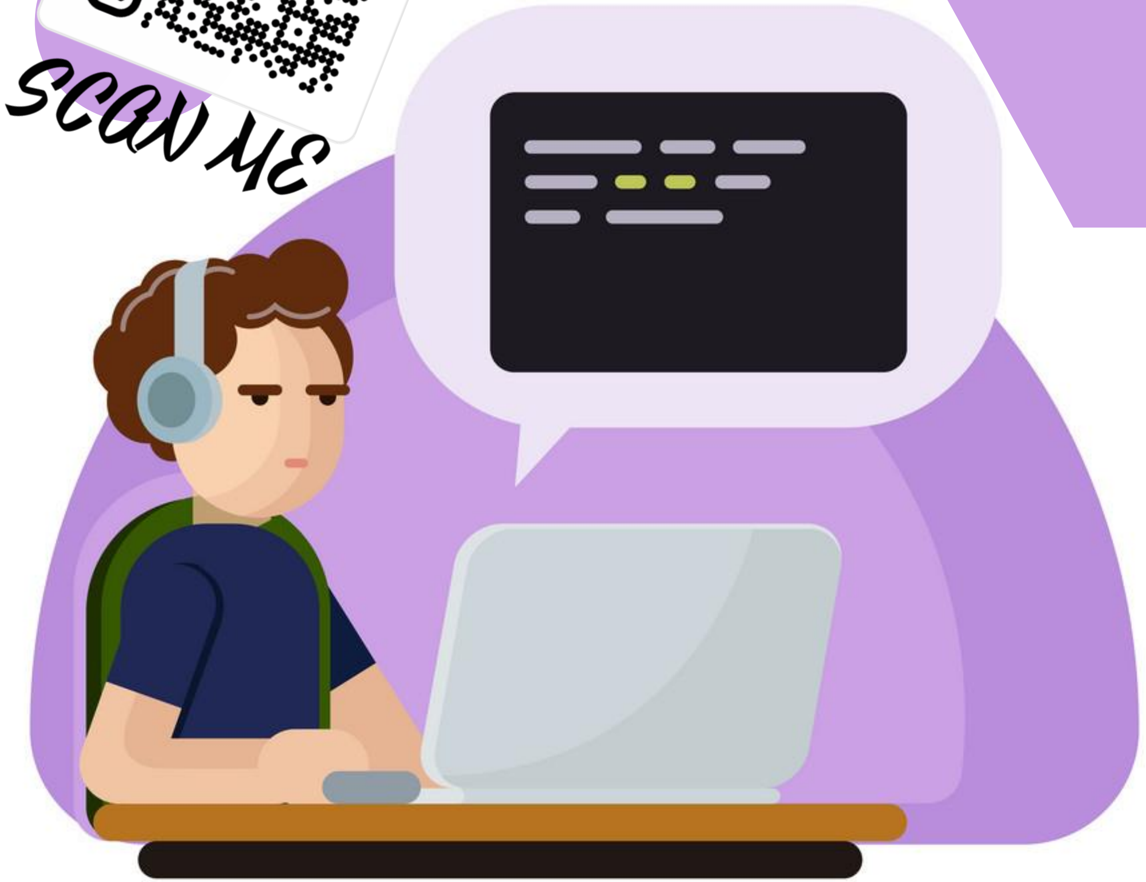
SCAN ME

How to think like a computer?

By: Babak Zolghadr-Asli



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A **computer program** is a sequential set of instructions written in a computer language that is used to direct the computer to perform a specific task of computation.

A **problem** is something the result of which is not readily available. A set of steps involving *arithmetic computation* and/or *logical manipulation* is required to obtain the desired result.

There is a law called the ***law of equifinality*** that states that the same goal can be achieved through different courses of action and a variety of paths.

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The different ways of solving a problem are called solution strategies. & This most effective way is called the optimum way.

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A set of steps that generates a finite sequence of elementary computational operations leading to the solution of a given problem is called an algorithm.

A flowchart is a diagrammatic representation of the steps of an algorithm.

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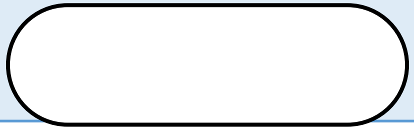
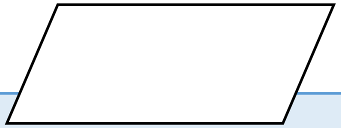
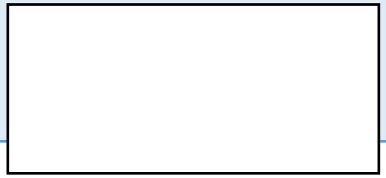
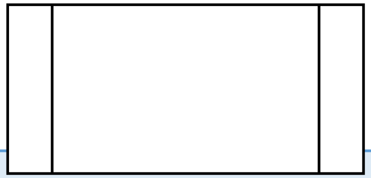
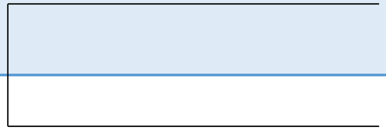
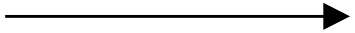
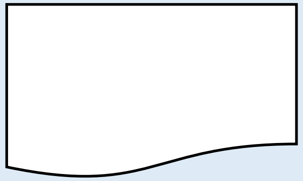
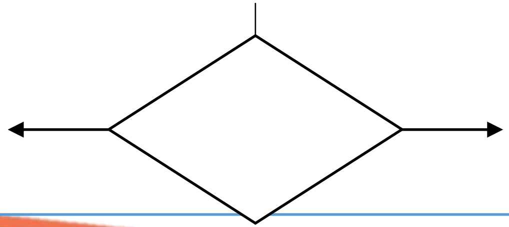
The following five rules should be followed while creating program flowcharts.

