Unit 2 Algorithms & Flowcharts

Structure:

2.1 Introduction

An algorithm (pronounced AL-go-rith-um) is a procedure for solving a problem. The word derives its sense from the name of the Mathematician, Mohammed ibn-Musa al-Khwarizmi, who was part of the Royal Court in Baghdad and who lived from about 780 to 850. Al-Khwarizmi's work is the likely source for the word *algebra* as well.

In Mathematics, Computing, Linguistics and related subjects, an **algorithm** is a sequence of finite instructions, often used for calculation and data processing. It is formally a type of effective method in which a list of well-defined instructions for completing a task will, when given an initial state, proceed through a well-defined series of successive states, eventually terminating in an end-state. The transition from one state to the next is not necessarily deterministic; some algorithms, known as probabilistic algorithms, incorporate randomness.

Objectives:

At the end of this unit, you will be able to:

- state the need for algorithm in programming
- explain how an algorithm is written
- explain the need for flowchart in programming
- state how a flowchart is constructed

2.2 Definition of Algorithm

An algorithm is any well-defined computational procedure that takes a value or a set of values as input and produces an output. The characteristics of a good algorithm are given below:

I	Algorithm may get any input but must have some output.
II	Algorithm must be finite. That is algorithm should terminate after a finite no of steps.

III	The algorithm must be definite. That is algorithm should not be ambiguous.
	Ex. If (a<0) then
	{
	X←1 or x← 1
	}

IV	The algorithm should be effective that means it must have the basic steps. Ex. Print(A), Scan(B) etc. Not basic primitive : ➔ max(A,B,C)
V	The algorithm must be complete and general. The steps of an algorithm should be complete for a class of problems, not for a specific problem.

The algorithm is very important for programmers. To be a good programmer, one must maintain the following basic sequence:

a) Design of algorithm

b) Prepare a flowchart for that algorithm

c) Write a program according to flowchart

d) Test the program by inputting different values

e) Implement the program

2.3 Examples of Algorithm

a) Write an algorithm to add two numbers

Step I	Start
Step II	Input A,B
Step III	C=0
Step IV	C=A+B
Step V	Print C
Step VI	End

b) Write an algorithm to convert temperature from Centigrade to Fahrenheit.

Step I	Start
Step II	Input C
Step III	F=0
Step IV	F= 9*C/5+32
Step V	Print F
Step VI	End

c) Write an algorithm to find whether a given number is odd or even.

Step I	Start
Step II	Input A
Step III	IF A%2=0 THEN
	Print “The Number is Even”
	Else
	Print “The Number is Odd”
	[End of If Structure]
Step IV	End

d) Write an algorithm to calculate the telephone bill as per the following rules after accepting the number of calls.

Calls	Rate per call
First 150 calls	Nil
Next 100 calls	50 Paisa
Next 100 calls	60 Paisa
Next 100 calls	70 Paisa
Next 150 calls	80 Paisa
Above 600 Calls	100 Paisa

The rental charge is Rs. 170 and service tax will be calculated 12.24% over the total call charges and rental charges. Calculate the total amount payable by the customer.

Step I	**Start**
Step II	Input CALLS
Step III	CALL_CHARGES ← 0.00 RENTAL_CHARGES ← 170.00 SERVICE_RATE ← 12.24 SERVICE_CHARGES ← 0.00 NET_CHARGES ← 0.00
Step IV	If CALLS less than or equal to 150 then CALL_CHARGES ←0.00 else if CALLS less than or equal to 250 then CALL_CHARGES ← (CALLS -150)*0.50 else if CALLS less than or equal to 350 then CALL_CHARGES ← 50.00 + (CALLS – 250)*0.60 else if CALLS less than or equal to 450 then CALL_CHARGES ← 110.00 +(CALLS – 350)*0.70 else if CALLS less than or equal to 600 then CALL_CHARGES ← 180.00 + (CALLS – 450) *0.80 otherwise CALL_CHARGES ← 300.00 + (CALLS – 600) * 1.00 [End of IF Structure]
Step V	SERVICE_CHARGES ← (CALL_CHARGES+RENTAL_CHARGES) * SERVICE_RATE /100

Step VI	NET_CHARGES ← RENTAL_CHARGES + CALL_CHARGES + SERVICE_CHARGES
Step VII	Print NET_CHARGES
Step VIII	Stop

e) Write an algorithm to print 1 to 100 all natural numbers

Step I	Start
Step II	N←100 I←1
Step III	While IF I less than N then goto Step V
	Print I
Step IV	I ← I+1 : goto Step III
Step V	End

f) Write an algorithm to print all prime numbers between 2 to N, where N is given input.

