require no human help to do so, they can spread much more rapidly through a system than a normal virus.

5. **Sniffing:** Sniffing is the act of intercepting TCP/IP packets while they are getting transferred on a network. The interception generally takes place through simple eavesdropping done by a hacker.

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Hackers and Crackers

- Hacking (and cracking) refers to the act of gaining unauthorized access to a computer, network, Web site, or areas of a system.

- Commonly, hackers will impersonate a valid user to gain access to a system.

- If the system requires a username and password before allowing entry, a hacker may take an authentic user's identity.

- On a network or an office with Internet access, a hacker can impersonate someone else by simply sitting at the unattended workstation of another user who hasn't logged off.

- It also commonly occurs when someone has an easy to guess username and password, or allows this information to be known by others.

- Another common method hackers use to gain access is to guess or crack a username and password that's used to access a computer, network, or Internet account.

- To prevent being hacked in this manner, you should use passwords that are difficult to guess.

- You should change your password at regular intervals, and set a minimal length to passwords (such as being a minimum of six or eight characters). **Different Types of Computer Viruses**

- Most common types of viruses are mentioned below:

1. **Resident Virus:** This type of virus is a permanent as it dwells in the RAM. From there it can overcome and interrupt all the operations executed by the system. It can corrupt files and programs that are opened, closed, copied, renamed etc.

2. **Direct Action Viruses:** The main purpose of this virus is to replicate and take action when it is executed. When a specific condition is met, the virus will go into action and infect files in the directory or folder.

3. **Overwrite Viruses:** Virus of this kind is characterized by the fact that it deletes the information contained in the files that it infects, rendering them partially or totally useless once they have been infected.

4. **Boot Sector Virus:** This type of virus affects the boot sector of a floppy or hard disk.

5. **Macro Virus:** Macro viruses infect files that are created using certain applications or programs that contain macros.

6. **Directory Virus:** Directory viruses change the path that indicates the location of a file. When you execute a program file with an extension .EXE or .COM that has been infected by a virus, you are unknowingly running the virus program, while the original file and program is previously moved by the virus.

7. **Polymorphic Virus:** Polymorphic viruses encrypt or encode themselves in a different way (using different algorithms and encryption keys) every time they infect a system.

8. **File Infector Virus:** This type of virus infects programs or executable files (files with .EXE or .COM extension).

9. **Companion Viruses:** Companion viruses can be considered as a type of file infector viruses like resident or direct action types. Companion viruses can wait in memory until a program is run (resident virus) or act immediately by making copies of them (direct action virus).

10. **FAT Virus:** The file allocation table or FAT is the part of a disk used to store all the information about the location of files, available space, unusable space etc. FAT virus attacks the FAT section and may damage crucial information.

11. **Multipartite Virus:** These viruses spread in multiple ways possible. It may vary in its action depending upon the operating system installed and the presence of certain files.

12. **Web Scripting Virus:** Many web pages include complex code in order to create an interesting and interactive content. This code is often exploited to bring about certain undesirable actions.

How Viruses or Worms Spread

➢ Most commonly viruses today use e-mail to spread however they have used one or more of the following methods to spread in the past.

  ▪ Some viruses will load themselves onto any part of a writable removable drive as possible and spread from computer to computer as people use the removable drive (USB).

  ▪ A worm is a program similar to a virus that will exploit vulnerability in an operating system or application that a computer user is running.

  ▪ Most viruses will spread themselves using e-mail attachments. .

Virus Damage

➢ In most cases, viruses can do any amount of damage the creator intends them to do.

➢ They can send your data to a third party and then delete your data from your computer.

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➢ They can also ruin your system and render it unusable without a re-installation of the operating system.

➢ The normal effect a virus will have on your system is that over time your system will run slower.

➢ Also when you are using the internet your connection may seem to run slower. Eventually you may have trouble running programs on your system, your system may freeze, and in the worst case you may not be able to get it to boot up when you turn your computer on.

General prevention methods for computer security

1. Backup

➢ It is important to avoid data and information loss in case of hard disk crashes. The only solution is to regularly keep backups of all the data on other media such as CD-ROM, etc. In this way, if data is lost, one can start again using the backup.

2. Firewall

➢ A firewall is a device that limits access to your system from the outside.

➢ A firewall may be a software program running on your computer or it may be a piece of hardware outside your computer.

➢ The firewall screens any attempts to access your system and only allows access that you decide to allow.

➢ In this way much vulnerability that could be used to gain unauthorized access to your system are eliminated.

