

Fundamentals of Health Informatics

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Objective

After the completion of this course, students will be able to:

- **Explain the major concepts, function and principles of ICT**
- **Explain the computer system**
- **Explain characteristics of Computer**
- **Describe data representation techniques and computer arithmetic**
- **Explain types of software**
- **Browse and use the Internet for information exchange**
- **Understand the principle of health informatics**
- **Understand the Special features of health informatics**
- **Understand the Field of Health informatics**
- **Explain the Components of EMR**
- **Understand the future of health informatics**
- **Understand the future of health informatics**

Outline Coverage

Chapter One: Introduction to ICT

- Introduction to computer
- Characteristics of computer
- Types of computer
- Components of computer
- Hardware
- Software

Chapter Two: Data Representation in Computers

- Types of Number System
- Conversion from one base to another
- Automatic operation using Binary
- Units of data representation
- Coding methods/Encoding System

Outline Coverage

Chapter Three: Information retrieval

- Components of IR
- Types of IR

Chapter Four: Brief introduction to Health informatics (definitions, concepts and theories)

Chapter Five: Principle of **health informatics (terminologies, domain, application, definition etc...)**

Chapter Six: Field of Health informatics

Chapter Seven: The future of health informatics

Chapter I

Introduction of Computer
Definition of ICT and Computer
Characteristics of Computer
Classification of Computer

What is computer?

- A computer is an electronic device designed to:
 - Accept data or instruction (input),
 - Performs prescribed mathematical & logical operations at high speed (processing)
 - And supply the results of these operations to the outside world (output) or store the data.
- It is an electronic device that performs any mathematical & logical operations

Application areas of computer

- We use computer in
 - Medicine and health care
 - Business
 - Education
 - Science
 - Technology
 - Government
 - Entertainment
 - Engineering
 - Architecture and agriculture.

(ICT)

Information and communication technology

- ICT is technology that merges computing with high-speed **communications** links **carrying data** and **information** in the form of **text audio**, or **video**.
- The most important consequence of **IT** is **technological convergence**.
- Technological convergence is derived from a combination of two recent technologies **computers** and **communications**.

Characteristics of Computer

- **Automatic**

- Once started on a job, they carry on until the job is finished

- **Speed.** A computer is a very fast device.

- **Units of time** are microseconds (10^{-6} second),
- **Nanoseconds** (10^{-9} second) or even **Picoseconds** (10^{-12}).

- **Accuracy (Correctness)**

- The degree of accuracy of a particular computer depends upon its design.

- **Power of Remembering**

- A computer can store and recall huge amount of information

- **No I.Q.**

- A computer is not a magical device.
- It can only perform tasks that a human being can
- No intelligence of its own.
- Its I.Q. is zero.
- It has to be told what to do and in what sequence.
- Hence, only the user can determine what tasks a computer will do.

- **Versatility**

- A computer is capable of performing almost any task

- **No Feelings**

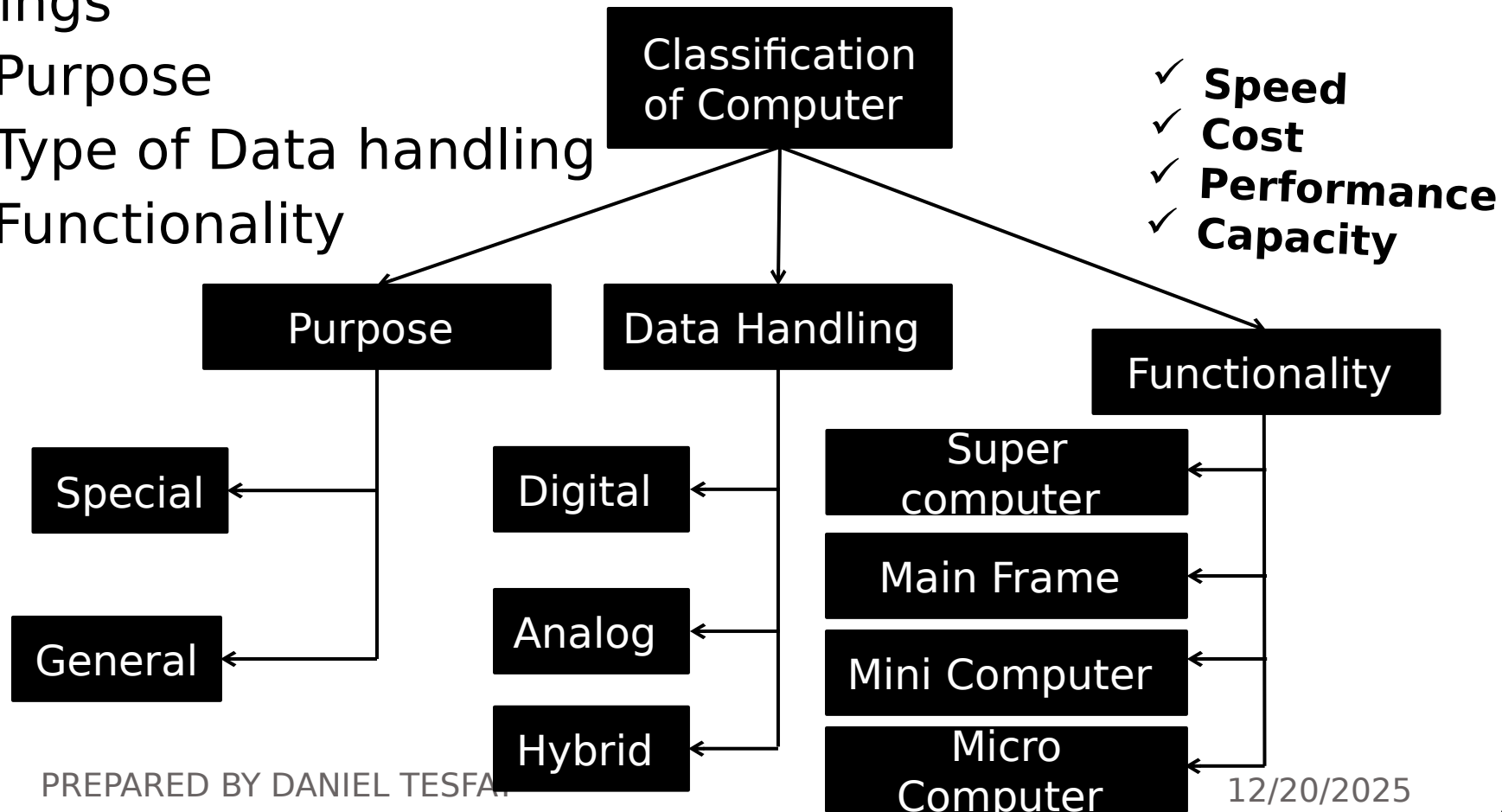
- Computers are free of emotion.
- Computers cannot make judgments on their own.