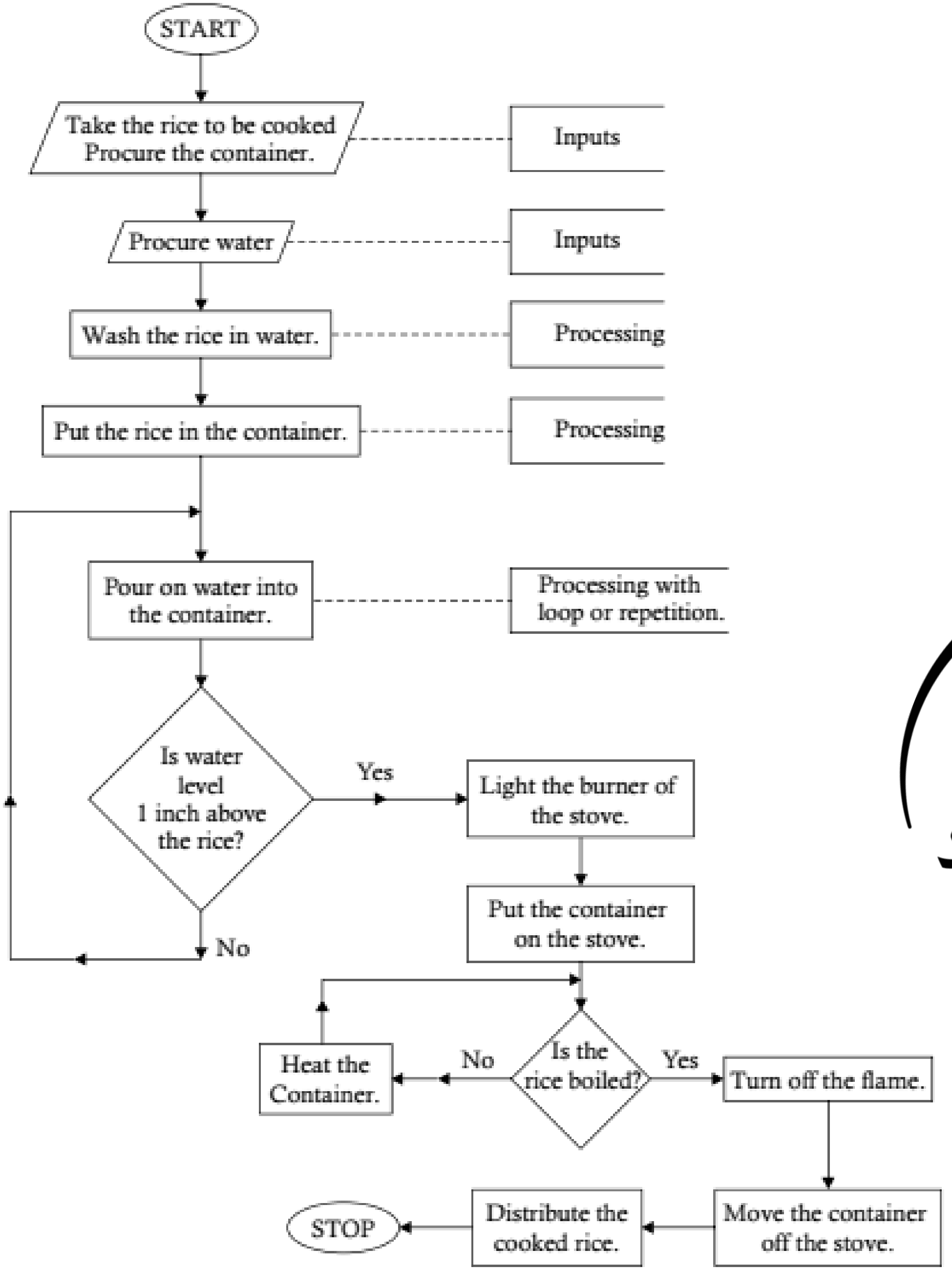
1. Only the standard symbols should be used in program flowcharts.
2. The program logic should depict the flow from top to bottom and from left to right.
3. Each symbol used in a program flowchart should contain only one entry point and one exit point, with the exception of the decision symbol. This is known as the *single rule*.
4. The operations shown within a symbol of a program flowchart should be expressed independently of any particular programming language.
5. All decision branches should be well-labeled.

Symbol	Description
	Terminal used to show the beginning and end of a set of computer-related processes
	Input/Output used to show any input/output operation
	Computer processing used to show any processing performed by a computer system
	Predefined processing used to indicate any process not specially defined in the flowchart
	Comment used to write any explanatory statement required to clarify something
	Flow line used to connect the symbols
	Document Input/Output: used when input comes from a document and output goes to a document
	Decision used to show any point in the process where a decision must be made to determine further action

```
Step 1. Take the rice to be cooked.
Step 2. Procure the container.
Step 3. Procure the water.
Step 4. Wash the rice in the water.
Step 5. Put the rice into the container.
Step 6. Pour water into the container.
Step 7. IF WATER LEVEL = 1 INCH ABOVE THE RICE
                        THEN GOTO STEP 8
            ELSE GOTO STEP 6
            ENDIF
Step 8. Light the burner on the stove.
Step 9. IF THE RICE IS BOILED
THEN GOTO STEP 12
ELSE GOTO STEP 10
ENDIF
Step 10. Heat the container.
Step 11. Go to step 9.
Step 12. Turn off the flame.
Step 13. Move the container off the stove.
Step 14. Distribute the cooked rice.
Step 15. STOP
```

The algorithm for cooking rice can be seen here; Draw a standard flowchart for it.

Solution


START
Take the rice to be cooked
Procure the container.
Inputs
Procure water
Inputs
Wash the rice in water.
Processing
Put the rice in the container.
Processing
Pour on water into the container.
Processing with loop or repetition.
Is water level 1 inch above the rice?
Yes
No
Light the burner of the stove.
Put the container on the stove.
Is the rice boiled?
No
Yes
Heat the Container.
Turn off the flame.
Move the container off the stove.
Distribute the cooked rice.
STOP

The algorithm for cooking rice can be seen here; Draw a standard flowchart for it.

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Quiz time!

Construct a flowchart to show the procedure to obtain the sum of two given numbers.