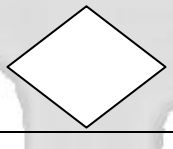
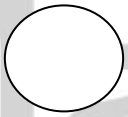
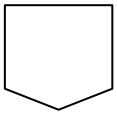
Step I	Start
Step II	I←2,j←2,C←0
Step III	Input N
Step IV	If I grater than N then goto Step IX
Step V	J ←2
Step VI	If J is equal to I then goto Step VIII
Step VII	IF I%J=0 then C=1 : goto Step VIII [End of If Structure]
	J←J+1 : goto Step VI

Step VIII	If C=0 then
	Print I
	else
	C←0
	[End of If Structure]
	I←I+1 : goto Step IV

Step IX	End

2.4 Definition of Flowchart

It is the pictorial representation of algorithm and the summary of the decisions and flows that make up a procedure or process from beginning to the end. As one of the seven tools of quality, a flowchart shows how the entire system functions and where error and wastes occur. This information is used in defining, documenting, studying, and improving the system. There are some standard symbols to draw the flow charts. Standard essential symbols are given below:

Symbols	Meaning
	Terminal (Start / End)
	Decision Making
	Processing
	Document / Hard Copy
	Same Page Connector
	Different Page Connector

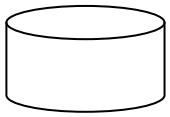
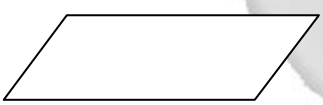
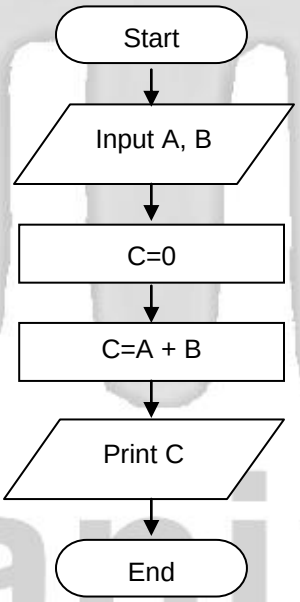
	Storage Disk
→	Flow Line
	Input / Output

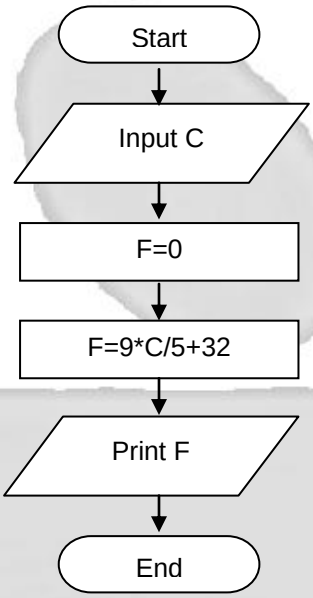
Table 2.1

2.5 Example of Flowchart

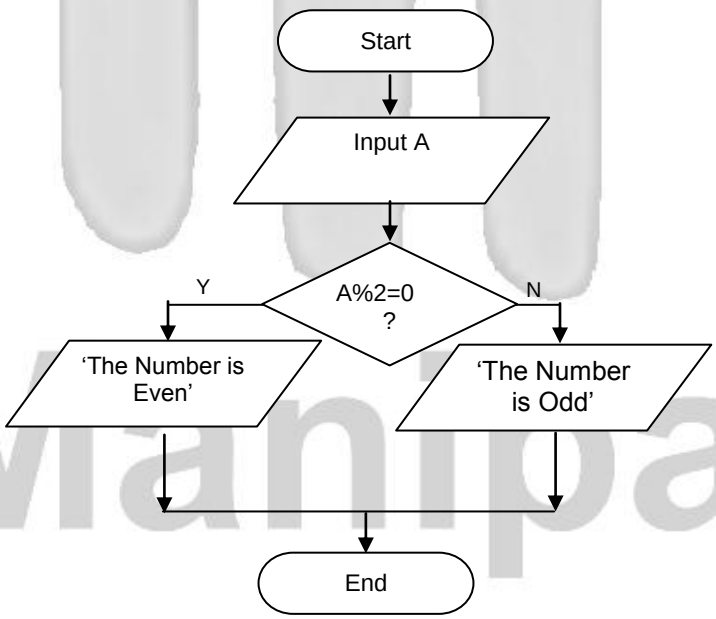
a) Draw a flowchart to add two numbers



b) Draw a flowchart to convert temperature from Centigrade to Fahrenheit



c) Draw a flowchart to check whether a given number is odd or even



d) Draw a flowchart to calculate the telephone bill as per the following rules after accepting the number of calls.