- Their judgment is based on the instructions

Classifications of computer

- Computer can categorize based on three things

- Purpose
- Type of Data handling
- Functionality



Based on purpose

- **General-purpose computers**

- Can be used for different purposes
- We need only have appropriate software to use a GPC to perform a particular task.
- **Example** Personal computers is **GPC**

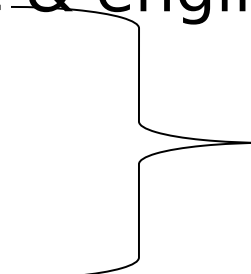
- **Special-purpose computers**

- Specifically designed to perform one particular task.
- Example:
 - A computer that Guides a **missile** is **SPC**
 - Public telephone box
 - Traffic control system
 - Ticket machines used in Grocery, super market
 - Pocket calculator
 - Counters

Based on Type of Data Handling

- **Analog computers:**

- **It operates by measuring**
- **Process data that vary continuously with time**
- Variations in temperature, speed, chemical composition of petroleum products, or current flowing through a conductor.
- Used for scientific & engineering purpose
- **Examples:**
 - Thermometer
 - Voltmeter
 - Speedometer
 - Gasoline pump
- However analog computers have limited accuracy



Based on Type of Data Handling conn...

- **Digital computers:**
 - Process digital data.
 - Process data with discrete variable
 - It operates by counting
 - All the PCs currently in wide use are digital computers.
 - Example
 - **Abacus**
 - **Desktop & pocket computers**
 - **General purpose computers**

Based on Type of Data Handling con...

- **Hybrid Computers:**

- They process both analog and digital data.
- Incorporate the **measuring feature of an analog computer** and **counting feature of digital computer**.
- For computational purposes, these computers use the analog components and for the storage of intermediate results, **digital memories** are used.
- **Example: In Hospital analog device measures**
 - Patient's heart function, Temperature and other vital signs and then the measurement convert the result in to number and supply to a digital component to the system

Based on its Functionality

- **Supercomputers:**

- **It is** most powerful and expensive computers
- Used for problems requiring complex calculations.
- The CRAY and CYBER are typical examples of the supercomputers.
- Are **fastest, costliest** and most **powerful** computers available today.

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- **Mainframe computers:**

- These are mainly found in large organizations.
- Multi user computer
- They can serve hundreds or thousands of users,
- They are used as e-commerce servers handling transactions over the Internet.
- They use punched card for data input
- Mainframes are the second largest (in capability & size) of the computer family.

Based on its Functionality con...

- **Minicomputers**

- A mini computer is a small digital computer
- These are **multi-user** computers

- **Workstations**

- Are powerful **single-user** computers
- Used for Product design and computer **animation.**
- They are often used as **network** and **Internet servers.**

Based on its Functionality

con...

- **Micro Computers:**

- It is a small, low cost digital computer,
- Consists of a microprocessor, a storage unit, an input and an output channel, with in a single chip
- It is smallest of all other computer family
- Are designed for **individual users only**,
- It include **desktop**, **laptop** and **hand** held models such as PDAs (Personal Digital Assistants).

Computer System Components

- A complete computer system includes **four** distinct parts:
 - **Data**
 - **Users**
 - **Hardware**
 - **Software.**

- **Data:**

- ✓ **Data** are raw facts which the computer can manipulate and process into information
- ✓ Organized, processed and meaning full data is **Information**

- **Users:**

- ✓ The users are the people operating the computers

- **Hardware:**

- ✓ Physical components of the system that you can touch and feel
display screen, keyboard and **mouse, disks** and **printers** (peripheral devices).

- **Software:**

- ✓ **Software** comprises the **programs** that tell the hardware what to do.
 - A **program** is a sequence of instructions stored in the memory of the computer system.
- ✓ The **central processing unit** fetches an instruction, decodes it and then executes the required operation

Computer Hardware

- Computer Hardware:

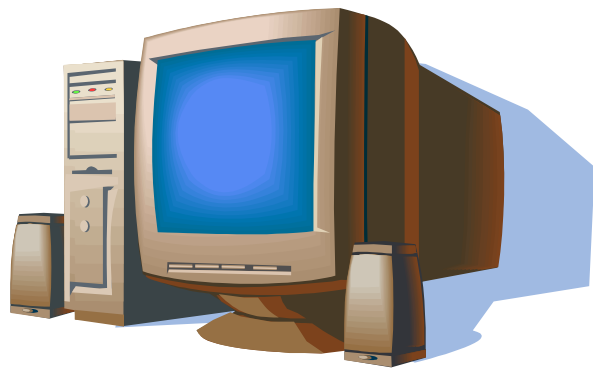
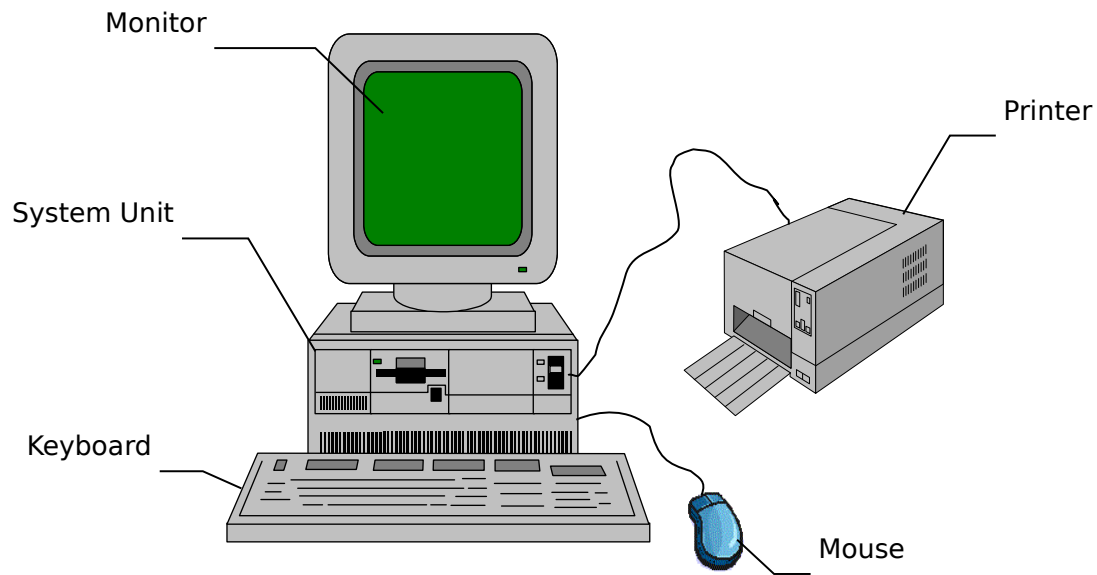
- ✓ Computer hardware is one component of computer system which is the **physical components of the computer**.

- ✓ It is the **part of the computer or any accessory attached** to the computer called “**peripheral**” which you **can touch or feel**.

E.g. computer case, monitor, keyboard, mouse, printer, modem and scanner all constitute hardware.

- A. **The Computer Physical Setup:**

- ✓ When you look at a computer externally...



i. The Computer Case

- ✓ houses all the major components of the computer.
- ✓ **On the front end** of the case may be found
 - on/off switch,
 - status indicators (power and HDD indicators) and
 - openings to floppy disk drives, CD-ROM drives
- ✓ **On the rear** end of the case are found
 - ports for connecting peripheral devices with the PC
 - and a power source.



ii. Expansion Slots and Cards

✓ **Expansion cards** are small circuit boards that **are used to upgrade a computer.**

○ These include: enhanced graphics cards, modems, networking cards, sound cards, etc.

✓ **Expansion cards** are inserted into **expansion slots** in the motherboard.

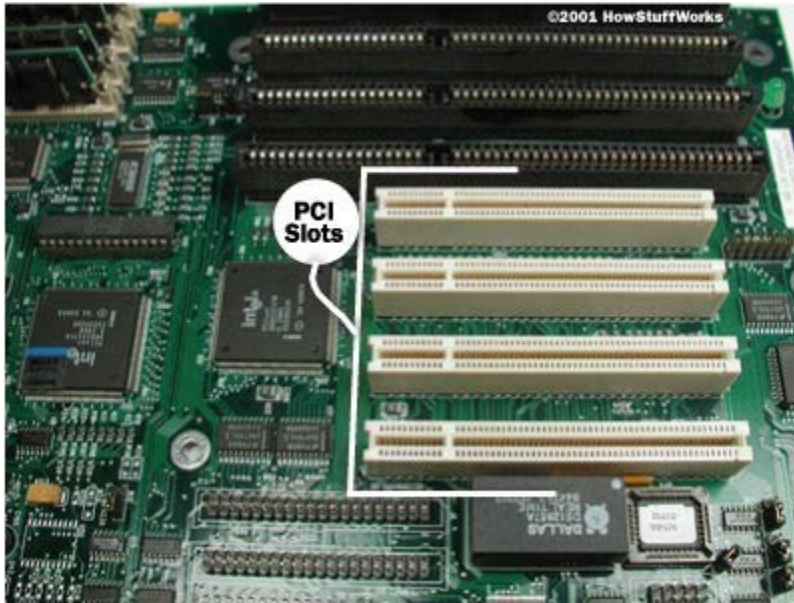
✓ **motherboard** a board into which most of the basic components of the computer are built.

a. **PCI** (Peripheral Component Interconnect)

b. **AGP** (Accelerated Graphics Port)

c. **USB** (Universal Serial Bus)

- **PCI** (Peripheral Component Interconnect) :
 - ✓ is a local bus system that allows devices to be inserted quickly and easily (plug-and-play compatible).
 - ✓ Most of today's computers come with PCI slots and cards.
- **AGP** (Accelerated Graphics Port)
 - ✓ is a new platform bus specification that enables high performance graphics capabilities, especially 3D graphical display applications
- **USB** (Universal Serial Bus)
 - ✓ defines a class of hardware that makes it easy to add devices to your computer.
 - ✓ The Universal Serial Bus gives you a single, standardized, easy-to-use way to connect up to **127 devices** to a computer.



Typical example of an **AGP-based graphics card**

AGP provides a much faster, more efficient way for your computer to get the information it needs to render complex graphics

