UNIT - 1.1

INTRODUCTION TO COMPUTER

1.1.1 INTRODUCTION

Definition

A computer is an electronic machine, devised for performing calculations and controlling operations that can be expressed either in logical or numerical terms.

Applications

The applications domain of a computer depends totally on human creativity and imagination it covers a huge area of applications including education, industries, government medicine, scientific research, low and even music and arts.

- Millions of complex calculations can be done in a mere fraction of time
- Difficult decisions can be made with unerring accuracy for comparatively little cost

1.1.2 COMPUTER GENERATIONS

First Generation (1940-56): Vacuum Tube

First generation computer were vacuum tubes/thermionic value based machines these computers used vacuum tubes for circuitry and magnetic drums for memory.

A magnetic drum is a metal cylinder coated with magnetic iron-oxide material on which data and programs can be stored.

Input was based on punched cards and paper tape and output was in the form of printouts.

For example: ENIAC, EDVAC AND UNIVAC.

Characteristics of First Generation Computers.

- These computers were based on vacuum tube technology.
- These were the fastest computing devices of their time.
- These computers were very large, and required a lot of space for installation.
- These were non-portable and very slow equipment's.

Second Generations (1956-63): Transistors

A transistor is made up of semiconductor material like germanium and silicon. It usually had three leads and performed electrical functions such as voltage, current or power amplification with low power requirement.

Since transistor is a small device, the physical size of computers was greatly reduced.

Computers became smaller, faster, cheaper, energy-efficient and more reliable than their predecessors.

Magnetic cores- were used as primary memory and magnetic disks as secondary storage devices. However, they still relied on punched cards for input and printouts for output.

For example: PDP – 8, IBM 1401 and IBM 7090

Characteristics of Second Generation Computer.

- These machines were based on transistor technology
- These were smaller as compared to the first generation computers.
- These were more portable and generated less amount of heat.

Third Generation (1964 – Early 1970), Integrated Circuits

The development of the integrated circuit was the trait of the third generation computer. Also called an ic, an integrated circuit consists of a single chip with many components such as transistors and resistors fabricated on it.

Integrated circuit replaced several individually wired transistor. This development made computers smaller in size, reliable and efficient.

Instead of punched cards and printouts, users interacted with third generation computers through keyboards and monitors and interfaced with operating system.

For example: NCR 395 and B6500

Characteristic of Third Generation Computer

- These computers were based on integrated circuit (ic) technology.
- They were able to reduce computational time from micro seconds to nano seconds.
- Extensive use of high – level language became possible

Fourth Generation (Early (1970 – Till Date) Microprocessors)

The technology of this generation was still based on the integrated circuit, these have been made readily available to use because of the development of the microprocessor.

The fourth generation computers led to an era of large scale integration (LSI) and very large scale integration (vlsi) technology. LSI technology allowed thousands of transistors to be constructed on one small slice of silicon material whereas vlsi squeezed hundreds of thousands of components on to a single ewp

ULTRA – large scale integration (ULSI) increased that number into millions the fourth generation computer became more powerful compact, reliable and affordable.

For example: Apple II, attair 8800 and CRAY-1

Characteristics of Fourth Generation Computers

- Fourth generation computers are microprocessor based systems
- These computers are very small
- GUI an d pointing devices enable users to learn to use the computer quickly
- Interconnection of computers leads to better communication and resource sharing

Fifth Generation (Present and Beyond): Artificial Intelligence

A computer would learn from its mistakes and possess the skill of experts the starting point for the fifth generation of computers has been set in the early 1990. The expert system it defined as a computer information system that attempts to mimic the thought process and reasoning of experts in specific areas three characteristics can be identified with the fifth generation computer these are.

Mega chips

Fifth generation computers will use super large scale integrated (SLSI) chips, which will result in the production of microprocessor having millions of electronic components on a single chip

Parallel processing

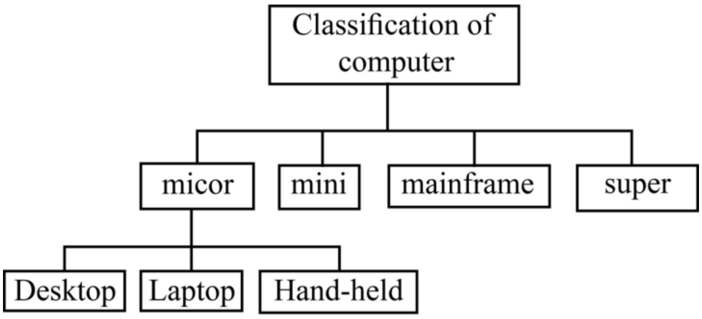
A computer using parallel processing accesses several instructions at once and works on them at the same time through use of multiple central processing units.

Artificial intelligence: (AI)

AI comprises a group of related technologies expert systems (ES), natural language processing (NLP) speech recognition, vision recognition and robotics.

1.1.3 CLASSIFICATION OF COMPUTERS

Four major categories: micro, mini, mainframe and super computers



Micro computers

A microcomputer is a small, low cost digital computer, which usually consists of a microprocessor, a storage unit, an input channel and an output channel, all of which may be on one chip inserted into are or several pc boards.

IBM – pc,Pentium 100, ibm-pc Pentium 200 and ***Apple Macintosh*** are some of the example of micro computers

Microcomputers include desktop, laptop and hand – held models such as PDAS (personal) digital assistants.

Desktop computer

Desktop computer also known as personal computer (pc) is principally intended per standalone use by an individual microcomputer typically consist of a system unit a display monitor, a keyboard internal hard disk storage and other peripheral devices.

