

# Algorithms and Complexity

## Problem Analysis

Lecturer: Dr. Alaa Ahmed Abbood

Lecture 2.

Class 2<sup>nd</sup> .

Time: 8:30-10:30

Department: Businesses Information Technology (BIT)

# Outline

- Introduction
- Algorithm pseudocodes
- Flowchart



# 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*
- *output: 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: Output: GRADE of student  
Step 3:  $\text{GRADE} \leftarrow (M1+M2+M3+M4)/4$   
Step 3:       if (GRADE < 50) then  
                    Print "FAIL"  
              else  
                    Print "PASS"  
              endif



# The Flowchart

- 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.



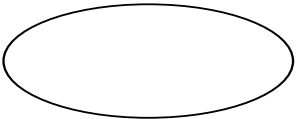
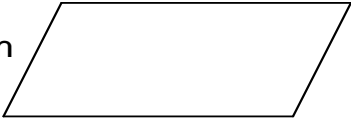

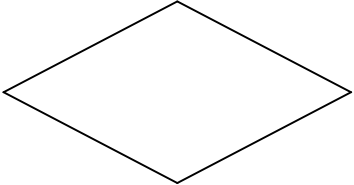




## A Flowchart

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

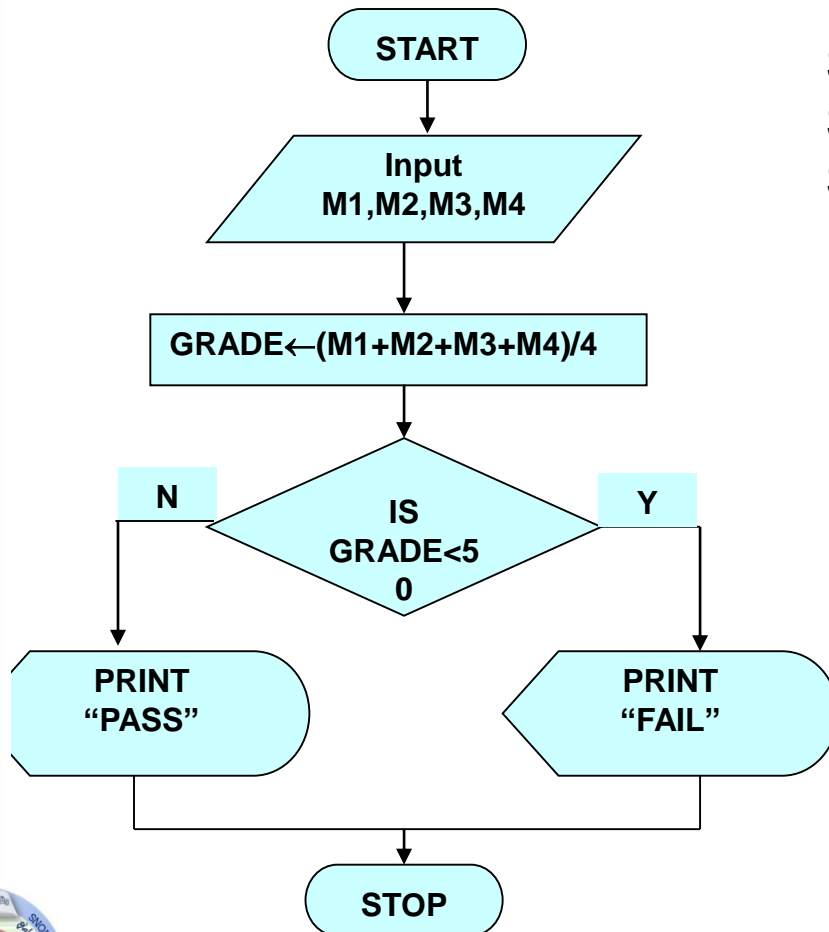


# Flowchart Symbols

| 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<br>e.g. addition, subtraction, division etc.  |
| Diamond       |   | Denotes a decision (or branch) to be made.<br>The program should continue along one of<br>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:  $GRADE \leftarrow (M1+M2+M3+M4)/4$   
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)*
- *Output the length in centimeter (Lcm)*
- *Calculate the length in cm (Lcm) by multiplying LFT with 30*
- *Print length in cm (LCM)*

