

Design & Analysis of Algorithms

PSEUDOCODE & FLOWCHART

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Lecture # 02

Levels of Program Development

- Define the problem. → Human thought
- **Plan the problem solution. → write the algorithm [pseudocode-natural language (English, Urdu) or drawing the flowchart diagram].**
- Code the program. → High Level
- Programming Language (Python C, C++, Java,)
- Compile the program. → Machine Code
- Run the program.
- Test and debug the program.

Plan the problem Solution

- When planning for a problem solution, algorithms are used to outline the solution steps using
 - English or Urdu like statements, Called **pseudocode**
Or
 - A **flowchart**, which is a graphical representation of an algorithm.

What is an Algorithm?

- An algorithm is a set of ordered steps for solving a problem.
- Examples:
 - An Algorithm for preparing a cup of coffee.
 - An Algorithm for converting Gregorian dates to Islamic dates.

Algorithms involve combination of

➤ Sequence

English imperative sentences, doing one thing after another

➤ Procedure

A mini-algorithm, that is a part of a bigger algorithm

➤ Selection

Choice of action depending on a comparison or test.

This uses the IF..THEN..ELSE statement

➤ Repetition

Doing the same thing over and over again . There are two statements to use here—While...Do and For...Do

Pseudocode Syntax

- **INPUT:** indicates a user will be inputting something
- **OUTPUT:** indicates that an output will appear on the screen
- **WHILE:** a loop (iteration that has a condition at the beginning)
- **FOR:** a counting loop (iteration)
- **REPEAT-UNTIL :** a loop(iteration that has a condition at the end
- **IF-THEN-ELSE:** a decision (selection) in which a choice is made

Example of Pseudocode:

Write a program to Print the Sum of Two Integer Numbers

1. Start the program
2. Read the first number and save in the variable (N1)
3. Read the second number and save in the variable (N2)
4. Sum the both numbers and save the result in the variable (Sum) $\rightarrow \text{Sum} = \text{N1} + \text{N2}$
5. Print the variable (Sum)
6. End the program.

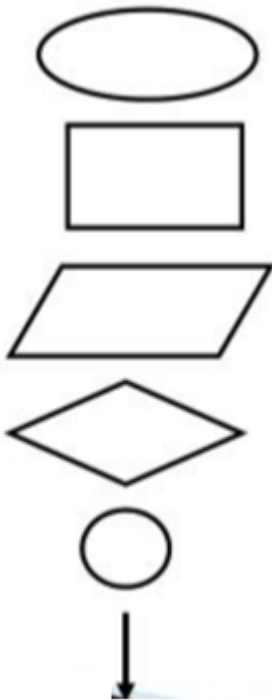
```
Begin
    input x, y
    sum = x + y
    print sum
End
```

Flowchart

- A flowchart is a type of diagram that represents an algorithm, showing the steps as boxes of various kinds [ex: rectangles, diamonds, ovals], and their order by connecting these with arrows.

Flowchart Notations

Symbol



Semantic

Start/End

Process

Input/Output

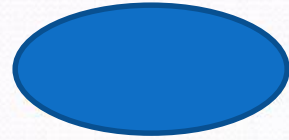
Test

Connector

Flow of activities

- START/END

- Used at the beginning and end of each flowchart.



- PROCESS

- Used to show calculations, storing of data in variables, and other “processes” that take place within a program.



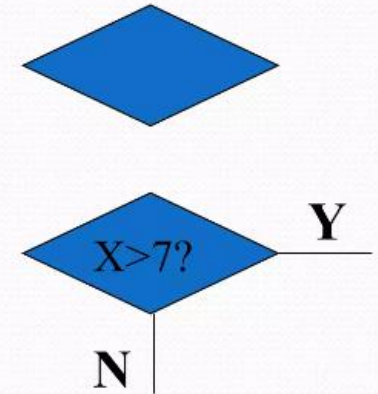
- INPUT/OUTPUT

- Shows when information/data comes into a program or is printed out.