Some of the major personal computer manufactures are ***Apple, IBM, Dell*** and ***Hewlett Packard***.

Laptop

A laptop is a portable computer that is a user can carry it around. Laptops are small computer enclosing all the basic features of a normal desktop computer.

The biggest advantage of this computer is that one can use this computer anywhere and at any time, especially when are is travelling

Hand held computers

A hard-held, also called personal digital assistant (PDA), is a computer that can conveniently be stored in a pocket and used while the user is holding it.

PDAs are essentially small portable computers and are slightly bigger than the common calculators.

Some example of PDAs are ***Apple Newton, Casio Cassiopeia*** and ***Franklin ebook man***

Mini computers

The mini computer is a small digital computer whose process and storage capacity is lesser than that of a mainframe, but more than that of microcomputer.

Its speed of processing data is in between that of a mainframe and a micro computes, generally, it is used as desktop device that is often connected to a mainframe in order to perform the auxiliary operations.

Mini computers are usually multi-user systems, so these are used in interactive applications in industries, research organizations colleges and universities.

High – performance workstations with graphics I/O capability use mini computers

Some of the widely used mini computers are ***PDP II, IBM (8000 series)*** and ***VAX 7500***.

Mainframe computer

A mainframe is an ultra – high performance computer made for high – volume, processor – intensive computing. It consists of a high end computer processor, with related peripheral devices, capable of supporting large volumes of data processing systems and extensive data storage and retrieval.

Mainframes are the second largest of the computer family, the largest being super computers.

Mainframe allows its user to maintain large information storage at a centralized location and be able to access and process this data from different computers located at different locations

It is typically used by large businesses and for scientific purpose.

Examples of mainframe computers are IBM's ***E5000, VAX8000*** and ***CDC6600***.

Super computers

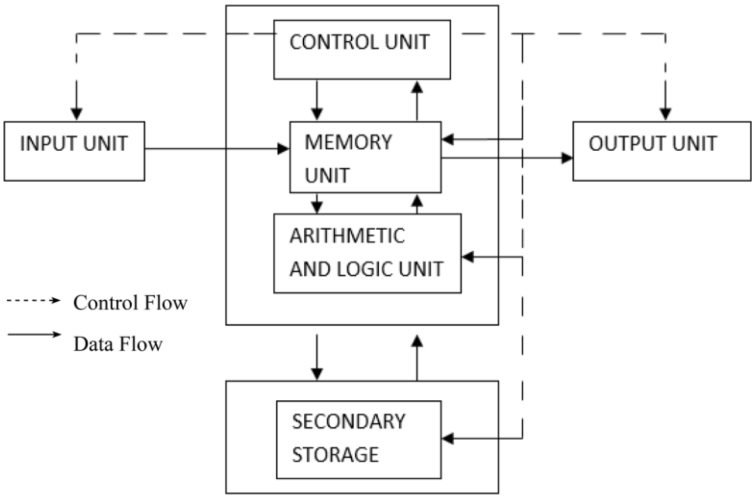
Super computers are the special purpose machine, which are specially designed to maximize the numbers of ***FLOPS*** (floating point operation per second). Any computer below one ***gigaflop/sec*** is not considered a super computer. A super computer has the highest processing speed at a given time for solving scientific and engineering problems.

Essentially, it contains a number of CPU, which operate in parallel to make it faster. Its processing speed lies in the range of 400 – 10,000 ***MF LOP's*** (millions of floating point operation per second).

Super computers are used to solve multivariate mathematical problems of existent physical processes, such as aerodynamics, metrologies, and plasma physics.

The largest commercial use of super computers is in the entertainment advertising industry, ***CRAY – 3, Cyber 205*** and ***PARAM*** are some well-known super computers.

1.1.4 BASIC COMPUTER ORGANIZATION



The block diagram of the computer system have the following three units, each functional unit corresponds to their basic operations performed as described in details.

(a) Input unit

(b) Central processing unit

(c) Output unit

(a) Input Unit

- Accept data and instructions from the outside world.
- Convert it to a form that the computer can understand
- Supply the converted data to the computer system for further processing
- The input unit is used to send information or instructions or commands to the computer. The data received from the input unit is immediately steered in main memory andthen processed.

Following are the some of the input devise.

(i) Keyboard

(ii) Mouse

(iii) Light pen

(iv) Joystick

(v) Ocr (optical character recognizer)

(vi) MICR (magnetic ink character recognizer)

(vii) OMR (optical mark recognizer)

(b) Central Processing Unit (CPU)

- It performs all calculations and all decisions.
- It controls and co-ordinates all units of the computer
- It interprets instructions of a program
- It stores data temporarily and monitors external requests.

The CPU is sub-divided into the following sub-system.

(i) Control unit

(ii) Arithmetic and logical unit

(iii) Memory unit

(a) Primary storage

(b) Secondary storage.

(i) Control unit

The control unit instructs the computer how to carry out program instructions. It directs the flow of data between memory and arithmetic logical unit.

The input unit does not know when to receive data and where to put the data in the storage unit after receiving it similarly, the control unit instructs the input unit where to store the data after receiving it from the user.

In the same way, it controls the flow of data and instructions from the storage unit to

ALU during program execution the control unit fetches instructions from the primary memory, decodes them to determine the operations required, and then sets up instructions execution.

Eg. To add two numbers or to read a character from a keyboard. A number registers are associated with the control unit.

