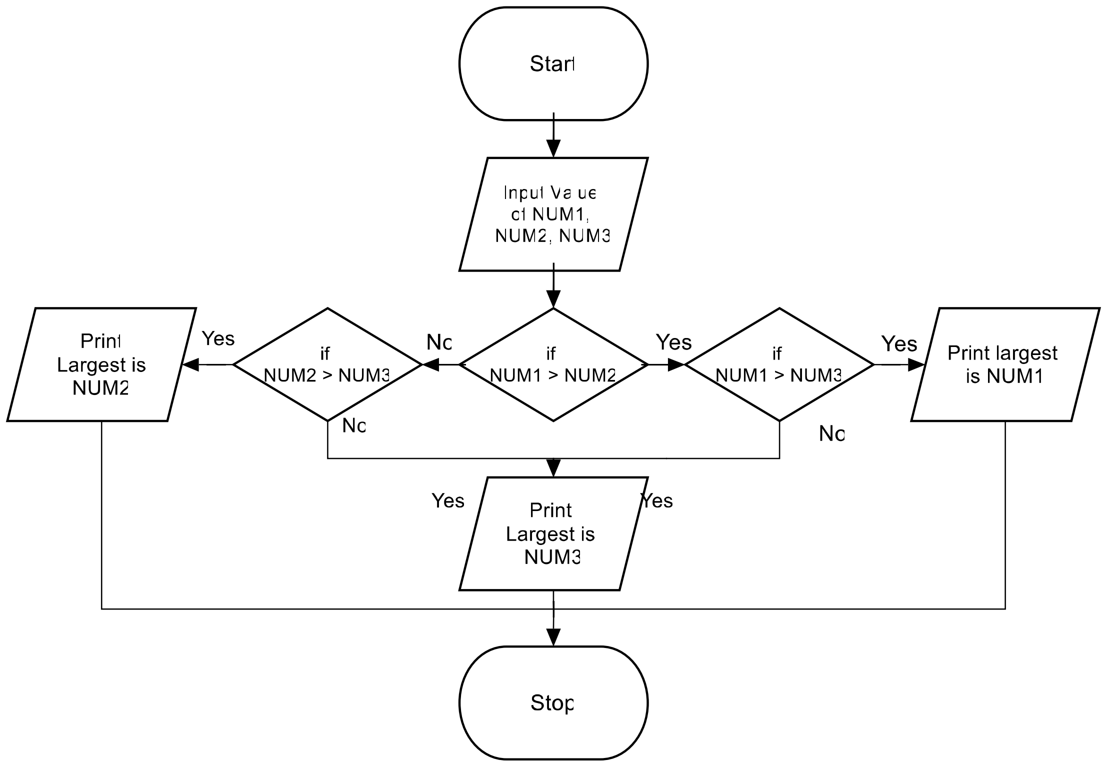
ALGORITHM & FLOWCHART MANUAL for STUDENTS



(Ravi K. Walia)
Assistant Professor & Incharge
Computer & Instrumentation Centre
Dr. Y. S. Parmar University of Horticulture & Forestry,
Nauni Solan INDIA (HP)

PREFACE

This document has been prepared for students at Dr. Y. S. Parmar University of Horticulture & Forestry, Nauni, Solan (HP) India. Software Engineer uses various programming languages to create programs. Before writing a program, first needs to find a procedure for solving the problem. The program written without proper pre-planning has higher chances of errors.

Algorithm and flowchart are the powerful tools for learning programming. An algorithm is a step-by-step analysis of the process, while a flowchart explains the steps of a program in a graphical way. Algorithm and flowcharts helps to clarify all the steps for solving the problem. For beginners, it is always recommended to first write algorithm and draw flowchart for solving a problem and then only write the program.

Beginners find it difficult to write algorithm and draw flowchart. The algorithm can vary from person to person to solve a particular problem. The manual will be useful for the students to learn algorithm and flowchart. It includes basics of algorithm and flowchart along with number of examples. Software ClickCharts by NCH (unlicensed version) has been used to draw all the flowcharts in the manual.

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ALGORITHM:

The word “algorithm” relates to the name of the mathematician Al-khowarizmi, which means a procedure or a technique. Software Engineer commonly uses an algorithm for planning and solving the problems. An algorithm is a sequence of steps to solve a particular problem or algorithm is an ordered set of unambiguous steps that produces a result and terminates in a finite time

Algorithm has the following characteristics

- **Input**: An algorithm may or may not require input
- **Output:** Each algorithm is expected to produce at least one result
- **Definiteness**: Each instruction must be clear and unambiguous.
- **Finiteness**: If the instructions of an algorithm are executed, the algorithm should terminate after finite number of steps

The algorithm and flowchart include following three types of control structures.

1. **Sequence**: In the sequence structure, statements are placed one after the other and the execution takes place starting from up to down.
2. **Branching (Selection):** In branch control, there is a condition and according to a condition, a decision of either TRUE or FALSE is achieved. In the case of TRUE, one of the two branches is explored; but in the case of FALSE condition, the other alternative is taken. Generally, the ‘IF-THEN’ is used to represent branch control.
3. **Loop (Repetition):** The Loop or Repetition allows a statement(s) to be executed repeatedly based on certain loop condition e.g. WHILE, FOR loops.

Advantages of algorithm

- It is a step-wise representation of a solution to a given problem, which makes it easy to understand.
- An algorithm uses a definite procedure.
- It is not dependent on any programming language, so it is easy to understand for anyone even without programming knowledge.
- Every step in an algorithm has its own logical sequence so it is easy to debug.

HOW TO WRITE ALGORITHMS

Step 1 **Define your algorithms input**: Many algorithms take in data to be processed, e.g. to calculate the area of rectangle input may be the rectangle height and rectangle width.

Step 2 **Define the variables**: Algorithm's variables allow you to use it for more than one place. We can define two variables for rectangle height and rectangle width as HEIGHT and WIDTH (or H & W). We should use meaningful variable name e.g. instead of using H & W use HEIGHT and WIDTH as variable name.

Step 3 **Outline the algorithm's operations:** Use input variable for computation purpose, e.g. to find area of rectangle multiply the HEIGHT and WIDTH variable and store the value in new variable (say) AREA. An algorithm's operations can take the form of multiple steps and even branch, depending on the value of the input variables.

Step 4 **Output the results of your algorithm's operations**: In case of area of rectangle output will be the value stored in variable AREA. if the input variables described a rectangle with a HEIGHT of 2 and a WIDTH of 3, the algorithm would output the value of 6.