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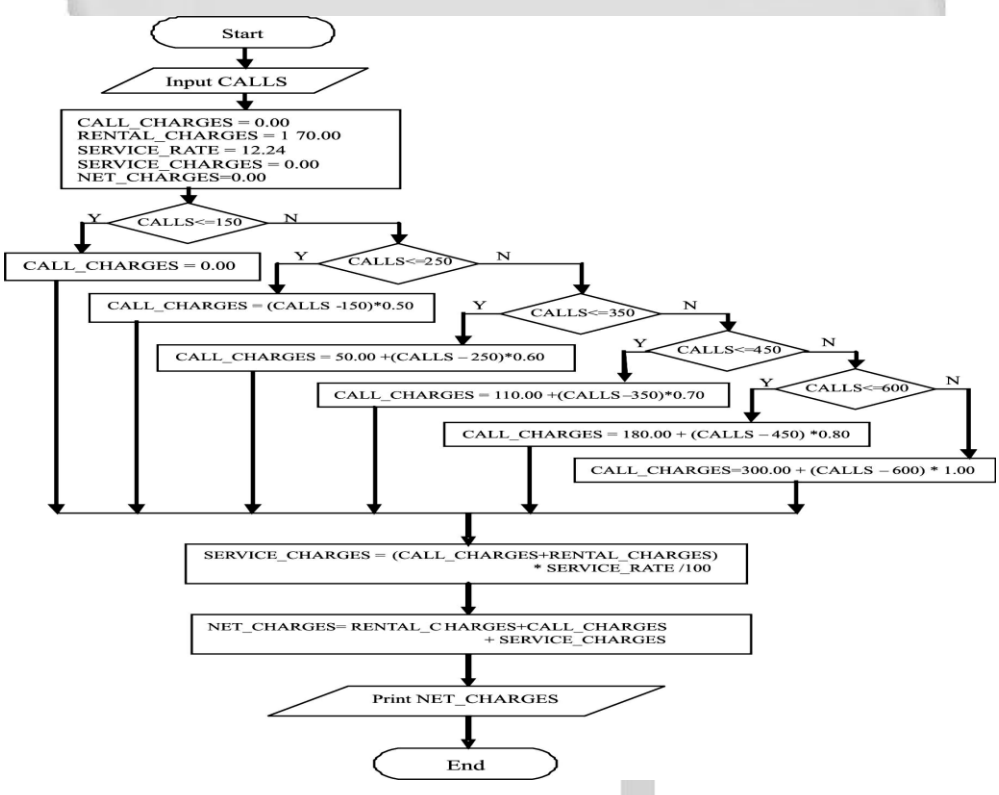
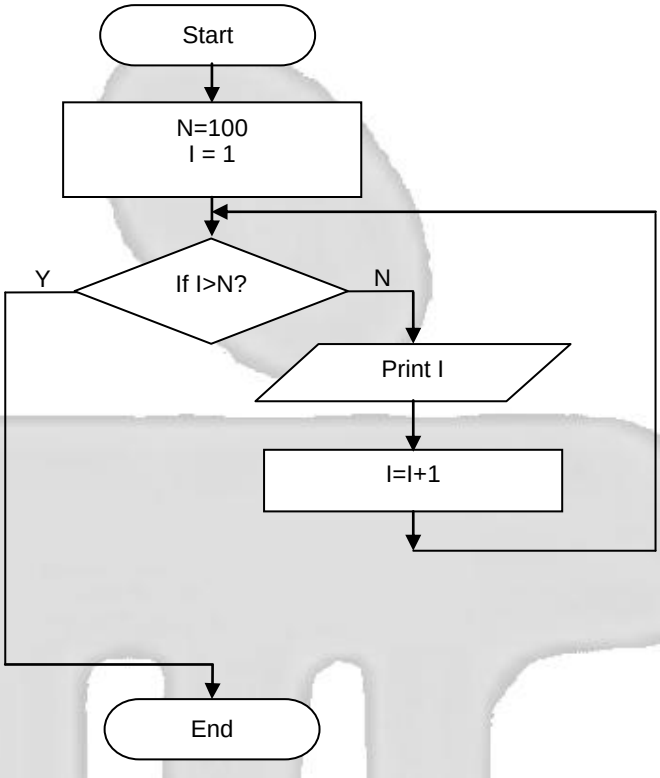
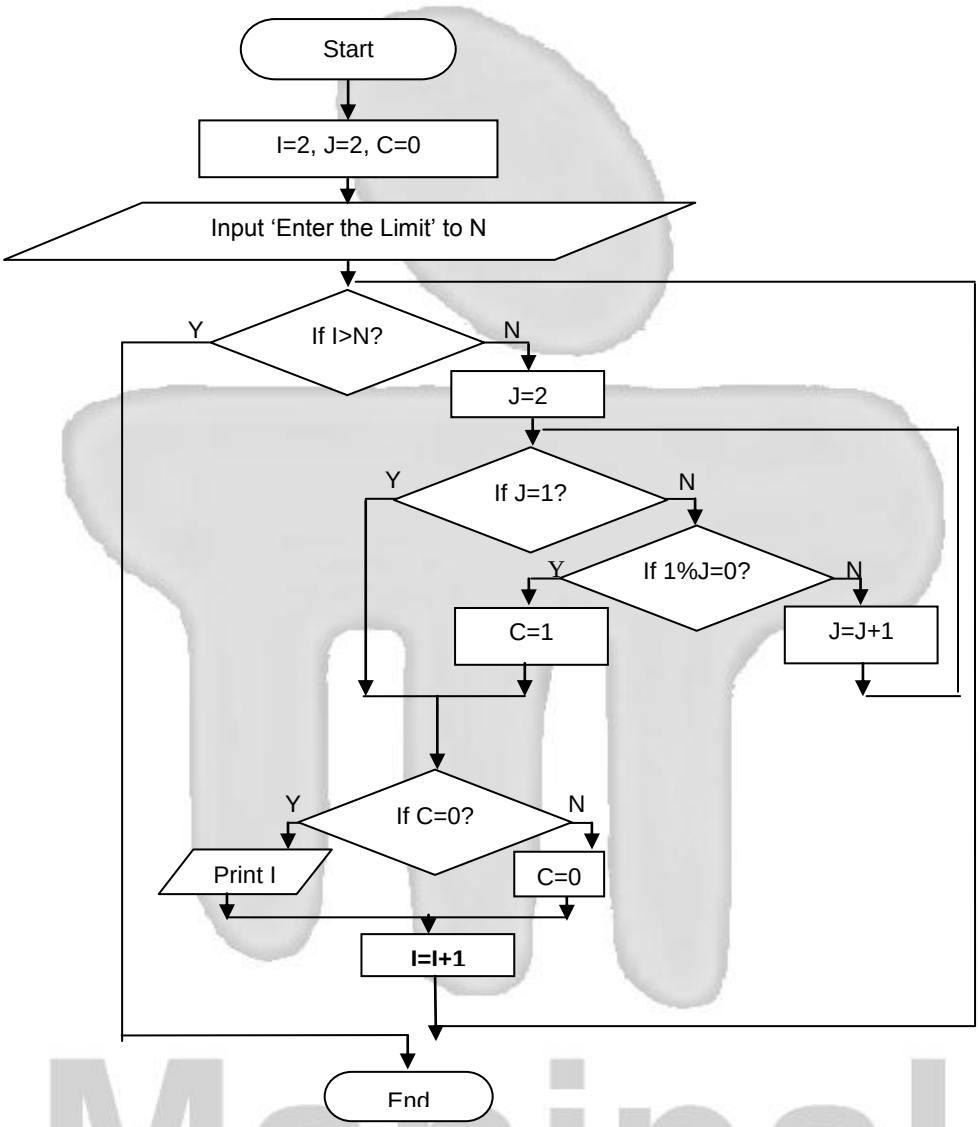


