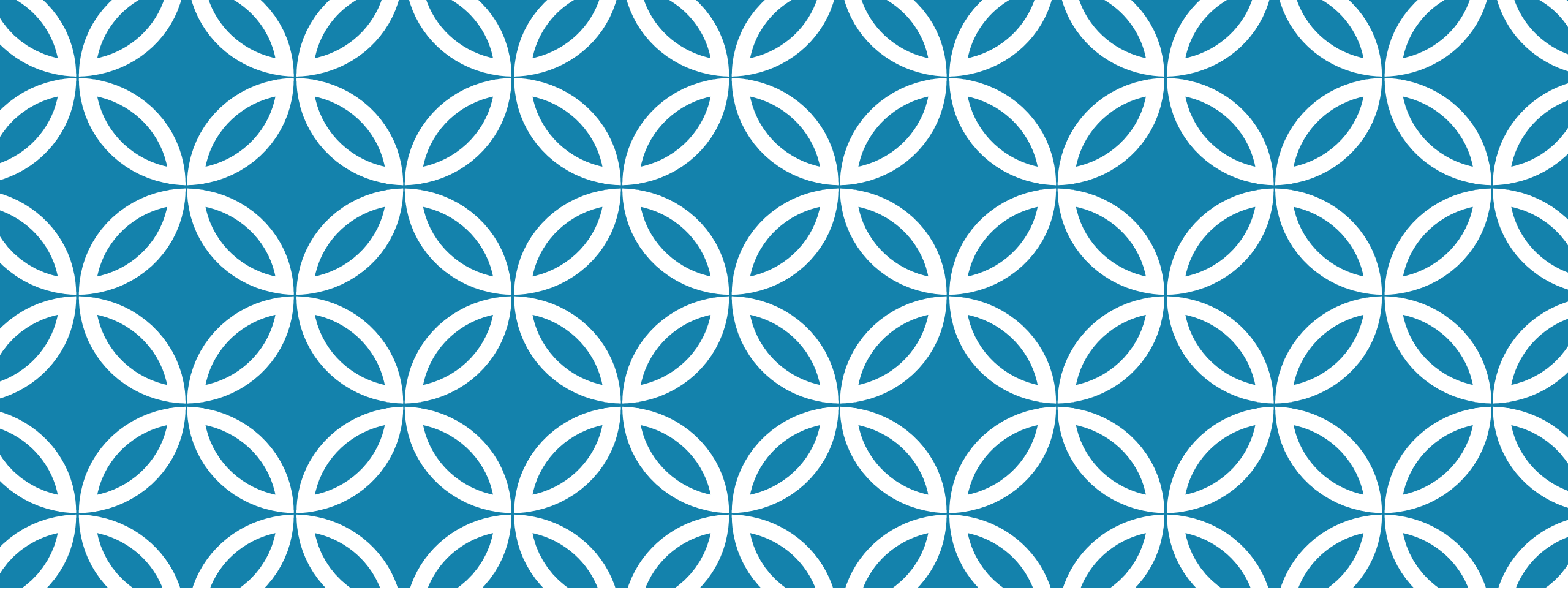


ALGORITHMS AND FLOWCHARTS

ALGORITHMS

Algorithm is a step-by-step procedure, which defines a set of instructions to be executed in a certain order to get the desired output.

An algorithm is the list of instructions and rules that a computer needs to do to complete a task.

Algorithms are simply a series of instructions that are followed, step by step, to do something useful or solve a problem.

STEPS IN PROBLEM SOLVING

First produce a general algorithm (one can use ***pseudocode***)

Refine the algorithm successively to get step by step detailed ***algorithm*** that is very close to a computer language.

Pseudocode is an artificial and informal language that helps programmers develop algorithms. Pseudocode is very similar to everyday English.

PSEUDOCODE & ALGORITHM

Example 1: Write an algorithm to determine a student's final grade and indicate whether it is passing or failing. The final grade is calculated as the average of four marks.