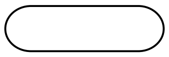
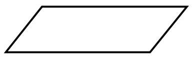
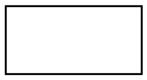
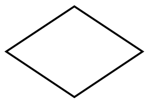
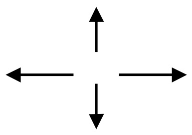
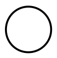
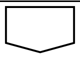
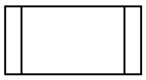
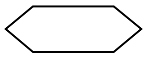
FLOWCHART:

The first design of flowchart goes back to 1945 which was designed by John Von Neumann. Unlike an algorithm, Flowchart uses different symbols to design a solution to a problem. It is another commonly used programming tool. By looking at a Flowchartone can understand the operations and sequence of operations performed in a system. Flowchart is often considered as a blueprint of a design used for solving a specific problem.

Advantages of flowchart:

- Flowchart is an excellent way of communicating the logic of a program.
- Easy and efficient to analyze problem using flowchart.
- During program development cycle, the flowchart plays the role of a blueprint, which makes program development process easier.
- After successful development of a program, it needs continuous timely maintenance during the course of its operation. The flowchart makes program or system maintenance easier.
- It is easy to convert the flowchart into any programming language code.

Flowchart is diagrammatic /Graphical representation of sequence of steps to solve a problem. To draw a flowchart following standard symbols are use

Symbol Name	Symbol	function
Oval		Used to represent start and end of flowchart
Parallelogram		Used for input and output operation
Rectangle		Processing: Used for arithmetic operations and data-manipulations
Diamond		Decision making. Used to represent the operation in which there are two/three alternatives, true and false etc
Arrows		Flow line Used to indicate the flow of logic by connecting symbols
Circle		Page Connector
		Off Page Connector
		Predefined Process /Function Used to represent a group of statements performing one processing task.
		Preprocessor
	|-------------- --------- | |--------------	Comments

The language used to write algorithm is simple and similar to day-to-day life language. The variable names are used to store the values. The value store in variable can change in the solution steps. In addition some special symbols are used as below

Assignment Symbol ($\leftarrow$ or =) is used to assign value to the variable.

e.g. to assign value 5 to the variable HEIGHT, statement is

HEIGHT $\leftarrow$ 5

or

HEIGHT = 5

The symbol '=' is used in most of the programming language as an assignment symbol, the same has been used in all the algorithms and flowcharts in the manual.

The statement C = A + B means that add the value stored in variable A and variable B then assign/store the value in variable C.

The statement R = R + 1 means that add I to the value stored in variable R and then assign/store the new value in variable R, in other words increase the value of variable R by 1

Mathematical Operators:

Operator	Meaning	Example
+	Addition	A + B
-	Subtraction	A – B
*	Multiplication	A * B
/	Division	A / B
^	Power	A^3 for A^3
%	Reminder	A % B

Relational Operators

Operator	Meaning	Example
<	Less than	A < B
<=	Less than or equal to	A <= B
= or ==	Equal to	A = B
# or !=	Not equal to	A # B or A !=B
>	Greater than	A > B
>=	Greater tha or equal to	A >= B

Logical Operators

Operator	Example	Meaning
AND	A < B AND B < C	Result is True if both A<B and B<C are true else false
OR	A< B OR B < C	Result is True if either A<B or B<C are true else false
NOT	NOT (A >B)	Result is True if A>B is false else true

Selection control Statements

Selection Control	Example	Meaning
IF (Condition) Then … ENDIF	IF (X > 10) THEN Y=Y+5 ENDIF	If condition X>10 is True execute the statement between THEN and ENDIF
IF (Condition) Then … ELSE ….. ENDIF	IF (X > 10) THEN Y=Y+5 ELSE Y=Y+8 Z=Z+3 ENDIF	If condition X>10 is True execute the statement between THEN and ELSE otherwise execute the statements between ELSE and ENDIF

Loop control Statements

Selection Control	Example	Meaning
WHILE (Condition) DO .. .. ENDDO	WHILE (X < 10) DO print x x=x+1 ENDDO	Execute the loop as long as the condition is TRUE
DO …. … UNTILL (Condition)	DO print x x=x+1 UNTILL (X >10)	Execute the loop as long as the condition is false

GO TO statement also called unconditional transfer of control statement is used to transfer control of execution to another step/statement. . e.g. the statement GOTO n   will transfer control to step/statement n.

Note: We can use keyword INPUT or READ or GET to accept input(s) /value(s) and keywords PRINT or WRITE or DISPLAY to output the result(s).

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Algorithm & Flowchart to find the sum of two numbers

Algorithm

Step-1 Start

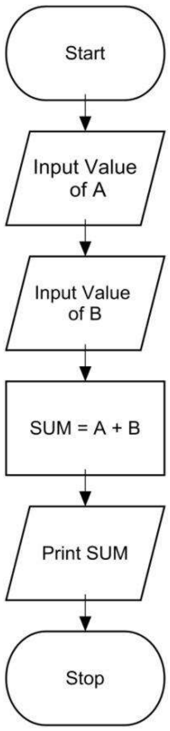
Step-2 Input first numbers say A

Step-3 Input second number say B

Step-4 SUM = A + B

Step-5 Display SUM

Step-6 Stop



OR

Algorithm

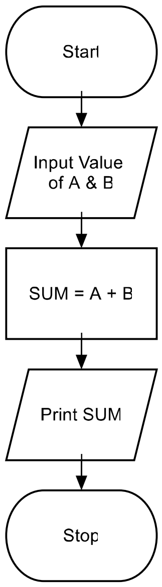
Step-1 Start

Step-2 Input two numbers say A & B

Step-3 SUM = A + B

Step-4 Display SUM

Step-5 Stop



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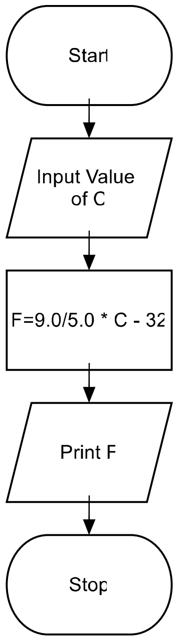
Algorithm & Flowchart to convert temperature from Celsius to Fahrenheit

C : temperature in Celsius
F : temperature Fahrenheit



Algorithm

Step-1 Start

Step-2 Input temperature in Celsius say C

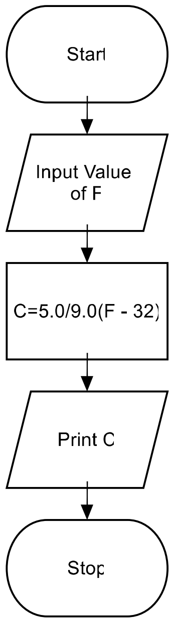
Step-3 F = (9.0/5.0 x C) + 32

Step-4 Display Temperature in Fahrenheit F

Step-5 Stop

Algorithm & Flowchart to convert temperature from Fahrenheit to Celsius

C : temperature in Celsius
F : temperature Fahrenheit



Algorithm

Step-1 Start

Step-2 Input temperature in Fahrenheit say F

Step-3 C = 5.0/9.0 (F - 32)