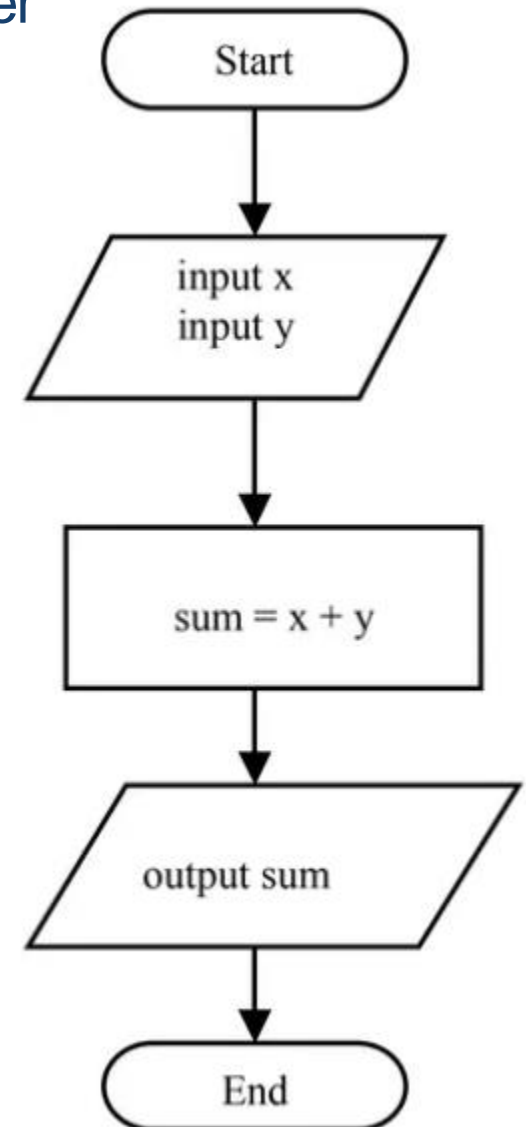
- DECISION

- Used to show that the program must decide whether something (usually a comparison between numbers) is true or false. YES and NO (or T/F) branches are usually shown.



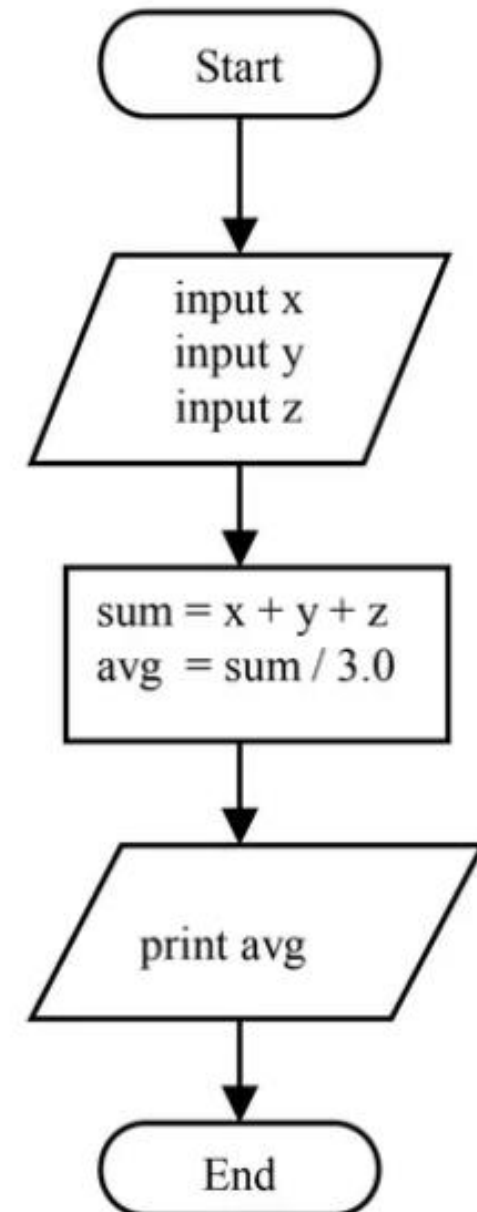
Example 1: Write a program to Print the Sum of Two Integer

```
Begin
  input x, y
  sum = x + y
  print sum
End
```