Step 1. INPUT TO A, B

Step 2. S ← A+B

(Store the sum of the values in A and B in S)

Step 3. PRINT S

(Show the sum obtained in Step 2)

Step 4. STOP

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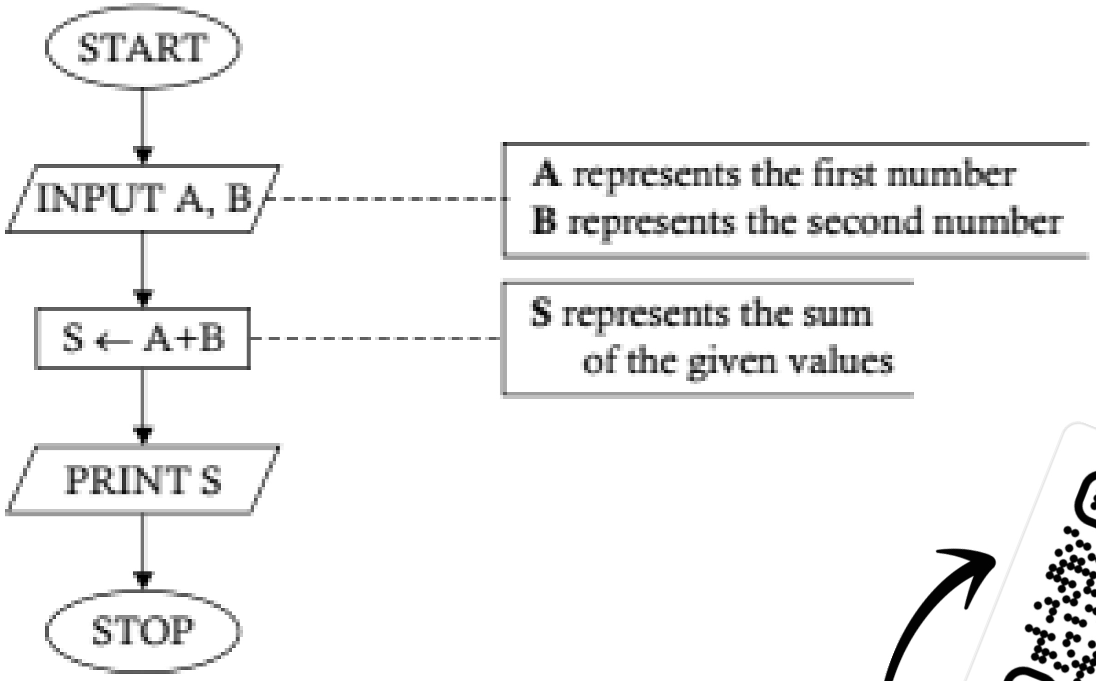
Solution

Construct a flowchart to show the procedure to obtain the sum of two given numbers.



A represents the first number
B represents the second number

S represents the sum of the given values

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Quiz time!

Construct a flowchart to show how to obtain the area of a triangle on the basis of the base and heigh.

Step 1. INPUT TO B, H

(B is for the base and H is for the height of the triangle)

Step 2. COMPUTE AREA ← *B*H

Step 3. PRINT AREA

Step 4. STOP

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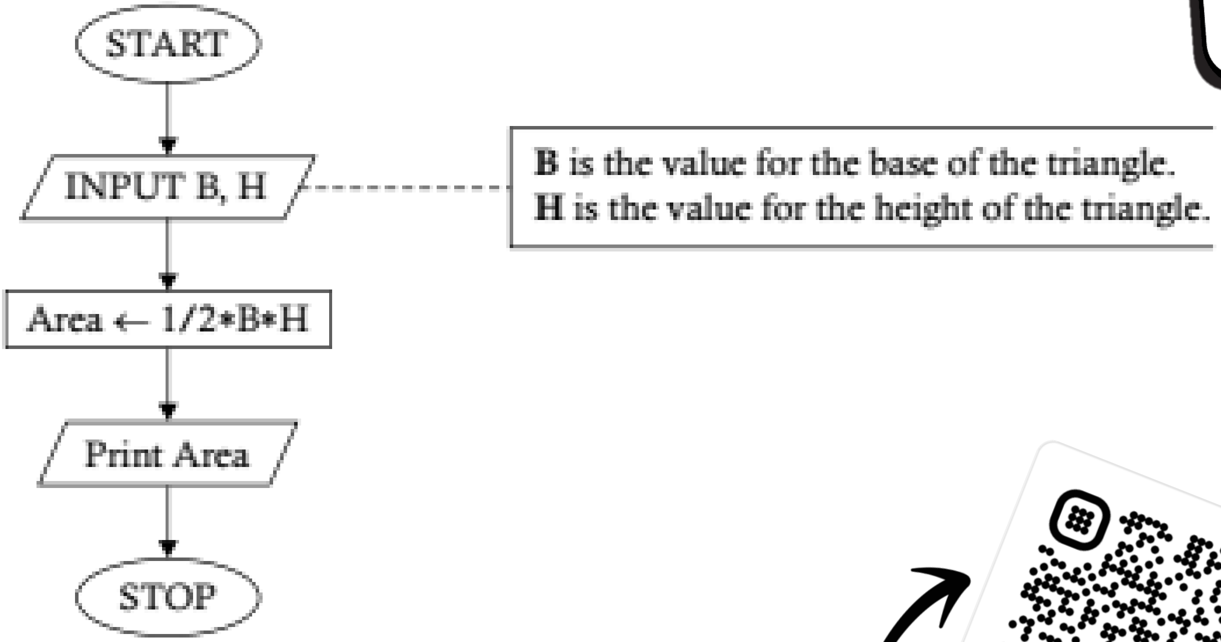
Solution

Construct a flowchart to show how to obtain the area of a triangle on the basis of the base and heigh.



START

INPUT B, H

B is the value for the base of the triangle.
H is the value for the height of the triangle.

Area ← 1/2*B*H

Print Area

STOP

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A *predicate*, also called a *condition*, is tested to see if it is true or false. If it is true, a course of action is specified for it; if it is found to be false, alternative course of action is expressed.