Step-4 Display Temperature in Celsius C

Step-5 Stop

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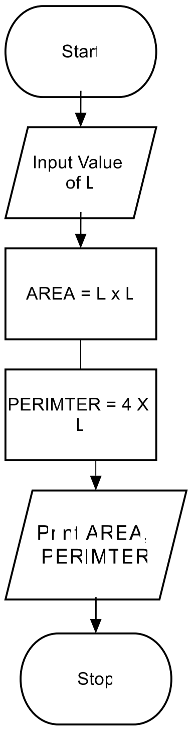
Algorithm & Flowchart to find Area and Perimeter of Square

L : Side Length of Square
AREA : Area of Square
PERIMETER : Perimeter of Square



Algorithm

Step-1 Start

Step-2 Input Side Length of Square say L

Step-3 Area = L x L

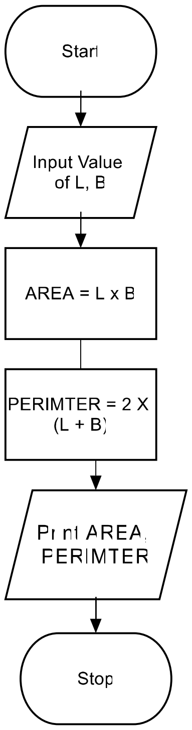
Step-4 PERIMETER = 4 x L

Step-5 Display AREA, PERIMETER

Step-6 Stop

Algorithm & Flowchart to find Area and Perimeter of Rectangle

L : Length of Rectangle
B : Breadth of Rectangle
AREA : Area of Rectangle
PERIMETER : Perimeter of Rectangle



Algorithm

Step-1 Start

Step-2 Input Side Length & Breadth say L, B

Step-3 Area = L x B

Step-4 PERIMETER = 2 x (L + B)

Step-5 Display AREA, PERIMETER

Step-6 Stop

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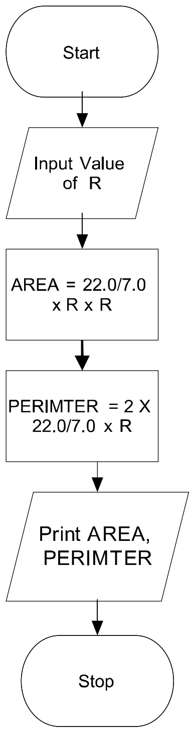
Algorithm & Flowchart to find Area and Perimeter of Circle

R : Radius of Circle
AREA : Area of Circle
PERIMETER : Perimeter of Circle



Algorithm

Step-1 Start

Step-2 Input Radius of Circle say R

Step-3 Area = 22.0/7.0 x R x R

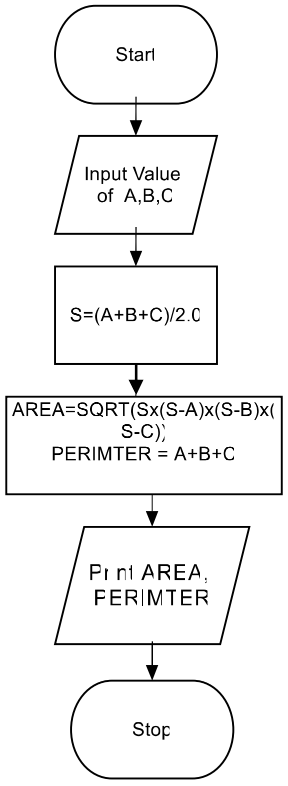
Step-4 PERIMETER = 2 x 22.0/7.0 x R

Step-5 Display AREA, PERIMETER

Step-6 Stop

Algorithm & Flowchart to find Area & Perimeter of Triangle
(when three sides are given)

A : First Side of Triangle
B : Second Side of Triangle
C : Third Side of Triangle
AREA : Area of Triangle
PERIMETER : Perimeter of Triangle



Algorithm

Step-1 Start

Step-2 Input Sides of Triangle A,B,C

Step-3 S= (A + B + C)/ 2.0

Step-4 AREA = SQRT(S x (S-A) x (S-B) x(S-C))

Step-5 PERIMETER = S1 + S2 + S3

Step-6 Display AREA, PERIMETER

Step-7 Stop

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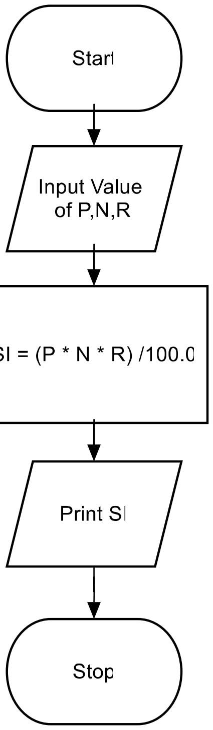
Algorithm & Flowchart to find Simple Interest

P : Principle Amount
N : Time in Years
R : % Annual Rate of Interest
SI : Simple Interest



Algorithm

Step-1 Start

Step-2 Input value of P, N, R

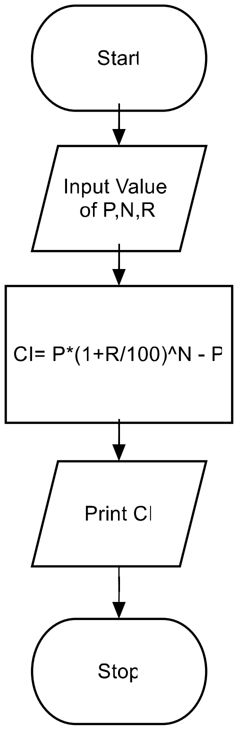
Step-3 SI = (P x N x R)/100.0

Step-4 Display SI F

Step-6 Stop

Algorithm & Flowchart to find Compound Interest

P : Principle Amount
N : Time in Years
R : % Annual Rate of Interest
CI : Compound Interest



Algorithm

Step-1 Start

Step-2 Input value of P, N, R C

Step-3 CI = $P(1+R/100)^N$ - P

Step-4 Display CI

Step-6 Stop

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Algorithm & Flowchart to Swap Two Numbers using Temporary Variable