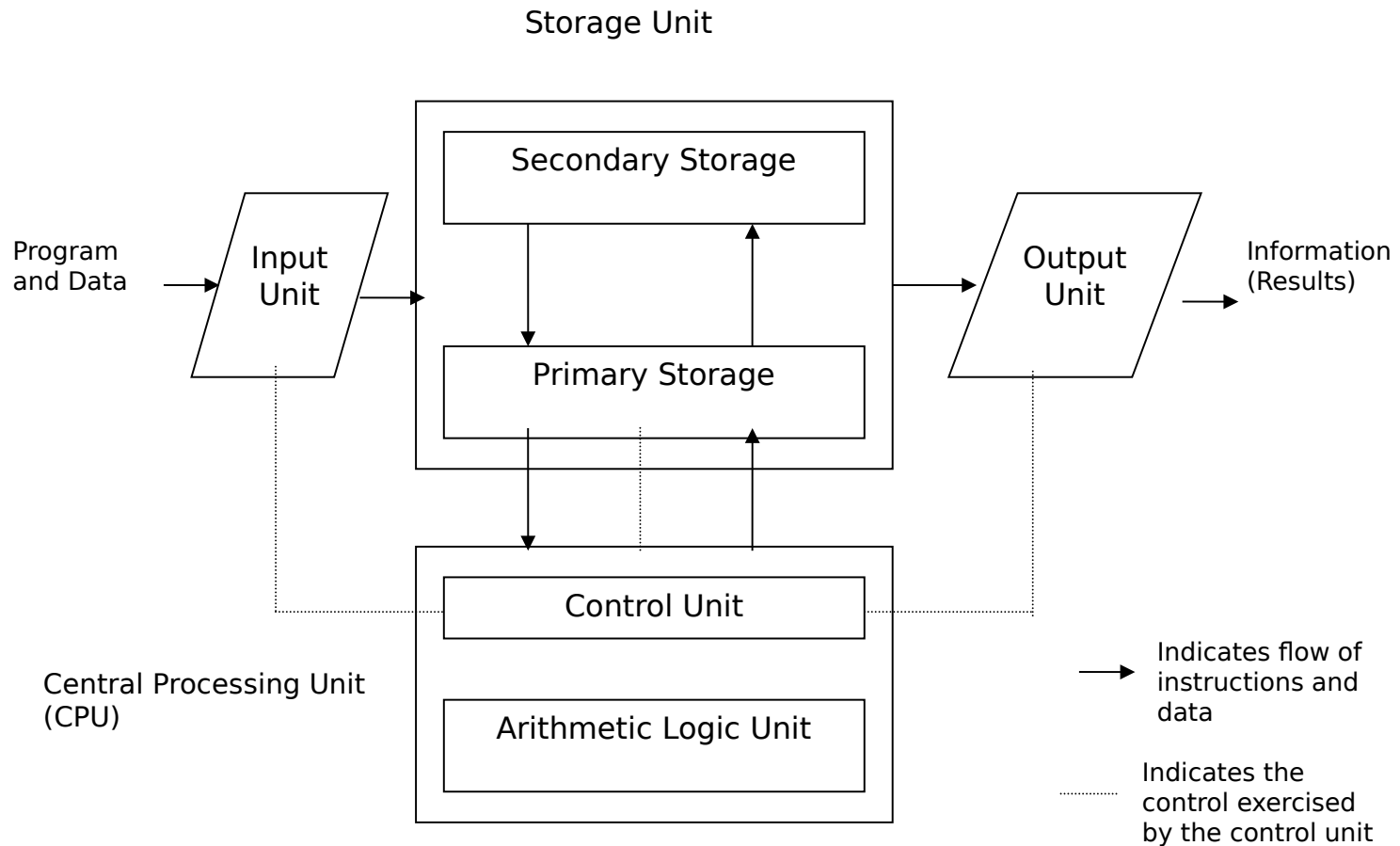


iii. Power Supplies

- ✓ **Power supply** converts normal household electricity, alternating current (AC), into electricity that can be used by the computer, direct current (DC).
- ✓ It also lowers the voltage level.

B. Operational Setup of Computer:

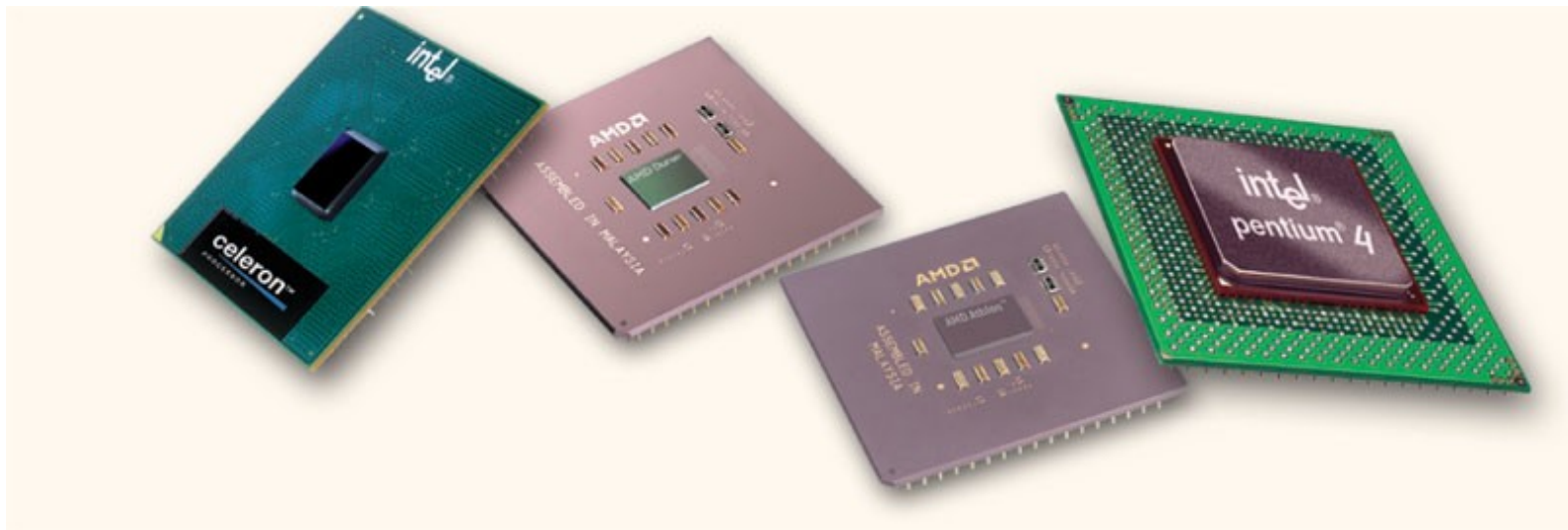
- ✓ The hardware part of a computer system is **composed of** a number **of interacting parts**.
- ✓ The **central element in the system** is the **CPU**.
- ✓ All what a computer does is that takes input (of various forms), processes it (according to some set of instructions), and produces an output (of various forms) or store the output.
- ✓ The following diagram displays the four major building blocks or functional units of a digital computer system namely
 - input unit,
 - output unit,
 - central processing unit
 - and storage unit.