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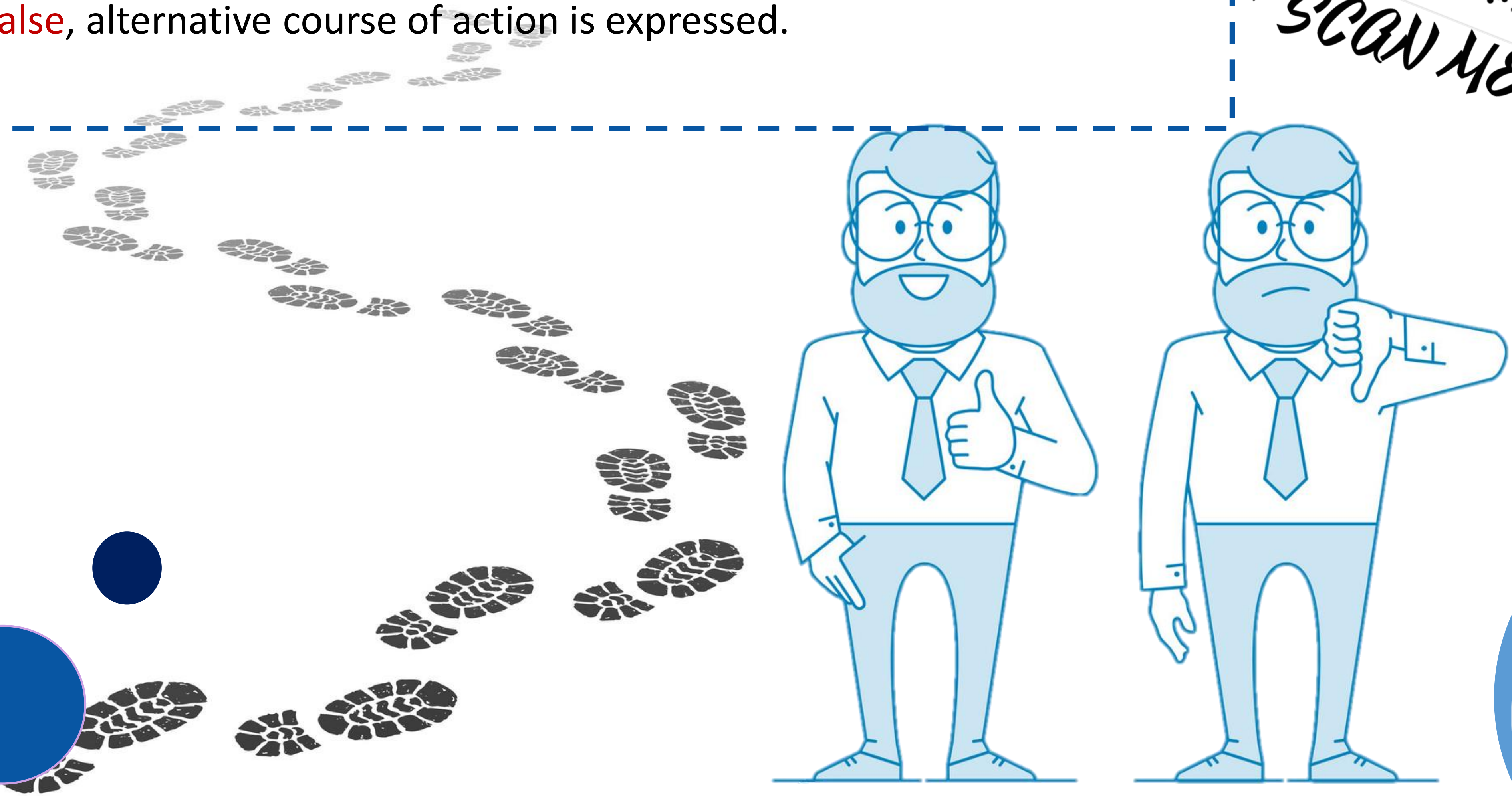

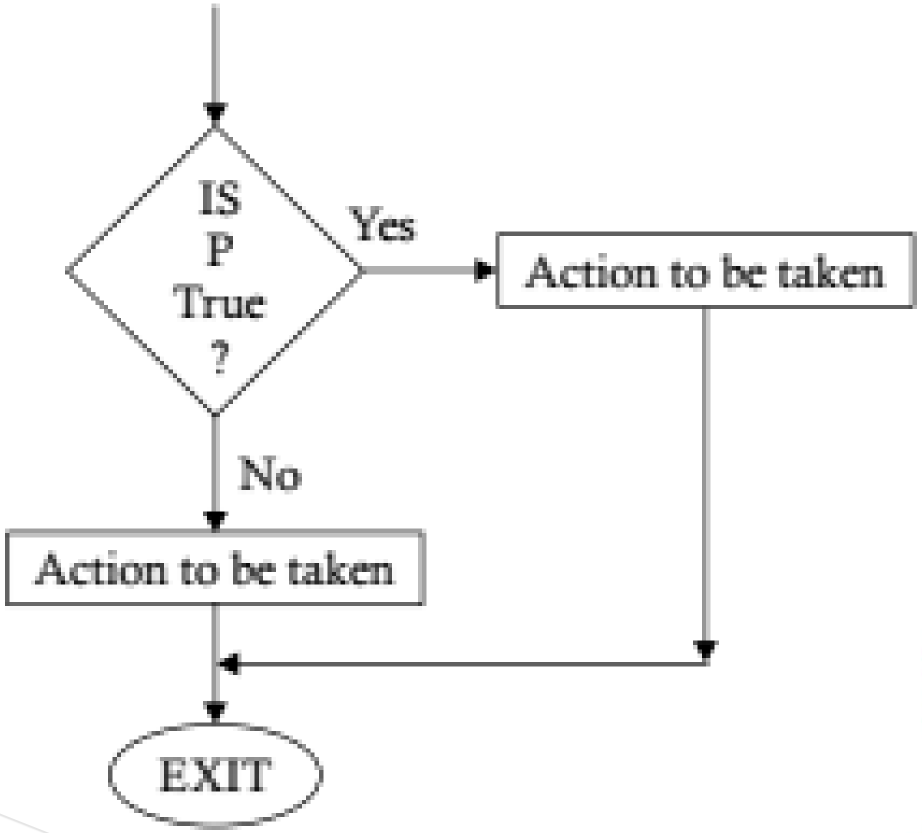

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Construct a flowchart to determine whether a given number is even or odd.

```
Step 1. INPUT TO A
Step 2. COMPUTE R ← Remainder of (A/2)
Step 3. IF R = 0
THEN PRINT "It is an even number."
ELSE
PRINT "It is an odd number."
END-IF
Step 4. STOP
```