Algorithm

Step-1 Start

Step-2 Input Two Numbers Say NUM1,NUM2

Step-3 Display Before Swap Values NUM1, NUM2

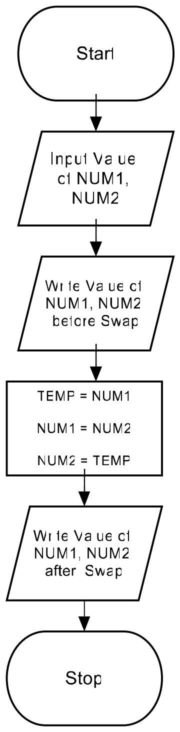
Step-4 TEMP = NUM1

Step-5 NUM1 = NUM2

Step-6 NUM2 = NUM1

Step-7 Display After Swap Values NUM1,NUM

Step-8 Stop


Start
Input Value of NUM1, NUM2
Write Value of NUM1, NUM2 before Swap
TEMP = NUM1
NUM1 = NUM2
NUM2 = TEMP
Write Value of NUM1, NUM2 after Swap
Stop

Algorithm & Flowchart to Swap Two Numbers without using temporary variable

Algorithm

Step-1 Start

Step-2 Input Two Numbers Say A,B

Step-3 Display Before Swap Values A, B

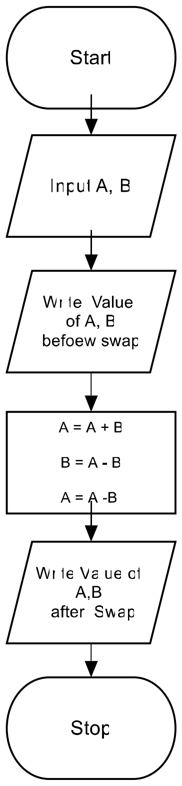
Step-4 A = A + B

Step-5 B = A - B

Step-6 A = A - B

Step-7 Display After Swap Values A, B

Step-8 Stop


Start
Input A, B
Write Value of A, B befoew swap
A = A + B
B = A - B
A = A -B
Write Value of A,B after Swap
Stop

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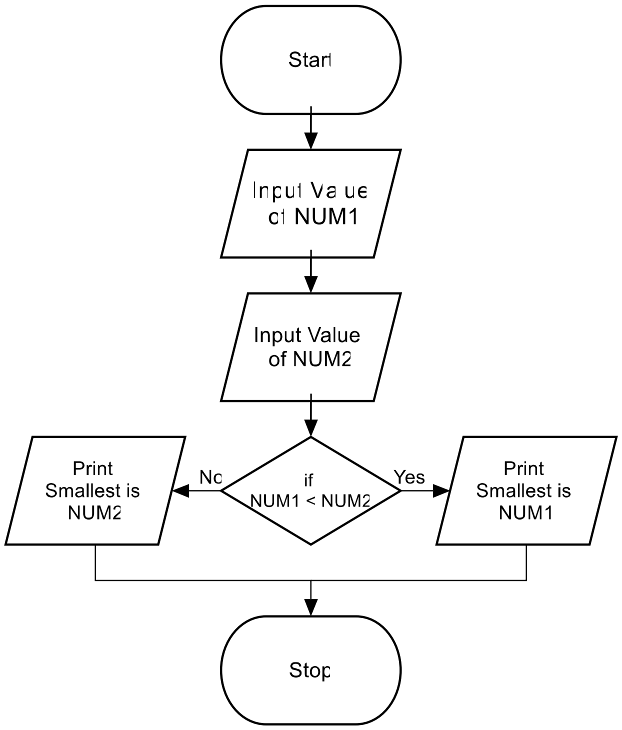
Algorithm & Flowchart to find the smallest of two numbers

Algorithm

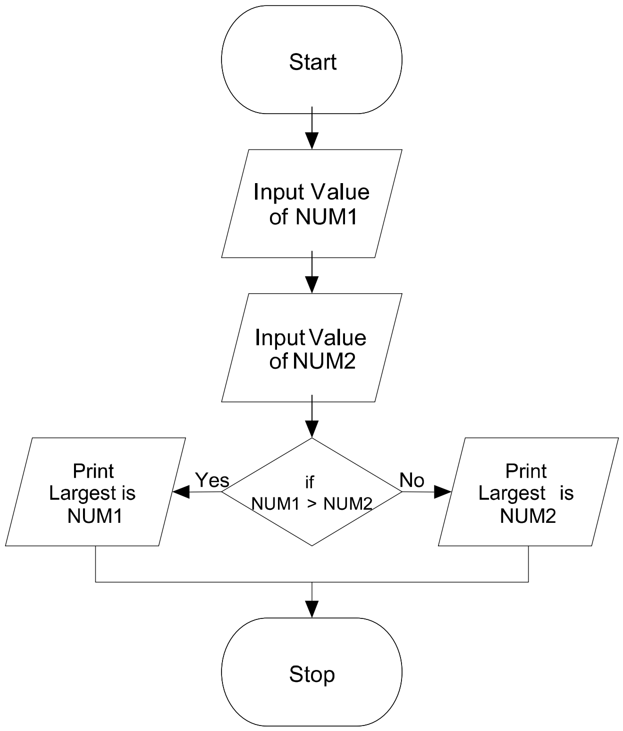
```
Step-1   Start
Step-2   Input two numbers say
NUM1,NUM2
Step-3   IF NUM1 < NUM2  THEN
                print smallest is NUM1
            ELSE
                print smallest is NUM2
            ENDIF
Step-4   Stop
```



Algorithm & Flowchart to find the largest of two numbers

Algorithm

```
Step-1   Start
Step-2   Input two numbers say
NUM1,NUM2
Step-3    IF NUM1 > NUM2 THEN
                print largest is NUM1
            ELSE
                print largest is NUM2
             ENDIF
Step-4     Stop
```



