Module I

Basic components of a computer, the Von Neumann architecture and the stored program model, binary and hexadecimal number systems, conversion from decimal to binary to hexadecimal systems and vise versa,

representation of data in a computer (numbers - integers and floating point, text - ASCII and UniCode, images - black and white, grayscale and RGB, audio and video).

Computer systems

A Computer is an electronic device which performs operations such as accepts data as an input, store the data, manipulate or process the data and produce the result as an output.

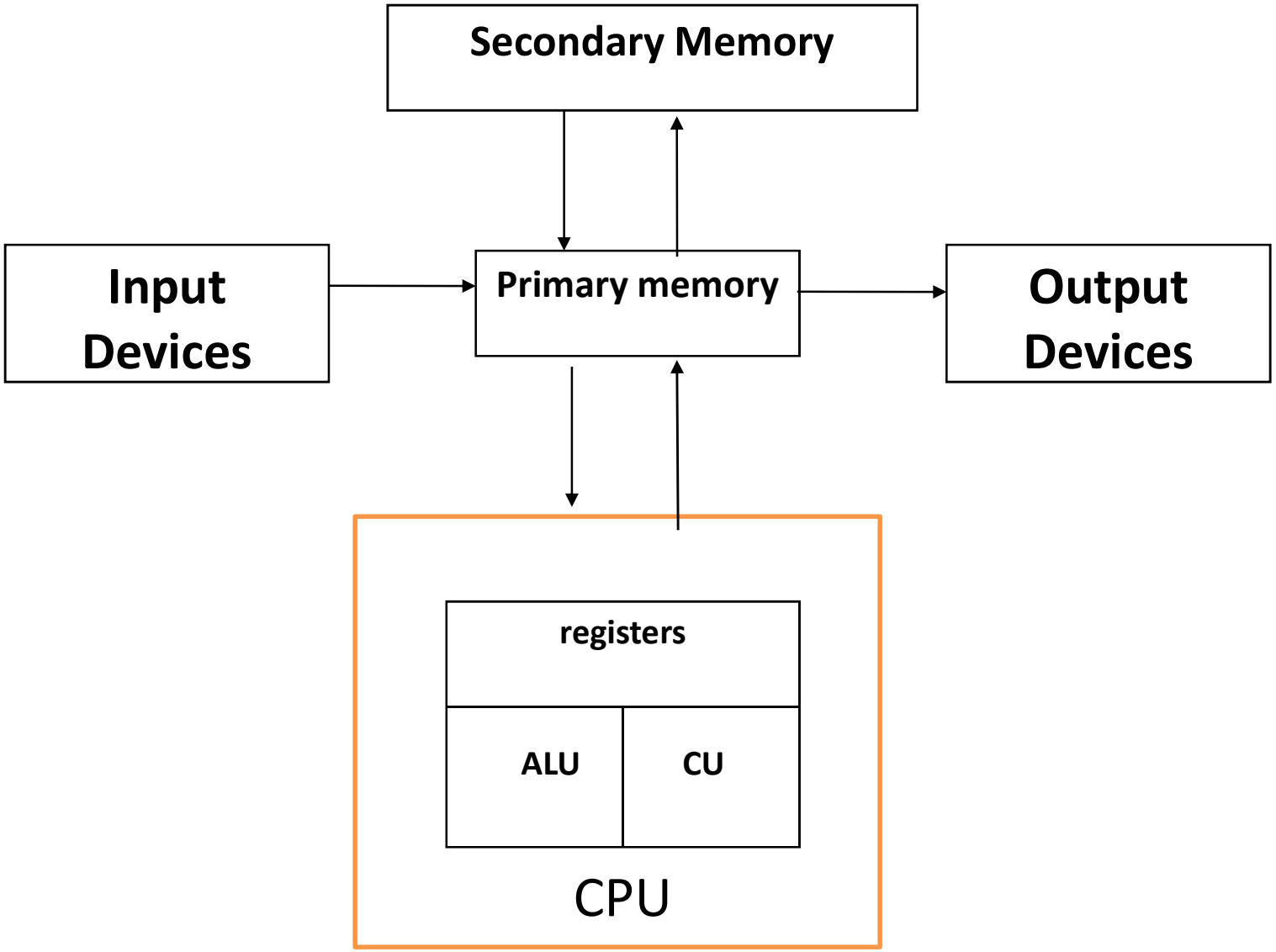
Main task performed by a computer

- Accept the data
- Process or manipulate the data
- Display or store the result in the form of human understanding
- Store the data, instructions and results.

Von Neumann Architecture and Stored Program Model

The Von Neumann architecture is a simple and widely used computer design that forms the foundation of most modern computers. Here is a straightforward explanation with a basic diagram

BLOCK DIAGRAM OF MODREN COMPUTER



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A computer comprises of various components:

- ❖Hardware
- ❖Software
- ❖User
- ❖Data

HARDWARE

The physical components of a computer which make up the computer system are termed as hardware. Any part of the computer that we can touch including the cables and wires is Hardware. The Primary Components of a Computer or basic hardware components of a computer system are categories as follows

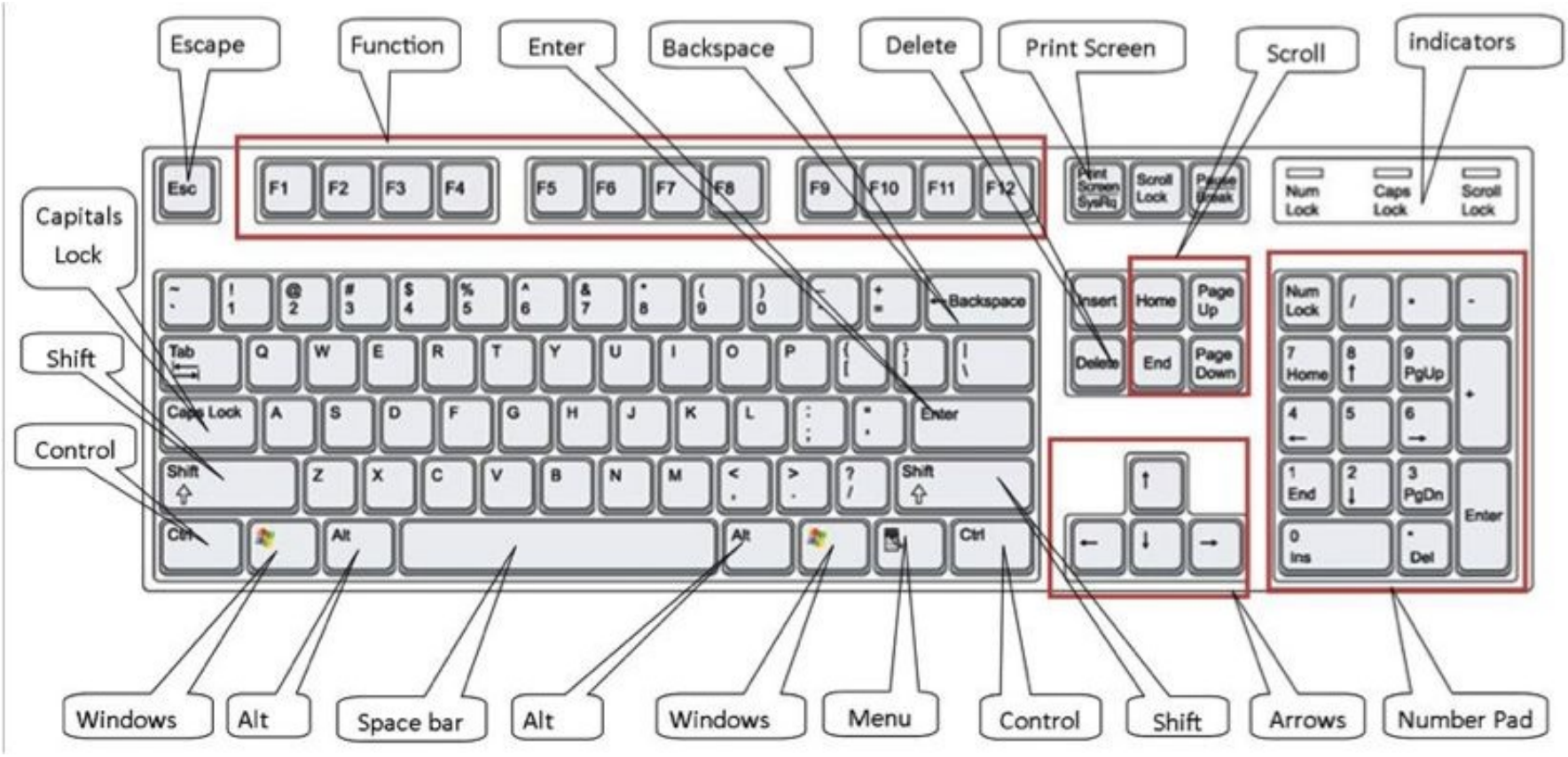
- ❖Input devices.
- ❖Central Processing Unit (CPU).
- ❖Memory
- ❖Output devices

Input and Output Devices:

Input and output devices are used to communicate with the computer. Specifically, these devices allow the user to enter the data and commands into the memory of the computer for computation and to observe the results of that computation. The common input devices are Keyboard, Mouse, Scanner etc.