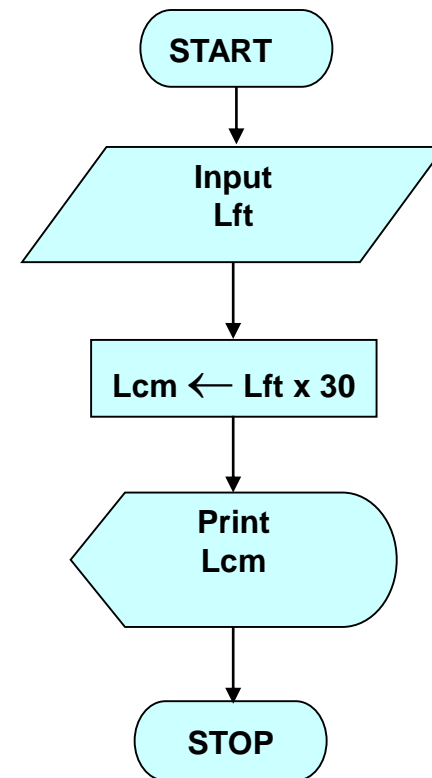


# Example 2

## Algorithm

- Step 1: Input Lft
- Step 2:  $Lcm \leftarrow Lft \times 30$
- 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**

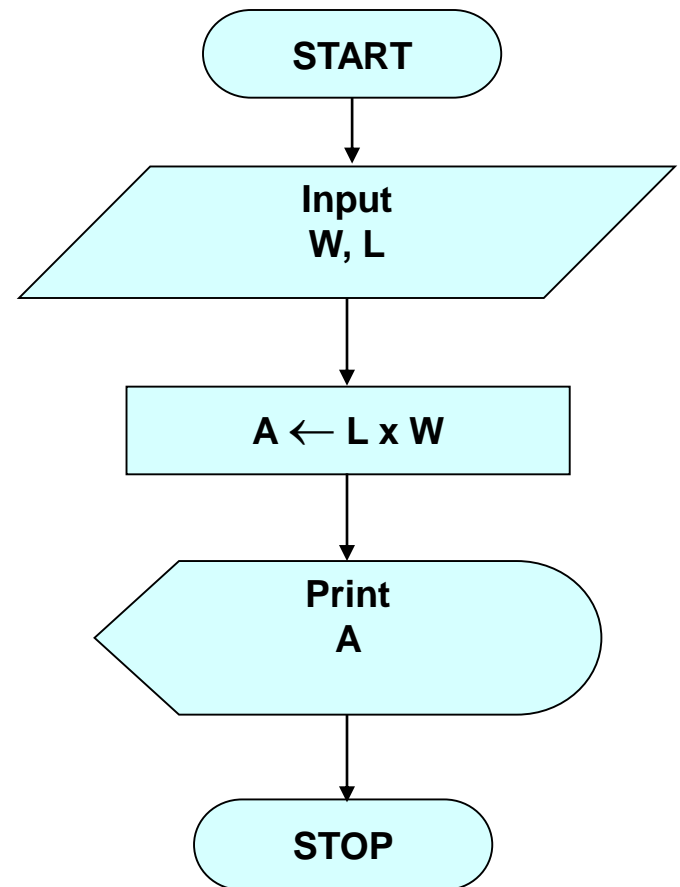
- *Input: the width ( $W$ ) and Length ( $L$ ) of a rectangle*
- *Output: Area of rectangle*
- *Calculate the area ( $A$ ) by multiplying  $L$  with  $W$*
- *Print  $A$*



# Example 2

## Algorithm

- Step 1: Input W,L
- Step 2:  $A \leftarrow L \times W$
- Step 3: Print A



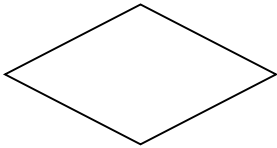
# Flowcharts

- Flowcharts is a graph used to depict or show a step by step solution using **symbols** which represent a task.
- The symbols used consist of geometrical shapes that are connected by **flow lines**.
- It is an alternative to pseudocoding; whereas a pseudocode description is verbal, a flowchart is graphical in nature.

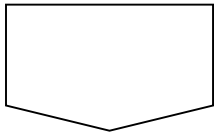




# Flowchart Symbols cont...



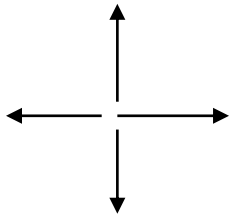
**Selection symbol** - shows a selection process for two-way selection.