e) Draw a flowchart to print 1 to 100 all natural numbers



f) Draw a flowchart to print all prime numbers between 2 to N, where N is given input.



2.6 Summary

In mathematics, computing, linguistics and related subjects, an algorithm is a sequence of finite instructions to solve a problem. It is formally a type of effective method in which a list of well-defined instructions for completing a task will, when given an initial state, proceed through a well-defined series of successive states, eventually terminating in an end-state. This unit demonstrated the application of algorithm and flowchart.

Self Assessment Questions

1. To write an algorithm there is no rules / regulation (True / False)
2. Input is a compulsory part of an algorithm. (True / False)
3. Flow charts has some standard symbols (True / False)
4. Flow chart has no start or end symbols (True / False)

2.7 Terminal Questions

1. Write an algorithm to print the factorial of a given number and after that draw the flowchart.
2. Write an algorithm to print all even numbers in descending order and after that draw the flowchart.
3. Write an algorithm to find all numbers which are divisible by 3 but not divisible by 6 and draw a flowchart.
4. Write an algorithm to find the fare of bus based on distance travelled as per the following rates:
   i) Rs.5.00 for the first 2 km
   ii) Rs.2.50 for every addition 2km

   Draw a flowchart to find the fare.

2.8 Answers to Self Assessment and Terminal Questions

Self Assessment Questions

1. False
2. False
3. True
4. False

Terminal Questions

1. Section 2.3 & 2.5
2. Section 2.3 & 2.5
3. Section 2.3 & 2.5
4. Section 2.3 & 2.5