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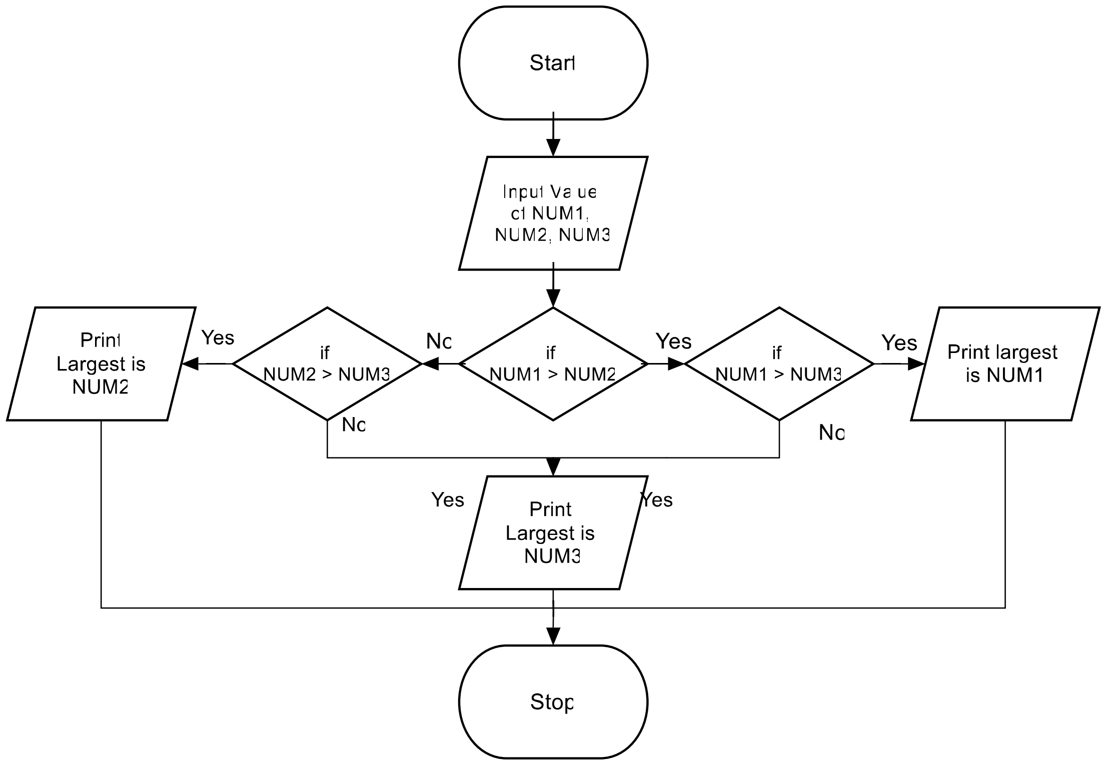
Algorithm & Flowchart to find the largest of three numbers

Algorithm

```
Step-1   Start
Step-2   Read three numbers say num1,num2, num3
Step-3   if num1>num2 then go to step-5
Step-4   IF num2>num3 THEN
            print num2 is largest
         ELSE
            print num3 is largest
         ENDIF
         GO TO Step-6
Step-5   IF num1>num3 THEN
            print num1 is largest
         ELSE
            print num3 is largest
         ENDIF
Step-6   Stop
```



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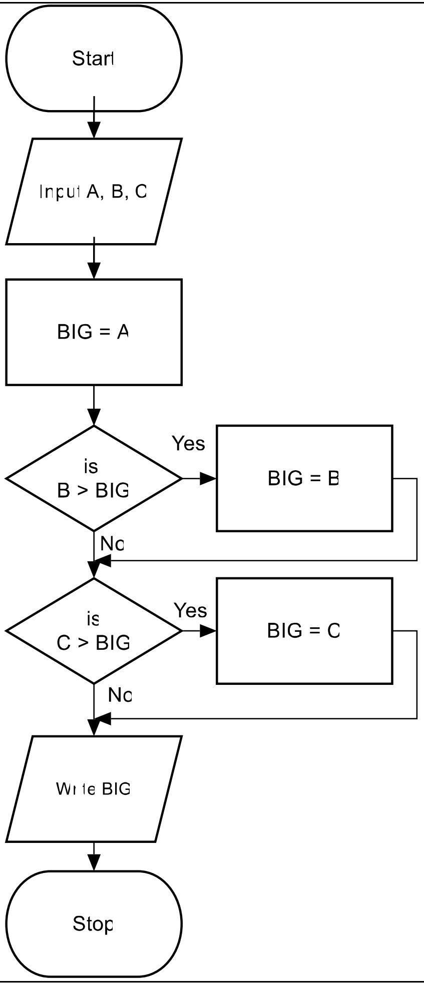
Algorithm & Flowchart to find the largest of three numbers (an another way)

Algorithm

```
Step-1   Start
Step-2   Read three numbers say A,B,C
Step-3   BIG = A
Step-4   IF B > BIG THEN
             BIG = B
         ENDIF
Step-5   IF C >BIG THEN
             BIG = C
         ENDIF
Step-6   Write BIG
Step-7   Stop
```



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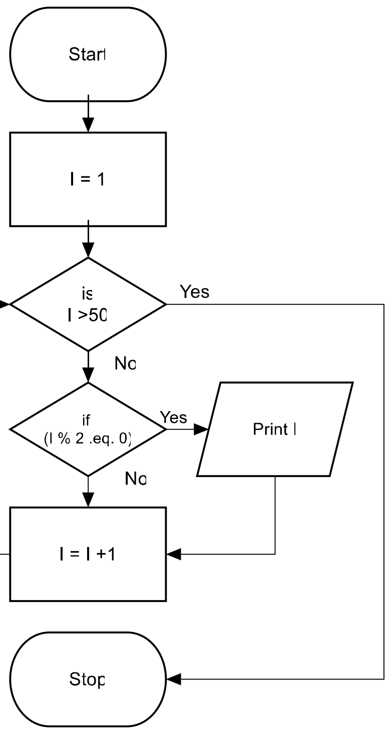
Algorithm & Flowchart to find Even number between 1 to 50

Algorithm

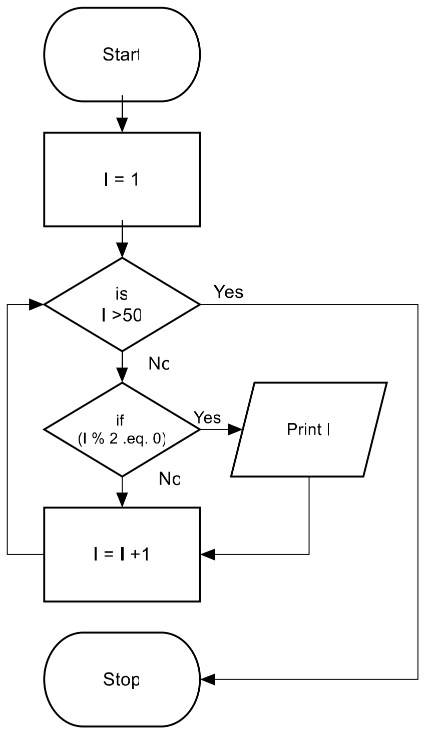
```
Step-1   Start
Step-2    I = 1
Step-3    IF (I >50)  THEN
              GO TO Step-7
            ENDIF
Step-4    IF (  (I % 2) =0)  THEN
             Display I
           ENDIF
Step-5   I = I + 1
Step-6   GO TO Step--3
Step-7  Stop
```