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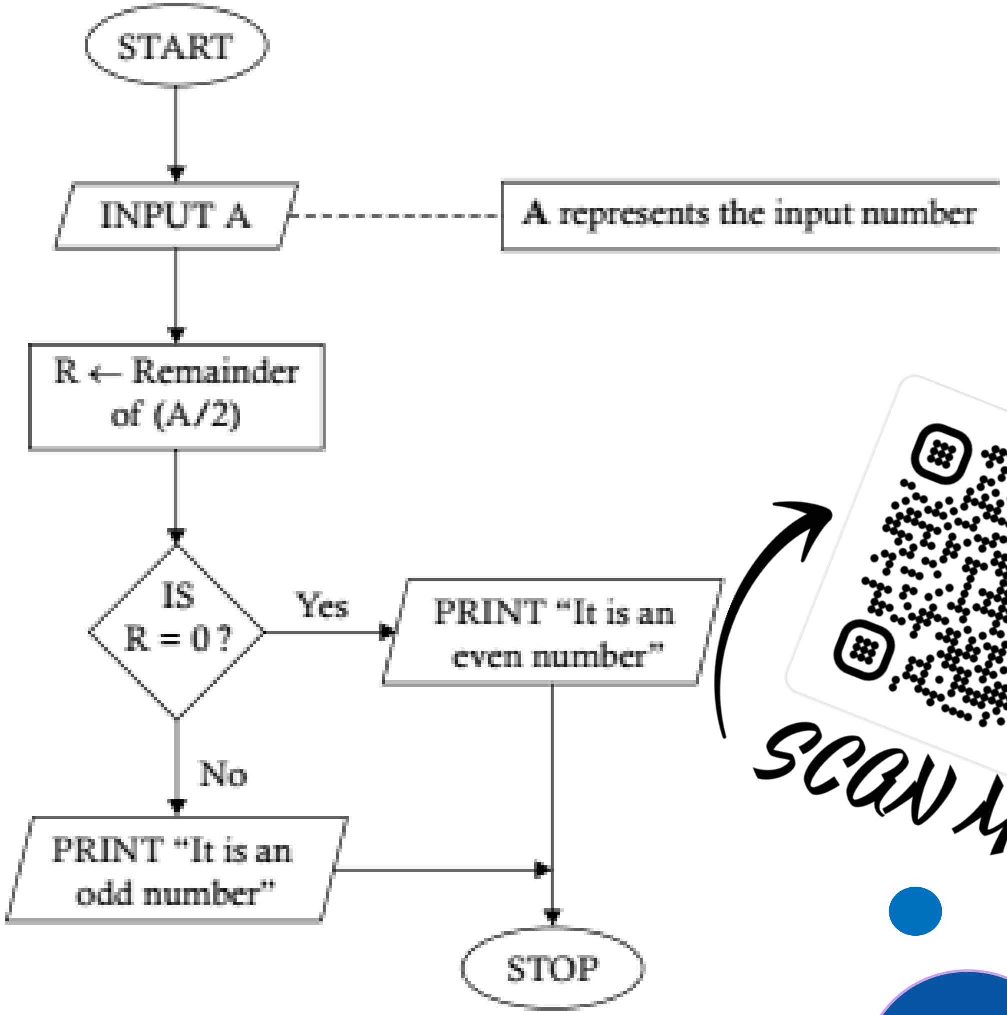
Solution


START
INPUT A
A represents the input number
R ← Remainder of (A/2)
IS R = 0 ?
Yes
PRINT "It is an even number"
No
PRINT "It is an odd number"
STOP

Construct a flowchart to determine whether a given number is even or odd.

```
Step 1. INPUT TO PAY
Step 2. IF PAY > 3000
            THEN BONUS ← 300
        ELSE
            IF PAY > 1600
            THEN BONUS ← PAY* 10/100
                IF BONUS > 240
                THEN
                    BONUS ← 240
                END-IF
            ELSE
                BONUS ← PAY* 15/100
                IF BONUS < 100
                    BONUS ← 100
                END-IF
            END-IF
        END-IF
Step 3. PRINT BONUS
Step 4. STOP
```

The following rules are used to calculate the bonus for the employees of an organization.

(i) *If the pay is more than $3,000, the bonus amount is fixed, and it is equal to $300.*

(ii) *If the pay is more than $1,600, but less than or equal to $3,000, the bonus will be 10% of the pay subject to a maximum of $240.*

(iii) *If the pay is less than or equal to $1,600, the bonus is 15% of pay, subject to a minimum of $100*

Solution

The following rules are used to calculate the bonus for the employees of an organization.

