

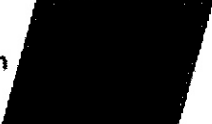




Algorithms

Before writing programs or solutions into an environment, one has to first write the steps involved in solving that problem. The step-by-step process to solving a problem is called an **algorithm**. The reason for doing algorithms is to make a task or program easier to write and to understand. An algorithm can take one of two forms namely **pseudocode** or **flowcharts**. Pseudocode is the process of writing the steps of a program using structured statements, without the use of any particular programming language while a flowchart is a diagrammatical representation of a program. Instructions and statements are placed in boxes that are linked by arrows depending on the flow direction of the flowchart. An algorithm can be checked using a trace table. A trace table is a logical representation of the steps of the algorithm using a table. The results of the table will indicate if the output of the algorithm is correct or not.

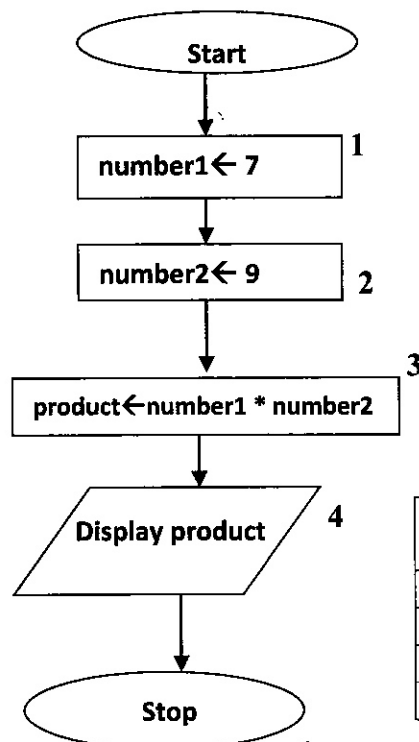
Flowchart representation

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

Example of a flowchart algorithm

Question 1: Draw a flowchart to assign a variable called number1 to 7 and a variable called number2 to 9. The flowchart must determine and display the product of the numbers

Answer:



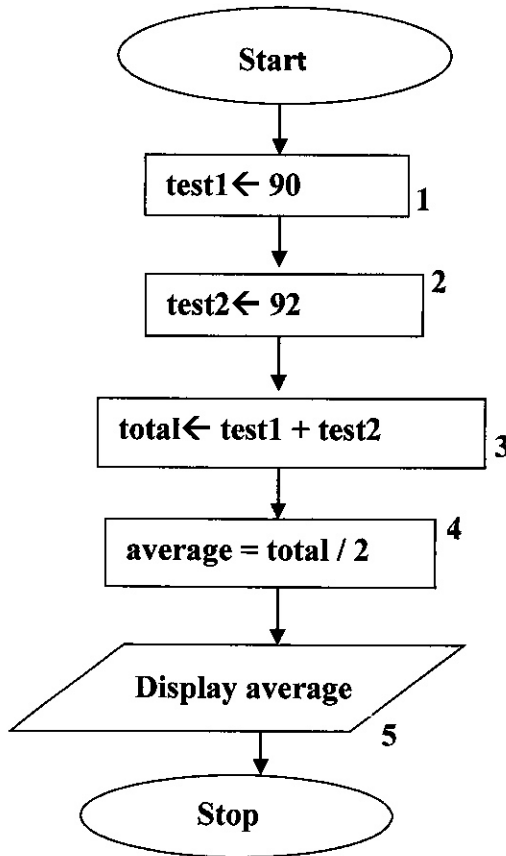
Trace Table

| Box | number1 | number2 | product | Screen output |
|-----|---------|---------|---------|---------------|
| 1 | 7 | | | |
| 2 | | 9 | | |
| 3 | | | 63 | |
| 4 | | | | 63 |

Question 2:

You have written two tests in English. You achieved 90 and 92 for the tests. Draw a flowchart to find and display the average mark. Also draw a trace table to display the results.

Answer:



Trace Table

| Box | test1 | test2 | total | average | Screen output |
|-----|-------|-------|-------|---------|---------------|
| 1 | 90 | | | | |
| 2 | | 92 | | | |
| 3 | | | 182 | | |
| 4 | | | | 91 | |
| 5 | | | | | 91 |

Activity 2.1

Draw flowcharts for the following questions.