➢ The vital role firewalls play in network security grows in parallel with the constant increase in 'cyber' attacks for the purpose of stealing/corrupting data, planting viruses, etc.

3. Anti-virus software

➢ Many users install anti-virus software that can detect and eliminate known viruses after the computer downloads or runs the executable.

➢ There are two common methods that an anti-virus software application uses to detect viruses.

   ▪ The first, and by far the most common method of virus detection is using a list of virus signature definitions.

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- The second method is to use a heuristic algorithm to find viruses based on common behaviors. This method has the ability to detect novel viruses that anti-virus security firms have yet to create a signature for.

➢ Anti-virus software resides in the active memory of your computer, and takes control of it to alert you to an active virus present on your machine. If the software cannot repair the infected file, it will quarantine this file or give you the option of safely deleting the file.

➢ Anti-virus software may also be used to scan your hard drive or CD ROMs. It may also be used to scan attachment files to e-mails. The important thing to remember is that new viruses are being discovered daily, so if you have anti-virus software installed then make sure that you keep it's library of known viruses up-to-date, otherwise you will have no protection against the latest batch.

Software copyright

➢ Software copyright is the extension of copyright law to machine-readable software.

➢ It is the right to use software on the computer.

➢ Software copyright is used by proprietary software companies to prevent the unauthorized copying of their software.

➢ The software companies give license for use of the software to those who purchase it.

➢ Usually one copy of the software is to be used by only one person on one computer only.

➢ The use of the software against the conditions of the license is illegal.

Advantages of Copy Right Law

➢ The software company that develops the costly software gets its costs back by selling the software.

➢ If software is used illegally, the software companies will not be able to develop new software for our growing needs. The development in the field of software will stop. Hence copy right law promotes the development of new software.

Computer crime

➢ Computer crime, or cyber crime, refers to any crime that involves a computer and a network.

➢ The computer may have been used in the commission of a crime, or it may be the target. Netcrime refers to criminal exploitation of the Internet.

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➢ Computer crime encompasses any criminal act dealing with computers and networks (called hacking).

➢ Computer crime encompasses a broad range of activities. Generally, however, it may be divided into two categories:

1. Crimes that target computers directly;
2. Crimes facilitated by computer networks or devices, the primary target of which is independent of the computer network or device.

Different Types of Cyber Crime ➢ As Internet usage continues to rise throughout the world, the threat of cyber crime also grows. While some of these crimes are relatively harmless and commonplace, others are very serious and carry with them lawbreaking charges. Here are a few of the more common forms of cyber crime.

1) **Spam:** The most common type of cyber crime is spam. Spam, or the unsolicited sending of bulk email for commercial purposes, is unlawful in some jurisdictions.

2) **Fraud:** Credit fraud is another common form of cyber crime. Certain computer viruses can log keystrokes on your keyboard and send them to hackers, who can then take your Social Security number, credit card number and home address. This information will be used by the hacker for his own means.

3) **Cyber terrorism:** Cyber terrorism in general, can be defined as an act of terrorism committed through the use of cyberspace or computer resources. As such, a simple propaganda in the Internet, that there will be bomb attacks during the holidays can be considered cyber terrorism. There are many forms of cyber terrorism. Sometimes it's a rather smart hacker breaking into a government website, other times it's just a group of like-minded Internet users who crash a website by flooding it with traffic. No matter how harmless it may seem, it is still illegal.

4) **Piracy:** Far and away the most talked about form of cyber crime is thievery. Yes, downloading music from peer-to-peer websites is illegal and therefore a form of cyber crime.

5) **Harassment**: Any comment that may be found derogatory or hateful is considered harassment. This often occurs in chat rooms, through newsgroups, and by sending hate e-mail to interested parties.

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Glossary

A

Accelerated Graphics Port (AGP) An Intel-design expansion port found on Pentium II and later computers that allows a separate data path for display adapters.

Access speed The time required to complete read or write instructions as required by the memory controller chip. Usually measured in nanoseconds (ns) for memory chips and milliseconds (ms) for disk drives. Most manufacturers rate average access time on a hard disk as the time required for a seek across one-third of the total number of cylinders plus one half of the time for a single revolution of the disk platters.

Address bus A group of parallel conductors (circuit traces) found on the motherboard that are used by the CPU to "address" memory locations. Determines what information or code is sent to or received from the data bus.

ASCII file Commonly used term to refer to a text file that contains only data as set forth by the **American Standard Code for Information Interchange** to conform to their standard.