Algorithm & Flowchart to find Odd numbers between 1 to n where n is a positive Integer

Algorithm

```
Step-1   Start
Step-2   Input Value of N
Step-3    I = 1
Step-4    IF (I >N)  THEN
              GO TO Step-8
            ENDIF
Step-5    IF (  (I % 2)=1) THEN
             Display I
            ENDIF
Step-6    I = I + 1
Step-7    GO TO Step-4
Step-8   Stop
```



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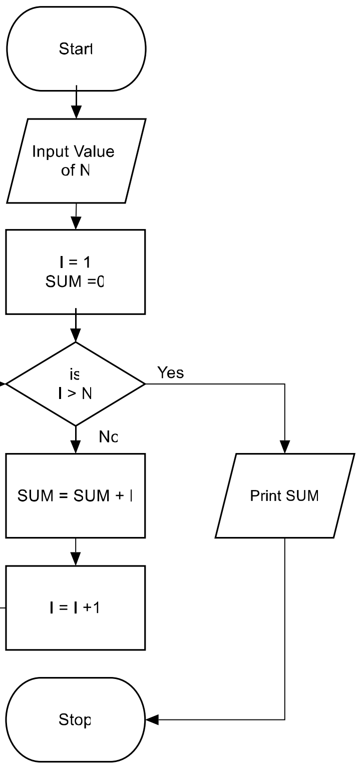
Algorithm & Flowchart to find sum of series 1+2+3+…..+N

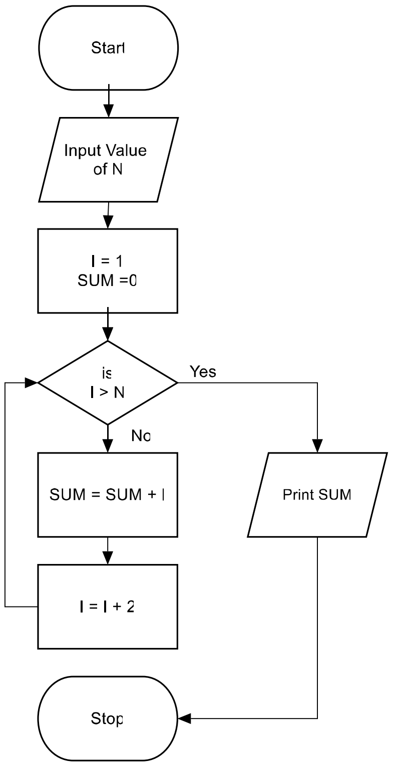


Algorithm

```
Step-1   Start
Step-2   Input Value of N
Step-3   I = 1, SUM=0
Step-4   IF (I >N)  THEN
             GO TO Step-8
         ENDIF
Step-5   SUM = SUM + I
Step-6   I = I + 1
Step-7   Go to step-4
Step-8   Display value of SUM
Step-9   Stop
```

Algorithm & Flowchart to find sum of series 1+3+5+…..+N, Where N is positive odd Integer

Algorithm



Algorithm

```
Step-1   Start
Step-2   Input Value of N
Step-3   I = 1, SUM=0
Step-4   IF (I >N)  THEN
             GO TO step 8
         ENDIF
Step-5   SUM = SUM + I
Step-6   I = I + 2
Step-7   Go to step-4
Step-8   Display value of SUM
Step-9   Stop
```

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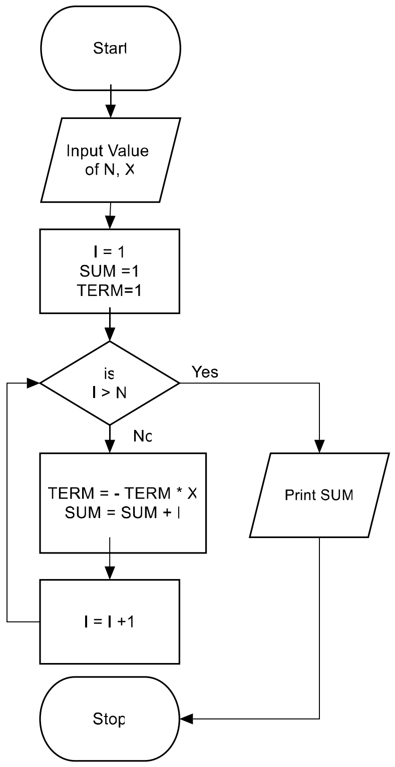
Algorithm & Flowchart to find sum of series $1 - X + X^2 - X^3 \ldots X^N$

Algorithm

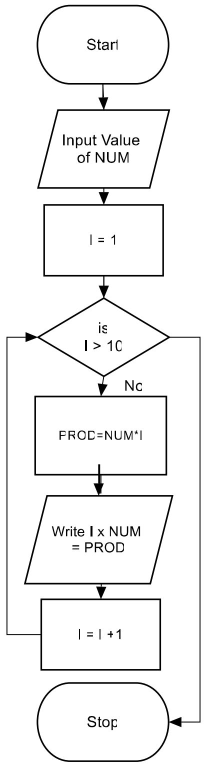
```
Step-1   Start
Step-2   Input Value of N, X
Step-3   I = 1, SUM=1, TERM=1
Step-4   IF (I >N) THEN
            GO TO Step-9
         ENDIF
Step-5   TERM = - TERM * X
Step-6   SUM = SUM + TERM
Step-7   I = I + 1
Step-8   Go to step-4
Step-9   Display value of SUM
Step-10  Stop
```



Algorithm & Flowchart to print multiplication Table of a number

Algorithm

```
Step-1   Start
Step-2   Input Value of NUM
Step-3   I = 1
Step-4   IF (I >10) THEN
            GO TO Step 9
         ENDIF
Step-5   PROD = NUM * I
Step-6   WRITE I "x" NUM "=" PROD
Step-7   I = I + 1
Step-8   Go to step-4
Step-9   Stop
```