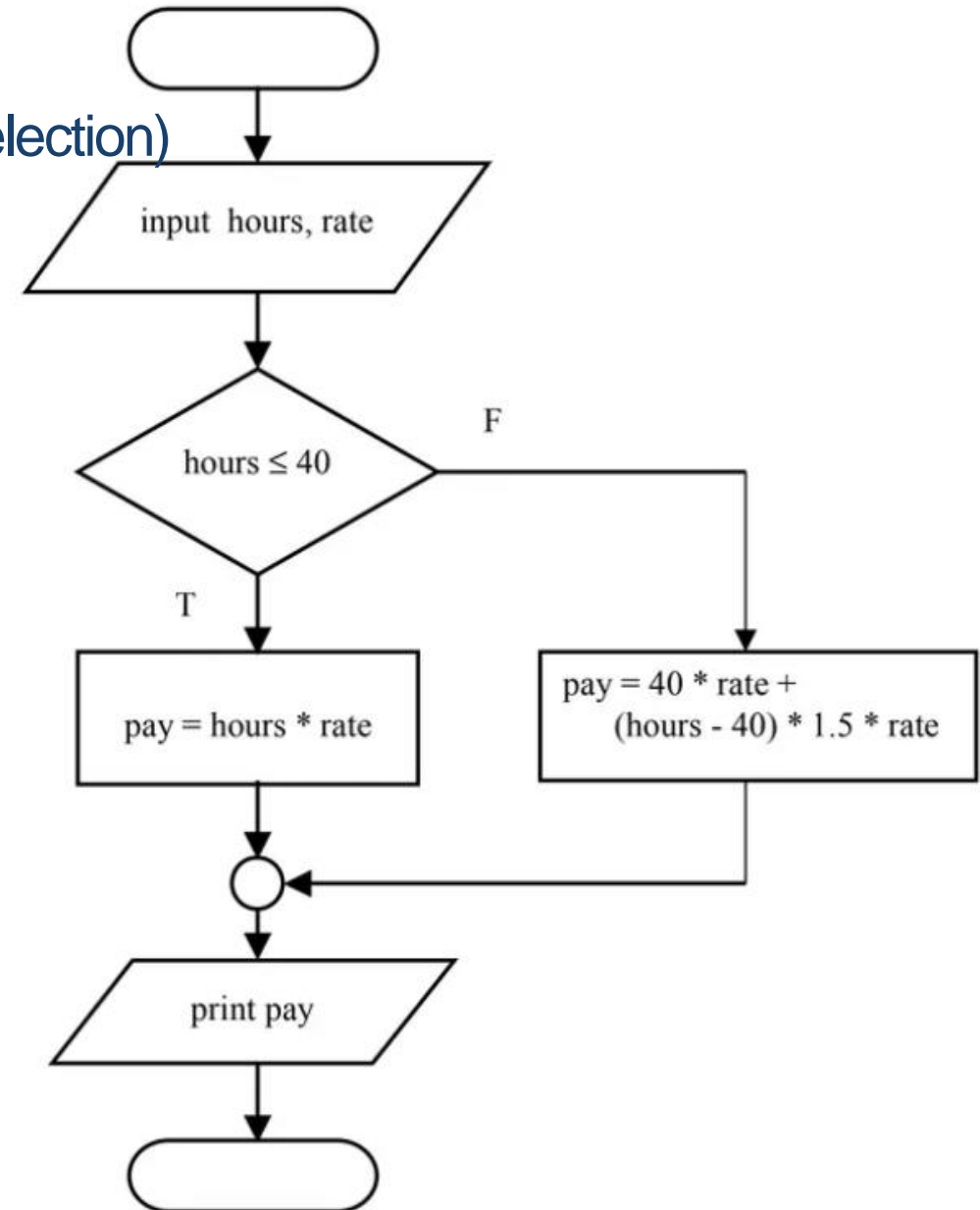
Example 2: Average of three numbers (sequence)

```
Begin
  input x
  input y
  input z
  sum = x + y + z
  avg = sum / 3.0
  print avg
End
```