Asynchronous Not synchronized—the computer is free to transmit any number of characters at any time. The bits constituting a single character are transmitted at a fixed rate, but the pauses between transmission can be of any duration.

Attachment A file attached to e-mail; most e-mail clients allow the user to append files (for instance, graphics files like GIFs or JPEGs) to e-mail as a handy way of sending information to other people.

B

Bandwidth Used in several ways to denote the amount of data or load capacity of a medium. 1) The range of frequencies that an electronic system can transmit. High bandwidth allows fast transmission or the ability to transmit many signals at once. 2) On a monitor screen, a higher bandwidth that provides a sharper image. 3) The rate at which data can be send over a modem or other telecommunication device.

Battery A power source for use outside or as an alternate to the electrical mains. Prevents unique information about the setup of the computer from being lost when the power is turned off. Also maintains the external clock time (not to be confused with the CPU's clock).

Baud Roughly speaking, a measurement of how fast data can be sent over telephone lines.

Binary file A file type in the form of pure data (1s and 0s) that needs to be converted to image, sound, or application to be used. Contrast this to an ASCII file.

Binary system The language used by computers—it is based on something being either on or off. There are only two digits used in binary language; 1 equals on and 0 equals off.

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BIOS (basic input/output system) Software that includes hundreds of little programs stored on ROM chips, used during the startup routine to check out the system and prepare to run the hardware.

bit The smallest unit of information that is recognized by a microcomputer. Shorthand term for binary digit. There are only two possible binary digits: 0 and 1.

Boot partition A hard-disk partition containing the portion of the operating system needed to launch the operating environment.

Boot up To start a computer; drawn from the phrase "pulling oneself up by one's own bootstraps."

bps (bits per second) The speed at which a modem transmits data. Typical rates are 14,400, 28,800, 33,600 and 56,600 bps. This represents the actual number of data bits that can be transmitted per second.

Bridge A device that provides communication between two or more network segments, thereby forming one logical network.

Broadband A network with high bandwidth (greater than 256 bps).

Browser Software used to navigate the World Wide Web, such as Microsoft's Internet Explorer and Netscape Navigator.

Bus The main communication avenue in a computer. It consists of a set of parallel wires that are connected to the CPU, memory, and all input/output devices. The bus can transmit data in either direction between any two components. If a computer did not have a bus, it would need separate wires to connect all the components.

Bus network A network in which all computers are connected to a single linear cable. Both ends of the cable must be terminated. Because there is no central point, it is harder to isolate problems in a bus network than in a star network topology.

Byte A group of 8 bits that represents 1 character of information (for instance, pressing one key on the keyboard). A byte is the standard unit of measuring memory in a microprocessor. Memory size is measured in terms of kilobytes (KB) or megabytes (MB). 1 KB of RAM is 1024 bytes; 1 MB is approximately one million bytes.

C

Cache A place where data is stored so that it does not need to be read from a slower device. Copies of frequently used disk sectors are stored in RAM so they can be accessed without accessing the hard disk.

CD-ROM (compact disc read-only memory) A disc similar to an audio compact disc, but it contains computer data.

CGA (Color Graphics Adapter) An early color graphics adapter standard with resolutions of 320 pixels by 200 pixels or 640 x 200. CGA supported no more than four colors.

Chip The ultimate integrated circuit; contains the complete arithmetic and logic unit of a computer. *See* microprocessor

Chip set A group of computer chips or ICs (integrated circuits) that, when working in harmony, manage and control the computer system. This set includes the CPU and other chips that control the flow of data throughout the system. Typical chip sets consist of a bus controller, a memory controller, data and address buffer, and a peripheral controller.

CISC (complex instruction set computing) A computer with many different machine-language instructions.

Client A computer that connects to a network and uses the available resources provided by the server.

Clock Establishes the maximum speed at which the processor can execute commands. Not to be confused with the clock that keeps time.

Clock speed Measured in megahertz (MHz)—millions of cycles per second—it is the speed at which a clock can cycle, or how fast a CPU can execute a command.

Clone A term that derives from the early days of personal computing used to denote a computer compatible with, but not manufactured by, IBM.

Clusters A unit of storage on a mass-storage device such as a hard disk drive or CD-ROM disc. On a hard drive a cluster usually consists of two to eight sectors. The actual amount of data a cluster can hold is dependent on the operating system and controller type.

Coaxial cable Made of two conductors that share the same axis. The center is a relatively stiff copper wire encased in insulating plastic. A wire-mesh tube around the insulation serves as shielding. The outside is a tough insulating plastic tube.