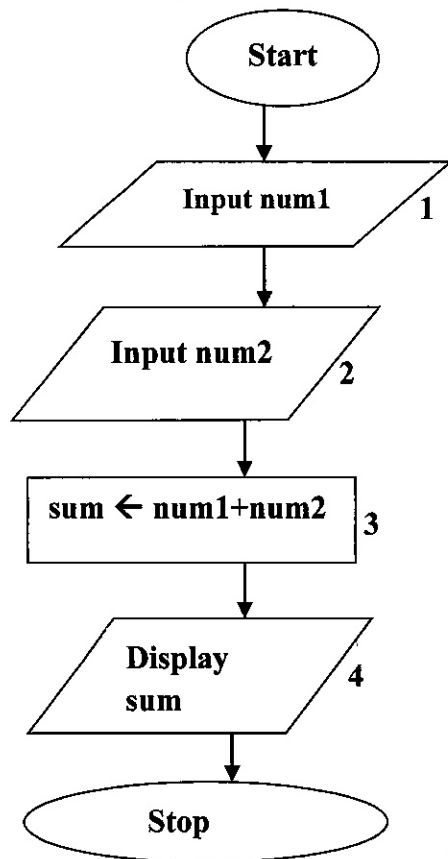
1. The length of a rectangle is 12m and the breadth is 8m. Determine and display the area of the rectangle.
2. A salesman works for 9 hours a day at a rate of R50.00 per hour. Calculate and display his earnings per day and for the week if he works only on weekdays.
3. A student gets an allowance of R500.00 per month. He buys the following:
A book for R120.00, a hot stone massage for R100.00 and an adventure ride for R85.00.
Calculate and display the amount spent and the amount left over.

Instead of assigning values as in the flow diagrams above, we can allow the user to input values as these values will differ each time.

Question 3:

Draw a flowchart to input two numbers. Process and display the sum of the numbers.

Answer:



Notice a parallelogram shape is used for input and for output.

Trace Table: Use values: num1 = 8, num2 = 3.

| Box | num1 | num2 | sum | Screen output |
|-----|------|------|-----|---------------|
| 1 | 8 | | | |
| 2 | | 3 | | |
| 3 | | | 11 | |
| 4 | | | | 11 |

Redraw the trace table to use num1 = 12, num2 = 9.

Activity 2.2: Draw flowcharts for each of the following:

- Assign 3 numbers num1 = 7, num2 = 4 and num3 = 5. Find and display the product. Draw a trace table to illustrate the results.
- The price of a chocolate is 9.49 and the price of a cool drink is 8.99. Draw a flowchart to find and display the total price. Draw a trace table to illustrate the results.
- The computer you wish to buy is an amount of R5000. You have saved R2550. Determine and display the outstanding amount.
- Input the length and breadth of a rectangle. Calculate and display the perimeter of the rectangle. Draw a trace table for length = 25 and breadth = 14.
- Input a temperature in °Celsius. Convert and display the same temperature in Fahrenheit. Formula: Fahrenheit = Celsius $\times \frac{9}{5} + 32$
Draw a trace table to indicate the result of 41°C.

6. Calculate and display the volume of a rectangle that has a length of 12.5m, breadth of 8.2m and a height of 7.9m. Draw a trace table to illustrate the results.
7. Input the prices of three items purchased. Calculate and display the total price. Calculate and display 14% VAT on the total price. If the customer tendered an amount of R300, calculate and display the change. Draw a trace table for the following values of the items, price1 = R54.99, price2 = R103.98 and price3 = R17.89.

Decision Boxes in Flow Diagrams

Get condition

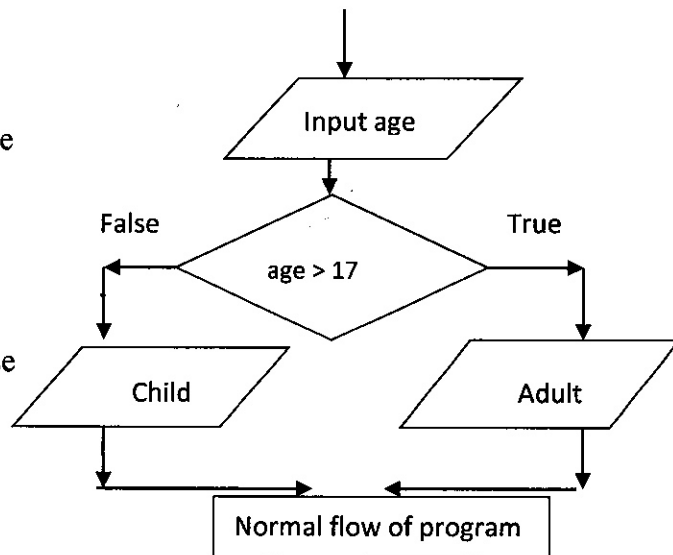
if (condition = true)

```
{
    statements executed if condition is true
}
```

else

```
{
    statements executed if condition is false
}
```

Flowchart representation



The decision box is a diamond shaped box controlled by the condition placed inside it.