(ii) Arithmetic and Logical Unit

Arithmetic and logical unit performs all the arithmetic and logical operations. Arithmetic operations like addition, subtraction, multiplication and logical operations, such as comparisons are performed in ALU.

All calculations are performed in the arithmetic and logical unit (ALU) of the computer ALU also does comparisons and take decision.

Example: it can check if the number A is less than equal to or greater than the number B. once the calculations or the logical operation is performed by ALU, then the result is transferred to the storage unit.

(iii) Memory unit

Memory is the part of computer which holds data for processing and other information it is also called as ***main memory*** or ***primary memory***.

A device that stores program instructions or data used by the CPU when performing a given function.

Memory is a device, which is used to store information temporarily/permanently, it is the place where the information is safe kept. Secondary memory, such as disk storage, is functionality considered I/O because it is accessed through the I/O system.

(a) Primary storage

The primary storage is also called as ***"main memory"*** stores and access information very fastly. This is generally used to hold the program being currently executed in the computer, the data being received from the input unit, the intermediate and final results of the program.

Primary storage is also known as ***system memory, internal, temporary*** and ***"RAM"***

- Installed on the main computer board (motherboard)
- Typically comprised of ICs (integrated circuits)
- Fast access – usually in the order of Nano seconds

(b) Secondary storage

The secondary storage is also known as ***Auxiliary Storage*** it may store several programs, documents, databases etc.

The program that we want to run on the computer is first transferred to the primary memory before it can run. Similarly, after running the program if need to save the result, we will transfer them to the secondary storage.

The secondary memory is slower and cheaper than the primary memory. Some of the commonly used secondary memory devices are ***Floppy diskette, Zip diskette, Hard disk and Magnetic disks*** and ***Tapes*** etc.

(c) Output unit

Devices used to get the response or result of a process from the computer is called output unit is the communication between the user and the computer.

The output unit of a computer provider the information and results of a computation to the outside world.

Computers do not work in the decimal system, they work in the binary system. Therefore if required, the output unit also converts the binary data into a form that users can understand.

Commonly used output devices are.

- Visual display unit (***VDU***) or monitor
- Printer
- Computer output microfilm
- Plotter.

1.1.5 NUMBER SYSTEMS

Introduction

A number is required for counting or to express the amount of some quantity it consists of a group of symbols called digits, which are arranged in a definite manner. There can be many ways in which the digits can be arranged to form a number. This gives rise to what we call a number system.

The ***decimal number*** system which has ten digits (0, 1, 2,……9), the ***octal system*** has eight digits (0,1,2,….7) the ***hexadecimal*** system has sixteen digits (0,1,2,…..9,a,b,c,d,e,f), the ***binary number*** system has only two (0,1)

The number of digits in a system is called ***radix*** or ***base***. Thus the decimal system may be called as radix-10 system, the binary system as radix – 2, system.

The number system are basically two types

(i) Non – positioning number system

(ii) Positioning number system.

(i) Non –positional number system

Using this system, the symbols i.e, I for 1, II for 2, III for 3, IIII for 4, iiiii for 5 etc, are used

In non-positioning number system each symbol represents the same values regardless of its position in the number. The symbols are simply added to find out the value of a particular number.

(ii) Positional number system

The positional number user only few symbol called digits

Example:

The decimal number 3977.39(10)

3×10^3 +	9×10^2 +	7×10^1 +	7×10^0 +	3×10^{-1} *	9×10^{-2}
1000th position	100th position	10th position	Unit position	1/10th position	1/100th position

The following four positional number system are commonly used.

(1) Decimal number system

(2) Binary number system

(3) Octal number system

(4) Hexadecimal system

(1) Decimal number system

In this number system the base or radix is 10 and there are altogethes ten number i.e, 0,1,2,3,4,5,6,7,8,9.

A number in a radix system would be written as ($a_n\ a_{n-1}\ a_{n-2} \ldots\ldots\ldots a_0\, a_{-1}\, a_{-2} \ldots\ldots\ldots a_{-m}$)

In this representation a_n is called the ‘Most-Significant Digit’ (MSD) of the number and a_{-m} is called the ‘Least Significant Digit’ (LSD).

Example:

In decimal number system $3967_{(10)}$ or 3967 Consists the digits

7 in the unit position (7×10^0)

6 in the unit position (6×10^1)

9 in the unit position (9×10^2)

3 in the unit position (3×10^3)

It values can be written as

$3\times10^3+9\times10^2+6\times10^1+7\times10^0$

$3\times1000+9\times100+6\times10+7\times1$

$3000+900+60+7$

3967

$3967_{(10)} = 3967$

(2) Binary number system

The binary system user only two digits i.e, 0’s and 1’s the base or radis of binary number system is 2 because it contains only two numbers.

User

- The circuits in computer have to handle by two binary digits or bits rather than decimal number
- The computer only identifies signals in the form of digital pulses, which represent either high or low voltage.
- Everything that can be alone with decimal numbers can also be done using binary numbers.

Example:

Convert the binary number $100111_{(2)}$ to decimal numbers.