Code A way of representing information on a machine or in some physical form so that the information can be placed on the external data bus to be read by all devices. Also, statements (source code) written in a programming language, which are compiled into executable instructions (object code).

Command mode The character mode used in an operating system such as Microsoft Windows, MS-DOS, or UNIX that has a prompt and in which actions take place while the user enters text strings to execute commands.

Compression "Squeezing" a file down in size by getting rid of all the bits it doesn't really need. Many files (especially those with graphics) are very large and require a long time to travel over the Internet, so they are best compressed before sent.

Cookie A special message stored on a computer that allows a Web site to keep track of when a user has visited that site.

Coprocessor A separate circuit inside a computer that adds additional functions to the CPU or handles extra work while the CPU is busy.

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CPU (central processing unit) The part of a computer in which arithmetic and logical operations are performed and instructions are decoded and executed. It controls the operation of the computer.

CRT (cathode-ray tube) The main component of a monitor. One end of the tube is a very slender cylinder containing an electron gun(s). The fatter end is the display screen.

Cursor When entering data, whether in an application or in an MS-DOS command, the cursor (often a small flashing line) indicates the place at which the characters will be inserted.

D

Data bus A group of parallel conductors (circuit traces) found on the motherboard that is used by the CPU to send and receive data from all the devices in the computer. Also called the external data bus.

Data Communications Equipment (DCE) The receiver in a telecommunications connection.

Default drive The active drive on the computer. Each drive has its own letter designation. Unless otherwise specified, any commands are performed upon the default drive.

Device driver A program that extends the operating system to support specific devices.

Direct memory access (DMA) Allows a peripheral device to access the memory of a computer directly, without going through the CPU. This speeds up the transfer of data to or from external devices.

DLC (Data Link Control) A protocol developed by IBM to connect token-ring-based workstations to IBM mainframe computers. Printer manufacturers have adopted the protocol to connect remote printers to network print servers.

DOS (disk operating system) The system used by most early PCs as the operating system software to manage hardware, data, and applications.

DOS prompt Displays the active drive letter (for instance, C:) and directory. This indicates that the operating system is ready to accept the next command.

Download The ability to transfer a file from a remote computer.

dpi (dots per inch) Units used to measure the resolution of images on many printers and scanners. Keep in mind that dpi is an exact measurement in laser printers, but often used as an approximation in ink jet printers.

DRAM (dynamic random access memory) Memory that requires a refresh signal to be sent to it periodically.

E

ECC (error-correction coding) The use of a code to verify or disprove that a data string received is the same as the data sent.

EGA (Enhanced Graphics Adapter) An improvement on the older CGA standard. Supports a resolution of up to 640 pixels by 350 pixels at 16 colors in text-only mode or 640 x 200 at 2 colors in graphics mode. The EGA standard was not fully backward-compatible with CGA and MDA.

e-mail (electronic mail) The transmission of messages by computer from one person to another, often via the Internet.

Encryption The act of encoding data so that it can be read only by the intended party. A secure Web site or Internet-based transaction uses some form of encryption.

Ethernet A type of local area network in which communication takes place by means of radio frequency signals carried by a coaxial cable.

Expansion slots Specialized sockets that allow additional devices (circuit boards/adapter cards) to be attached to the motherboard (by means of the expansion bus). These are used to expand or customize a computer. They are an extension of the computer's bus system.

F

Fiber-optic cable A cable that is made out of light-conducting glass or plastic fibers. Multiple fiber cores can be bundled in the center of its protective tubing.

filenames (also filespec) Ways to designate files. A filename is made up of three parts—a name of up to eight characters, a period, and extension of up to three characters. The name can include any number, character, or the following symbols: _()~'!%$&#. For example: "myfile.doc." Spaces cannot be used in MS-DOS filenames.

File Transfer Protocol (FTP) 1) An application used for transferring files to and from another computer, usually over the Internet. 2) The protocol by means of which these transfers take place.

Firewall A gateway with special security software. It intercepts and inspects packets of data moving between an organization's main computer system and the Internet. It allows only authorized access and is a major defense against certain types of hacker attacks. **floppy disk drive** Low-capacity magnetic removable storage drive.

G

gateway A link between different computer networks. It is usually a computer that acts as a translator between two completely dissimilar systems. Because it is both a translator and a router, it is usually slower than a bridge or router alone.

GIF (Graphics Interchange Format) A file type for storing and exchanging pictures.