Basic Organization of a Computer System

i. Central Processing Unit (CPU):

- ✓ The **CPU** is the computing part of the computer; it is referred to as the **brain** of the computer.
- ✓ It **controls** and **manipulates** the data to **produce** information.
- ✓ The CPU and other components necessary to make it work are mounted on a main circuit



The main components of a CPU are:

- **the Control Unit (CU)**
- **Arithmetic and Logic Unit (ALU) and**
- **Registers.**

I - Arithmetic and Logic Unit (ALU) -

- executes the computer's commands by doing arithmetic or the logical comparisons.
- The data and instructions, stored in the primary storage prior to processing are transferred as and when needed to the ALU, where processing takes place.
- Intermediate results generated in the ALU are temporarily transferred back to the primary storage until needed at a later time.
- Data may thus move from primary storage to ALU and back again to storage many times before the processing is over.

II - Control Unit (CU) -

- directs the operation of the entire system.
- It obtains instructions from the program stored in main memory, interprets the instructions, and issues signals that cause other units of the system to execute them.
- It acts as a **central nervous system** for the other components of the computer system.

III- Registers -

- The registers **are special purpose, high speed temporary memory** units.
- They hold various types of information such as **data, instructions, addresses and the intermediate results of calculations.**
- *Essentially they hold the information that the CPU is currently working on.*
- *Registers can be thought of as CPU's working memory.*
- The important registers within CPU are Program Counter, Instruction Register, Accumulator, Memory Address Register, Memory Buffer Register and Data Register.

C. INPUT DEVICES:

- ✓ Data and instructions are entered into the computer's main memory through an input device.
- ✓ Input devices capture information and translate it into a form that can be processed and used by other parts of the computer.
- ✓ Input devices can be classified into the *following categories*:

i. Keyboard



- ✓ Keyboard is the **standard input device**.
- ✓ Data is entered into computer by simply pressing various keys.
- ✓ The number of keys in a typical keyboard varies from 82 keys to 108 keys. The keys are arranged as follows:
 - **Alphanumeric keys** – used for typing, similar to that of a typewriter.
 - **Numeric keypad** – found at the right side of the keyboard, it is used for entering numbers and moving the pointer.
 - **Function keys** – these are the twelve function keys, F1 – F12, at the first row of the keyboard. They may be programmed to perform different tasks.
 - **Modifier keys** – include keys like Alt, Ctrl and Shift.

ii. Pointing Devices

- ✓ A pointing device is used to communicate with the computer by pointing to location on the monitor screen
- ✓ the user can move a cursor on the screen and perform move, click or drag operations
- ✓ Some of the commonly used pointing devices are **mouse**, **trackball**, **joystick**, **light pen** and **touch screen**.

a. Mouse:

- Mouse is a small hand held pointing device.
- Usually a mouse contains two or three buttons for **left clicking**, **right clicking** and **for scrolling**.
- The mouse may be **classified as a *mechanical mouse* or an *optical mouse***, based o the technology it uses.

- **A mechanical mouse uses a rubber ball** at the **bottom surface**, which rotates as the mouse is moved along a flat surface to move the cursor.
- **An optical mouse uses a light beam** instead of a **rotating ball** to move the cursor.
- Some of the common mouse actions are pointing, **click**, **Right-click**, **Double-click**, **Drag** and **drop**.



b. Trackball :

- Similar to a mouse except the ball is on top where it can be moved with the thumb.



c. Track pad (or touchpad)

- is a touch-sensitive pad that is used to move the pointer by gliding your finger across its surface.



d. Touch screen

- is a type of display screen device that is placed on the computer monitor in order to **allow the direct selection or activation of the computer when somebody touches the screen.**

e. Integrated pointing device :

- is a small joystick built into the keyboard. You can move it in the direction that you want to move the pointer.



iii. Speech Recognition

- ✓ Speech recognition is the technology by which **sounds, words or phrases spoken by humans are converted into digital signals**, and **these signals are transformed into coding patterns** where the meaning has been assigned.
- ✓ It is more generally called as sound recognition.

iv. Digital Camera

- ✓ Digital camera stores images digitally rather than recording them on a film.
- ✓ Once a picture has been taken, it can be downloaded to a computer system and then manipulated with an image editing software and printed.



v. Scanner

- ✓ **Scanner:** A scanner is a device that scans an image and transforms the image into ASCII code.
- ✓ generates a digital representation of an image for data input to a computer