Solution: $100111_{(2)} =?_{(10)}$

6th	5th	4th	3rd	2nd	1st	Position
1	0	0	1	1	1	Given Binary Number
$\times 2^5$	$\times 2^4$	$\times 2^3$	$\times 2^2$	$\times 2^1$	$\times 2^0$	Weights

$1\times32 + 0\times16 + 0\times8 + 1\times4 + 1\times2 + 1\times1$

$32 + 0 + 0 + 4 + 2 + 1 = 39_{(10)}$

$100111_{(2)} = 39_{(10)}$

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

(3) Octal number system

The number system with base or radix digit (8) is known as octal number system. There are only eight digits is i.e. 0,1,2,3,4,5,6,7

Each position in this number system represents a power of the base (8)

The decimal equivalent of the octal number $3077_{(8)}$ is

$3077_{(8)} = 3\times8^3 \quad +0\times8^2+7\times8^1+7\times8^0$

$= 3\times512 +0\times64 +7\times8+7\times1$

$=1536+0+56+7 \quad =1599_{(10)}$

$3077_{(8)} \quad =1599_{(10)}$

Decimal	Octal	**Binary Equivalent**
0	0	000
1	1	001
2	2	010
3	3	011
4	4	100
5	5	101
6	6	110
7	7	111

(4) Hexadecimal number system

The base 16 suggests choices of 16 single character digits or symbol

The first 10 digits are digits of decimal system (0 to 9) and the remaining 6 digits are denoted by (A to F) representing decimal value (10 to 15) where a = 10, B = 11, C = 12, D = 13, E=14 and F = 16. The largest single digit is F or 15 (one less that the base).

Since number (0 to 9) and alphabets (A to F) are used to represent the digit in hexadecimal numbers system, it is also called the alphanumeric number systems.

Decimal	**Hexadecimal**	**Binary Equivalent**
0	0	0000
1	1	0001
2	2	0010
3	3	0011
4	4	0100
5	5	0101
6	6	0110
7	7	0111
8	8	1000
9	9	1001
10	A	1010

11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

Example:

Convert the hexadecimal number 39a (16) to decimal number

Solution

$$
\begin{aligned}
39A_{(16)} &= ?_{(10)} \\
&= 3\times16^{2}+9\times16^{1}+A\times16^{0} \\
&= 3\times256 +9\times16 +A\times1 \\
&= 3\times256 +9\times16 +10\times1 \\
&=768+144+10 \\
&=922_{(10)}
\end{aligned}
$$

$$39A_{(16)}= 922_{(10)}$$

1.1.6 CONVERSION OF NUMBER SYSTEM

- Conversion of Decimal Number System
- Conversion of Binary
- Conversion of Octal
- Conversion of Hexadecimal

1.1.8.1 Conversion of Decimal Number System

⇒ Decimal to binary system

⇒ Decimal to octal

⇒ Decimal to hexadecimal

(1) Conversion of Decimal to Binary System

Example:

Convert the 37.8125(10) decimal number to its binary equivalent

$$
\begin{array}{r|cl}
2 & 37 & \\ \cline{2-2}
2 & 18 & -1 \\ \cline{2-2}
2 & 9 & -0 \\ \cline{2-2}
\end{array}
$$

2	4	– 1
2	2	– 0
	1	– 0

Therefore, $37_{(10)} = 100101_{(2)}$

Fraction		**Radix**	**Result**	
0.8125	*2	=1.625	=0.625	with carry as 1
0.625	*2	=1.25	=0.25	with carry as 1
0.25	*2	=0.5	=0.50	with carry as 0
0.5	*2	=1.0	=0.00	with carry as 1

$0.8125_{(10)} = 0.1101$

Therefore $37.8125_{(10)} = 100101.1101_{(2)}$

Exercise:

Convert $(68)_{10}$ to binary

Answer = $(1000100)_2$

(2) Conversion of Decimal to-Octal System

Example:

Convert the $35.45_{(10)}$ decimal number to its octal equivalent

8	35	
	4	– 3

Therefore, $35_{(10)}=43_{(8)}$

Fraction		**Radix**	**Result**	
0.45	*8	=3.6	= 0.6	with carry as 3
0.6	*8	=4.8	= 0.8	with carry as 4
0.8	*8	=6.4	= 0.4	with carry as 6
0.4	*8	=3.2	= 0.2	with carry as 3
0.2	*8	=1.6	= 0.6	with carry as 1

$0.45_{(10)} = 0.34631_{(8)}$

Therefore, $35.45_{(10)} = 43.34631_{(8)}$

Exercise:

Convert decimal number 214 to its octal equivalent

Answer = 326

(3) Conversion of Decimal to Hexadecimal System

Example:

Convert the $22.64_{(10)}$ decimal number to its hexadecimal equivalent.

```
16 | 22
   ------
      1    – 6
```

Therefore, $22_{(10)} = 16_{(16)}$

Fraction		**Radix**	**Result**	
0.64	*16	=10.24	=10.24	with carry as 10
0.24	*16	=3.84	=0.84	with carry as 3
0.84	*16	=13.44	=0.44	with carry as 13
0.44	*16	=7.04	=0.04	with carry as 7

$0.64_{(10)} = 0.A3D7_{(16)}$

Therefore, $22.64_{(10)} = 16.A3D7_{(16)}$

Exercise:

Convert decimal number 3509 to its hexadecimal equivalent

Answer = 13115

$= DB5_{(16)}$

1.1.8.2 Conversion of Binary System

⇒ Binary to decimal conversion

⇒ Binary to octal

⇒ Binary to hexadecimal

(1) Binary to Decimal Conversion

Example:

Convert $1101.101_{(2)}$ to its decimal equivalent

$= 1\times2^3+1\times2^2+0\times2^1+1\times2+1+1\times2^{-1}\times0\times2^{-2}+1\times2^{-3}$

$= 8+4+0+1+0.5+0+0.125$

$= 13.625_{(10)}$

Exercise:

Convert $(1000100)_2$ to its decimal equivalent

Answer = $(68)_{10}$

(2) Binary to Octal Conversion

Example:

Convert the $111101100_{(2)}$ to its octal equivalent.