GUI (graphical user interface) Microsoft Windows is a GUI-based operating system. A GUI allows users to choose commands and functions by pointing to a graphical icon using either a keyboard or pointing device such as a mouse.

H

Handshaking A term used to describe the sequence of data and related tones used to align and synchronize two modems before working data is sent between the devices.

Hard disk drive High-capacity magnetic disk for data storage and program files. Also called a fixed disk.

Hardware The physical elements of the computer system.

header The top part of an e-mail or newsgroup message that shows where the message came from and when it was posted. The declaration at the "head" of a graphics file.

Host A computer that you connect to in order to access information. For instance, a computer at an ISP that lets you access the Internet is a host.

HTML (Hypertext Markup Language) An application of SGML (Standardized General Markup Language) used to create Web pages.

HTTP (Hypertext Transfer Protocol) The protocol used to transmit data in the HTML format.

I

icon A small picture on a computer screen that represents a group of files, an object, or operations. A user accesses the item he or she wants by clicking on the picture with the mouse.

image map A "clickable" graphic that performs different actions depending on where in the graphic the user clicks.

Integrated circuit (IC) An electronic device consisting of many miniature transistors and other circuit elements (resistors and capacitors and so forth).

Integrated Drive Electronics (IDE) The most common standard for interfacing hard disk and CD-ROM drives in the PC environment. Much of the actual work of controlling the hard disk drive is handled by the system BIOS. This reduces hardware cost, but introduces an overall system performance penalty during I/O operations. *See also* Enhanced IDE (EIDE)

International Organization for Standardization (ISO) Groups of experts drawn from the industry that set standards for various technologies. The work of these teams has led to development of SCSI, SMAL and the Internet, and the ASCII character set.

Internet A system that links computer networks all over the world.

I/O address A unique name assigned to each device that allows the CPU to recognize the device with which it is communicating.

IP (Internet Protocol) The protocols used to define how data is transmitted over the Internet.

IP address (Internet Protocol address) A unique address that identifies every network and host on the Internet. (A host is defined as the TCP/IP network interface within the computer, not the computer itself— a computer with two network cards will have two IP addresses.)

ISP (Internet service provider) A host computer that users can dial into over a modem to connect to the Internet.

J

JPEG (Joint Photographic Experts Group) A graphics file format named after the group. JPEGs are compressed file formats used for photographic images on the Web. The image quality of a JPEG can vary with the degree of compression used. It is possible to reduce a picture file to one-twentieth of its original size. Compare with GIFs. The counterpart for movies is called MPEG (Motion Picture Experts Group). **K**

keyboard A primary input device for a computer, used for entering text and shortcuts for command functions.

kilobyte (**KB**) A unit of memory equal to 1,024 characters or bytes (1 KB = one kilobyte).

L

LAN (local area network) A network that covers a limited distance (such as a single building or facility) to allow computers to share information and resources.

link Means, also known as a hyperlink, by which reader is moved to a different location on the Internet when the link is activated. When text is used for a hyperlink, it is often colored differently from the body text of the page so it stands out.

logging on Means by which—when connecting to a remote computer—the host computer (the one that is called) gives permission to connect. The process of sending the appropriate information to sign on is called logging on. Often a user name and password are required.

M

megabyte (MB) An amount of computer memory equal to 2^{20}. 1,048,576 bytes = 1024 kilobytes. One megabyte can store more than one million characters. **megahertz (MHz)** One million hertz (one million cycles per second). A measurement of clock speed.

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memory The area within a computer where information is stored while being worked on. It stores information (in the form of data bits) that the CPU and software need to keep running.

microphone Just like the microphone on a tape recorder. Allows input of voice or music to be recorded and saved to a computer file.

microprocessor An integrated circuit containing the entire CPU of a computer, all on one chip, so that only the memory and input/output devices need to be added.

MIME (Multipurpose Internet Mail Extensions) A new Internet standard for moving around sound and pictures by email.

modem (MOdulator/DEModulator) Converts computer data to information that can be transmitted via wires (telephone, ISDN, fiber optics, as well as wireless communication). Allows communication between computers over long and short distances. **monitor** The primary output device that resembles a television set—it visually displays text and graphics.

motherboard Also known as a PWB or printed wiring board. The large circuit board found inside the computer. For all practical purposes, it is the computer. It contains the following items: chip set, data bus, address bus, expansion slots, clock, battery, and memory.

mouse Device used with graphical environments to point and select objects on the system's monitor. They come in a variety of shapes and sizes. **N network** A group of computers connected together in order to share data and resources.

network card An expansion card that connects a computer to a group of computers so they can access information and programs. Also known as a network interface card, NIC, and network adapter card.
O

offline Networked computers that are not actively connected so that transmission of data is not possible.

online The state in which two or more computers are connected to each other, making possible data transmission.

operating system The program that controls a PC and makes it possible for users to run their own applications. The operating system provides the built-in routines that allow the computer to recognize commands, manage files, connect devices, and perform input/output operations. **P packet** A group of consecutive characters transmitted from one computer to another over a network. **parallel** The transmission of several bits at the same time over separate wires.