**Off-page connector** - provides continuation of a logical path on another page.

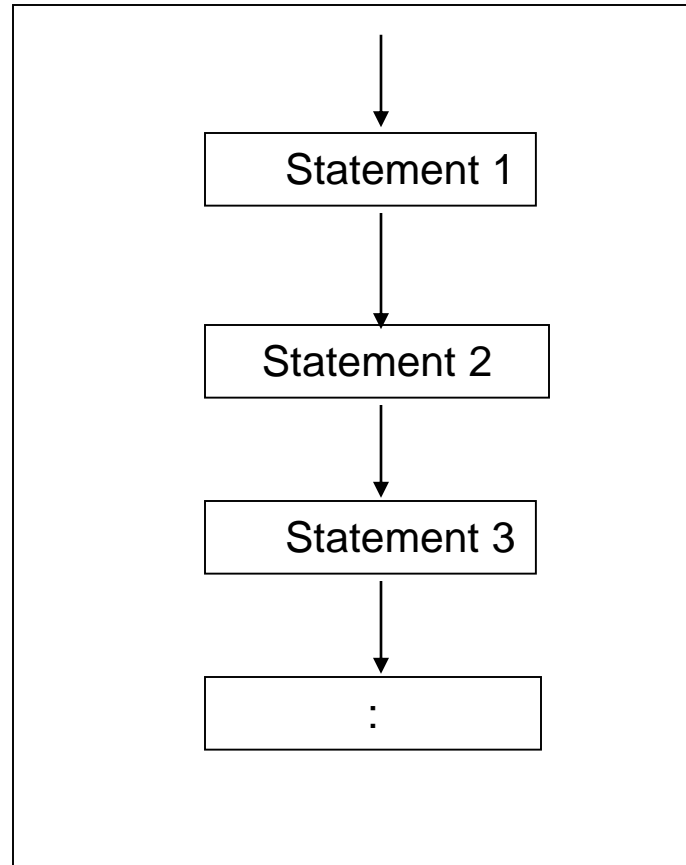


**On-page connector** - provides continuation of logical path at another point in the same page.