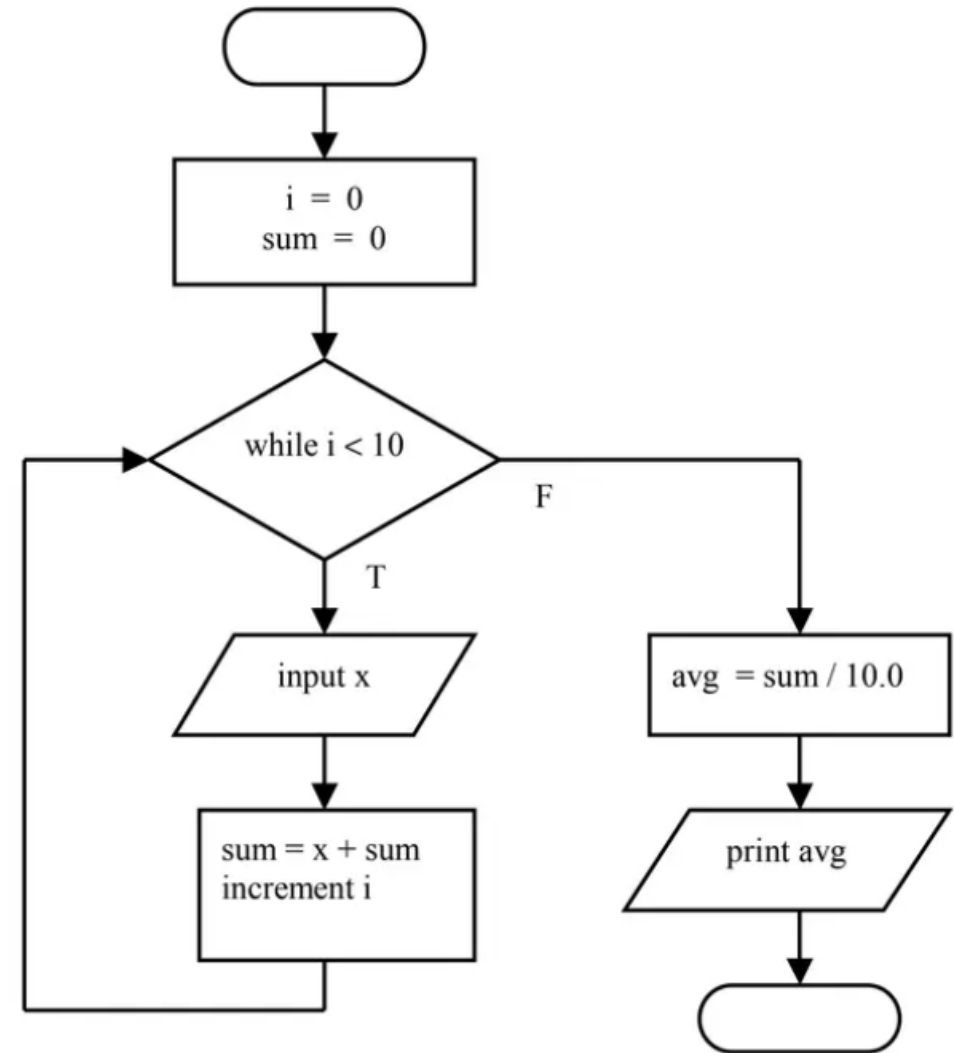
Example 3: Calculate with pay overtime (selection)

```
Begin
  input hours, rate
  if hours ≤ 40 then
    pay = hours * rate
  else
    pay = 40 * rate + (hours - 40) * rate * 1.5
  print pay
End
```