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parity bit A very basic method of error-correcting code that uses the value of an extra bit sent at the end of a data string. The bit must have a set value based on an algorithm to verify that the data at the receiving end is correct.

path The address to a file. The path consists of the drive name, the location of the file in the directory structure, and the filename. Example: C:\Mystuff\Myfile.doc.

peer-to-peer network A network in which each connected computer acts as either a server or a client depending on the users' needs. Each user or workstation establishes its own security and determines which resources are available to other users. These networks are limited in size, usually 15 to 20 workstations. **peripheral** An external device connected to a computer such as a printer, scanner, modem, or joystick.

pixel Short for "picture element." One of the dots that make up a graphical image.

plotter Similar to a printer, but uses pen(s) to draw an image. Used most often with graphics and drawing programs.

port Specific channel used by a network service. For example, Gopher often uses port 70, while some Web sites use port 80.

power supply Takes alternating current (AC) power from a local source (a wall outlet) and converts it to direct current (DC) for on-board electronics use. **printer** A peripheral device that transfers computer output to paper or other form of hard copy.

prompt The command prompt—a user interface provided by COMMAND.COM to signal to the user that the computer is ready to receive input (for example, C:\> or A:\>).
protocol A set of rules that govern the transfer of information. The format used to upload or download files to allow two different computers to communicate in a standard format.

R

RAM (random access memory) The main memory where a computer temporarily stores data.

register Temporary memory storage areas located inside the CPU. Used to hold the intermediate results of calculations or other operations.

repeater A device that works like an amplifier; it increases or boosts a signal to allow transmissions over longer distances. **ring network** A type of network in which all the servers and clients are connected in a closed loop.

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ROM (read-only memory) Computer memory that contains instructions that do not need to be changed, such as operating system startup instructions. The computer can access data from ROM but cannot put new data into it.

router A device that works like a bridge but is able to select the best route from network to network based on traffic load. A router can also connect dissimilar networks. **S**

scanner A peripheral that converts information from the written page (or a printed graphic) to digital information that can be used by the computer. Works similarly to the scanning process in a photocopy machine.

search engine A program that searches indexes of Internet addresses using keywords. There are hundreds of search engines located on servers throughout the Internet. Some popular search engines are AltaVista, Yahoo, HotBot, and Excite.

serial Transmission of 1 bit at a time over a single wire.

server The computer that runs the network operating system, manages security, and administers access to resources. Strictly speaking, any computer that stores information and allows outside users to get copies of that information. **software** Any program (set of instructions) that causes a computer to carry out a task or function.

star network A type of network configuration in which all computers are connected to a central point called a hub. The hub collects and distributes the flow data within the network. In large networks, several hubs may be connected. This is the easiest form of network topology to troubleshoot because all information goes through a hub, making it easier to isolate problems.

SVGA (Super Video Graphics Array) A video standard. The minimum requirement for SVGA compatibility is 640 pixels by 480 pixels at 256 colors. At the low end, typical SVGA systems are operated at 800 x 600 at any color depth. Today, most SVGAs run at 1024 x 768 at 256 with 64K colors or better.

synchronous Form of computer communication in which data is transmitted in packets containing more than one character. This is faster than asynchronous transmission because there is no start/stop bit between each individual character.

T

TCP/IP (Transfer Control Protocol/Internet Protocol) The name given to a collection of protocols that were designed in the 1970s for use on the large-scale mixed-platform that became the Internet.

telecommunications The ability to transmit data over telephone lines to a remote computer.

Topology The layout scheme that describes the way in which network nodes are wired in relation to each other.

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twisted-pair cable Consists of two insulated wires twisted around each other to form a pair. One or more twisted pairs are used in a twisted-pair cable. **U**

universal serial bus (USB) A new external expansion bus that is popular for use with low-speed mass storage devices such as ZIP drives, modems, and printers. **upload** The ability to transfer (send) a file from one computer to a remote computer.