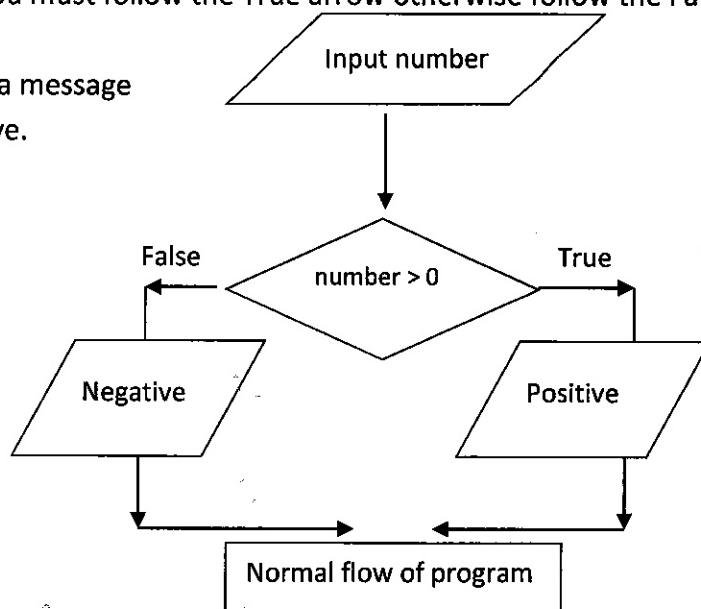
The result of the decision box can either be true or false.

The result of the decision box will determine the flow control of the flowchart; that is if the result of the decision is true, you must follow the True arrow otherwise follow the False arrow.

Example 1: Enter a number. Display a message indicating Positive or Negative.

```

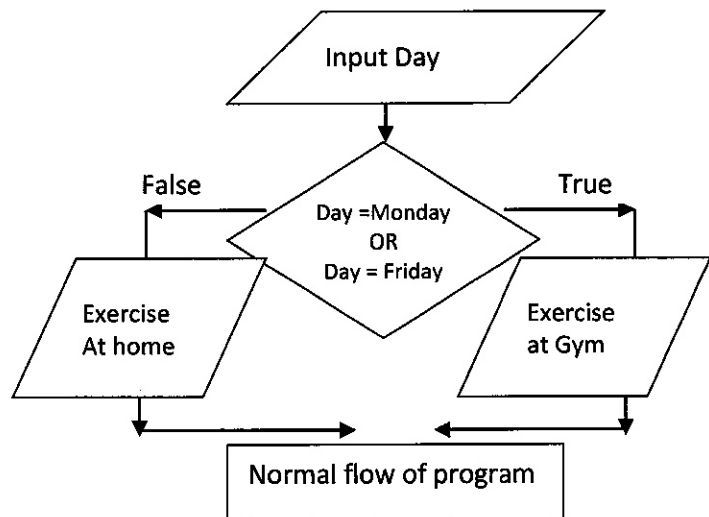
Input number
if (number > 0)
{
    Display Positive
}
else
{
    Display Negative
}
    
```



Example 2

Enter the day of the week. If day = Monday or Friday, display a message "Exercise at Gym".
For all the other days, display a message "Exercise at home".

```
Input Day
if (Day = Monday OR Day = Friday)
{
    Display "Exercise at Gym"
}
else
{
    Display "Exercise at home"
}
```