Keyboard:

The most commonly used input device is the keyboard with which the data is entered manually by keying in or typing certain keys. A keyboard typically has 101 or 105 keys


Escape
Function
Enter
Backspace
Delete
Print Screen
Scroll
indicators
Capitals Lock
Shift
Control
Windows
Alt
Space bar
Alt
Windows
Menu
Control
Shift
Arrows
Number Pad

Mouse:

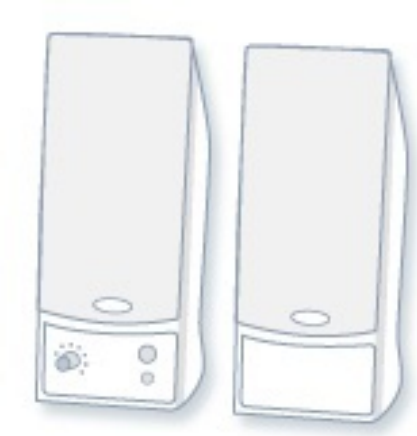
The mouse is a device that allows user to control the movement of the insertion point on the screen.

Scanner:

A scanner is an input device that converts documents and images as the digitized images understandable by the computer system

Output unit:

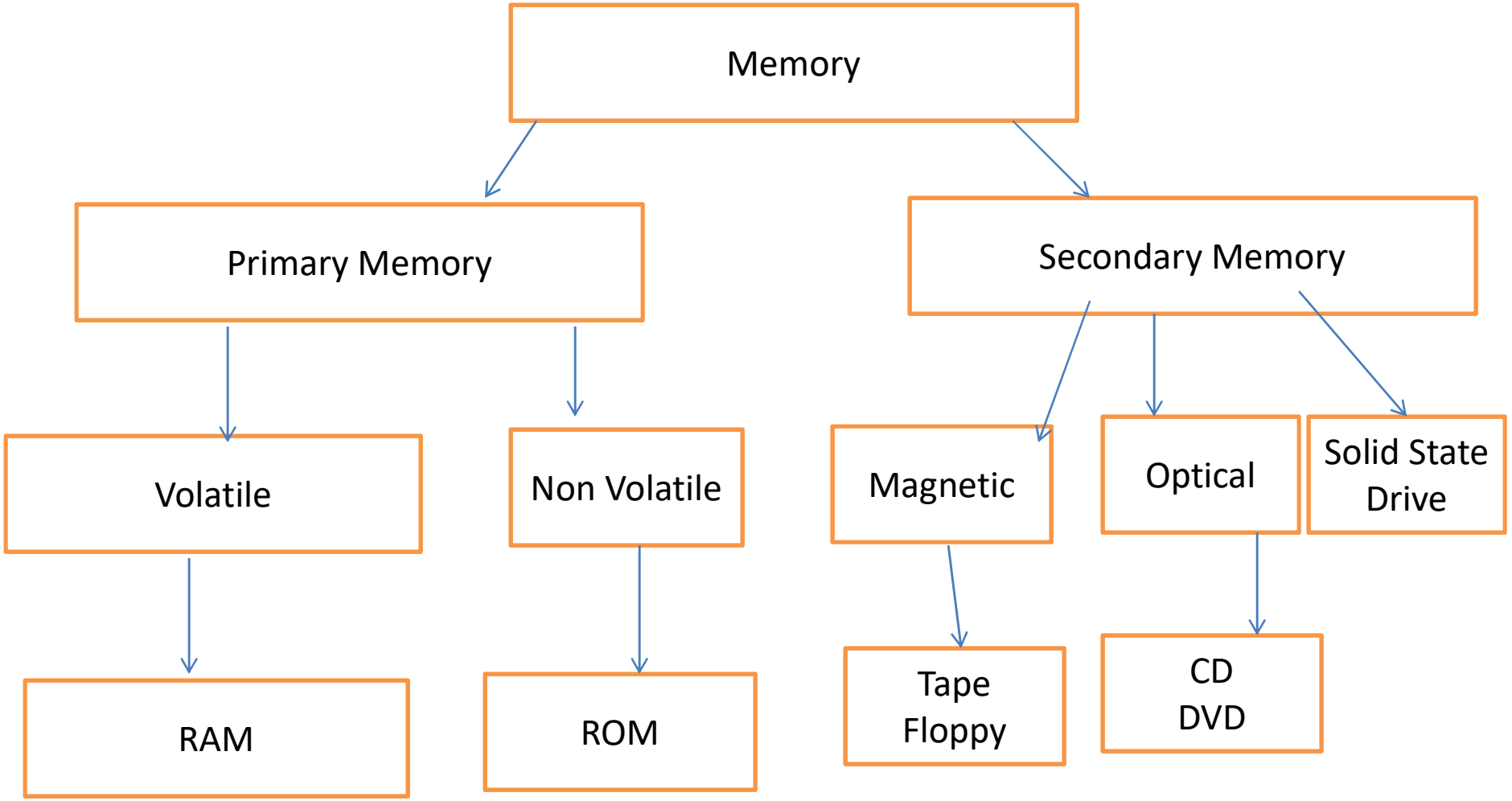
This section of the computer takes information that has been processed by the computer and places it on various output devices to make the information available for use outside the computer. The common output devices are: Monitor, Printer, Plotter, Speaker etc.



Memory: is an essential element of a computer. Without its memory, a computer is of hardly any use. Memory plays an important role in saving and retrieving data. The performance of the computer system depends upon the size of the memory. Memory is of following types:

1. Primary Memory / Volatile Memory.

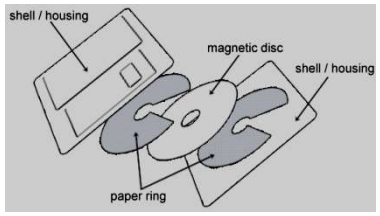
2. Secondary Memory / Non Volatile Memory.

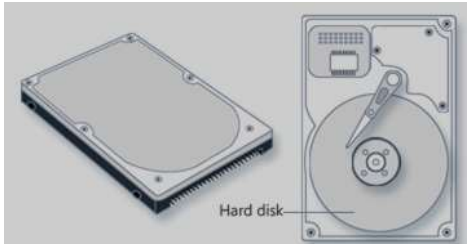

Memory
Primary Memory
Secondary Memory
Volatile
Non Volatile
Magnetic
Optical
Solid State Drive
RAM
ROM
Tape
Floppy
CD
DVD

Random Access Memory (RAM): The primary storage is referred to as random access memory (RAM) because it is possible to randomly select and use any location of the memory directly store and retrieve data. It takes same time to any address of the memory as the first address. It is also called **read/write** memory. The storage of data and instructions inside the primary storage is temporary. It disappears from RAM as soon as the power to the computer is switched off. The memories, which lose their content on failure of power supply, are known as volatile memories .So now we can say that RAM is volatile memory

Read Only Memory (ROM): There is another memory in computer, which is called Read Only Memory (ROM). Again it is the ICs inside the PC that form the ROM. The storage of program and data in the ROM is permanent. The ROM stores some standard processing programs supplied by the manufacturers to operate the personal computer. The ROM can only be read by the CPU but it cannot be changed. The basic input/output program is stored in the ROM that examines and initializes various equipment attached to the PC when the power switch is ON. The memories, which do not lose their content on failure of power supply, are known as non-volatile memories. ROM is non-volatile memory.