UPS (uninterruptible power supply) Acts as both a surge suppresser and a power leveler to provide the computer with a constant source of power. It also provides power during a power failure or interruption so the user can safely save data before shutting down.

V

VGA (Video Graphics Array) A graphics adapter that offers 16 colors at a resolution of 640 pixels by 480 pixels. To gain more colors, VGA uses an analog video signal instead of a digital signal. With the analog signal, the VGA standard is able to provide 64 distinct levels for each color, giving users 64^3 or 262,144 possible colors. It uses a 15-pin, three-row, female DB-type connector.

W

WAN (wide area network) A network that spans a large geographical area. The network is connected by means of telephone lines, ISDN (Integrated Services Digital Network) lines, radio waves, or satellite links.
Word The largest amount of data that can be handled by the microprocessor in one operation and also, as a rule, the width of the main data bus.

worm (write once, read many) drives A type of older optical drive that allows the user to "write once, read many," allowing reader to reread, but not to alter, data after it has been recorded.

Z

Zip files Files compressed into Zip format, which requires them to be decompressed with a special program such as PKUNZIP or WINZIP before being used or installed.

MULTIPLE CHOICE QUESTIONS

Q. # : **Choose the correct answer for each from the given options**:

1. An ink-jet printer is an example of a/an:
   * Laser printer   * Impact printer   * LCD printer   * Non-impact printer

2. Two dissimilar networks can be connected by a:
   * Gateway   * Bus * Node * Server

3. ISP stands for:
   * International Service Provider   * Internet Switching Protocol
   * Internet Service Provider   * Internal Service Provider

4. This is the standardized set of rules of data communication:
   * HTML   * www   * DHTML   * TCP/IP

5. 1 Terabyte is equal to :
   * 1024 MB   * 1024 KB   * 1024 GB   * 1024 Bytes

6. This is related to downloading a computer file:
   * File Transmission Protocol   * File Transfer Protocol
   * File Service Provider   * File Server Provider

7. Illegal copy of a copyright software is called:
   * Hacking   * Software Piracy   * Theft of Service   * Theft of Hardware

8. This is not related to optical media:
   * CD-R   * Magnetic Disk   * DVD   * CD-RW

9. Transmission that allows flow of data in both directions at once is:
   * Half-Duplex   * Simplex   * Full-Duplex * none of these

10. USB stands for:
    * Universal Serial Bus   * Unified Serial Bus * Undefined Serial Bus * Universal Sequential Bus

11. This is not an operating system:
    * Windows   * Complier   * MS-DOS   * UNIX

12. This is the fastest Data Communication cable:
    * Co-axil cable   * Twisted Pair cable * Fiber Optic cable   * none of these

13. OSI stands for:
    * Open System Interconnection   * Operating System Interface

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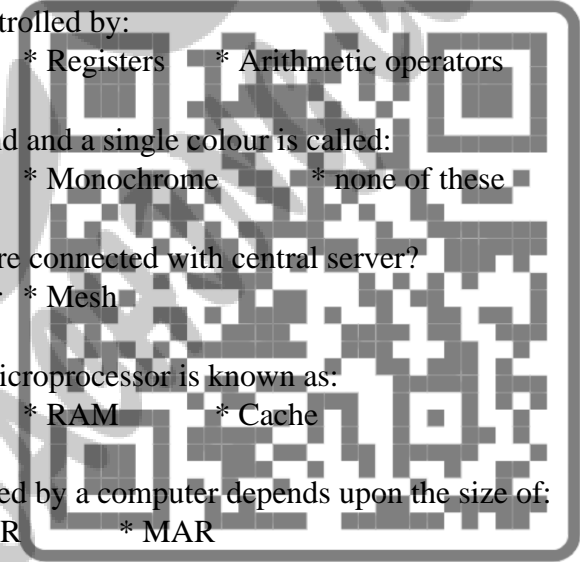
* Open Service Interconnection   * Operating System Interconnection

14. A secondary storage device is:
   * RAM   * ROM   * Cache   * Flash memory

15. Daisy wheel printer is an example of:
   * Character printer   * Line printer   *Ink-jet printer   * none of these

16. The capacity of memory may be measured in :
   * MHz   * Microseconds   * Megabytes   * none of these

17. The speed of processor is measured in:
   * MHz   * Microseconds   * Megabytes   * none of these

18. The printer quality of laser printer is measured in:
   * DPI   *CPI   * MMX   * MHz

19. HTTP stands for:
   * High text transfer protocol * Hugh text transfer protocol * Hyper text transfer protocol
   * High test transfer protocol