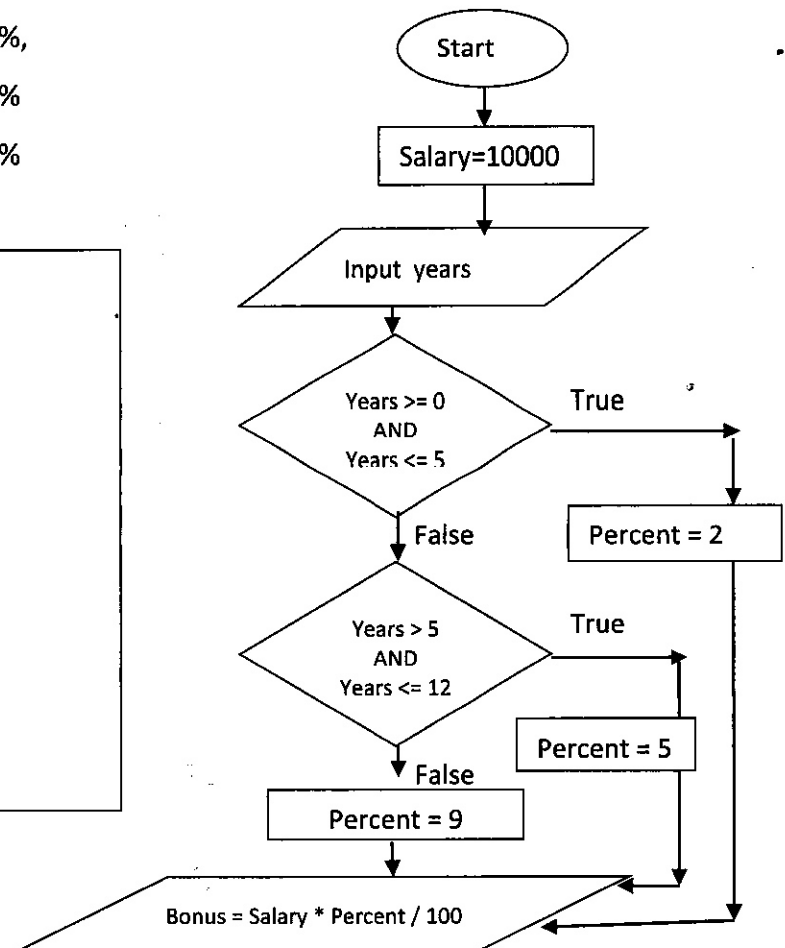
Example 3

An employee earns a basic salary of R10000.00. Calculate the bonus as follows.

The employee qualifies for a bonus based on the number of year's service at the company.

| | |
|--------------------|-------|
| 0 years – 5 years | : 2%, |
| >5 years – 12years | : 5% |
| >12 years | : 9% |

```
Salary = 10000
Input years
If years >= 0 And Years <=5
    Percent = 2
Else
    If years > 5 And Years <=12
        Percent = 5
    Else
        Percent = 9
    End
Bonus = Salary * Percent / 100
```



Activity 2.3

Draw flowcharts for each of the following.

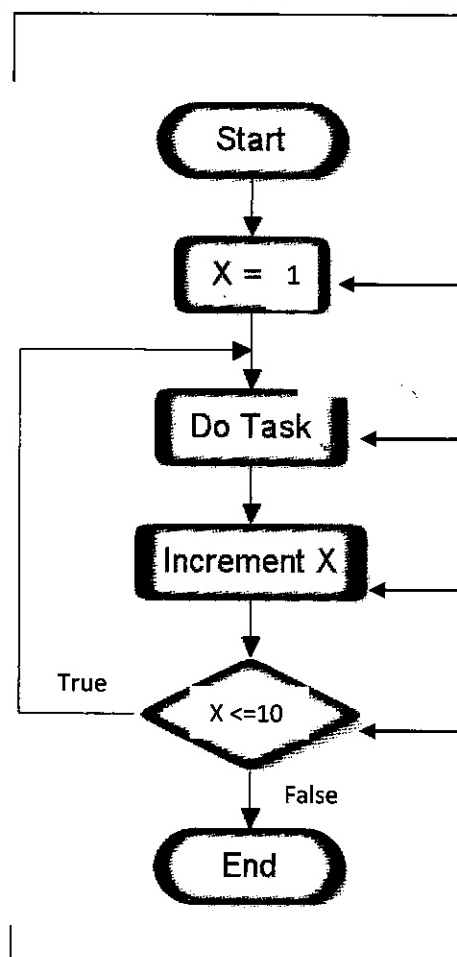
1. Input two numbers. Determine and display the smaller number.
2. Input the price of an item purchased at a store. A discount of 5% is awarded if the price is ≥ 1000 . Determine and display the discount and the final price.
3. Enter the value of sales made by an agent. The following percentages are awarded in commission based on the amount of sales made.

| | | |
|---------------|---|----|
| 0 – 5000 | : | 0% |
| >5000 – 10000 | : | 6% |
| >10000 | : | 8% |

Display the value of commission based on the sales.