Secondary Memory / Non-Volatile Memory or Auxiliary storage: Secondary memory is external and permanent in nature. The secondary memory is concerned with magnetic memory. Secondary memory can be stored on storage media like floppy disks, magnetic disks, magnetic tapes, This memory can also be stored optically on Optical disks - CD-ROM. The following terms comes under secondary memory of a computer are discussed below:





Bits and Bytes

The term **bit** is derived from the words binary digit, is the smallest element a computer can deal.

Bits are grouped together in sets of eight. Each set of eight bits is called a byte. Setting different combinations of those eight "on and off" combinations can be developed to stand for letters numbers, spaces, and symbols. For practical purposes, think of a byte as one character. When computers refer to memory or storage they refer to terms using the following forms of measurement.

Bits and Bytes

1 Bit = Binary Digit

8 Bits = 1 Byte

1024 Bytes = 1 KB (Kilo Byte)

1024 KB = 1 MB (Mega Byte)

1024 MB = 1 GB(Giga Byte)

1024 GB = 1 TB(Terra Byte)

1024 TB = 1 PB(Peta Byte)

1024 PB = 1 EB(Exa Byte)

1024 EB = 1 ZB(Zetta Byte)

1024 ZB = 1 YB (Yotta Byte)

1024 YB = 1 (Bronto Byte)

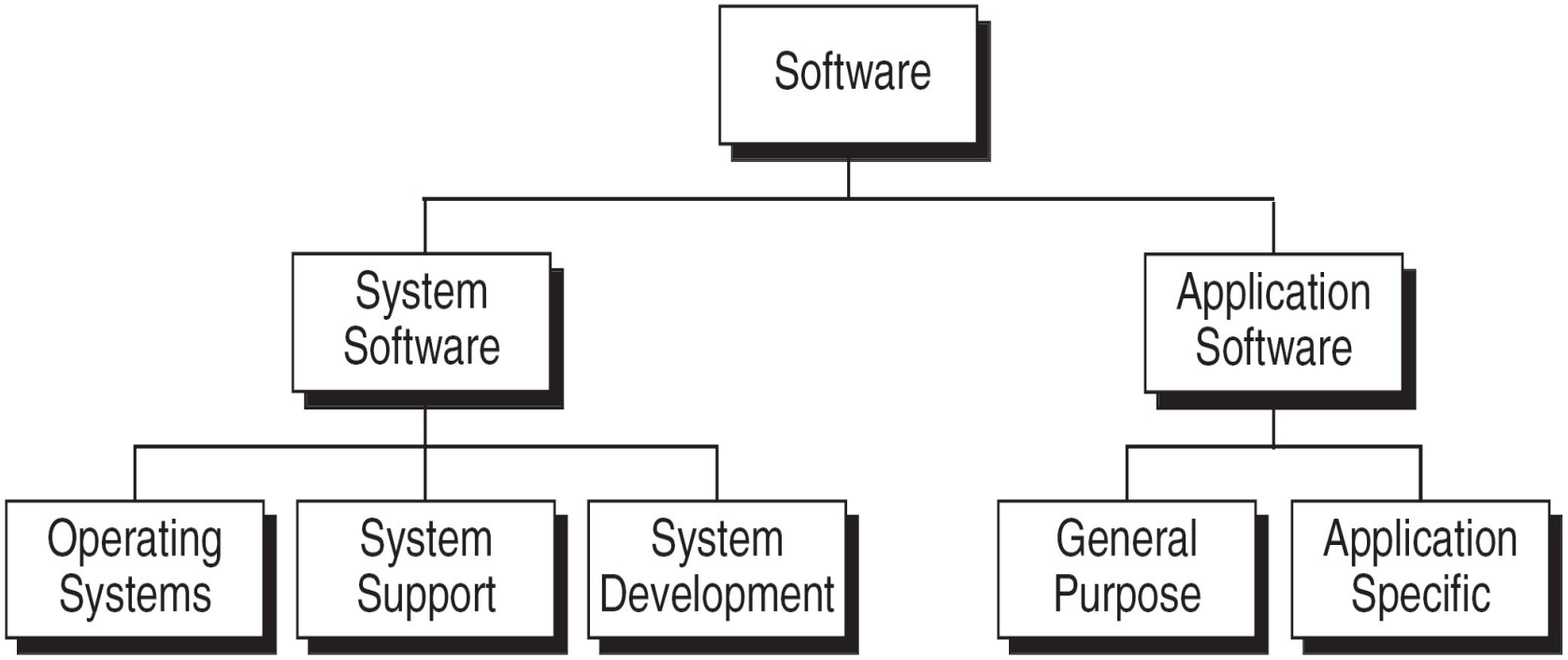
1024 Brontobyte = 1 (Geop Byte)

Geop Byte is The Highest Memory Measurement Unit

Software:

Software is a set of instructions or programs that make up the computer to perform certain job or a task. Software supports the functioning of the computer ,without software computer will not work. It is stored on the secondary memory. Most software falls into two major categories:

1. System software
2. Application software


Software
System Software
Application Software
Operating Systems
System Support
System Development
General Purpose
Application Specific

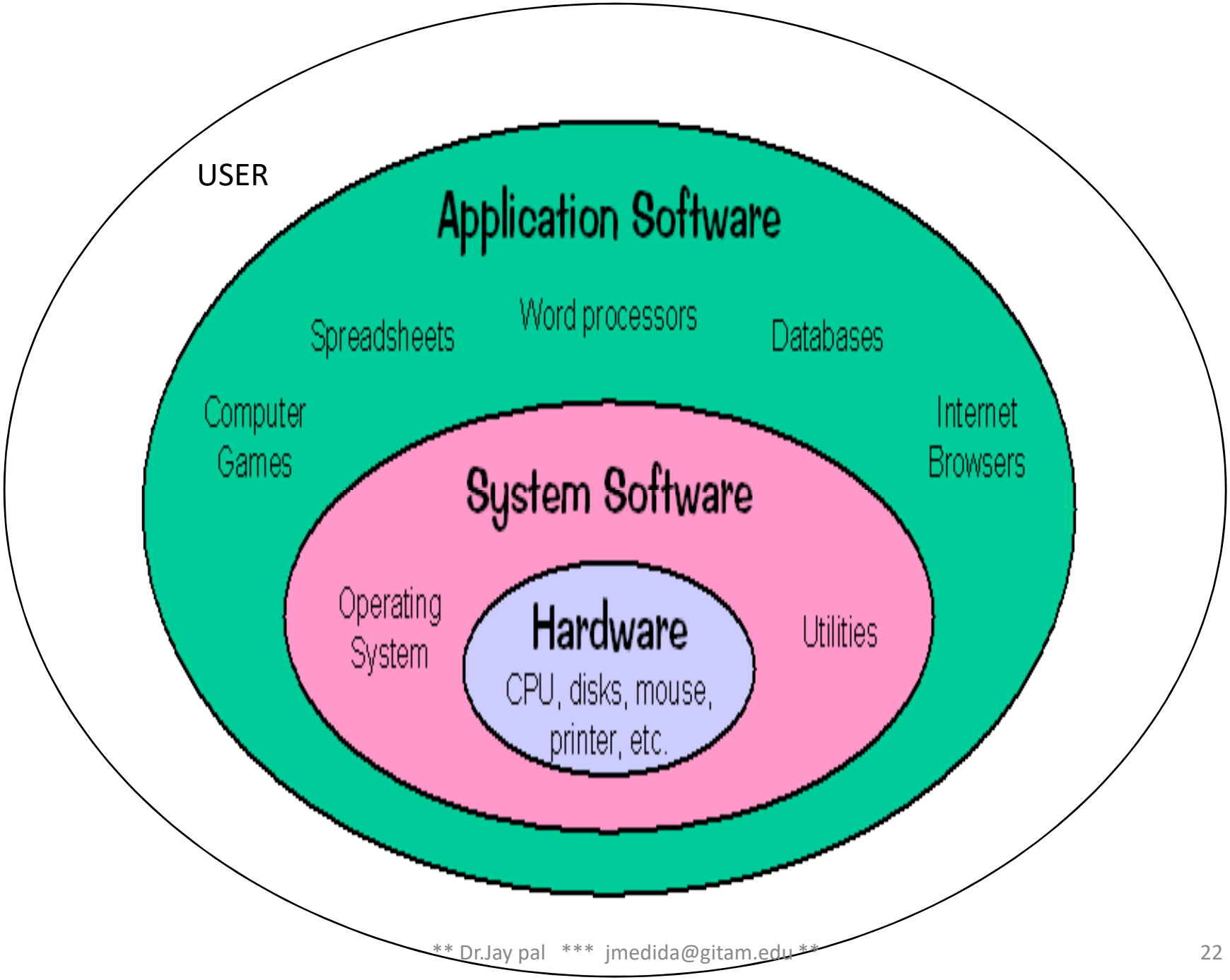
System Software:

System software consists of programs that manage the hardware resources of a computer and perform required information processing tasks. These programs are divided into three classes: the operating system, system support, and system development.