PSEUDOCODE & ALGORITHM

Pseudocode:

Input a set of 4 marks

Calculate their average by summing and dividing by 4

if average is below 50

    Print "FAIL"

else

    Print "PASS"

PSEUDOCODE & ALGORITHM

Detailed Algorithm

Step 1: Input M1,M2,M3,M4

Step 2: GRADE ← (M1+M2+M3+M4)/4

Step 3: if (GRADE < 50) then

Print “FAIL”

else

Print “PASS”

endif

THE FLOWCHART

(Dictionary) A schematic representation of a sequence of operations, as in a manufacturing process or computer program.

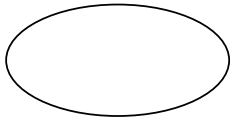
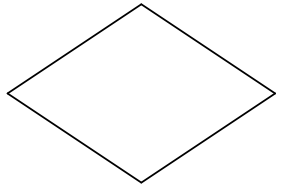
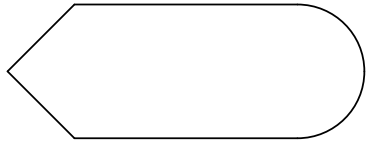
(Technical) A graphical representation of the sequence of operations in an information system or program. Information system flowcharts show how data flows from source documents through the computer to final distribution to users. Program flowcharts show the sequence of instructions in a single program or subroutine. Different symbols are used to draw each type of flowchart.

THE FLOWCHART

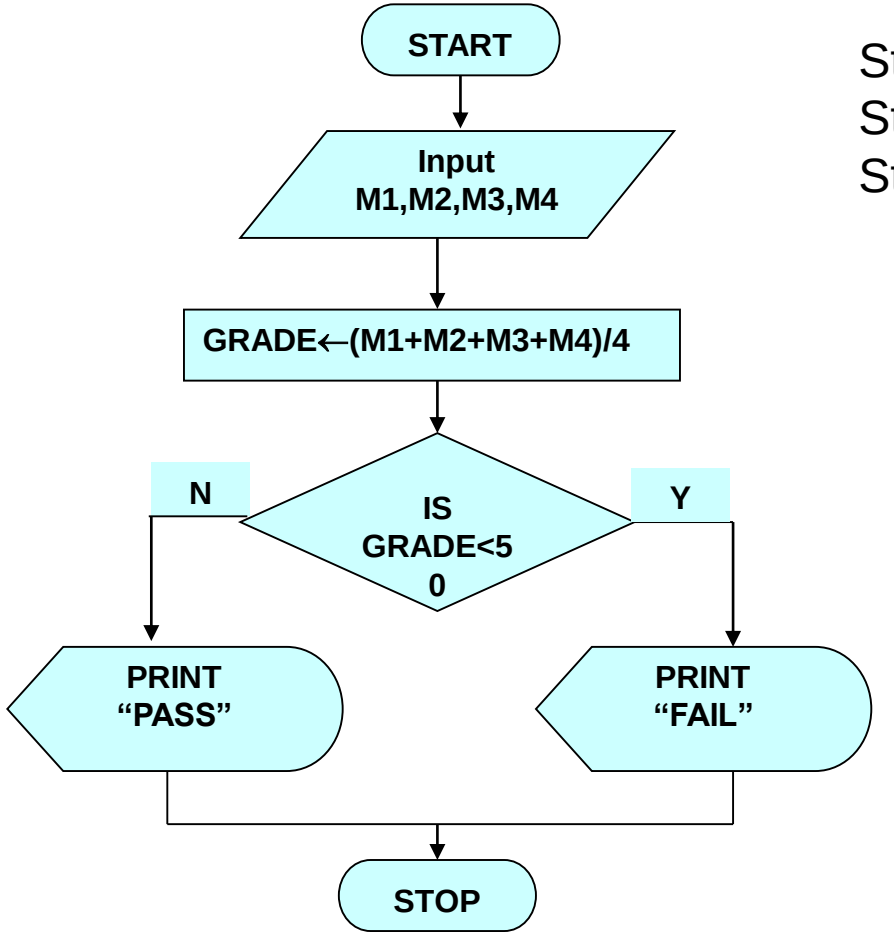
A Flowchart

- shows logic of an algorithm
- emphasizes individual steps and their interconnections
- e.g. control flow from one action to the next