20. An operating system is an example of:
   * Application software   * System software   * Network software   * Database
   software

21. Which is called a sequential storage medium?
   * Magnetic Disk   * Magnetic tape   * DVD   * Flash Memory

22. A group of 4 bits is called:
   * Byte   * Word   * Nibble   * none of these

23. A group of 8 bits is called a:
   * Byte   * Word   * Nibble   * none of these

24. Compact Disk (CD) technology is based on:
   * Laser beams   * Solar beams   * Iron Oxide   * none of these

25. How many layers have an OSI model?
   * 5   * 6   * 7   * 8

26. A word processing program is a type of:
   * Application software   * System software   * Language translator   * All of these

27. MBR is an acronym for:
   * Memory Buffer Register   * Memory Bit Register   * Memory Back Register
   * Memory Black Register

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28. The cheapest topology is:
    * Star   * Bus   * Tree   * Ring

29. The most powerful & the fastest computers are:
    * Super PCs   * Super Mainframes * Super Computers   * Workstations

30. The main circuit board in a personal computer is called:
    * BIOS   * Mother Board   * RAM/Bus board   * ASCII Board

31. MBR, AC, MAR, PC and IR are:
    * Secondary storage * Auxiliary Memory * CPU Buffer * CPU Registers

32. The entire computer system is controlled by:
    * ALU   * Control Unit   * Registers   * Arithmetic operators

33. The monitor with black background and a single colour is called:
    * Colour   * Flat Panel   * Monochrome   * none of these

34. In which topology all computers are connected with central server?
    * Bus   * Ring   * Star   * Mesh

35. The special storage area built in microprocessor is known as:
    * Flash memory   * Register   * RAM   * Cache

36. The number of instructions executed by a computer depends upon the size of:
    * Opcode   *Decoder   * MBR   * MAR

37. Which of the following is not a web browser?
    * Mozilla   * Firewall   * Internet explorer   * Netscape

38. Extension of Microsoft word document is:
    * .ppt   * .xls   * .bmp   * .doc

39. The legal copying a software or data is called:
    * Threat   * Piracy   * Copyright   * Hacking

40. Coaxil cable, fiber optic, Microwave & satellite refers to:
    * Communication Media   * Topology   * Communication Mode
    * none of these

41. TCP/IP is a:
    * Protocol   * Network topology * transmission Media * All of these

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42. Mega hertz (MHz) unit is used to measure:
    * speed of processor   * storage space of a hard disk
    * Rotation speed of CD-ROM   * none of these

43. Translator that translates a high level language program into a low level language program
    is:
    * Compiler   * Interpreter   * Assembler * none of these

44. 1 GB is equal to:
    * 1024 KB   * 1024 MB   * 1024 TB   * 1024 Bytes

45. To transmit data from memory to a microprocessor and vice versa is carried on by:
    * Address bus * Control bus * Data bus   * None of them

46. The software used to access the world wide web is called:
    * Browser   * Web   * Server   * e-mail

47. The physical connectivity of different computers is called:
    * Topology   * Link   * Contention * Switch

48. The process of converting digital signal into analog signal is called:
    * Modulation   * Demodulation   * Telecommunication   * None of these

49. The register that collects the results of computation is called:
    * Data register   * Counter register   * Instruction register * Accumulator

50. The internal process of starting up a computer is known as:
    * Booting   * Self start   * Warm up   * Startup

51. Which software is suitable to enter and edit text in document?
    * MS Word   * MS Excel   * MS Power Point   * MC Access

52. A line printer is an example of a/an:
    * Laser Printer   * Impact Printer   * Non-impact printer   * None of these

53. A bar code reader is an example of a/an:
    * Processing device * Storage device   * Input Device   * Output device

54. A program that converts a source code into a machine code is called a/an:
    * Compiler   * Assembler * Driver   * All of them

55. Microwave transmission, coaxial cables and fiber optics are examples of:
    * Modems   * Routers   * Communication media   * Ring network

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56.   A computer virus is a:
        * Bacteria   * software   * signal   * hardware

57.   Microprocessor, RAM and buses are known as:
        * Software   * Hardware   * Firmware   * All of them

58.   A group of parallel conductors that are used by the CPU to "address" memory locations.
        * Address bus   * Control bus   * Data bus   * None of them

59.   A device that works like a bridge but is able to select the best route from network to
        network based on traffic load
        * Modem   * Router   * Communication media   * Ring network

60.   The transmission of messages by computer from one person to another, via the Internet.
        * Browser   * Web   * Server   * e-mail

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