Ex: The operating system provides services such as a user interface, file and database access, and interfaces to communication systems such as Internet protocols

Application software:

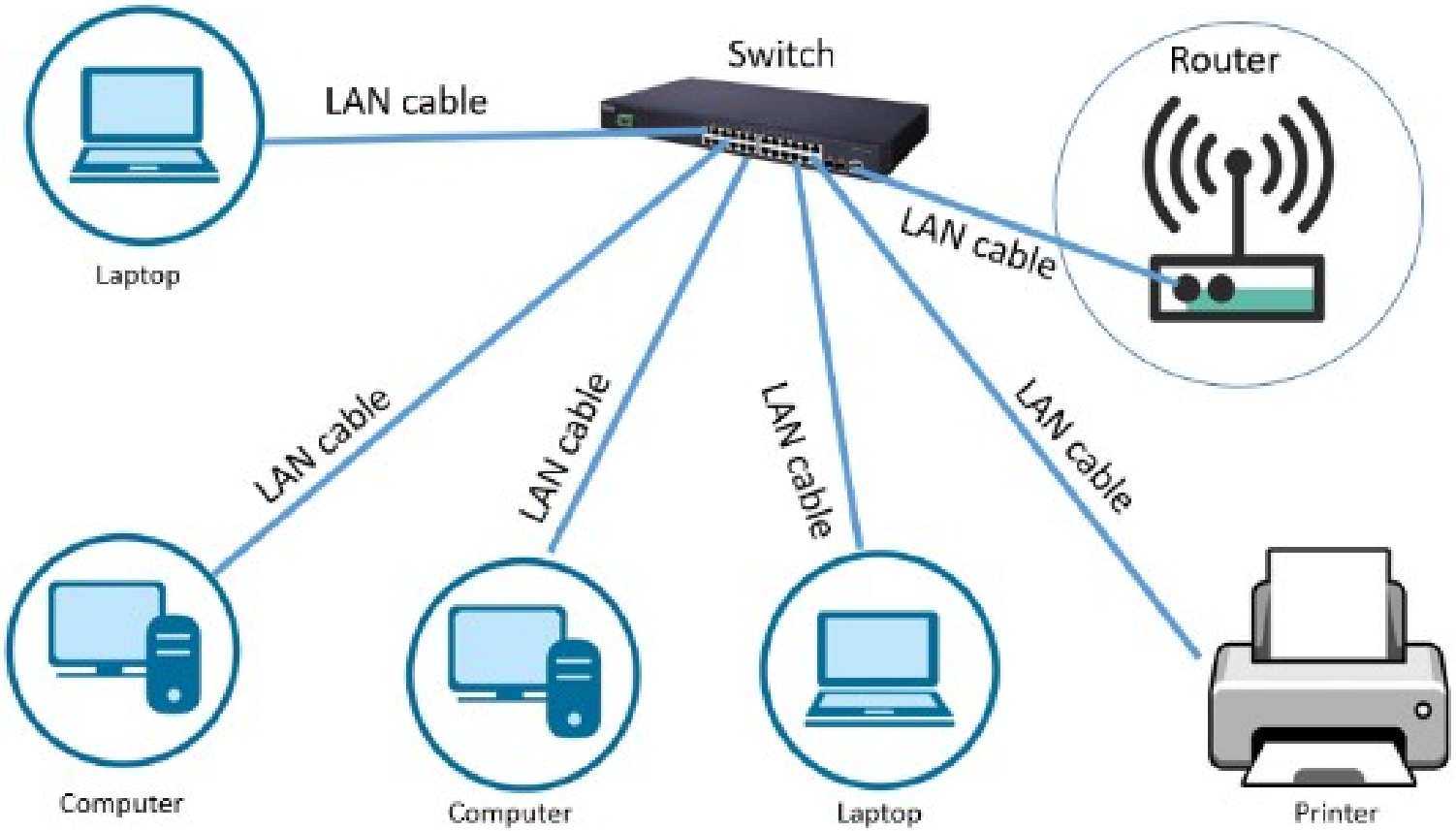
Application software is broken in to two classes :general-purpose software and application –specific software. General purpose software is purchased from a software developer and can be used for more than one application. Examples of general purpose software include word processors ,database management systems ,and computer aided design systems


USER
Application Software
Spreadsheets
Word processors
Databases
Computer Games
Internet Browsers
System Software
Operating System
Utilities
Hardware
CPU, disks, mouse, printer, etc.

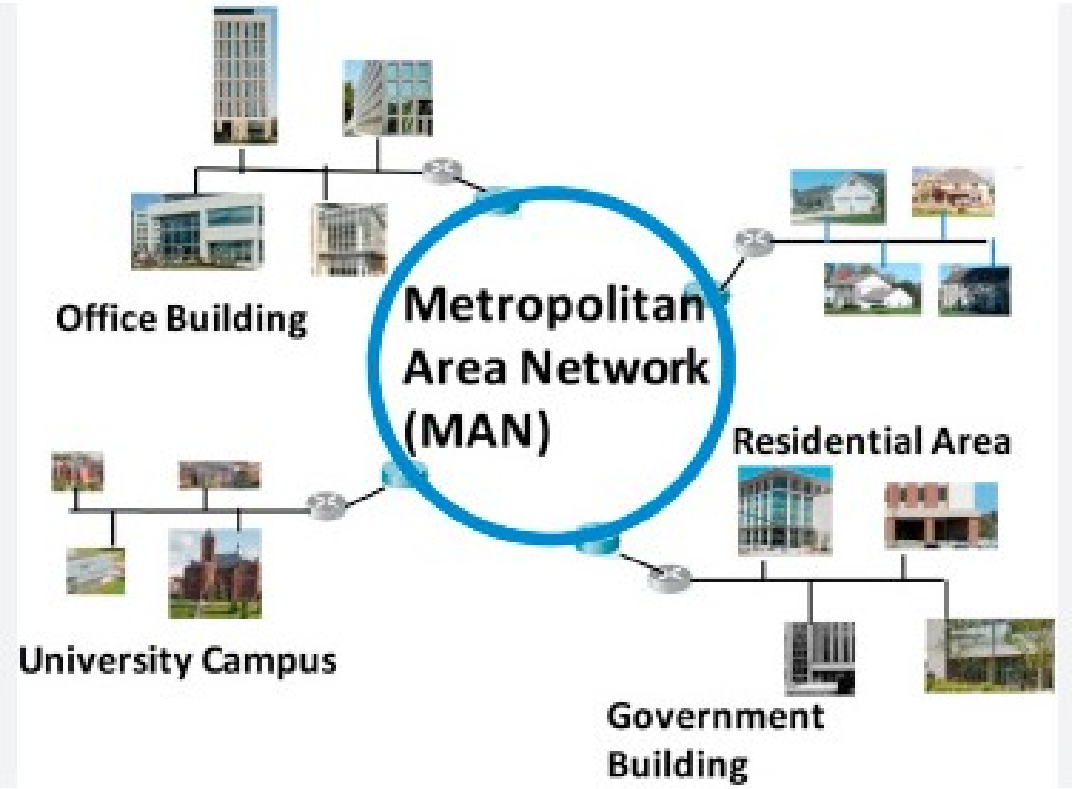
Computer Network: A network is a group of two or more computer systems linked together such that they are able to share resource and data