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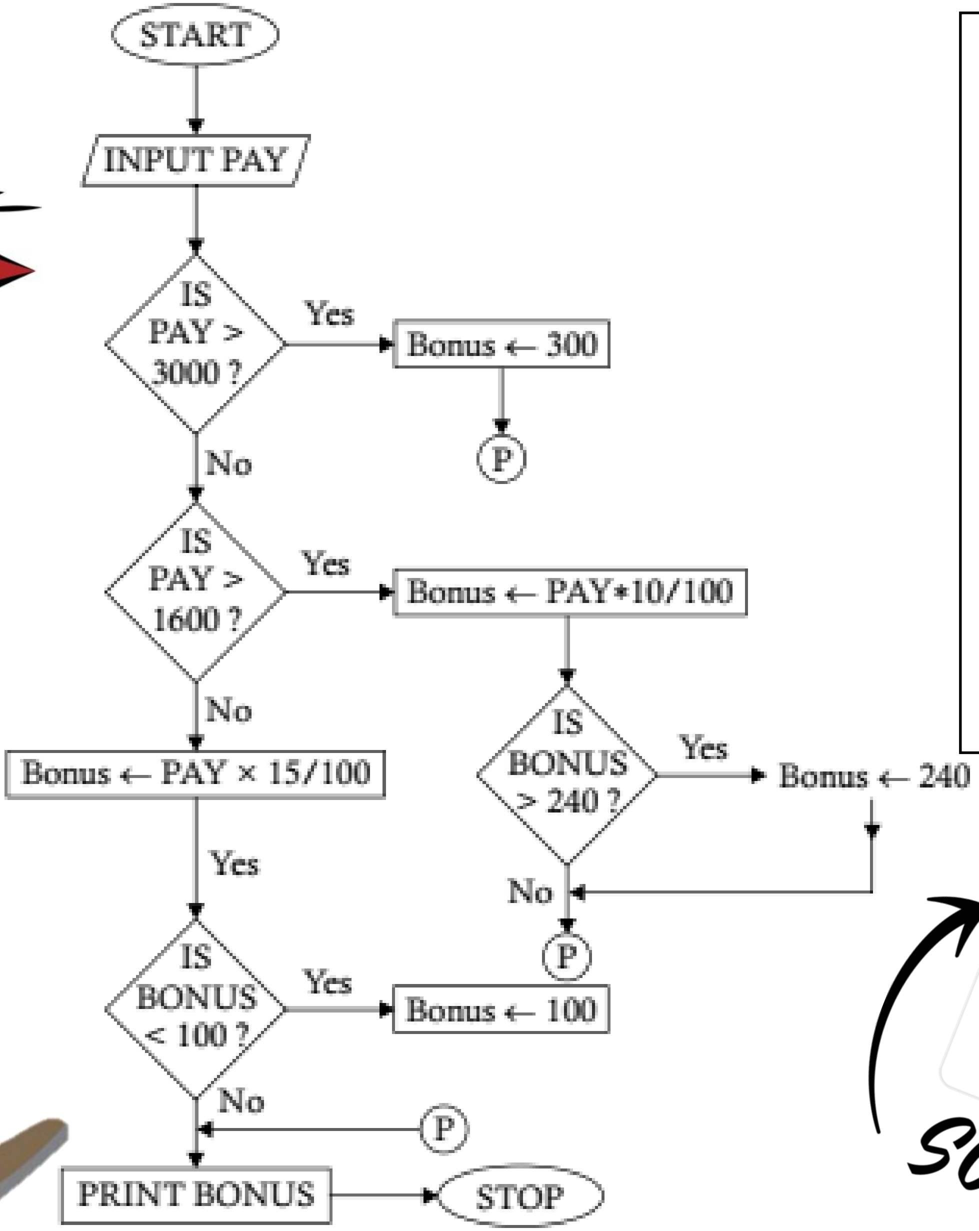
(iii) *If the pay is less than or equal to $1,600, the bonus is 15% of pay, subject to a minimum of $100*



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Looping or iteration means repeating a set of operations to obtain a result repeatedly.

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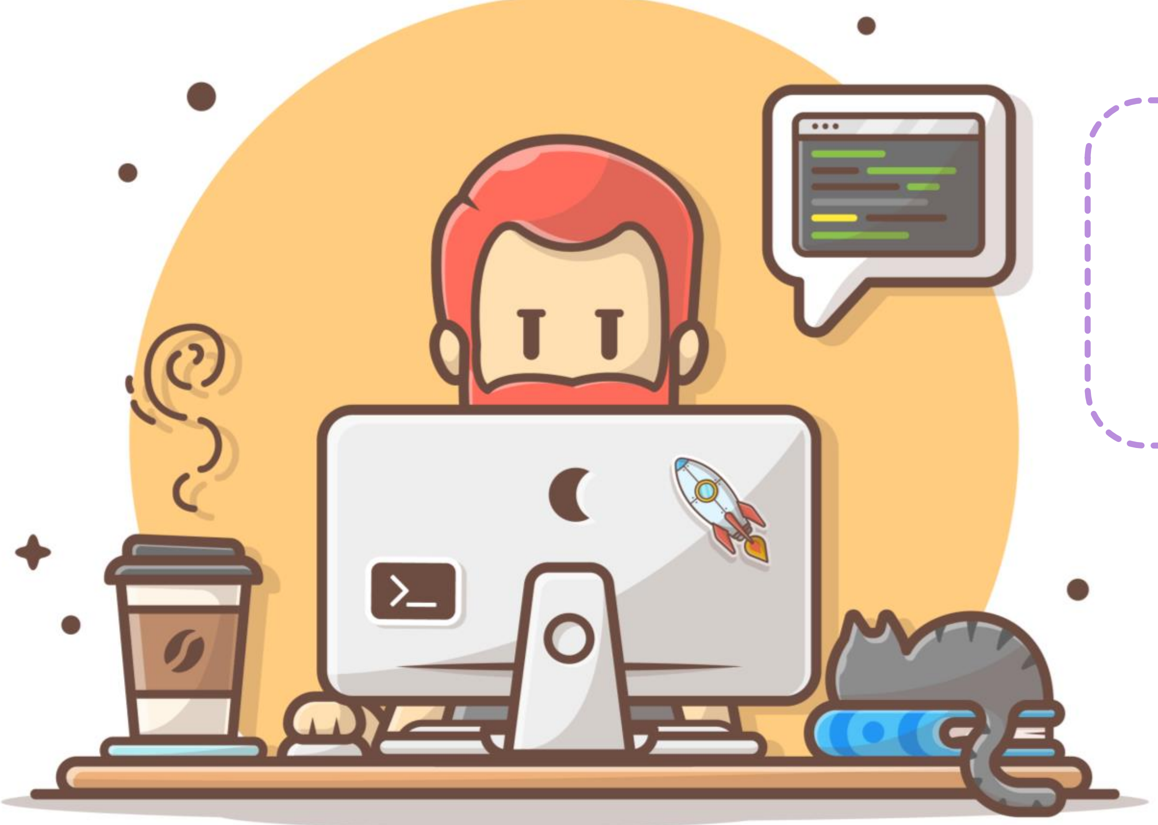

An iteration may be implemented in two ways: a pre-test iteration and post-test iteration.