⇒ Group the number by 3

111 101 100

⇒ Specify the octal equivalent

111	101	100
7	5	4

Therefore, the octal number is $754_{(8)}$

Exercise:

Convert 111 01 111 0 $_{(2)}$ to its equivalent octal number

Answer = $735_{(8)}$

(3) Binary to Hexadecimal Conversion

Example:

Convert the $1101100010011011_{(2)}$ to its hexadecimal equivalent.

⇒ Group the number by 4

1101 1000 1001 1011

⇒ Specify the hexadecimal equivalent

1101	1000	1001	1011
D	8	9	B

Therefore, the octal number is $D89B_{(16)}$

Exercise:

Convert 11111101 . 0001 $0011_{(2)}$ to its equivalent hexadecimal number.

Answer = $FD13_{(16)}$

1.1.8.3 Conversion of Octal Number System

⇒ Octal to Decimal Conversion

⇒ Octal to Binary Conversion

⇒ Octal to Hexadecimal

(1) Octal to Decimal Conversion

Example:

Convert the $51.63_{(8)}$ to its decimal equivalent.

$=5\times8^{1}+1\times8^{0}+0.6\times8^{-1}\times0.3\times8^{-2}$

$=40+1+(0.075+0.0046875)$

$=41.0796875_{(10)}$

Therefore, $51.63_{(8)} = 41.0796875_{(10)}$

Exercise:

$516_{(8)} = 324$

(2) Octal to Binary Conversion

Example:

Convert the $51.63_{(8)}$ to its binary equivalent.

$$\begin{array}{ccccc} 5 & 1 & \bullet & 6 & 3 \\ \downarrow & \downarrow & & \downarrow & \downarrow \\ 101 & 001 & & 110 & 011 \end{array}$$

$101001.110011_{(2)}$

$51.63_{(8)}=101001.110011_{(2)}$

Therefore, the binary number is $101001.110011_{(2)}$

Exercise:

convert 5613 to its binary equivalent

Answer = $1010011110011_{(2)}$

(3) Octal to Hexadecimal Conversion

Example:

Convert the $345.30_{(8)}$ to its hexadecimal equivalent.

$$\begin{array}{ccccccc} & \text{Octal} & \leftrightarrow & \text{Binary} & \leftrightarrow & \text{Hexadecimal} & \\ \Rightarrow & 3 & 4 & 5 & \bullet & 3 & 0 \\ \Rightarrow & 011 & 100 & 101 & \bullet & \multicolumn{2}{c}{\underbrace{011 \qquad\qquad 0}\,0\ 0} \\ & & \downarrow & \downarrow & & \downarrow & \\ \Rightarrow & 0000 & 1110 & 0101 & \bullet & 0110 & 0000 \\ \Rightarrow & 0 & E & 5 & \bullet & 6 & 0 \end{array}$$

Therefore, the hexadecimal number is $E5.60_{(16)}$

Exercise

34530(8)

Answer = E560(16)

011 1 00 10 1 011 0000

↓ ↓ ↓ ↓

E 5 6 0

1.1.8.4 Conversion of Hexadecimal Number System

⇒ Hexadecimal to Decimal Conversion

⇒ Hexadecimal to Binary

⇒ Hexadecimal to Octal

⇒ Hexadecimal to Decimal Conversion

(1) Hexadecimal to Decimal Conversion

Example:

Convert the $5B.2E_{(10)}$ to its decimal equivalent.

$=5\times16^1+B\times16^0+2\times16^{-1}\times E\times16^{-2}$

$=80+11+(0.125+0.0546875)$

$=91.1796875_{(10)}$

$5B.2E_{(16)}=91.1796875_{(10)}$

Exercise

$5B^2(16)$

Answer = 1458

(2) Hexadecimal to Binary Conversion

Convert the $8B2F.9A_{(16)}$ to its binary equivalent.

8	B	2	F	•	9	A
↓	↓	↓	↓	•	↓	↓
1000	1011	0011	1111	•	1001	1010

$8B2F.9A_{(16)}=1000101100111111.10011010_{(2)}$

Therefore, the binary number is $1000101100111111.10011010_{(2)}$

Exercise

8B2F

Answer = $1000101100101111_{(2)}$

(3) Hexadecimal to Octal Conversion

Example:

Convert the BDAF.AC9$_{(16)}$ to its octal equivalent.

$$\begin{array}{cccccccccc}
\Rightarrow & \text{B} & & \text{D} & \text{A} & \text{F} & \bullet & \text{A} & \text{C} & 9 \\
 & \downarrow & & \downarrow & \downarrow & \downarrow & \bullet & \downarrow & \downarrow & \downarrow \\
 & 1011 & & 1101 & 1010 & 1111 & \bullet & 1010 & 1100 & 1001
\end{array}$$

$$\begin{array}{cccccccccccc}
\Rightarrow & 1 & 011 & 110 & 110 & 101 & 111 & \bullet & 101 & 011 & 001 & 001 \\
 & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \bullet & \downarrow & \downarrow & \downarrow & \downarrow \\
 & 1 & 3 & 6 & 6 & 5 & 7 & \bullet & 5 & 3 & 1 & 1
\end{array}$$

Therefore, the hexadecimal number is 136657.5311$_{(8)}$

Algorithms

An algorithm is defined as a finite sequence of explicit instructions that, when provided with a set of input values, produces an output and then terminates.