FLOWCHART SYMBOLS

Name	Symbol	Use in Flowchart
Oval		Denotes the beginning or end of the program
Parallelogram		Denotes an input operation
Rectangle		Denotes a process to be carried out e.g. addition, subtraction, division etc.
Diamond		Denotes a decision (or branch) to be made. The program should continue along one of two routes. (e.g. IF/THEN/ELSE)
Hybrid		Denotes an output operation
Flow line		Denotes the direction of logic flow in the program

EXAMPLE



Step 1: Input M1,M2,M3,M4
Step 2: GRADE ← (M1+M2+M3+M4)/4
Step 3: if (GRADE <50) then
Print “FAIL”
else
Print “PASS”
endif

EXAMPLE 2

Write an algorithm and draw a flowchart to convert the length in feet to centimeter.

Pseudocode:

Input the length in feet (Lft)

Calculate the length in cm (Lcm) by multiplying LFT with 30

Print length in cm (LCM)

EXAMPLE 2

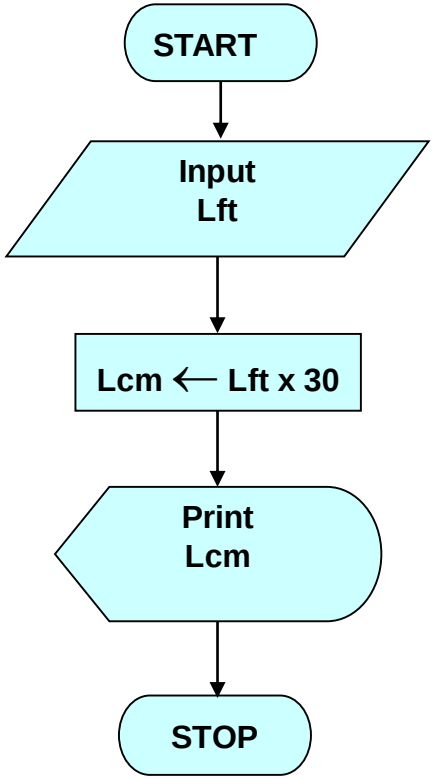
Algorithm

Step 1: Input Lft

Step 2: Lcm ← Lft x 30

Step 3: Print Lcm

Flowchart



EXAMPLE 3

Write an algorithm and draw a flowchart that will read the two sides of a rectangle and calculate its area.