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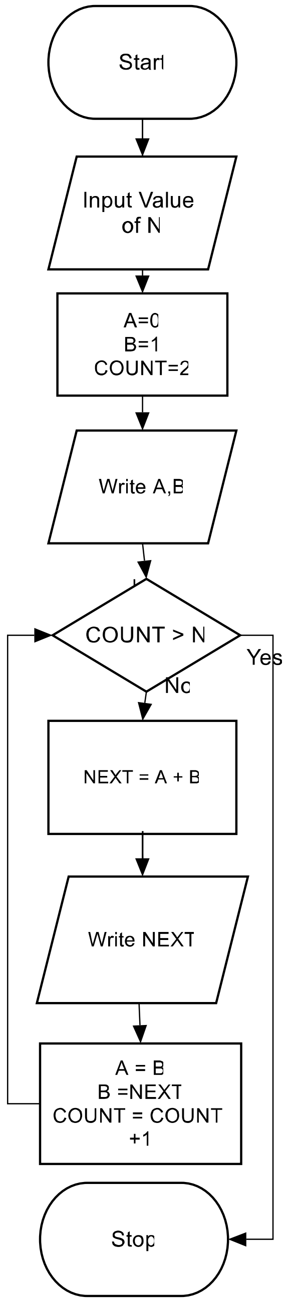
Algorithm & Flowchart to generate first n Fibonacci terms 0,1,1,2,3,5…n (n>2)

Algorithm

```
Step-1    Start
Step-2    Input Value of N
Step-3    A=0, B=1, COUNT=2
Step-4    WRITE A, B
Step-5    IF (COUNT  >N)  then go to step 12
Step-6    NEXT= A + B
Step-7    WRITE NEXT
Step-8    A=B
Step-9    B=NEXT
Step-10   COUNT=COUNT  + 1
Step-11   Go to step-4
Step-12   Stop
```



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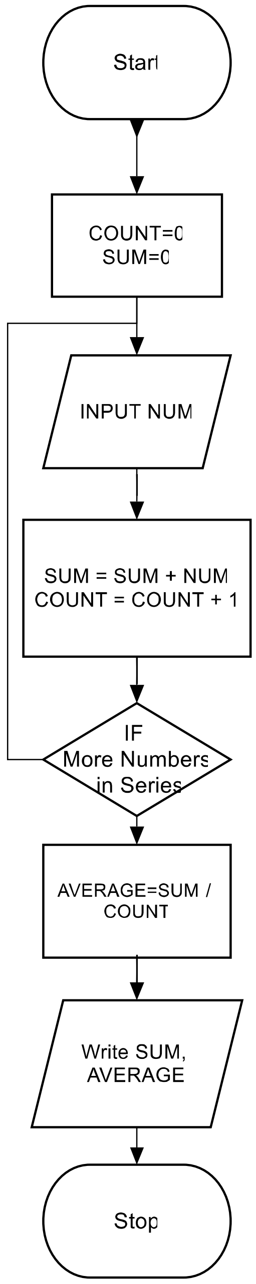
Algorithm & Flowchart to find sum and average of given series of numbers

Algorithm

```
Step-1   Start
Step-2   COUNT=0
Step-3   SUM=0
Step-4   Input NUM        (next number in series)
Step-5   SUM= SUM +NUM
Step-6   COUNT=COUNT+1
Step-7   IF More Number in Series then
              GOTO Step-4
         ENDIF
Step-8   AVERGAE=SUM / COUNT
Step-9   WRITE SUM, AVERAGE
Step-10 Stop
```



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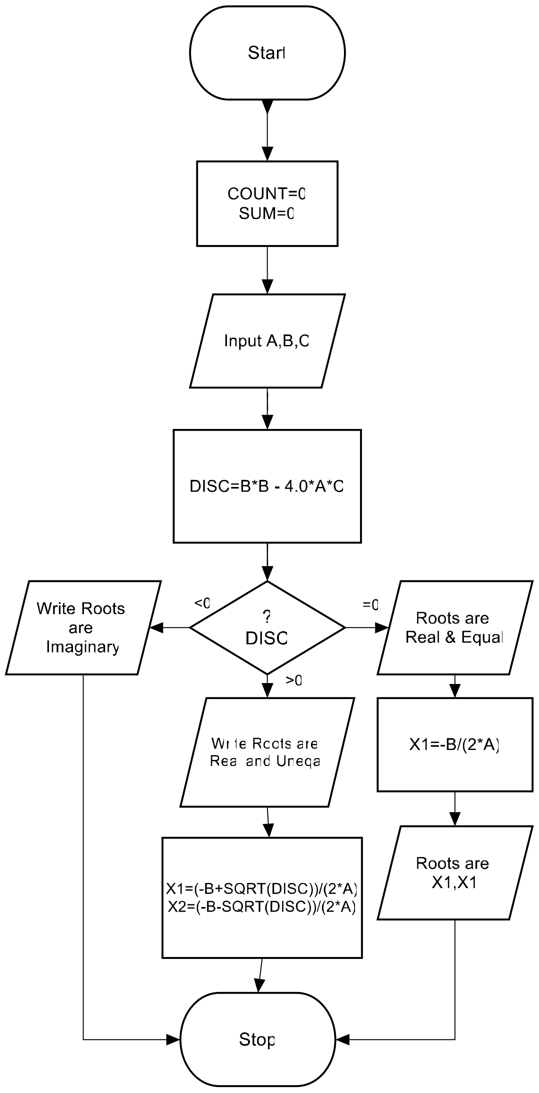
Algorithm & Flowchart to find Roots of Quadratic Equations $AX^2+BX+C=0$

Algorithm

```
Step-1   Start
Step-2   Input A,B,C
Step-3   DISC= B^2 – 4 A * C
Step-4   IF (DISC < 0) THEN
             Write Roots are Imaginary
             Stop
         ENDIF
Step-5   IF (DISC==0) THEN
             Write Roots are Real and Equal
             X1 = - B/(2*A)
             Write Roots are X1,X1
             Stop
         ENDIF
Step-6   IF (DISC >0)
             Write Roots are Real and Unequal
             X1= (- B + SQRT(DISC)) / (2*A)
             X2= (- B + SQRT(DISC)) / (2*A)
             Write Roots are X1,X2
             Stop
         ENDIF
```



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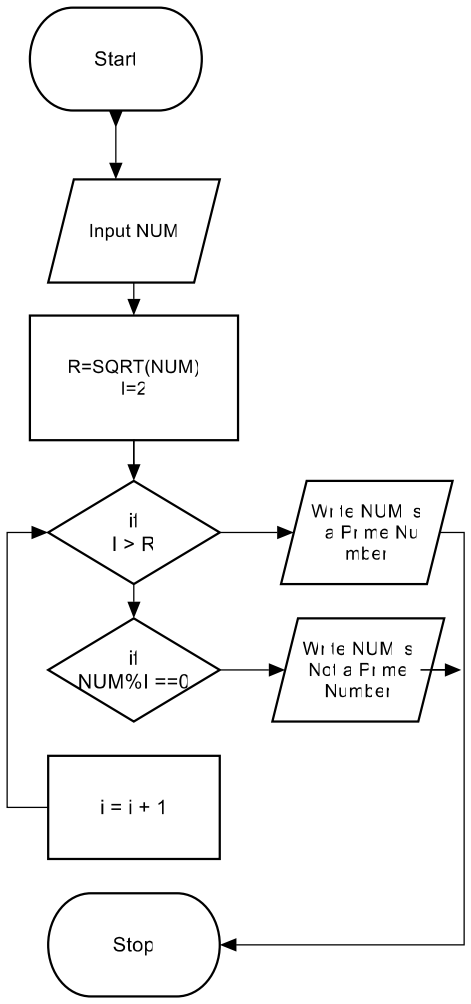
Algorithm & Flowchart to find if a number is prime or not