In algorithm, after a finite number of steps, solution of the problem is achieved.

Algorithms can have steps that repeat (iterate) or require decision (logic and comparison)

until the task is completed.

For example, to determine the largest number out of three numbers A,B and C the following algorithm may be used.

Step 1: Start

Step 2: Read three numbers say A, B, C

Step 3: Read the larger number between A and B and store it in MAX_AB.

Step 4: Find the larger number between MAX_AB, C and store it in MAX.

Step 5: Display MAX.

Step 6: Stop.

2.1.1 Algorithm properties

(1) There must be no ambiguity in any instruction

(2) There should not be any uncertainty about which instruction is to be executed next.

(3) The algorithm should conclude after a finite number of steps an algorithm cannot be open ended

(4) Then algorithm must be general enough to deal with any contingency.

2.2 FLOWCHART

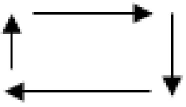
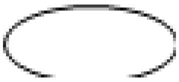
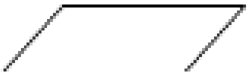
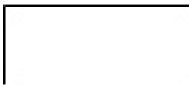
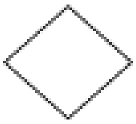
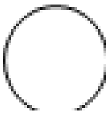
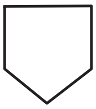
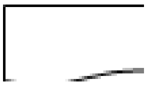
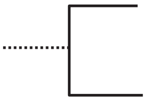
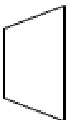
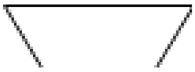
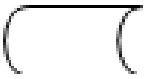
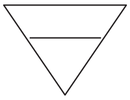
A flowchart is a pictorial representation of an algorithm in which the step are drawn in the form of different shapes of boxes and the logical flow is indicated by interconnecting arrow

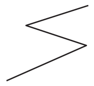
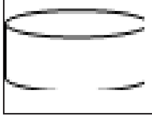
The boxes represent operations and the arrows represent the sequence in which the operation are implemented.

The primary purpose of the flowchart is to help the programmes in understanding the logic of the program.

Standard flowchart symbols prescribed by American nation's standard institute (ANSI)

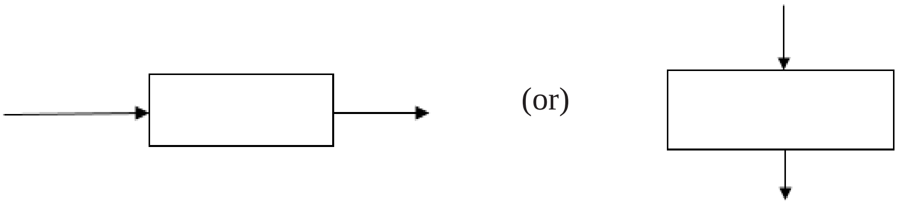
2.2.1 Flowchart symbols

Symbol	Symbol name	Description
	Flow lines	Flow lines are used to connect symbols. These lines indicate the sequence of steps and the direction of flow of control.
	Terminal	This symbol is used to represent the beginning (star), the termination (end) or halt (pause) in the program logic.
	Input / Output	It represents information entering or leaving the system, such as customer order(input) and servicing(output)
	Processing	Process symbol is used for representing arithmetic and data movement instructions.
	Decision	Decision symbol denotes a decision (or branch). The program should continue along one the two routes (IF/ELSE). This symbol has one entry and two exit paths. The path chosen depends on whether answer to a question is yes or no.
	Connector	Connector symbol is used to join different flow lines.
	Off-page connector	This symbol is used to indicate that the flowchart continues on the next page.
	Document	Document is used to represent a paper document produced during the flowchart process.
	Annotation	It is used to provide additional information about another flowchart symbol. the content may be in the form of descriptive comments remarks or explanatory notes.
	Manual Input	Manual input sysmbol representes input to be given by a developer programmer
	Manual Input	It represents input to be given by a developer/ programmer
	Online storage	This symbol represents the online data storage such as hard disk, magnetic drums, or other storage.
	Offline storage	This symbol represents the offline data storage such as sales on OCR and data on punched cards

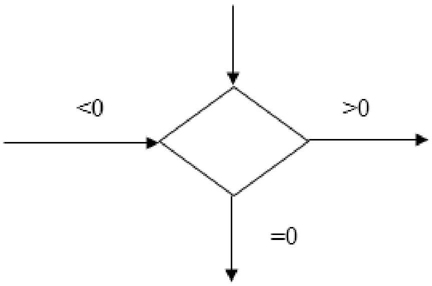
	Communication Link	Communication link symbol is used to represent data received or to be transmitted from an external system.
	Magnetic Disk	This symbol is used to represent data input or output from and to a magnetic disk.