Pseudocode

Input the width (W) and Length (L) of a rectangle

Calculate the area (A) by multiplying L with W

Print A

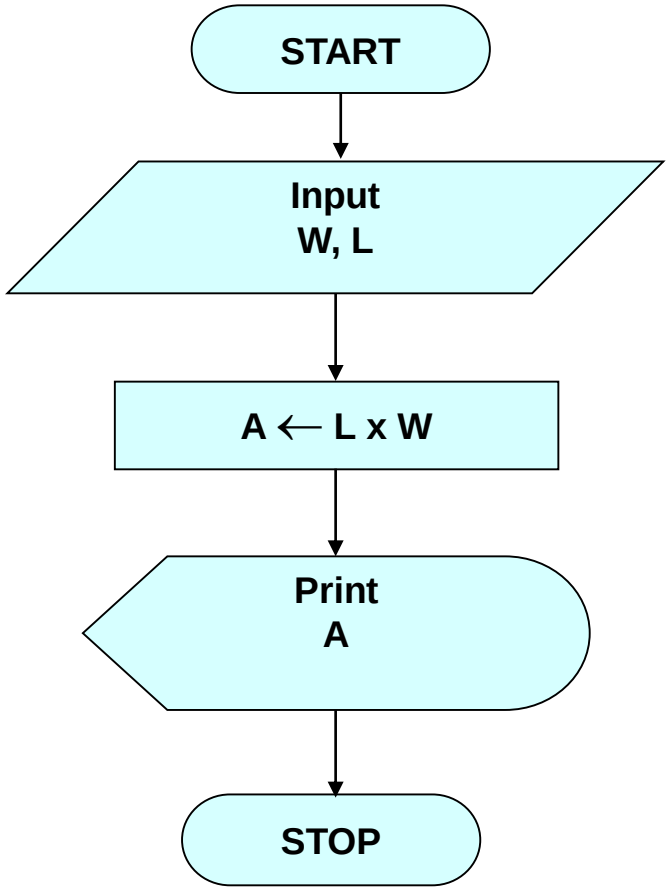
EXAMPLE 3

Algorithm

Step 1: Input W,L

Step 2: A ← L x W

Step 3: Print A



EXAMPLE 4

Write an algorithm and draw a flowchart that will calculate the roots of a quadratic equation

$$ax^2 + bx + c = 0$$

Hint: **d** = sqrt ($b^2 - 4ac$) and the roots are: **x1** = $(-b + d)/2a$ and **x2** = $(-b - d)/2a$

EXAMPLE 4

Pseudocode:

Input the coefficients (a, b, c) of the quadratic equation

Calculate **d**

Calculate **x1**

Calculate **x2**

Print x1 and x2

EXAMPLE 4

Algorithm:

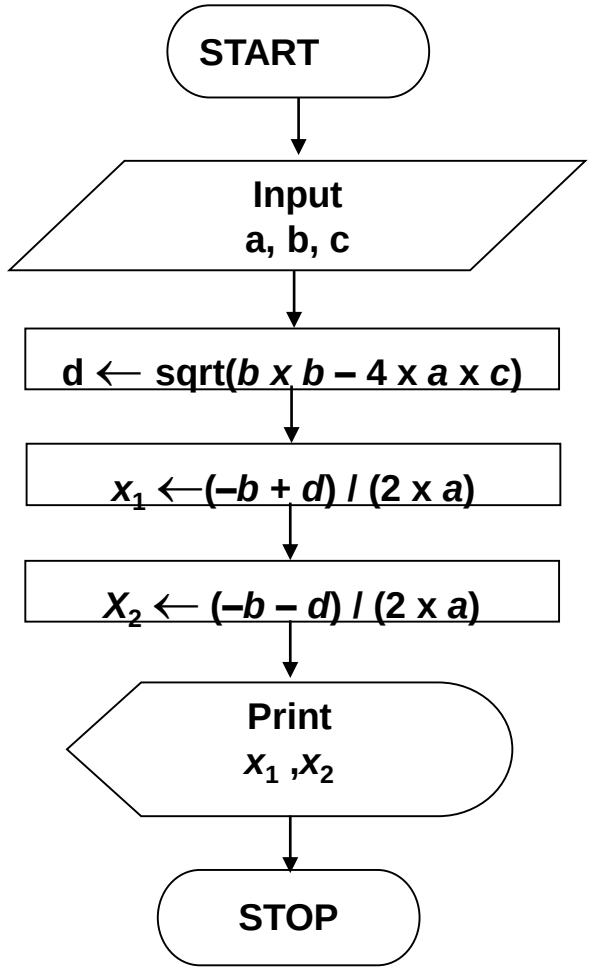
Step 1: Input a, b, c

Step 2: $d \leftarrow$ sqrt ($b \times b - 4 \times a \times c$)