Types of networks based on physical scope: LAN, MAN & WAN

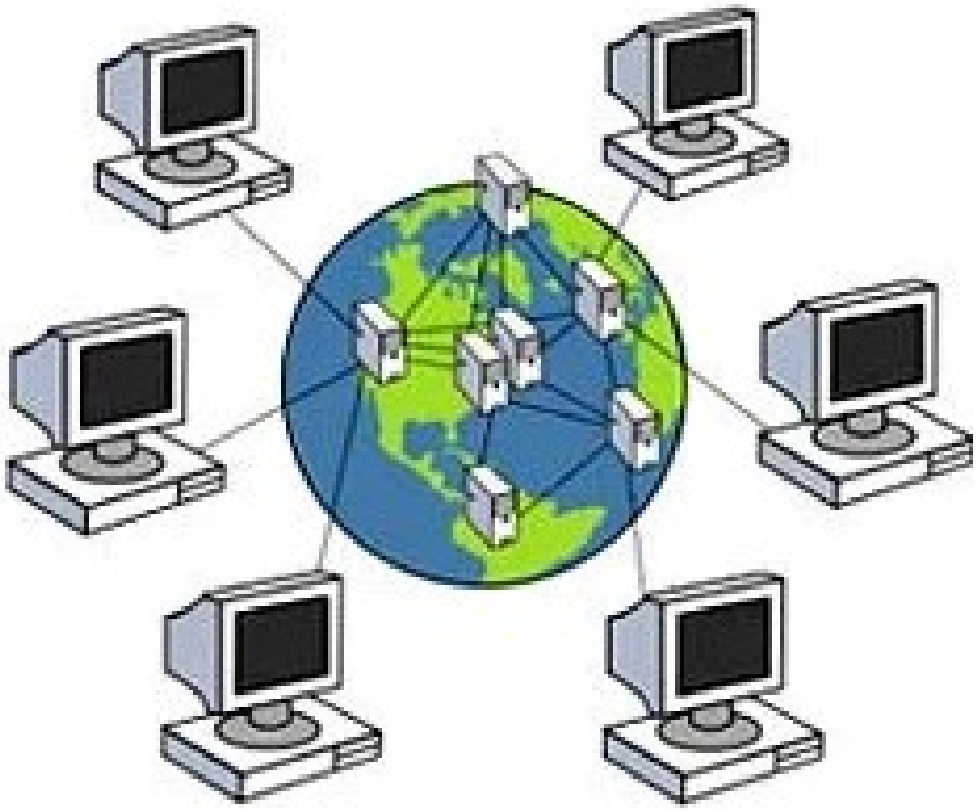
1.LAN is a network that connects computers and devices in a limited area such as home, school,computer laboratory, office building, or closely positioned group of buildings(i.e., up to 1KM Range).


Switch
Router
LAN cable
Laptop
LAN cable
LAN cable
LAN cable
LAN cable
Computer
Computer
Laptop
Printer

2. **MAN** (***metropolitan Area Network***) is works with in a city, ranging from several blocks of buildings to entire cities. A MAN might be owned and operated by a single organization.



3.**WAN (Wide Area Network)** spans a large geographic area, such as a state, province or country. The world's most popular WAN is the Internet



Number Conversions

Decimal to Binary: Divide the number by 2, noting the remainder, until the quotient is 0. Write the remainders in reverse order.

Example: 10 → 1010 **(Binary)**

Decimal to Octal: Divide the number by 8, noting the remainder, until the quotient is 0. Write the remainders in reverse order.

Example: 10 → 12 (Octal) Decimal to **Hexadecimal:** Divide the number by 16, noting the remainder, until the quotient is 0. Write the remainders in reverse order.

Example: 10 → A (Hexadecimal)

Representation of data in a computer

1. Binary Representation

Binary System: At the core of data representation is the binary system, where all data is represented using two states: 0 and 1. These states correspond to the off and on states of a computer's transistors.

Bit: The smallest unit of data in a computer, representing a single binary value (0 or 1).

Byte: A group of 8 bits. It is the basic addressable element in many computer architectures.

Representation of data in a computer

2. Numerical Data
Integers:
Unsigned Integers: Represent non-negative whole numbers. For example, an 8-bit unsigned integer can represent values from 0 to 255.
Signed Integers: Can represent both positive and negative whole numbers, often using two's complement notation.
Floating-Point Numbers:
Represent real numbers (numbers with fractional parts) using IEEE 754 standard. They consist of a sign bit, exponent, and mantissa. Common formats include single precision (32-bit) and double precision (64-bit).

Representation of data in a computer

3. Character Data
ASCII (American Standard Code for Information Interchange):
Represents text using a 7-bit or 8-bit binary number. Each character (letter, digit, symbol) is assigned a unique binary code.
Example: The ASCII code for the letter 'A' is 65, which is represented in binary as 01000001.
Unicode:
A more comprehensive system that assigns a unique code to every character and symbol in most of the world's writing systems.
UTF-8 and UTF-16 are common encoding forms of Unicode.
4. Boolean Data
Represents logical values as either true (1) or false (0). Used extensively in conditions, flags, and control structures.

Representation of data in a computer

5. Images

Bitmap Images (Raster Graphics):

Images are represented as a grid of pixels, with each pixel having a specific color. The color of each pixel is stored as a binary value, typically using RGB (Red, Green, Blue) color model.

The color depth (e.g., 24-bit color) determines how many bits are used to represent each pixel's color.

Vector Images:

Images are represented using geometric shapes like lines, curves, and polygons. These shapes are defined by mathematical equations rather than pixels, allowing for scaling without loss of quality.

Representation of data in a computer

6. Audio Data

Digital Audio:Sound is represented as a sequence of binary numbers that correspond to the amplitude of the audio signal at different points in time. This process is called sampling.

The quality of the audio depends on the sampling rate (number of samples per second) and bit depth (number of bits per sample).

Formats: Common audio formats include MP3, WAV, and AAC, which use different encoding and compression techniques.

7. Video Data

Video Representation:Video is a sequence of images (frames) displayed rapidly in succession. Each frame is represented similarly to a bitmap image.

Videos are often compressed using codecs like H.264 or HEVC to reduce file size while maintaining quality.

COMPUTER LANGUAGE:

To write a program for a computer, we must use a **computer language.** Over the years computer languages have evolved from machine languages to natural languages.

1940's Machine Language (low level language

1950's Assembly (or Symbolic) Languages

1960's High-Level Languages

Machine Language: It is the lowest and most elementary level of Programming language and was the first type of programming language to be Developed. Machine Language is basically the only language which computer Can understand. In fact, a manufacturer designs a computer to obey just one Language, its machine code, which is represented inside the computer by a String of binary digits (bits) 0 and 1. The symbol 0 stands for the absence of Electric pulse and 1 for the presence of an electric pulse . Since a computer is Capable of recognizing electric signals, therefore, it understand machine Language.

```
 1          00000000 00000100 0000000000000000
 2 01011110 00001100 11000010 0000000000000010
 3          11101111 00010110 0000000000000101
 4          11101111 10011110 0000000000001011
 5 11111000 10101101 11011111 0000000000010010
 6          01100010 11011111 0000000000010101
 7 11101111 00000010 11111011 0000000000010111
 8 11110100 10101101 11011111 0000000000011110
 9 00000011 10100010 11011111 0000000000100001
10 11101111 00000010 11111011 0000000000100100
11 01111110 11110100 10101101
12 11111000 10101110 11000101 0000000000101011
13 00000110 10100010 11111011 0000000000110001
14 11101111 00000010 11111011 0000000000110100
15          01010000 11010100 0000000000111011
16                   00000100 0000000000111101
```

Advantages of Machine Language

i) It makes fast and efficient use of the computer.

ii) It requires no translator to translate the code i.e. Directly understood by the computer

Disadvantages of Machine Language:

i) All operation codes have to be remembered

ii) All memory addresses have to be remembered.

iii) It is hard to amend or find errors in a program written

In the machine language

iv) These languages are machine dependent i.e. a particular

Machine language can be used on only one type of computer

Assembly level or symbolic Language

It was developed to overcome some of the many inconveniences of machine language. This is another low level but a very important language in which operation codes and operands are given in the form of alphanumeric symbols instead of 0's and l's. These alphanumeric symbols will be known as mnemonic codes and can have maximum up to 5 letter combination e.g. ADD for addition, SUB for subtraction, START,LABEL etc.