2.2.2 Guidelines for preparing flowcharts

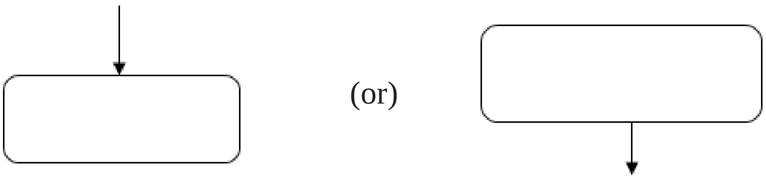
- The flowchart should be clear, neat and easy to follow
- The flowchart must have a logical start and finish
- In drawing a proper flowchart, all necessary requirements should be listed in logical order.
- Only one flow line should come out form a process symbol



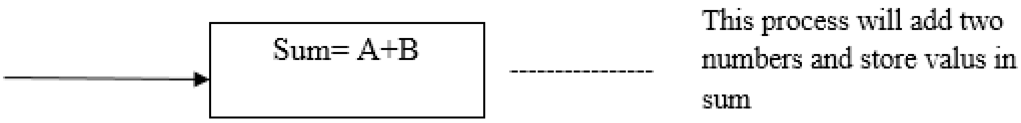
- Only one flow line should enter a decision symbol. However, two or three flow lines may leave the decision symbol



- Only one flow line is used with a terminal symbol



- Within standard symbol write briefly if necessary use the annotation symbol to describe data or process more clearly



- In case of complex flowchart, connector symbols are used to reduce the number of flow lines

- Intersection of flow lines should be avoided to make it a more effective and better way of representing communication
- It is useful to test the validity of the flowchart with normal/ unusual test data.

2.2.3 Benefit of Flowchart

Makes Logic Clear

The main advantage of using a flowchart to plan a task is that it provided a plctonal representation of the basic which makes the logic easier to follow

Communication

Being a graphical representation of a problem – solving logic, flowcharts are better way of communicating the logic of a system to all conserved.

Effective Analysis

With the help of a flowchart, the problem, can be analyzed in an effective way.

Useful in Coding

The flowcharts act as a guide or blueprint during the analysis and program development phase.

Proper Testing and Debugging

By nature, a flowchart helps in detecting the errors in a program, as the developers know exactly what the logic should do.

Appropriate Documentation

Flow charts serve as a good program documentation tool.

2.2.4 Limitations of Flowcharts

Complex

The major disadvantage in using flowcharts is that when a program is very large, the flowcharts may continue per many pages, making them hard to follow.

Costly

Drawing flowcharts are viable only if the problem solving logic is straight forward and not very lengthy.

Difficult to Modify

Due to its symbolic nature, any changes or modification to a flowchart usually requires redrawing the entire logic again, and redrawing a complex flowchart is not a simple basic.

No Update

Usually programs are updated regularly

2.3 PSEUDOCODE

Pseudocode is made up of two words ***pseudo*** and ***code***. Pseudo means limitation and code refers to instructions, written in a programming language.

Pseudocode used plain English statements rather than symbols to represent the processes of a computer program. It is also known as ***PDL*** (Program Design Language)

For example, the pseudocode given below calculated the area of a rectangle.

```
PROMT the user to enter the height of the rectangle
PROMT the user to the enter the width of the rectangle
COMPUTE the area by multiplying the height with width
DISPLAY the area STOP
```

Pseudocode uses some keywords to denote programming processes. Some of them are:

- Input : READ, OBTAIN, GET and PROMPT
- Output: PRINT, DISPLAY AND SHOW
- Compute : XOMPUTE, CALCULATE AND DETERMINE
- Inittalise: SET AND INITIALISE
- Add One: INCREMENT

2.3.1 Pseudocode Guideline

- Statements should be written in simple English and should be programming language independent.
- Steps must be understandable and when the steps ……. Are followed the must produce a solution to the specified problem
- Pseudocodes should be concise.
- Each instruction should be written in a separate line an each statement in pseudocode should express just one action per the computer.
- Capitalise keywords such as READ, PRINT and so on.
- Each set of instructions is written from top to bottom, with only one entry and one exit.
- It should allow for easy transition from design to coding in programming language

2.3.2 Benefits of Pseudocode

- Since it is language independent, it can be used by most programmes, it allows the developer to express the design in plain natural language.
- It is easier to develop a program from a pseudocode than with a flowchart
- Often, it is easy to translate pseudocode into a programming language a step which can be accomplished by less experienced programmes.

- The use of words and phrases in pseudocode, which are in line with basic computer operations, simplifier the translation from the pseudocode algorithm to a specific programming language.
- Its simple structure and readability makes it easier to modify.

2.3.3 Limitations of Pseudocode

- The main disadvantage of using pseudocode is that it does not provide visual representation of the program's logic
- Pseudocode cannot be complied nor executed and more are not real formatting or syntax rules

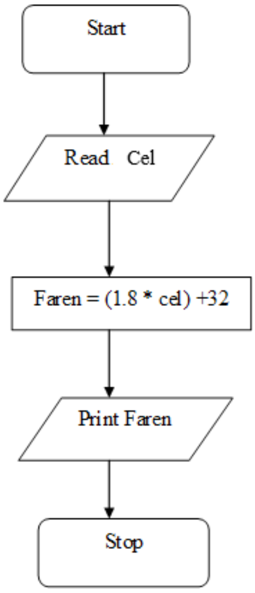
Problem Solving through Algorthims, Flowcharts and Pseudocode

1. Write a program to convert the celcius into fahrenneit.

Algorithm:

```
Step 1: Start
Step 2: Read the Celsius value
Step 3: Calculate the fahrenhiet value by using the formula
            Fahrenhelt (1.8* Celsius) + 32
Step 4: Print the falrenheit value
Step 5: Stop
```

Flowchart:

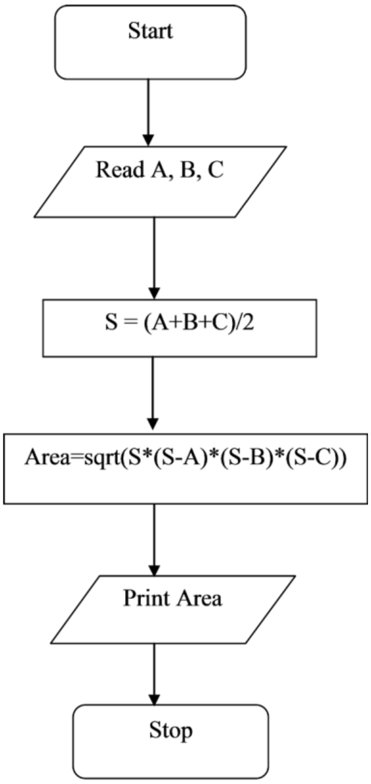


Pseudocode:

```
Set initial celsiue
READ the value of Celsius
Calculate faren = (1.8*Celsius) +32
Write the output Fahrenheit
Stop
```

2. Write a program to find area of the manage

Flowchart



Algorithm:

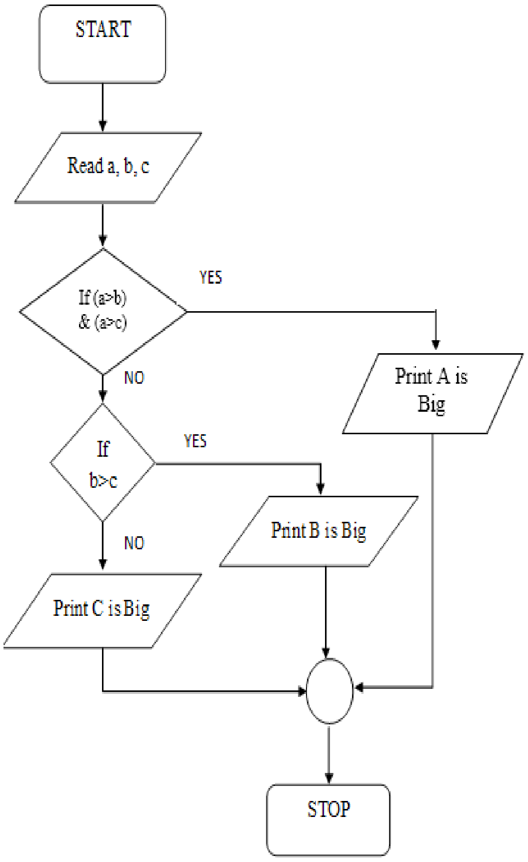
```
Step 1: Start
Step 2: Read the value of a,b,c
Step3: To calculate three sides of the triangle using formula
        $S \leftarrow (a+b+c)/2$
Step 4: To Find area of a triangle apply formula
        Area sqrt $(s*(s – a)*(s–b)*(s–c))$
Step 5 : Print the area
Step 6: Stop
```

Pseudocode:

```
Set initial a,b,c
Read the value of a,b,c
To calculate three sides of triangle using formula
    s = (a+b+c)/2
To find area of a triangle using formula
    Area sqrt (s*(s – a)*(s–b)*(s–c))
WRITE the output area
Stop
```

3. Write a program to find the larget of three numbers.

Flowchart:



Algorithm:

```
Step1  : Start
Step2  : READ a, b, c
Step3  : IF (a>b) and (a>c) Then print ‘A is Big’.
```

Step 4 : Else, IF (b>c) Then print ‘B is Big’.

Step 5 : Else print ‘C is Big’

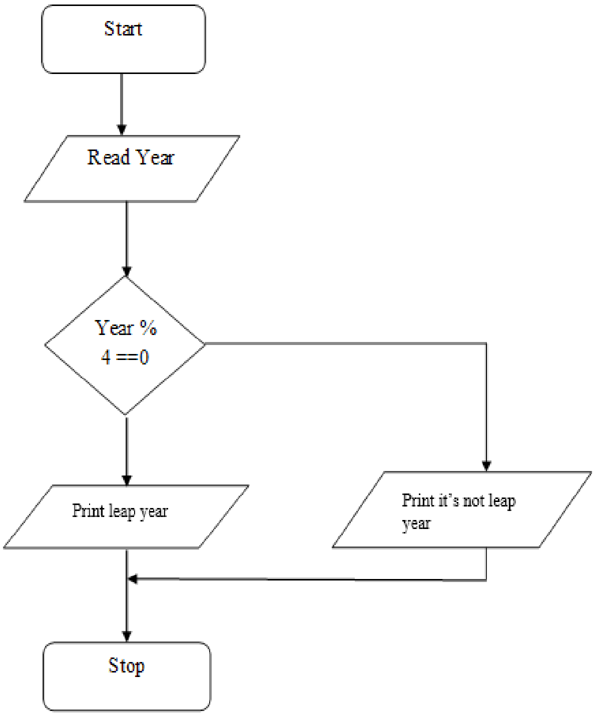
Step 6 : Stop.

Pseudo code:

```
Set initial a, b, c
READ the value for a, b, c
 IF (a>b) and (a>c) THEN
      WRITE ‘A is Big’
  Else, IF (b>c) THEN
       WRITE ‘B is Big’
  ELSE
       WRITE ‘C is Big’
  END IF
Stop.
```

4. Write a program to find the given year is a leap year or not.

Flowchart



Algorithm:

```
Step 1 : Start.
Step 2 : Read the value of year.
Step 3 : if ((year mod 4) = 0) then print “It is a Leap Year”.
             ELSE print “it is not Leap Year”
Step 4 : Stop.
```

Pseudo code:

```
Set initial value of year.
READ the value of year.
IF (year % 4 == 0) Then
        WRITE the year is leap year
ELSE
        WRITE the year is not leap year.
ENDIF
STOP
```