Step 3: $x1 \leftarrow (-b + d) / (2 \times a)$

Step 4: $x2 \leftarrow (-b - d) / (2 \times a)$

Step 5: Print $x1$, $x2$



DECISION STRUCTURES

The expression A>B is a logical expression

*it describes a **condition** we want to test*

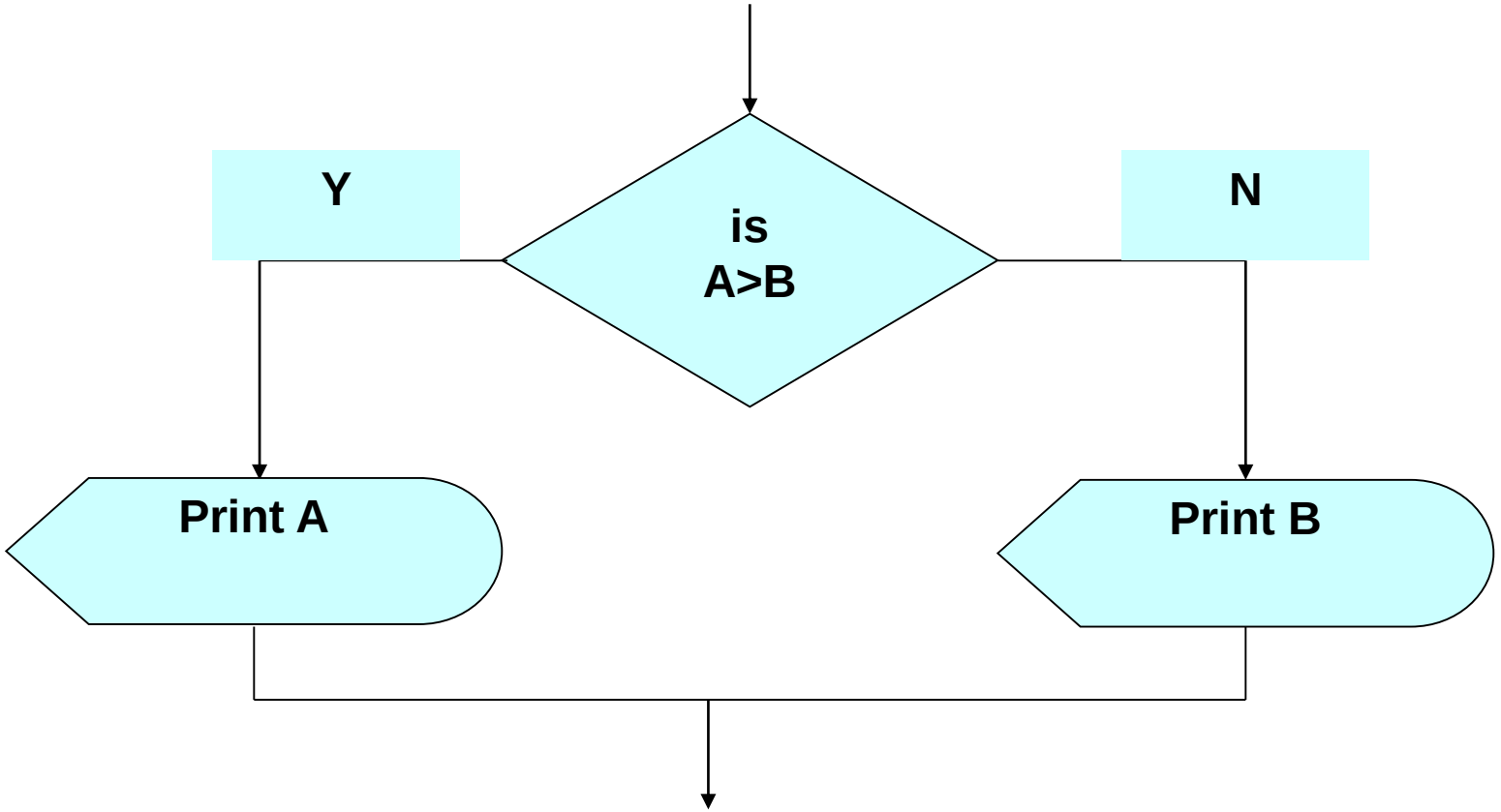
***if A>B is true (if A is greater than B)** we take the action on left*

print the value of A

***if A>B is false (if A is not greater than B)** we take the action on right*

print the value of B

DECISION STRUCTURES



IF–THEN–ELSE STRUCTURE

The structure is as follows

If condition then

true alternative

else

false alternative

endif

IF–THEN–ELSE STRUCTURE

The algorithm for the flowchart is as follows:

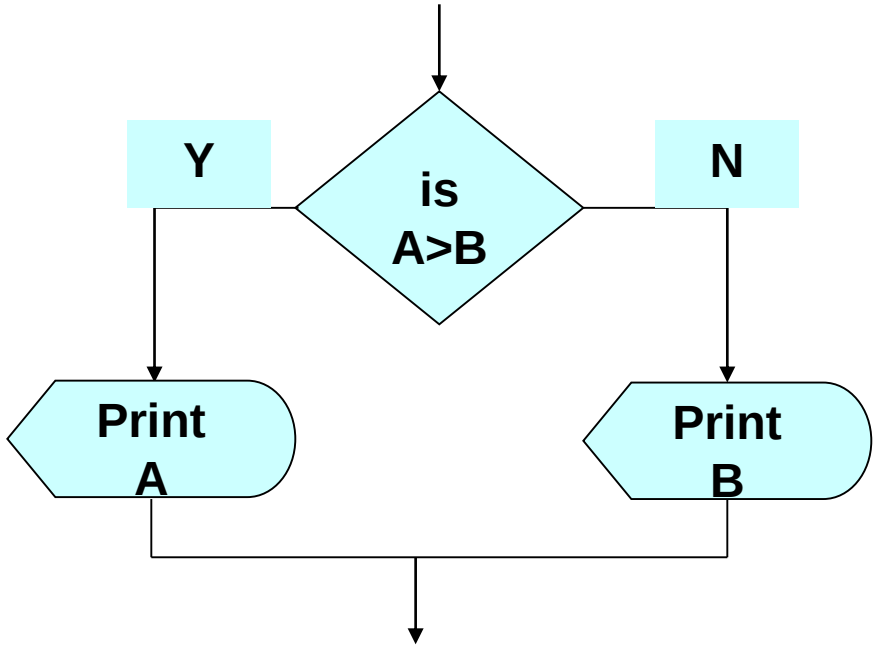
If A>B then

print A

else

print B

endif



RELATIONAL OPERATORS

Relational Operators	
Operator	**Description**
>	Greater than
<	Less than
=	Equal to
≥	Greater than or equal to
≤	Less than or equal to
≠	Not equal to

EXAMPLE 5

Write an algorithm that reads two values, determines the largest value and prints the largest value with an identifying message.