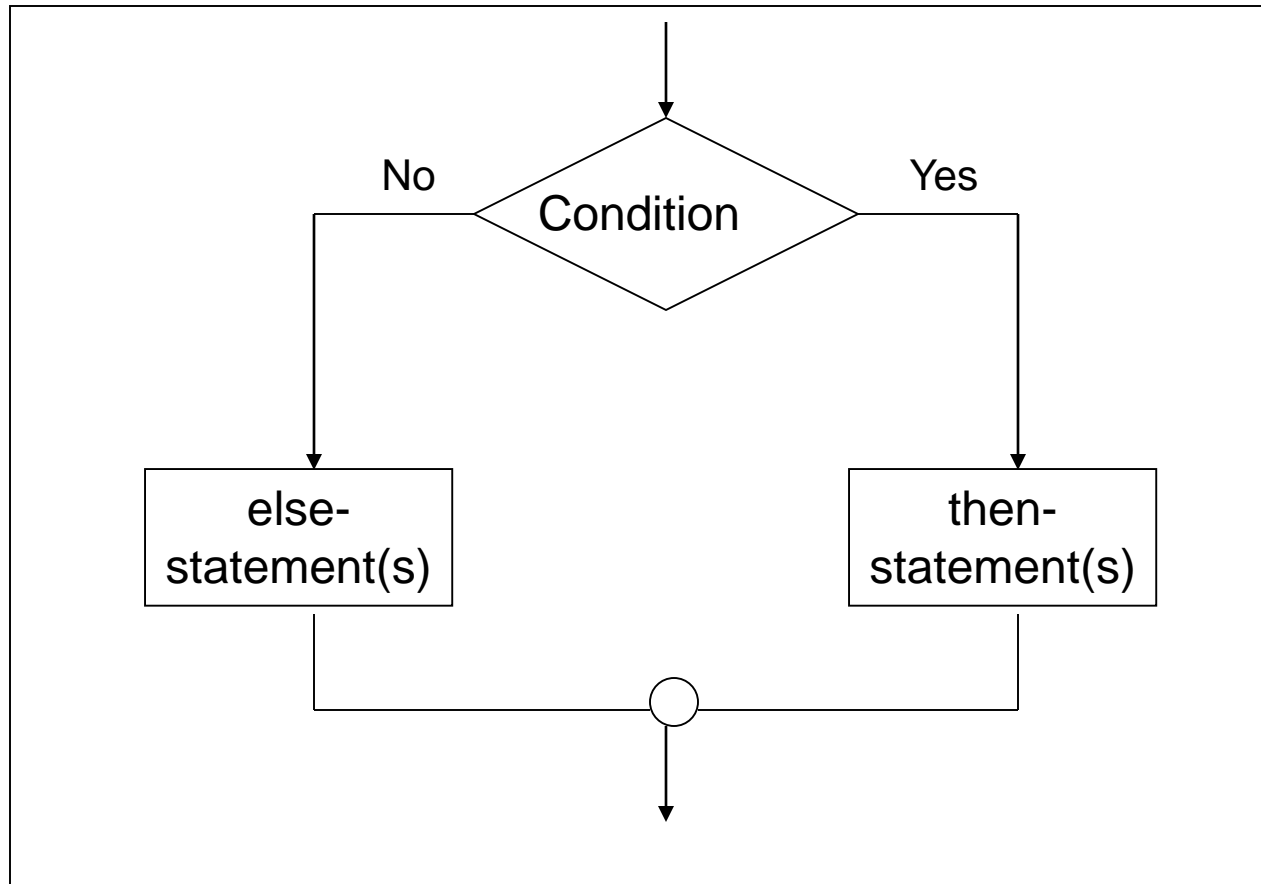


**Flow lines** - indicate the logical sequence of execution steps in the algorithm.

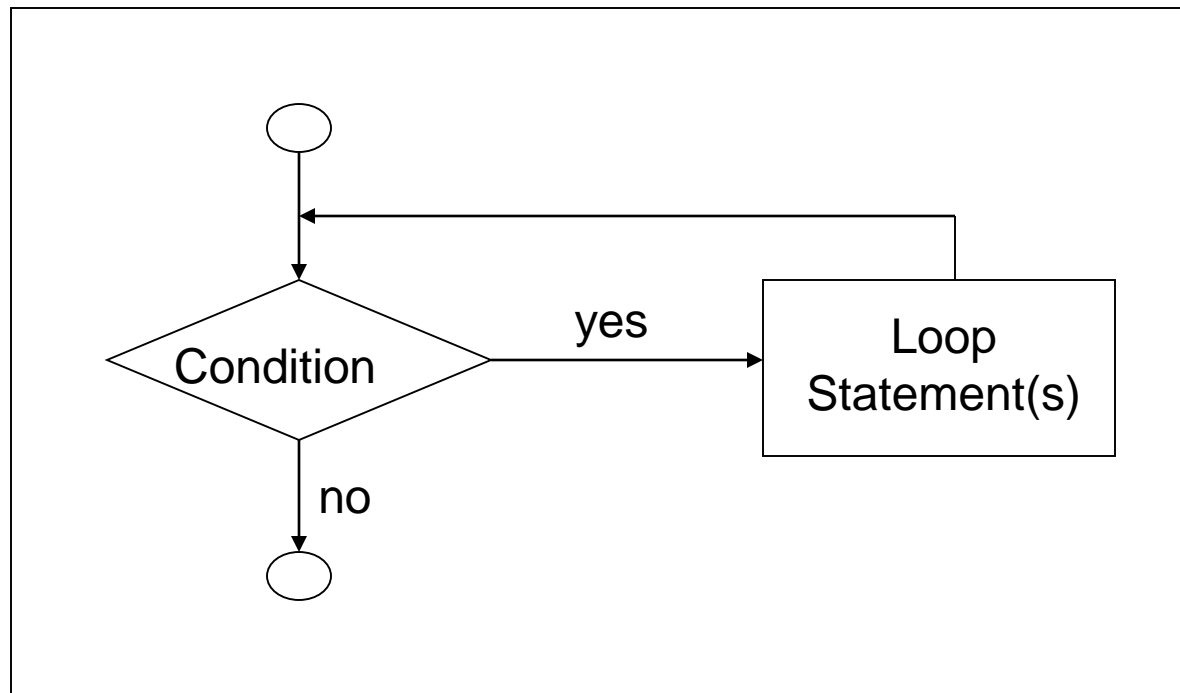
# Flowchart – sequence control structure