Intel **8085 program to add two 8 bit numbers**

Memory Address	Mnemonics	Comment
2000	LDA 2050	A<-[2050]
2003	MOV H, A	H<-A
2004	LDA 2051	A<-[2051]
2007	ADD H	A<-A+H
2008	MOV L, A	L←A
2009	MVI A 00	A←00
200B	ADC A	A←A+A+carry
200C	MOV H, A	H←A
200D	SHLD 3050	H→3051, L→3050
2010	HLT	

Advantages of Assembly Language

i) It is easier to understand and use as compared to machine language.

ii) It is easy to locate and correct errors.

iii) It is modified easily

Disadvantages of Assembly Language

i) Like machine language it is also machine dependent.

ii) Since it is machine dependent therefore programmer Should have the knowledge of the hardware also.

High Level Languages

High level computer languages give formats close to English language and the purpose of developing high level languages is to enable people to write programs easily and in their own native language environment (English). High-level languages are basically symbolic languages that use English words and/or mathematical symbols rather than mnemonic codes. Each instruction in the high level language is translated into many machine language instructions thus showing one-to-many translation

List of Few High level languages are

- C
- C++
- Java
- Python
- Visual Basic
- Visual Java
- Visual C
- BASIC (Beginners All Purpose Symbolic Instruction Code).
- FORTRAN (Formula Translation).
- PL/I (Programming Language, Version 1).
- ALGOL (Algorithmic Language).
- COBOL (Common Business Oriented Language).
- LISP (List Processing).
- Prolog (Program in Logic).

Advantages of High Level Language

Following are the advantages of a high level language:

- ❖User-friendly
- ❖Similar to English with vocabulary of words and symbols
- ❖Therefore it is easier to learn.
- ❖They require less time to write.
- ❖They are easier to maintain.
- ❖Problem oriented rather than 'machine' based.
- ❖Program written in a high-level language can be translated into many machine language
- ❖ and therefore can run on any computer for which there exists an appropriate translator.
- ❖It is independent of the machine on which it is used i.e.Programs developed in high level language can be run on any Computer

Disadvantages of High Level Language

A high-level language has to be translated into the machine language by a translator and thus a price in computer time is paid.

The object code generated by a translator might be inefficient Compared to an equivalent assembly language program

ALGORITHMS:

Algorithm is the step-by-step procedure for solving a problem. Algorithm is a recipe for finding the right answer to a problem or to a complex problem by breaking down the problem into smaller simple sub problems.

An algorithm must possess the following properties:

1.Finiteness: An algorithm must terminate after finite number of steps.

2.Definiteness: Each step of the algorithm must be precisely and unambiguously stated.

3.Effectiveness: Each step must be simple and can be performed exactly in a finite amount of time.

4.Generality: Algorithm should be complete in itself, so that it can be used to solve
all problems of given type for any input data.

5.Input & Output: An algorithm must take zero, one or more quantities as input data and
gives one or more output values.

Characteristics of Algorithms: The instructions must be in an ordered form.

1. The instructions must be simple. They must not be ambiguous.
2. There must be an instruction (condition) for program termination.
3. The algorithm must completely solve the given problem statement.
4. The repetitive programming constructs must possess an exit condition. Otherwise, the
5. program might run infinitely.

Advantages of Algorithms:

1. It provides the core solution to a given problem. This solution can be implemented on a
2. Computer using any computer language
3. It facilitates program development by acting as a design document or a blue print of given problem solution.
4. It ensures easy comprehension of a problem solution as compared to an equivalent
5. computer program.
6. It eases identification and removal of logical errors in a program.
7. It facilitates algorithm analysis to find out the most efficient solution to a given problem.

Disadvantages of Algorithms:

1. In large algorithms, the flow of program control becomes difficult to track.
2. Algorithms lack visual representation of programming constructs like flowcharts thus understanding the logic becomes relatively difficult.

Examples : to add two numbers

Step 1: Start
Step 2:Read the two numbers in to a,b
Step 3: c ← a+b
Step 4: print c
Step 5: Stop.

Algorithm to find average of five numbers:-

Step 1: Start

Step 2: sum=0

Step 3:Read a num

Step 4: sum← sum+num

Step 5: if numbers read is 5 goto step 6

else goto **step 3**

Step 6: average←sum/5

Step 7:- Print the average

Step 8:- Stop.

Algorithm to find largest of two numbers:-

Step 1:- Start

Step 2:- Read two numbers A,B

Step 3:- If A>B,

print A goto step 5

Step 4:- Else print B

Step 5:- Stop.

Algorithm to find largest of three numbers:-

Step 1:Start

Step 2: Read three numbers A,B and C

Step 3: If A>B goto step 4

else goto step 5

Step 4: if A>C

print “A is large” goto step 6

else

print “C is large” goto step 6

Step 5: if B>C

print “B is large” goto step 6

else

print “C is large” goto step 6

Step 6: Stop

Algorithm to find sum of first n natural numbers:-

Step 1:Start

Step 2: Read n

Step 3: sum $\leftarrow$ 0

Step 4: i$\leftarrow$1

Step 5 : if i<=n goto step 6

else

goto step 7

Step 6: sum$\leftarrow$sum+i

i$\leftarrow$i+1

goto step 5

Step 7: print sum

Step 8:stop

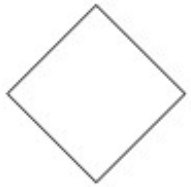
FLOW CHART :

A Flow chart is a Graphical representation of an Algorithm or a portion of an Algorithm. Flow charts are drawn using certain special purpose symbols such as Rectangles, Diamonds, Ovals and small circles. These symbols are connected by arrows called flow lines.

(or)

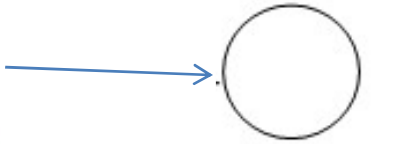
The diagrammatic representation of way to solve the given problem is called flow chart.

most common symbols used in Drawing flowcharts:

Oval		Terminal	start/stop/begin/end.
Parallelogram		Input/output	Making data available For processing (input) or recording of the process information (output).
Document		Print Out	show data output in the form of document.
Rectangle		Process	any processing to be Done .A process changes or moves data. An assignment operation.
Diamond		Decision	Decision or switching Type of operations.

most common symbols used in Drawing flowcharts:

Circle with arrow — Connector — Used to connect Different parts of flowchart.



Arrow — Flow — Joins two symbols and also represents flow of execution.

double sided rectangle — Function call or pre defined process

Hexagon — represents loop

Flowchart Design rules

1. It must begin with a Start and end with stop´ symbol.
2. The standard process flow should be either from top to bottom or from left to right.
3. The instructions specified in the flowchart must be crisp and concise.
4. The arrows must be aligned properly so as to clearly depict the flow of program control.
5. The usage of connectors should be generally avoided as they make the program look more complex.
6. A process or action flowchart symbol must have only one input arrow and one output arrow.
7. Two arrows must never intersect or cross each other. if such a need arises, then appropriate bridge or crossover symbols must be used.