ALGORITHM

Step 1: *Input* VALUE1, VALUE2

Step 2: *if* (VALUE1 > VALUE2) *then*

MAX ← VALUE1

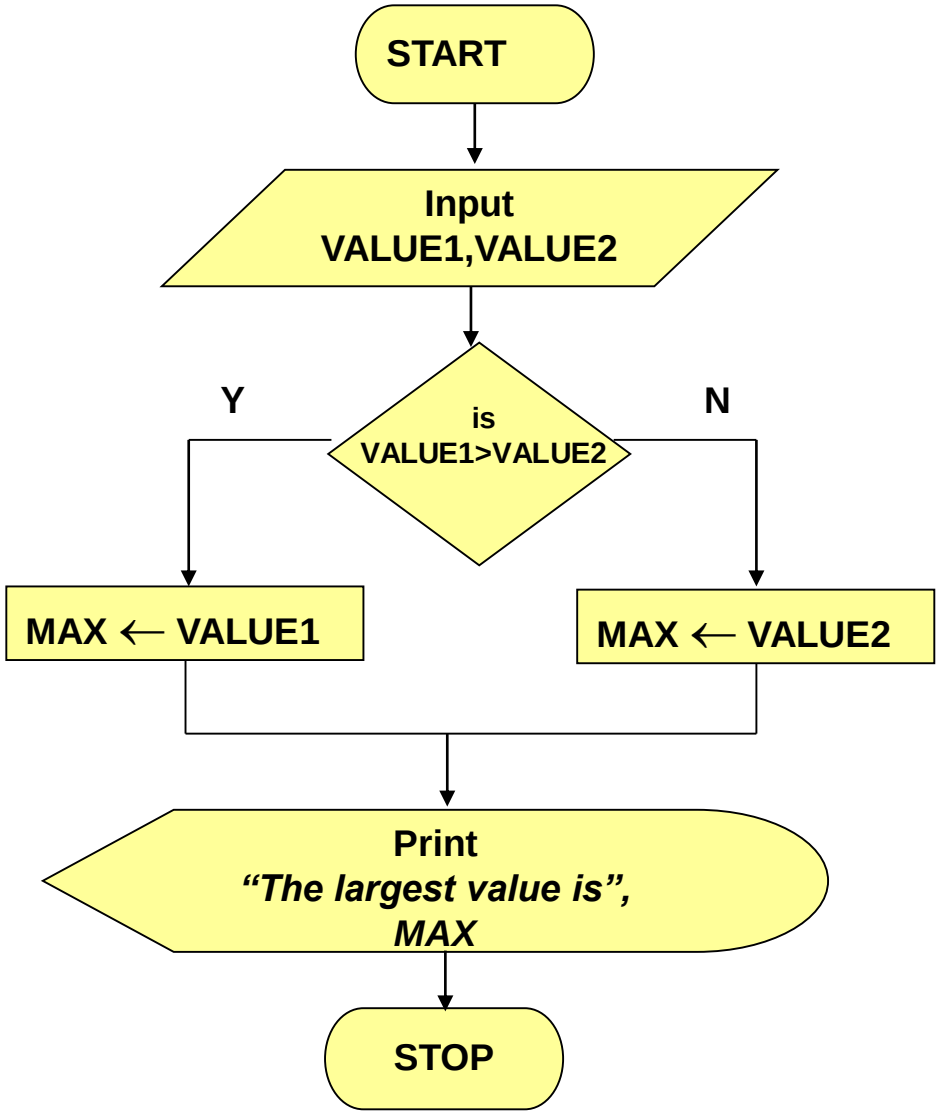
else

MAX ← VALUE2

endif

Step 3: *Print "The largest value is", MAX*

EXAMPLE 5


START
Input
VALUE1,VALUE2
Y
is
VALUE1>VALUE2
N
MAX ← VALUE1
MAX ← VALUE2
Print
"The largest value is",
MAX
STOP

NESTED IFS

One of the alternatives within an IF–THEN–ELSE statement

- may involve further IF–THEN–ELSE statement

EXAMPLE 6

Write an algorithm that reads **three** numbers and prints the value of the largest number.

EXAMPLE 6

Step 1: *Input* **N1, N2, N3**

Step 2: *if* **(N1>N2)** *then*

if **(N1>N3)** *then*

MAX ← N1[N1>N2, N1>N3]

else

MAX ← N3[N3>N1>N2]

endif

else

if **(N2>N3)** *then*

MAX ← N2[N2>N1, N2>N3]

else

MAX ← N3 [N3>N2>N1]

endif

endif

Step 3: *Print "The largest number is", MAX*

EXAMPLE 6

Flowchart: Draw the flowchart of the above Algorithm.

EXAMPLE 7

Write and algorithm and draw a flowchart to

a) read an employee name (NAME), overtime hours worked (OVERTIME), hours absent (ABSENT) and

b) determine the bonus payment (PAYMENT).

EXAMPLE 7

Bonus Schedule	
OVERTIME – (2/3)*ABSENT	Bonus Paid
>40 hours >30 but ≤ 40 hours >20 but ≤ 30 hours >10 but ≤ 20 hours ≤ 10 hours	$50 $40 $30 $20 $10

Step 1: *Input* NAME,OVERTIME,ABSENT
Step 2: *if* (OVERTIME–(2/3)*ABSENT > 40) *then*
PAYMENT ← 50
*else if (*OVERTIME–(2/3)*ABSENT > 30) *then*
PAYMENT ← 40
*else if (*OVERTIME–(2/3)*ABSENT > 20) *then*
PAYMENT ← 30
*else if (*OVERTIME–(2/3)*ABSENT > 10) *then*
PAYMENT ←20
else
PAYMENT ← 10
endif
Step 3: *Print* “Bonus for”, NAME “is $”, PAYMENT

EXAMPLE 7

Flowchart: Draw the flowchart of the above algorithm?

END OF FLOWCHART