Algorithm

```
Step-1   Start
Step-2   Input NUM
Step-3   R=SQRT(NUM)
Step-4   I=2
Step-5   IF ( I > R) THEN
            Write NUM is Prime Number
            Stop
         ENDIF
Step 6   IF ( NUM % I ==0) THEN
            Write NUM is Not Prime
            Stop
         ENDIF
Step-7   I = I + 1
Step-8   Go to Step-5
```



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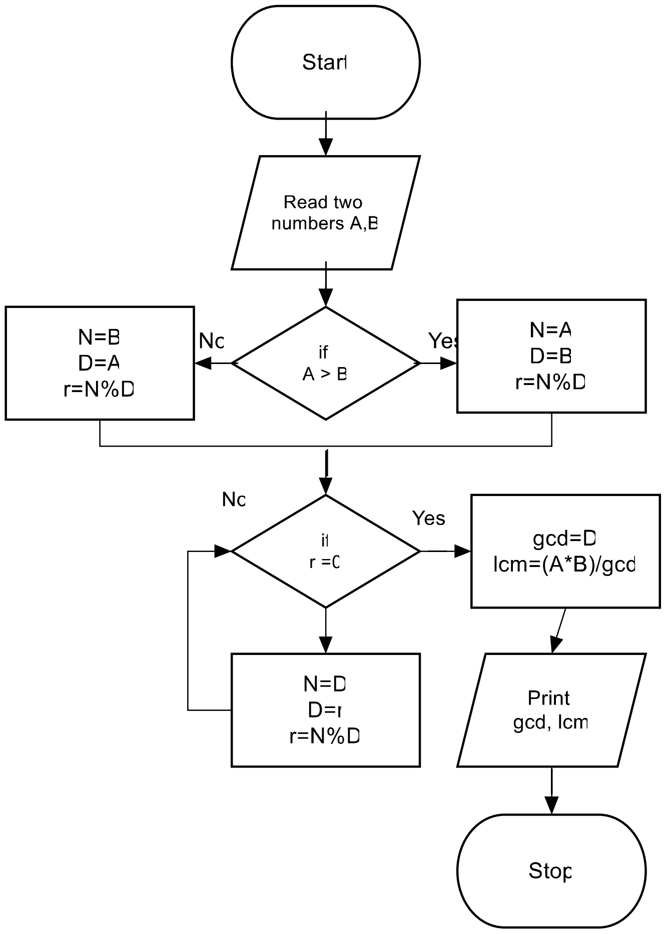
Algorithm & Flowchart to find GCD and LCM of two numbers

Algorithm

```
Step-1   Start
Step-2   Read two number A, B
Step-3   IF (A > B) THEN
             N =A
             D=B
         ELSE
             N=B
             D=A
         ENDIF
Step-4   r=N/D
Step-5   WHILE (r != 0)
         DO
             N=D
             D=r
             r =N%D
         DONE

Step-6   gcd=d
Step-7   lcm = (a*b)/gcd
Step-8   Display gcd, lcm
Step-9   Stop
```

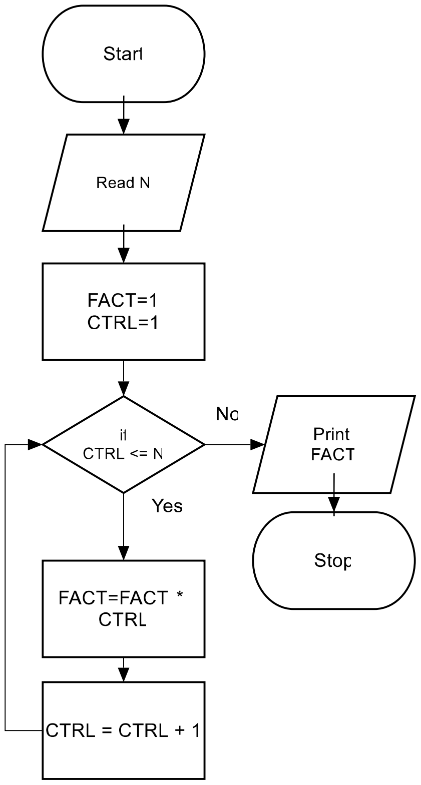


…

Algorithm & Flowchart to find Factorial of number n (n!=1x2x3x…n)

Algorithm

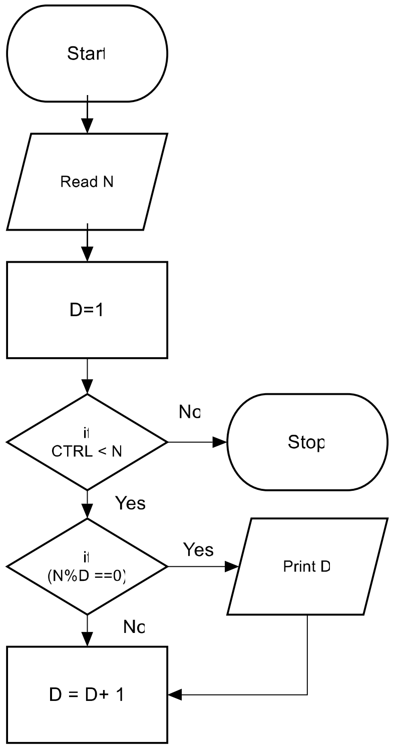
```
Step-1   Start
Step-2   Read number N
Step-3   FACT=1  CTRL=1
Step-4   WHILE (CTRL <= N)
           DO
             FACT=FACT*I
             CTRL=CTRL+1
         DONE
Step-5   Display FACT
Step-6   Stop
```



Algorithm & Flowchart to find all the divisor of a number

Algorithm

```
Step-1   Start
Step-2   Read number N
Step-3   D=1
Step-4   WHILE (D< N)
           DO
             IF ( N % D ==0)   THEN
               PRINT D
             ENDIF
             D=D+1
         DONE
Step-5  Stop
```


Start
Read N
D=1
if
CTRL < N
No
Stop
Yes
if
(N%D ==0)
Yes
Print D
No
D = D+ 1