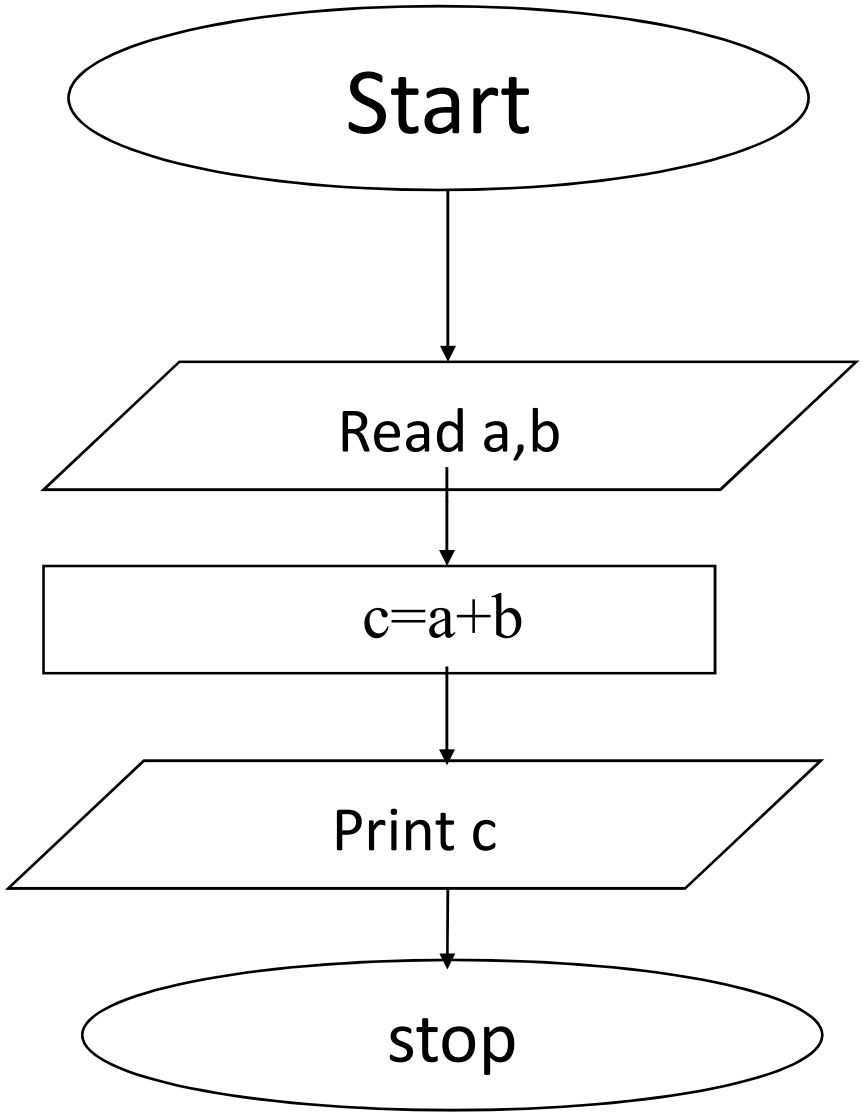
Advantages of Flowcharts:

1. It helps to understand the flow of program control in an easy way.
2. Developing program code by referring its flow chart is easier in comparison to developing the program code from scratch.
3. It helps in avoiding semantic errors.
4. A flowchart acts as documentation for the process or program flow.
5. The usage of flowcharts works well for small program design.
6. Any concept is better understood with the help of visual representation. This fact also holds true for flowcharts. It is easier to understand the pictorial representation of programming logic.

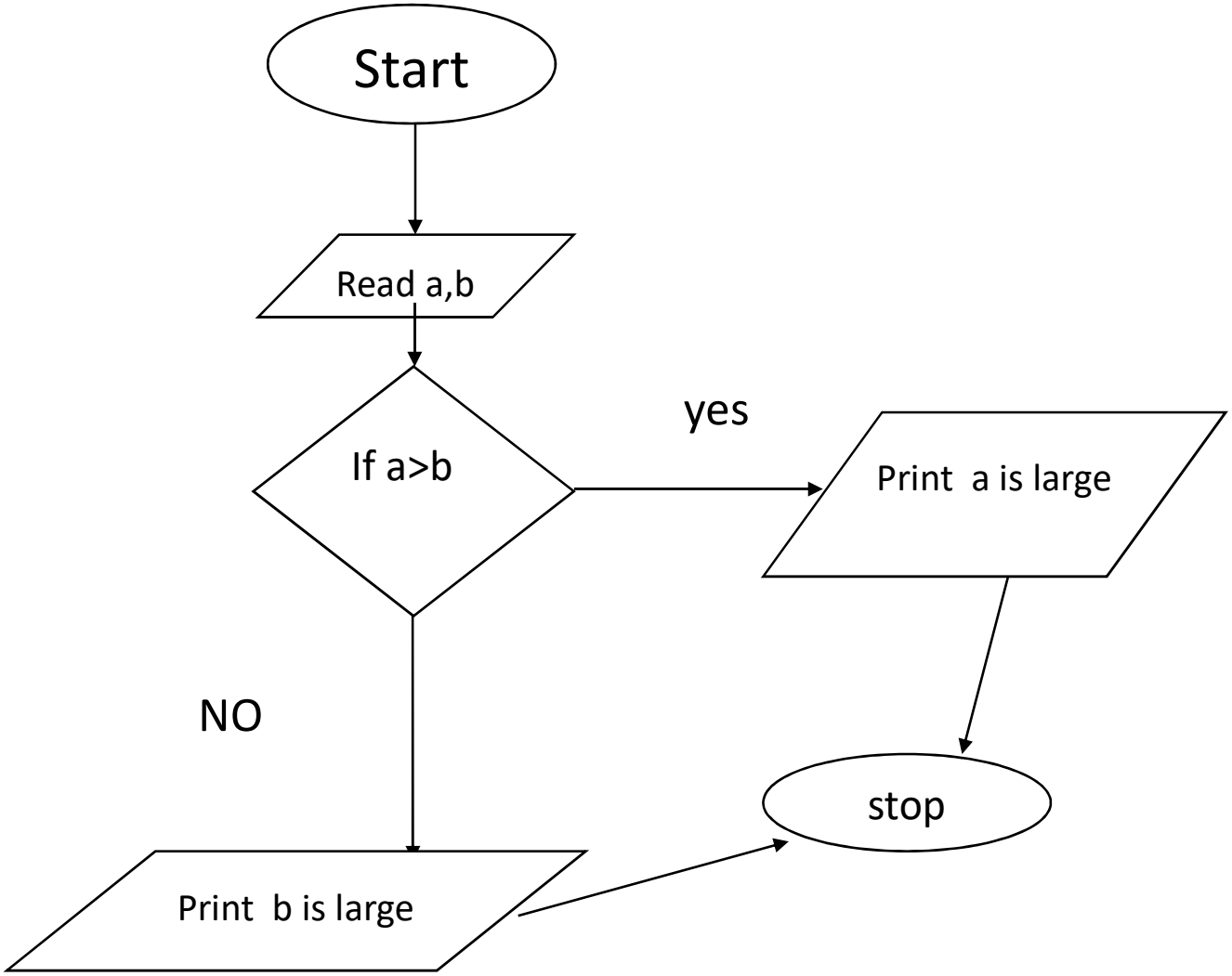
Disadvantages of Flowchart:

1. For a large program, the flowchart might become very complex and confusing.
2. Modification of a flowchart is difficult and requires almost an entire rework.
3. Excessive use of connectors in a flowchart may at times confuse the programmer.
4. Time consuming to create a flowchart.

Draw a flow chart to add two numbers

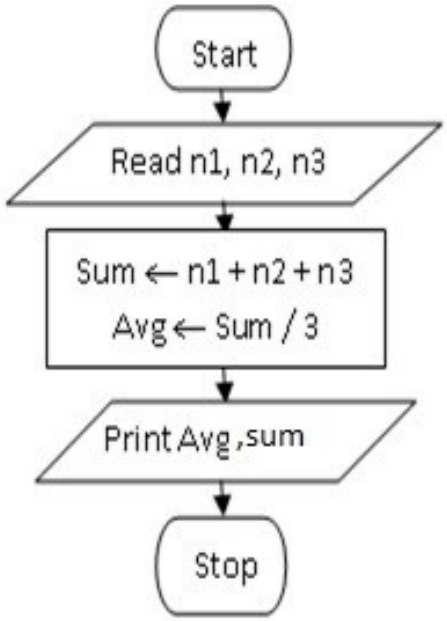


Draw a flow chart to find largest of two numbers



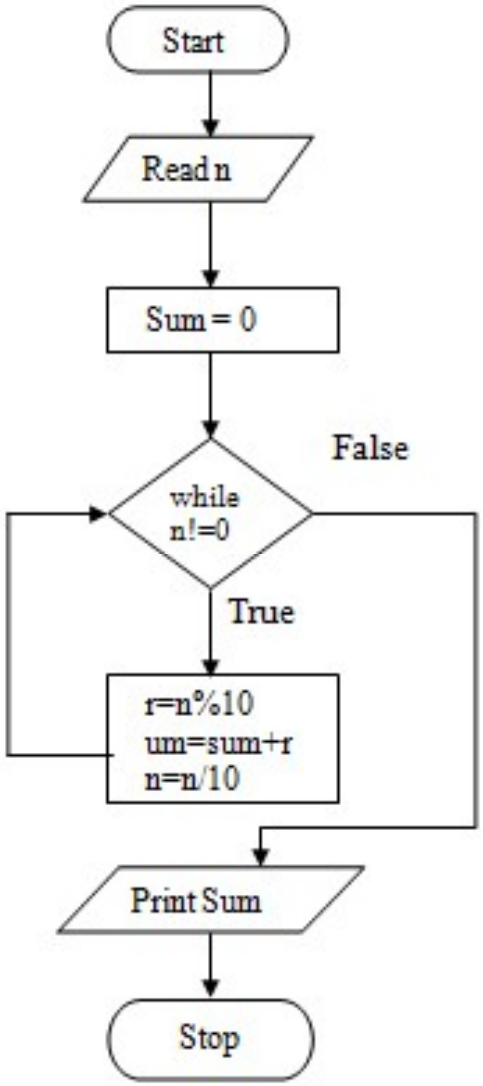
find the sum and average of three numbers