Quiz time!

```
Step 1. FINISH ← "N"
Step 2. REPEAT STEPS 3 THROUGH 9 WHILE FINISH = "N"
Step 3. INPUT TO FSAL, SAMT
Step 4. IF SAMT > 5000
            THEN COMPUTE COM ← (SAMT – 5000) * .12
ELSE
            COM ← 0
END-IF
Step 5. COMPUTE REMU ← FSAL + COM
Step 6. PRINT "REMUNERATION IS", REMU
Step 7. PRINT "FINISH (Y/N)?"
Step 8. INPUT TO FINISH
Step 9. IF FINISH = "Y"
            THEN EXIT
END-IF
Step 10. STOP
```

A sales organization offers a fixed salary and a percentage of sales as a commission to determine the monthly remuneration of an employee under the following conditions.

If the sales amount of an employee exceeds $5,000, then the commission is 12% of the sales that exceed $5,000; otherwise, it is nil. Draw a flowchart to show how the remuneration of an employee is decided.

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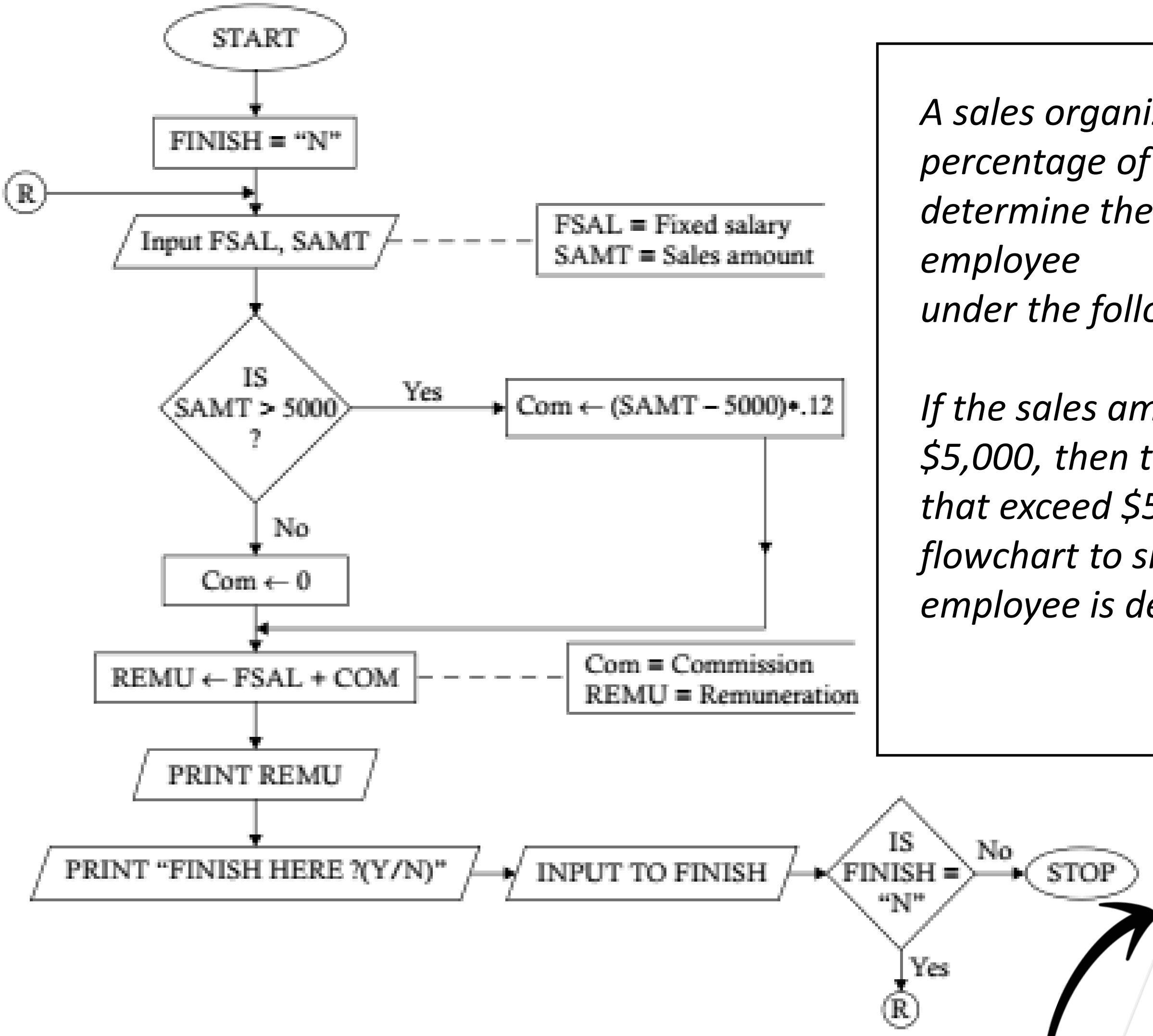
Solution



A sales organization offers a fixed salary and a percentage of sales as a commission to determine the monthly remuneration of an employee
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If the sales amount of an employee exceeds $5,000, then the commission is 12% of the sales that exceed $5,000; otherwise, it is nil. Draw a flowchart to show how the remuneration of an employee is decided.

Quiz time!