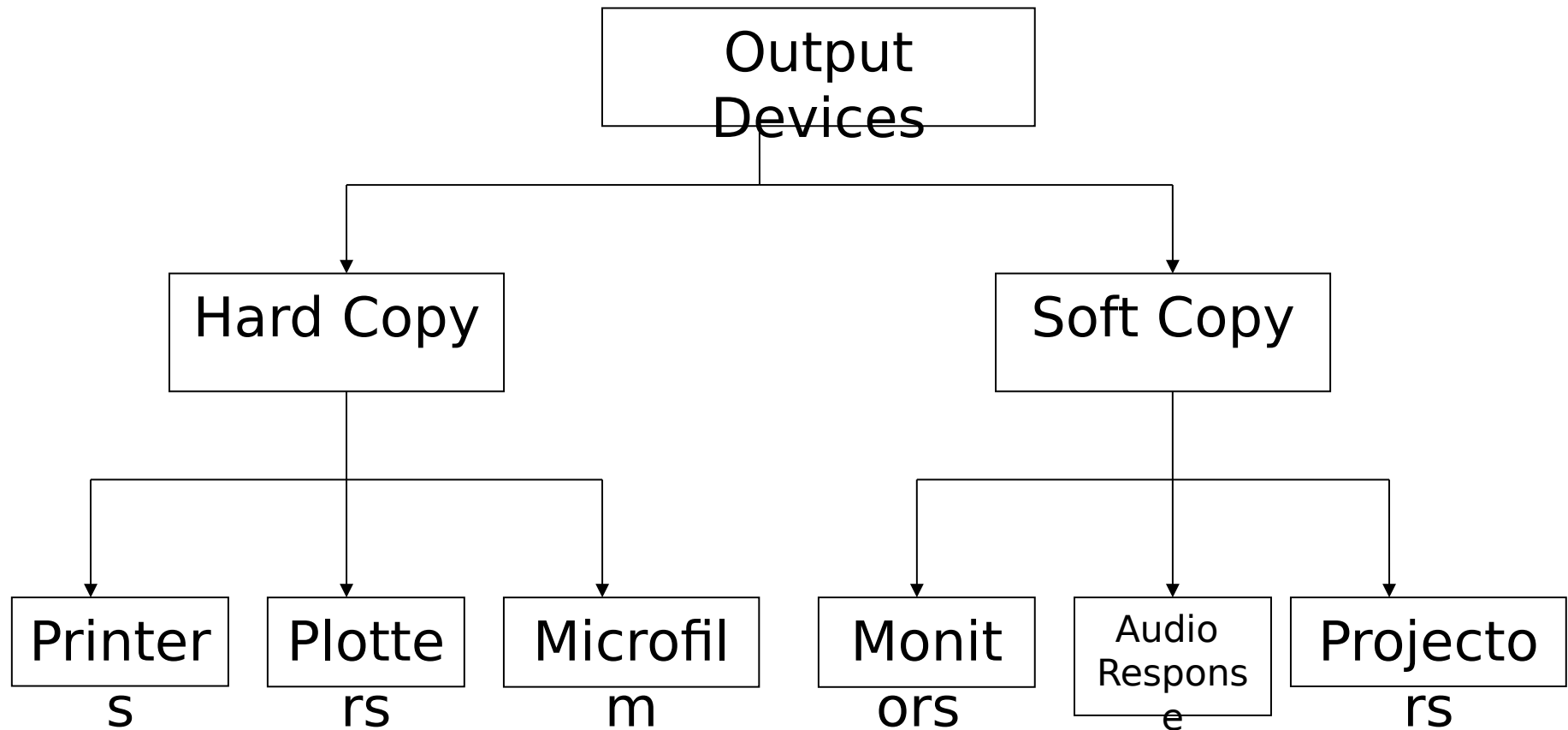


- Other devices like:
 - **devices for hand-** include pens, and game controllers;
 - **optical input devices-** include bar code readers;
 - **audio devices-** include **microphones** also used as input device.

D. OUTPUT DEVICES:

- ✓ Output devices are **peripheral devices through which processed data is made available for humans.**
- ✓ An output device is an electromechanical device, which **converts machine readable data** or the information **into human readable form.**
- ✓ The computer output generated by output devices is of two forms: **Hard copy** and **soft copy.**
- ✓ The **printed form of output** is referred as **hard copy**
- ✓ The form of **output** which is **shown on a display screen** or is in **audio** or **voice** form is referred as **soft copy**

- ✓ The output devices are classified into two types: **Hard copy output devices** and **soft copy output devices**.



i. Monitors

- ✓ The monitor displays the output of the computer.
- ✓ Monitors are categorized by **the colors they produce** and **by the technology they use**.
- ✓ **By the colors** they produce, monitors are classified as follows:
 - **Monochrome** - one color text/image on single color background, i.e. white on blue, or green on black.
 - **Grayscale** - shades of gray on a white background
 - **Color** - can display different colors, from 16 to 16 million colors.
- ✓ **By the technology** they use, monitors are classified as follows:
 - **Cathode ray tube (CRT)**
 - **Liquid Crystal Display (LCD)**

Cathode ray tube (CRT)

- ✓ in these monitors, electrons are fired at phosphor dots on the screen.
- ✓ The dots are grouped into picture elements called **pixels**, which glow when struck by electrons.
- ✓ In color CRT monitors, each pixel contains a red, green and blue dot. These glow at varying intensities to produce color images.

Liquid Crystal Display (LCD)

- ✓ The screen is still made of dots but is **quite flat**.
- ✓ LCD displays are made of two layers of a polarizing material with a liquid crystal solution in between.
- ✓ An electrical signal makes the crystals line up in a way that keeps light from going through entirely or just partly.
- ✓ A black screen has all the crystals lined up so that no light gets through.
- ✓ A color LCD screen uses groups of 3 color cells instead of 3 phosphor dots. The signal for a picture cleverly lets just the right spots show their colors.

Points to be considered when comparing monitors:

- **Size** – the diagonal measurement of its face in inches. 17” is common.
- **Resolution** – number of pixels on the screen. This is important especially for graphics, page layout and CAD.
 - ✓ **VGA (Video Graphics Array)** monitors have resolution of 640 X 480 pixels.
 - ✓ **SVGA (Super VGA)** monitors have resolutions ranging from 800 X 600 pixels to 1024 X 768 pixels or more.
- **Refresh rate** – indicates how often the picture is redrawn on the monitor.
 - ✓ If the rate is low, the picture will appear to **flicker**.
 - ✓ Flicker is not only annoying but also causes eye strain and nausea.
 - ✓ **So, a high refresh rate is desirable.** 60 times per second is tolerable at low resolutions for most people. 75 times per second or more is better and is necessary for high resolutions.

iii. Printers

- ✓ Printers are used to produce “hard copy” of documents, programs and data.
- ✓ Some printers use **serial communication** (RS232 standard) while others use **parallel communication** to transfer information from the PC to the printer.
- ✓ In **serial communication**, data is transferred **one bit at a time** while in the case of **parallel communication**; **one byte (8 bits)** is transferred at one time.
- ✓ The printing method (the actual forming of characters) also varies.
- ✓ **Based on the printing method used**, printers are categorized as **impact printers** and **non-impact printers**.
- ✓ Impact printers strike an inked ribbon, pressing ink from the ribbon onto the paper while non-impact printers use different methods to place ink on paper.