Step 1: Start
Step 2: Declare variables num1, num2,num3 and sum, average.
Step 3: Read values num1,num2,num3
Step 4: Add num1,num2,num3 and assign the result to sum.
sum←num1+num2 +num3
average ← sum/3
Step 5: Display sum and average
Step 6: Stop



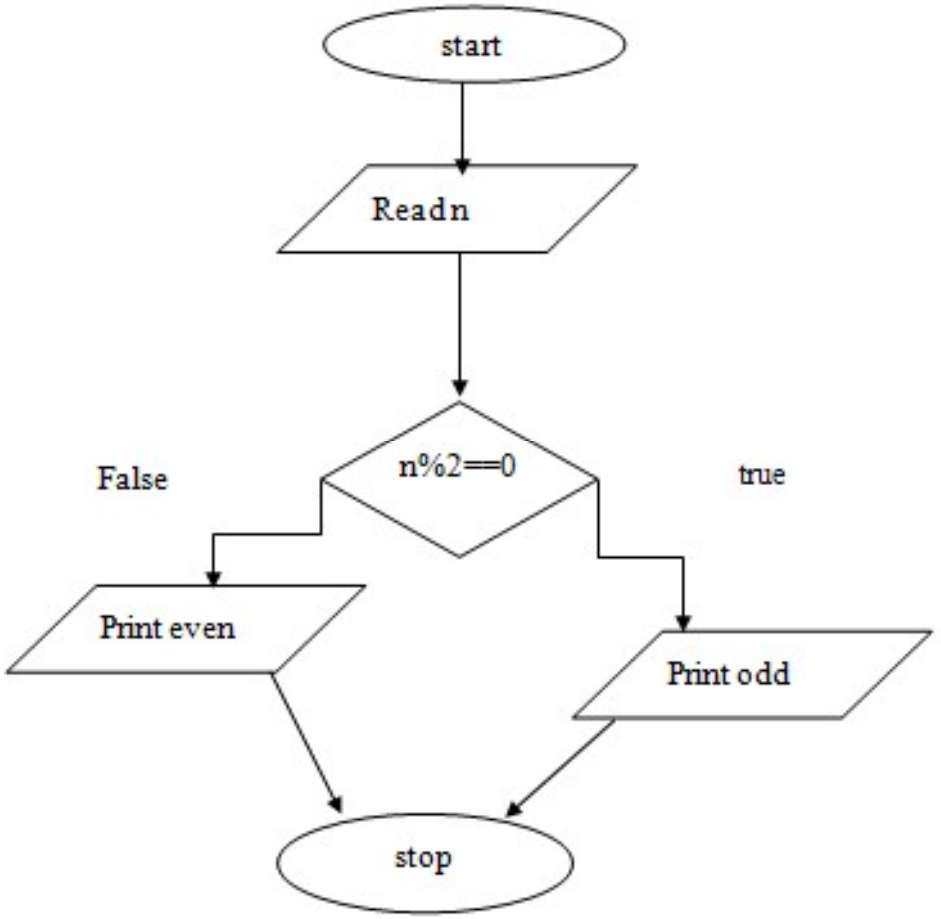
To find the sum of individual digits of positive integer

Step 1: Start
Step 2: Read n
Step 3: Initialize sum ← 0
Step 4: while(n!=0)
Begin
Step 5: r←n%10
Step 6: sum←sum+r
Step 7: n←n/10
End
Step 8: Print "sum"
Step 9: Stop

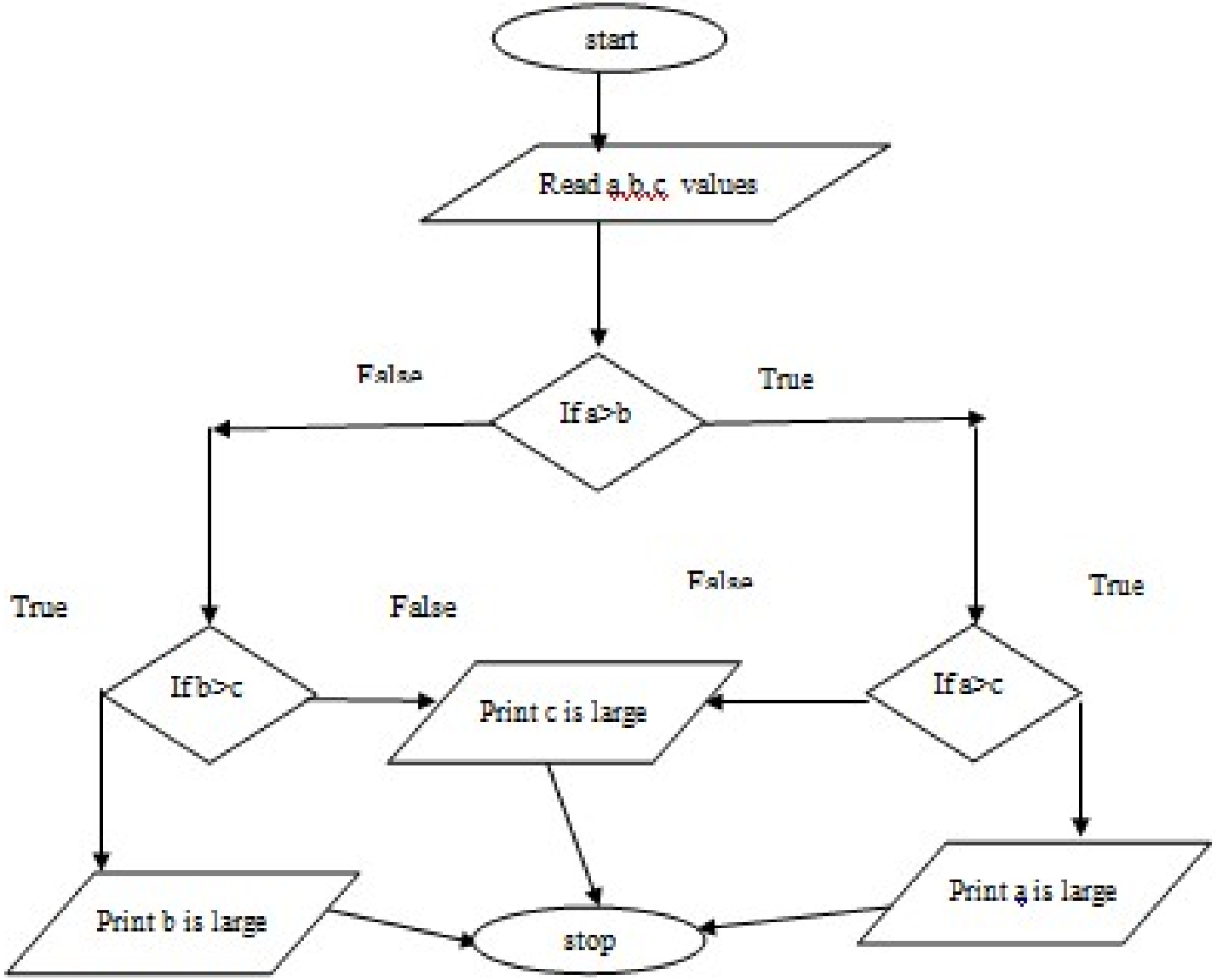


Check whether given number is even or odd

Step 1 : Start
Step 2 : Read n
Step 3 : if n%2=0 goto step 5
Step 4 :print n is odd
Step 5 :goto step 7
Step 6 : print n is even
Step 7 : Stop



To find largest of three numbers



Evaluate algebraic expression (ax+b)/(ax-b)

Step 1:start
Step 2:read a,b,x
Step 3:s←(a*x + b)/(a*x - b)
Step 4:print s
Step 5:stop