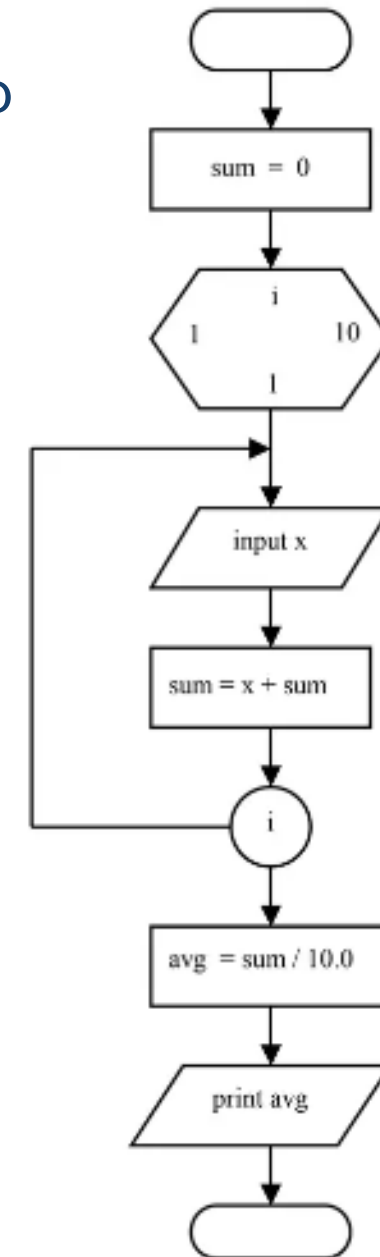
Example 4: Average of 10 Numbers-iteration with a while loop

```
Begin
  i = 0
  sum = 0
  while i < 10
    input x
    sum = sum + x
    ++i
  avg = sum / 10.0
  print avg
End
```



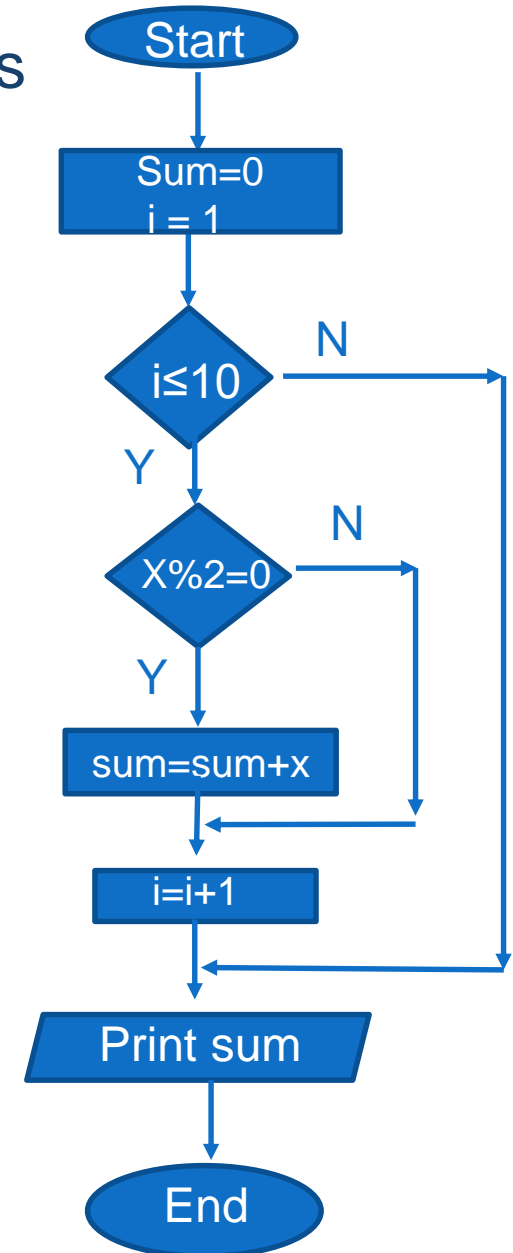
Example 4: Average of 10 Numbers-iteration with a for loop

```
Begin
  sum = 0
  for i = 1 to 10
    input x
    sum = sum + x
  avg = sum / 10.0
  print avg
End
```



Example 6: find the sum of even number of first 10 numbers

```
Begin
  sum = 0
  for i=1 to 10
    input x
    If x % 2==0 then
      sum=sum+x
    End If
  End for
  Print sum
End
```



Example 7: Make a cup of tea.

Program Make A Cup Of Tea:

Begin

 Organize everything together;

 Plug in Kettle;

 Put teabag in cup;

 while (Kettle is not full)

 do keep filling kettle;

 End while;

 while (water is not boiled)

 do keep boiling water;

 End while;

 Add water to cup;

 Add milk;

 If (sugar is required)

 then add sugar;

 else do nothing;

 End if;

 Serve;

End