Dot-Matrix Printers:

- ✓ are common types of **impact printers**.
- ✓ The print head has an assembly of tiny pins that are activated in a row and physically “hit” the paper through the ribbon to produce the desired impression.
- ✓ Speeds are expressed in characters per second (cps) and vary between 180cps and 400cps.
- ✓ These printers are **loud**, **inexpensive** and **slow**.
- ✓ The **quality of the printout** is **not so good** as that of inkjet or Laser printers.
- ✓ But, we can have **carbon copies** and **printouts** on stencils from these printers.

Inkjet Printers:

- ✓ are non-impact printers.
- ✓ Tiny particles of ink are electrically charged after leaving the nozzle.
- ✓ The droplets are then guided to the right position on paper by electrically charged deflection plates.
- ✓ **The print quality is very good.**
- ✓ **We cannot use them with stencils nor can we produce carbon copies** using these printers.
- ✓ Inkjet printers are available for color or black and white.

Laser (Light Amplification by Stimulated Emission of Radiation) Printers:

- ✓ are the most advanced of all.
- ✓ In this printer the laser beam forms an image of the characters to be printed on to the light sensitive drum.
- ✓ Laser printer speeds are specified in pages per minute (PPM), e.g. 6PPM, 12PPM or 24PPM.

Factors to be considered while selecting printers:

- **Speed** (measured in PPM or CPS)
- **Quality** (measured in dots per inch – dpi)
- **Initial cost**, cost of operation and
- **Special features** like support for color and large page formats.

Other Output Devices

- **PC Projector** – connects to a PC and is used to project images on a large screen.
- **Sound systems** – multimedia PCs come with a sound card, speakers and a CD-ROM or DVD drive.
 - ✓ A **sound card** translates digital signals into analog that drive the speakers.

D. STORAGE DEVICES:

- ✓ provides space for storing data and instructions, space for intermediate results, and also space for the final results.
- ✓ The storage unit comprises of two types of storage:
 1. Primary Storage
 2. Secondary Storage

I - Primary Storage:

- ✓ also known as **Main Memory** or **RAM (Random Access Memory)**
- ✓ stores data and program code needed by the CPU
 - ❖ **Stores data & instruction CPU is currently working on**
- ✓ **Contents** of RAM **change rapidly** and **often**
- ✓ RAM can hold information only while the computer system is on.
 - ❖ When computer system is **switched off** or **reset**, the information held in the **primary storage disappears**
 - ❖ **Hence, it is generally VOLATILE memory**
- ✓ the primary storage normally has **limited storage capacity**

ROM(Read Only Memory):

- ✓ Is another primary memory
- ✓ is a non-volatile memory whose contents cannot be changed by the user
- ✓ contains minimum instructions that the computer needs to get started

II – Secondary Storage:

- ✓ is used to take care of the limitations of the primary storage
- ✓ to supplement the **limited storage capacity** and the **volatile characteristic** of primary storage.
- ✓ It is much cheaper than primary storage
- ✓ It **can retain information** even when the computer system is **switched off or reset**.
- ✓ Holds data & instruction the computer system is not working on currently
- ✓ The physical material that actually holds data is called **storage medium**. The hardware that writes data to or reads data from a storage medium is called a **storage device**.

(... Secondary Storage ...)

- ✓ two technologies for secondary storage:
 - ❖ **Magnetic:** **Eg.** **Floppy Disk, Hard Disk**
 - ❖ **Optical:** **Eg.** **CD-ROM, DVD-ROM, CD-R, CD-RW**
- ✓ ...

Factors Affecting processing speed of a computer :

1. Registers:

- these are the memory areas in the CPU that store data and instructions while the CPU processes them.
- The size of the registers, also called word size, determines the amount of data with which the computer can work at one time. Most PCs have 32-bit registers.

2. RAM

- The more the RAM size, the faster the computer is

3. System Clock

- A single “tick” of the clock is the time required to turn a transistor off and back on.

➤ The faster the PC's clock runs, the more instructions the PC can execute each second.

Factors Affecting processing speed of a computer :

4. Bus Width

- determines how many bits can be transmitted between the CPU and other devices
- The bus refers to the path between components of a computer.
- The larger the bus width, the faster the computer.

5. Cache Memory

- cache is a high speed memory that holds the most recent data and instructions that have been loaded by the CPU.
- It is located directly on the CPU (L1 cache) or between the CPU and RAM (L2 cache).
- The larger the cache size, the faster the

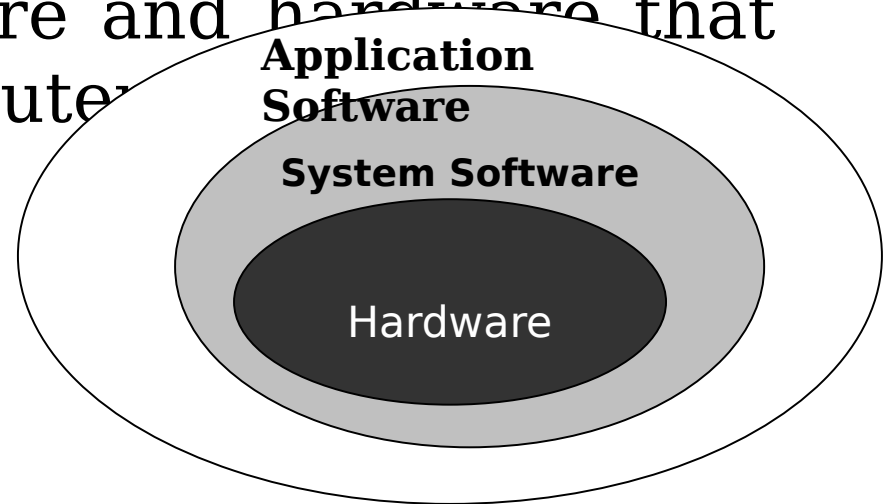
Software

What is Computer software?

- ✓ Computer cannot perform on its own
- ✓ The term **software** refers to the set of **computer programs, procedures** and **associated documents**.
- ✓ The sets of instructions which control the sequence of operations are known as programs
- ✓ Collectively computer programs are called **software**.