# Flowchart – selection control structure



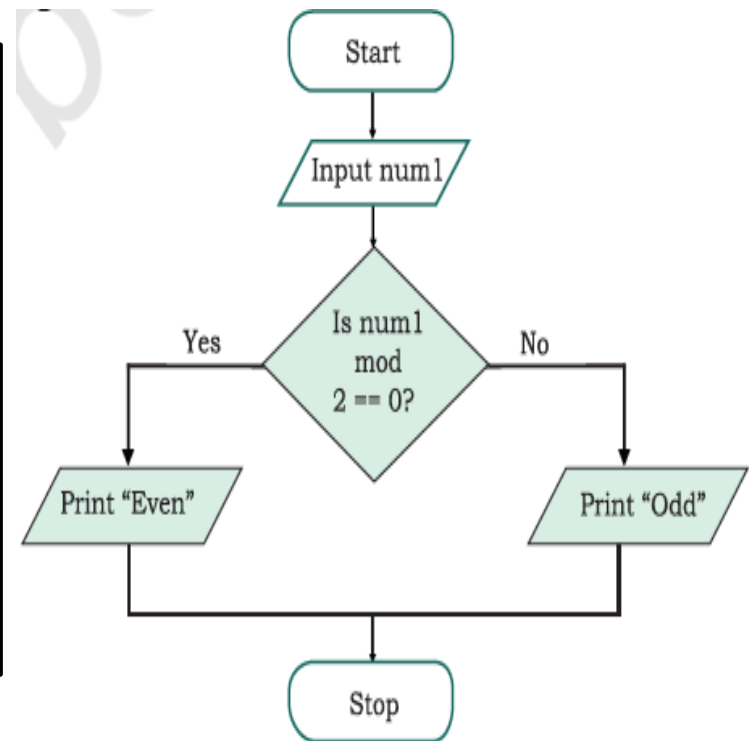
# Flowchart – repetition control structure



# Example

write an algorithm and flowchart to check whether a number is odd or even.

- Input: Any number
- Output: Message “Even” or “Odd”
- PRINT "Enter the Number" INPUT number
- IF number MOD 2 == 0 THEN
- PRINT "Number is Even"
- ELSE PRINT "Number is Odd"



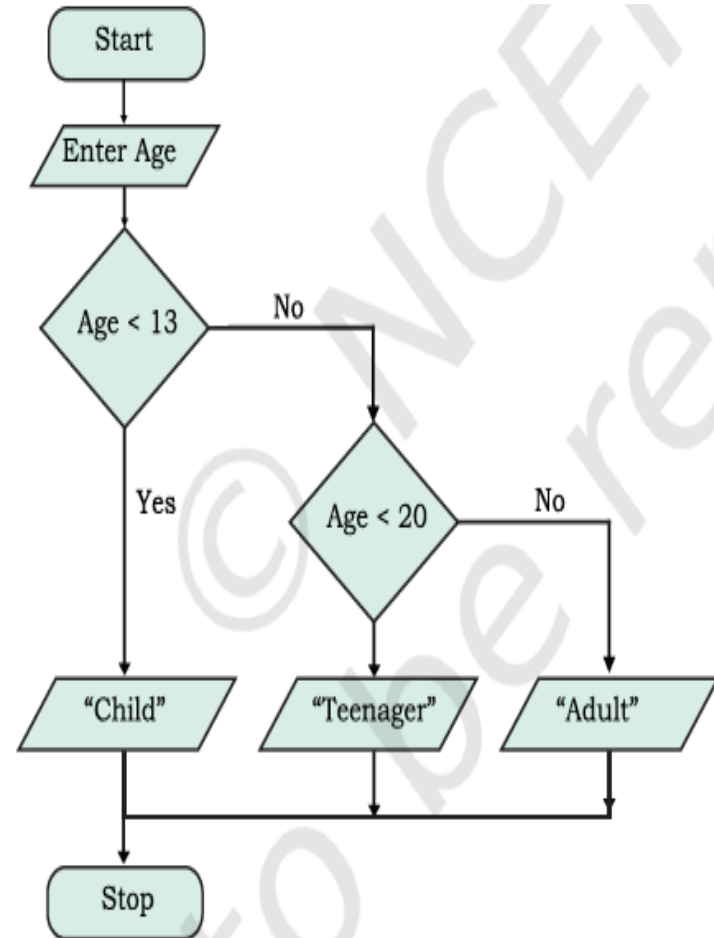
# Example

write a pseudocode and draw a flowchart where multiple conditions are checked to categories a person as either child ( $<13$ ), teenager ( $\geq 13$  but  $<20$ ) or adult ( $\geq 20$ ), based on age specified:



# Example

- INPUT Age
- Output category of the age
- if Age < 13 then
  - PRINT "Child"
- else if Age < 20 then
  - PRINT "Teenager"
- Else
  - PRINT "Adult"



# Home work

1. Create an algorithm and a flowchart that will accept/read two numbers and then display the bigger number.
2. Write pseudocode and draw flowchart to accept numbers till the user enters 0 and then find their average.
3. Write pseudocode that reads two numbers and divide one by another and display the quotient.







THANK YOU