Repetition in Flowcharts: *When a task needs to be carried out more than once*

Figure A: Looping using a counter



This loop is known as a **counter driven loop**. This loop is used when the **number of repetitions is given or is known**. An example would be to input 10 numbers and to calculate the sum of the numbers. The instruction is to input 10 numbers so we know the amount of numbers to input.

X is known as the counter variable. This variable is used to keep track of the amount of values that are entered.

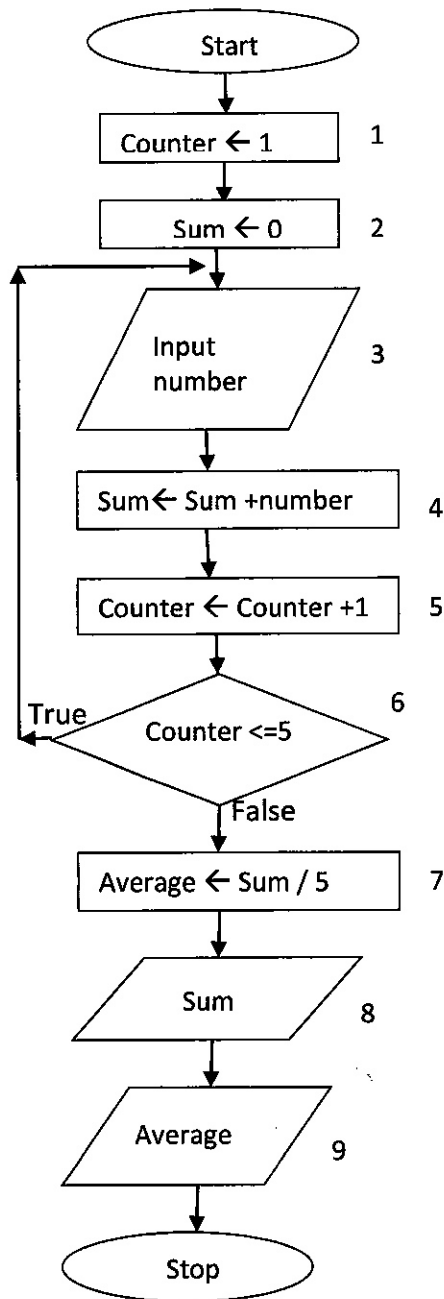
A task will be carried out as long as the value of X is less than the number of values required.
(This example requires a maximum of 10 values)

The value of X increases by 1 for every run of the loop.

The decision box checks the value of X to determine if it satisfies the condition. The direction of the flowchart will depend on the result of the condition.

Example 1:

Draw a flowchart to input 5 numbers. Calculate and display the sum and average of the numbers. Draw a trace table with the following data: 7; 9; 4; 12; 3



Trace Table

| Step | Counter | Sum | number | Counter ≤ 5 | Average | Out put |
|------|---------|-----|--------|----------------|---------|------------|
| 1 | 1 | | | | | |
| 2 | | 0 | | | | |
| 3 | | | 7 | | | |
| 4 | | 7 | | | | |
| 5 | 2 | | | | | |
| 6 | | | | True | | |
| 3 | | | 9 | | | |
| 4 | | 16 | | | | |
| 5 | 3 | | | | | |
| 6 | | | | True | | |
| 3 | | | 4 | | | |
| 4 | | 20 | | | | |
| 5 | 4 | | | | | |
| 6 | | | | True | | |
| 3 | | | 12 | | | |
| 4 | | 32 | | | | |
| 5 | 5 | | | | | |
| 6 | | | | True | | |
| 3 | | | 3 | | | |
| 4 | | 35 | | | | |
| 5 | 6 | | | | | |
| 6 | | | | False | | |
| 7 | | | | | 7 | |
| 8 | | | | | | 35 |
| 9 | | | | | | 7 |

Activity 2.4

Draw flowcharts and trace tables for the following:

1. Input 4 numbers, count and display the amount of positive and the amount of negative numbers. Sample data: 13; -8; 9; 21
2. Input 5 numbers, determine and output the largest number. Sample data: 7; 12; 20; 14; 9
3. Input a number. Determine and output the factorial of the number.
Example: The factorial of 4 = $1 \times 2 \times 3 \times 4 = 24$.
4. Input a number. Display the square of every alternate number from 1 to the number entered. Example if 10 is entered, the output would be 1 9 25 49 81.