Relationship between Software and Hardware

- ✓ Software is computer programs that are loaded into a computer system
- ✓ Hardware is all the visible devices, which are assembled together to build a computer system.
- ✓ Blending of software and hardware that gives life to a computer



Software Categories

Computer Software

System software

Application software

System Management System Development

Operating System

Utility

Device Driver

Low Level Programming Language

High Level Programming Language

System software

- It is designed to **control** the **operations** and **processing** capabilities of a computer system
- Managing computer system
- It performs the following functionalities
 - ✓ Provides user interface
 - ✓ Monitors the effective use of various hardware
 - ✓ Support the development and execution of other application software.

Operating System

- Basic functions of operating system are
 - ✓ Process management
 - ✓ Memory management
 - ✓ File management
 - ✓ Device management
 - ✓ Security management
 - ✓ User interface

Device Drivers

- ✓ Device drivers are system programs
- ✓ Are responsible for proper functioning of devices.
- ✓ Every device or hardware, such as printer, monitor, mouse or keyboard, has a driver program for support.
- ✓ Whenever a new device is added to the computer system, a new device driver must be installed before the device can be used.
- ✓ It acts like a translator between the device

System Utilities

- ✓ Utilities are a set of programs that help users in system maintenance tasks and in performing tasks of routine nature.
- ✓ Tasks performed by utility programs are:
 - ✓ Formatting hard disks or floppy disks.
 - ✓ Reorganizing files on hard disk to conserve storage space.

System Utilities

conn...

- ✓ Taking back up of files stored on hard disk
- ✓ Checking the amount of available memory
- ✓ Checking the amount of available storage space
- ✓ Scanning the system for computer viruses

System Development software

- They are associated with the development of computer programs.
- These program development tools allow programmers to write and construct programs that the operating system can execute.
- Examples : **Translators, linkers and loaders.**

Programming Language

- It is a primary interface of a programmer with a computer.
- A programming language includes a series of commands, which are used in development of software.
- Programming language are further divided into three categories namely, **Machine language**, **assembly** language and **high level language**.

Language Translator

- ✓ There are three types of translators.

Assemblers:

- ✓ Translate programs written in assembly language into machine code

Compilers:

- ✓ Translate programs written in a high level language into machine code,

Interpreters:

- ✓ Translate programs written in a high level language into machine code.

Application Software

- ✓ It is used to accomplish specific tasks
- ✓ Application software are in turn controlled by system software
- ✓ Some examples of application software:
 - ✓ Word processing
 - ✓ Spreadsheet
 - ✓ Database management system
 - ✓ Graphics software

Word processing

- ✓ It is a computerized typewriter,
- ✓ used to creating, editing, formatting, filing and printing of text.
- ✓ writing memos, letters, reports,
- ✓ It Increases speed and quality documents .

✓ Examples are **MS Word,**

WordPerfect etc

Spreadsheet

- A spreadsheet is an electronic worksheet
- Commonly used by accountants / finance, human resource, PPM etc ... data management
- Used to perform mathematical operations and large data storage
- **Examples of spreadsheet:**
 - **Microsoft Excel, Lotus 1-2-3 etc.**

Chapter II

Number System

Number system

- The 4 Common types of Number system
 - **Decimal number system :**
 - It represents 10 symbols (0-9)
 - It is Our day to day number system
 - **Binary number system**
 - It represents two symbols (0 and 1)
 - Computer uses binary number system
 - **Octal number system**
 - It represents 8 symbols(0-7)
 - **Hexadecimal number system**
 - It represents 16 symbols (0-9) and A, B, C, D, E, F

Number system Conversion

- From Decimal to Binary
 - Use Long Division Method
- From Binary To Decimal
 - Use Multiplication Method

Units of Data Representation

- **Bit**

- Bit is Binary Digit
- The smallest unit of data in the computer

- **Byte**

- It is a collections of Bits
- 1 Byte = 8 bit

- **Word**

- It is a collections of bits
- It can be of 8 bit, 16 bit, 32 bit, 64 bit together to give word

Binary Coding

- There are common encoding systems
 - Binary Coded Decimal (**BCD**)
 - American Standard Code for Information Interchange (**ASCII 7 and ASCII 8**)
 - Extended Binary Coded Decimal Interchange Code (**EBCDIC**)
 - **Unicode**

BCD(Binary Coded Decimal)

BCD 4 Bit

- It uses 4 bit digit
- Used to represent only 0-9
- Example 9 can be represented as 1001

BCD 6 Bit

- Used to represent 64 characters
- 26 Capital Character and some symbols can be represented in BCD 6
- 2 bit for zone and
- 4 bit for actual digit

<u>Character</u> <u>Digit(4 Bit)</u>	<u>Zone(2bit)</u>
0-9	0
0-9	
A-I	3
1-9	

EBCDIC

- It is an 8-bit coding scheme
- It accommodates to code 2^8 or 256 different characters

EBCDIC

<u>Character Bit)</u>	<u>Zone (4 Bit)</u>	<u>Digit (4</u>
0-9	15	0-9
a-i	8	1-9
j-r	9	1-9
s-z	10	2-9
A-I	12	1-9
J-R	13	1-9
S-Z	14	2-9

ASCII 7

- Use 7 bit to represent characters
- It can represent up to 128 characters
- 3 bit zone and 4 bit digit

<u>Character</u> <u>Digit(4bit)</u>	<u>zone</u> (3 bit)	
0-9	3	
0-9		
A-O	4	1-15
P-Z	5	
0-10		

ASCII 8

- Use 8 bit to represent characters
- It can represent up to 128 characters
- 4 bit zone and 4 bit digit

<u>Character</u>	<u>zone (4 bit)</u>	
<u>Digit(4 bit)</u>		
0-9	3	0-9
A-O	4	1-15
P-Z	5	0-
10		
a- o 6	1-15	
p- z 7	0-10	

UNICODE

- Two bytes (16 bits) for each character.
- It can handle 2^{16} (65,536) character combinations,
- It allows almost all the written languages
- The Latin alphabet used in English, Spanish, German, Portuguese, Hindi

End of the Chapters

**Thank You for your
attention**