ALGORITHMS AND FLOWCHARTS

ALGORITHMS AND FLOWCHARTS

- A typical programming task can be divided into two phases:
- ***Problem solving phase***
  - produce an ordered sequence of steps that describe solution of problem
  - this sequence of steps is called an ***algorithm***
- ***Implementation phase***
  - implement the program in some programming language

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.

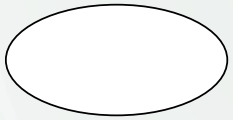
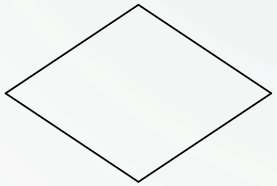
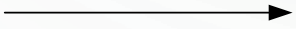
THE FLOWCHART

A Flowchart

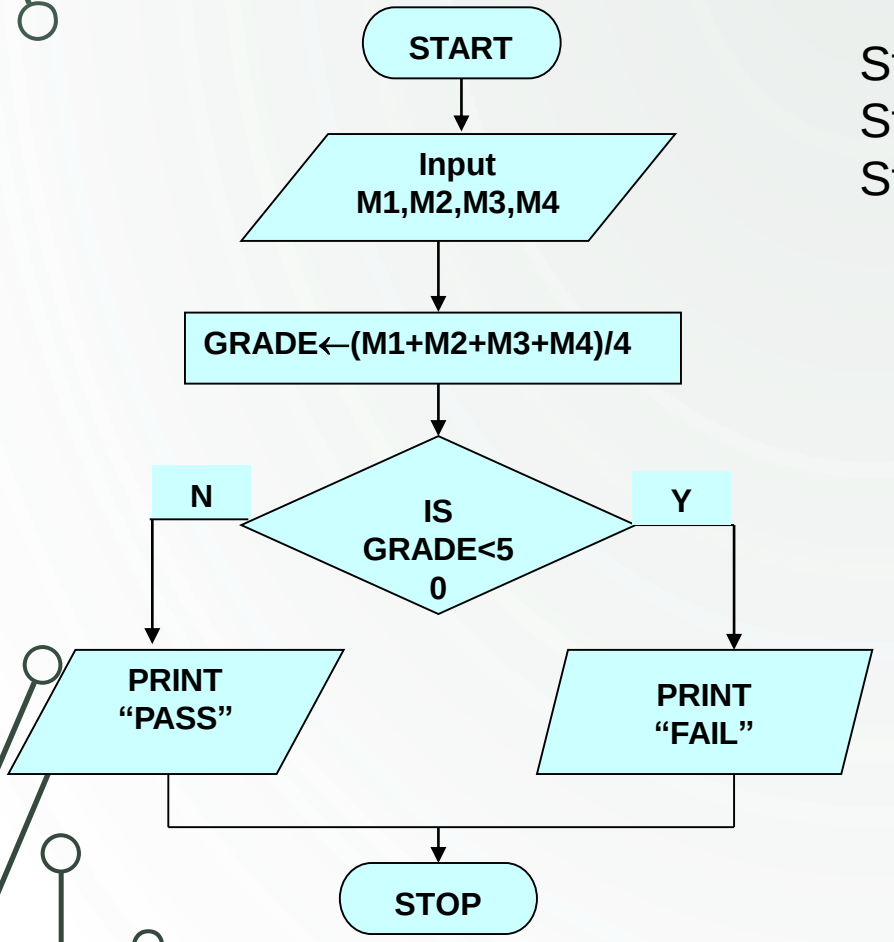
- shows logic of an algorithm
- emphasizes individual steps and their interconnections
- e.g. control flow from one action to the next

FLOWCHART SYMBOLS

Basic

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:

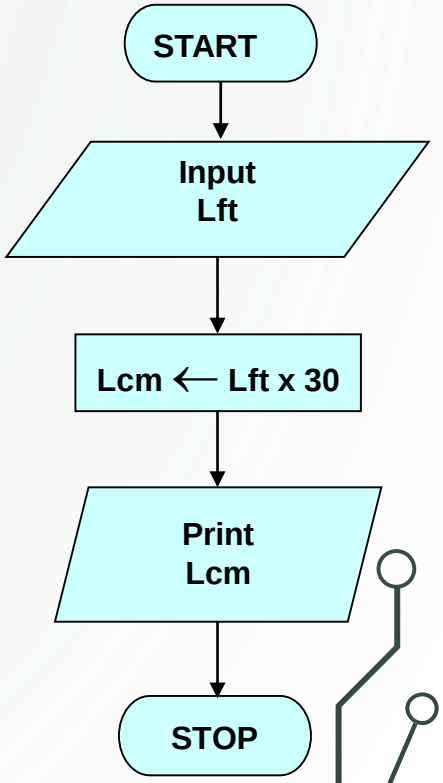
- *Input the length in feet (Lft)*
- *Calculate the length in cm (Lcm) by multiplying LFT with 30*
- *Print length in cm (LCM)*

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.

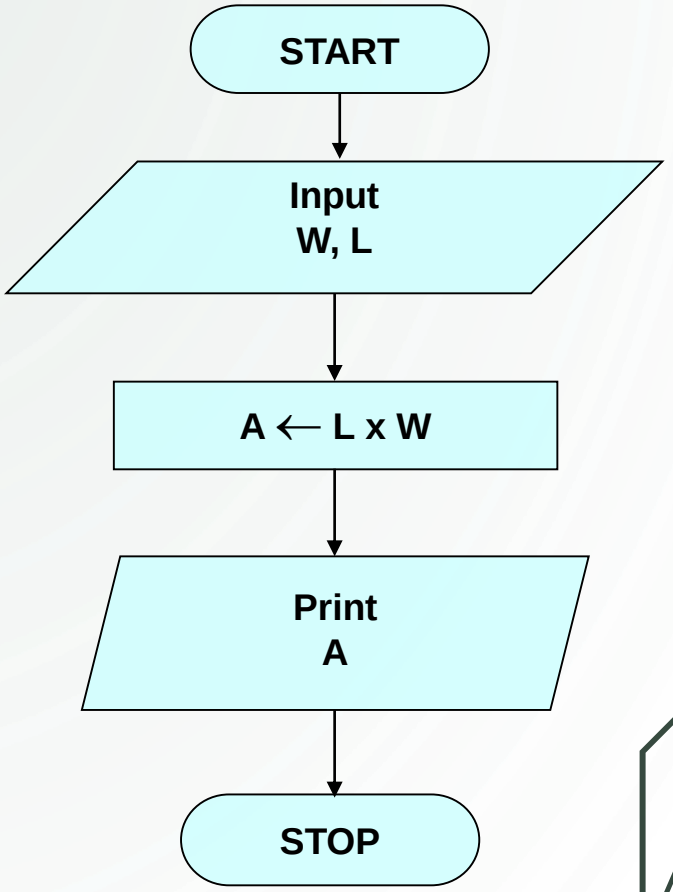
Pseudocode

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

$$b^2 - 4ac$$

- Hint: **d** = sqrt ( ), and the roots are: **x1** = (–b + d)/2a and **x2** = (–b – d)/2a

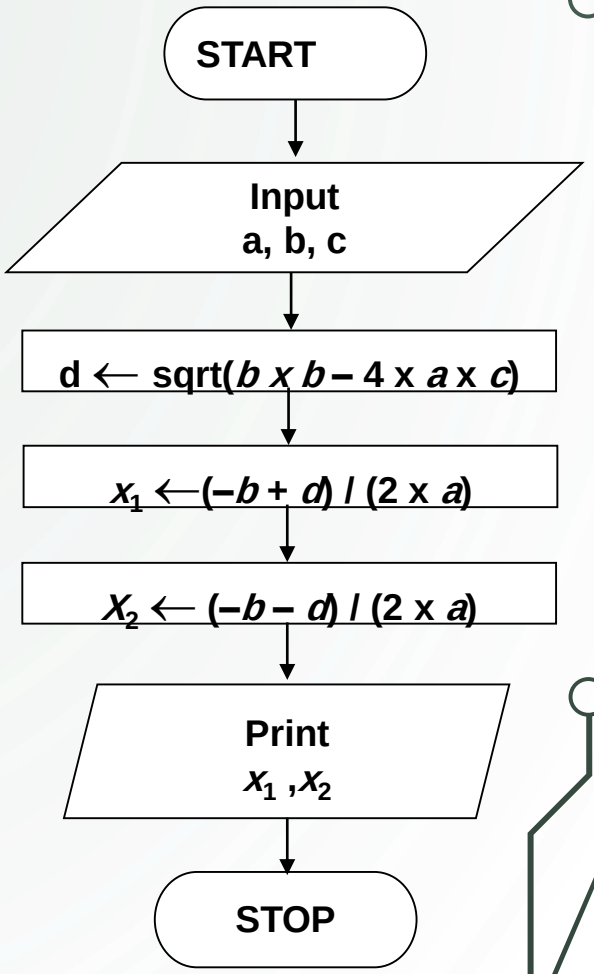
EXAMPLE 4

Pseudocode:

- *Input the coefficients (a, b, c) of the quadratic equation*
- *Calculate* **d**
- *Calculate* **x1**
- *Calculate* **x2**
- *Print x1 and x2*

EXAMPLE 4

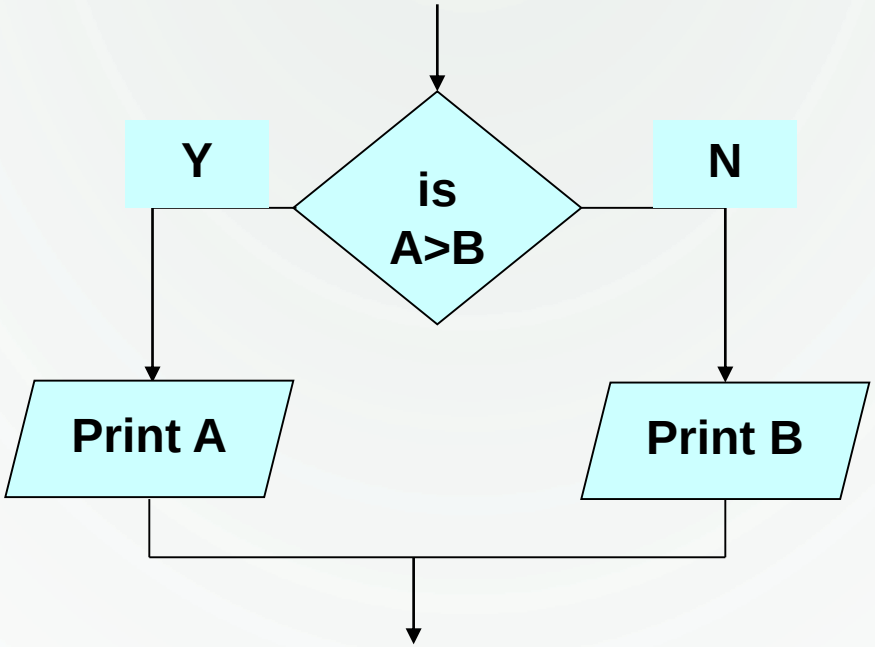
- **Algorithm:**
  - Step 1: Input a, b, c
  - Step 2: $d \leftarrow \text{sqrt}\,(b \times b - 4 \times a \times c)$
  - Step 3: $x1 \leftarrow (-b + d) / (2 \times a)$
  - Step 4: $x2 \leftarrow (-b - d) / (2 \times a)$
  - Step 5: Print $x1, x2$



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:

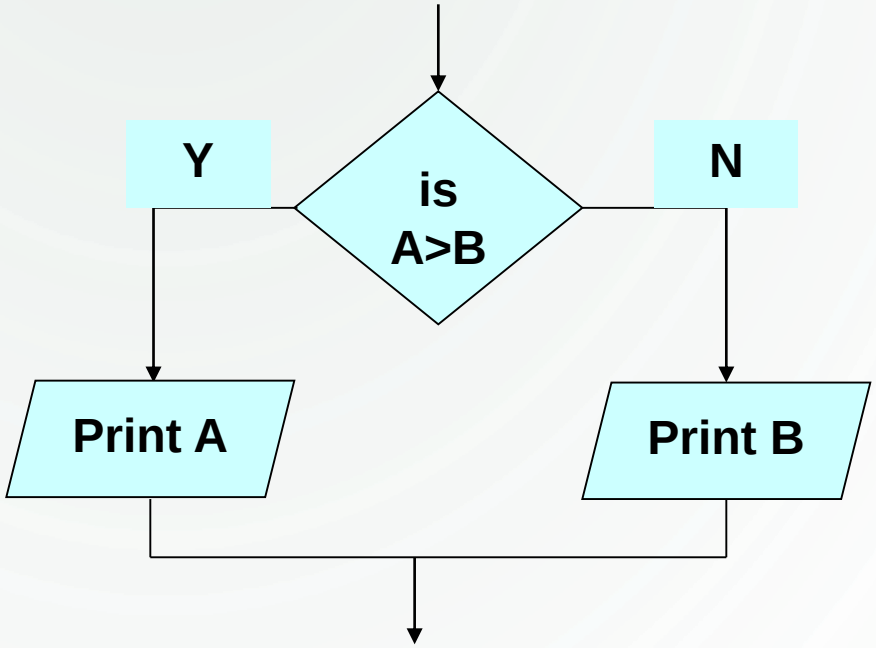
If A>B then

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

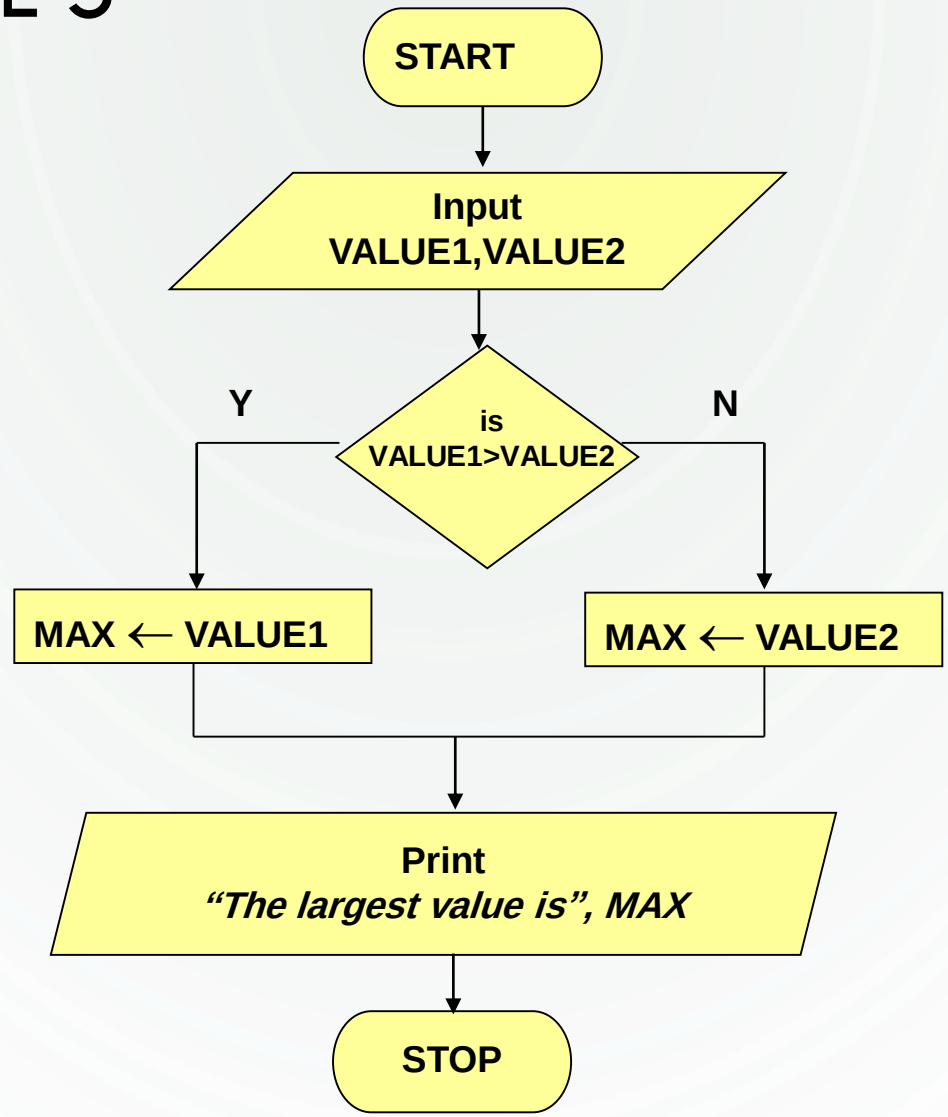
else

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).