Draw a flowchart to show how to find the product of first 10
natural numbers.

```
Step 1. PRODUCT ← 1, NUM ← 1, CNT ← 0
(Initialize the variables required)
Step 2. REPEAT STEPS 3 THROUGH 5 WHILE CNT <= 10
Step 3. COMPUTE PRODUCT ← PRODUCT*NUM
Step 4. COMPUTE CNT ← CNT + 1
(Increment the Counter)
Step 5. COMPUTE NUM ← NUM + 1 (The next number is generated)
Step 6. PRINT "THE PRODUCT IS", PRODUCT
Step 7. STOP
```

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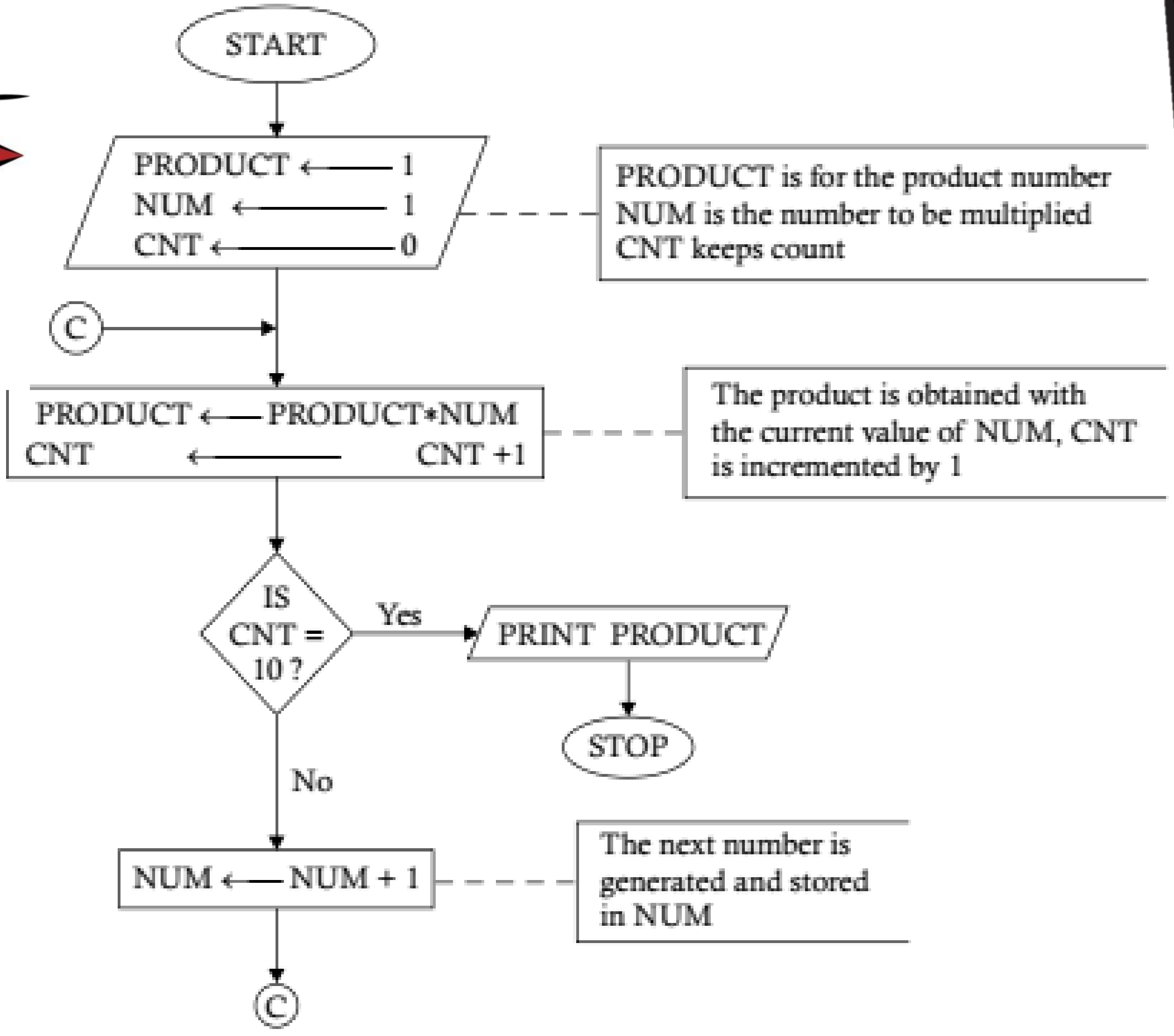
Solution

Draw a flowchart to show how to find the product of first 10
natural numbers.



START

PRODUCT ← 1
NUM ← 1
CNT ← 0

PRODUCT is for the product number
NUM is the number to be multiplied
CNT keeps count

C

PRODUCT ← PRODUCT*NUM
CNT ← CNT +1

The product is obtained with the current value of NUM, CNT is incremented by 1

IS CNT = 10 ?

Yes

PRINT PRODUCT

STOP

No

NUM ← NUM + 1

The next number is generated and stored in NUM

C

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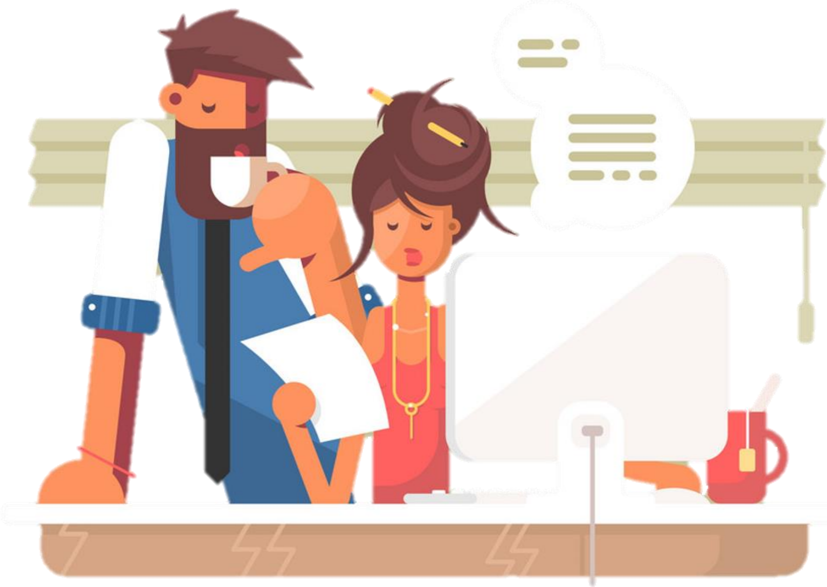
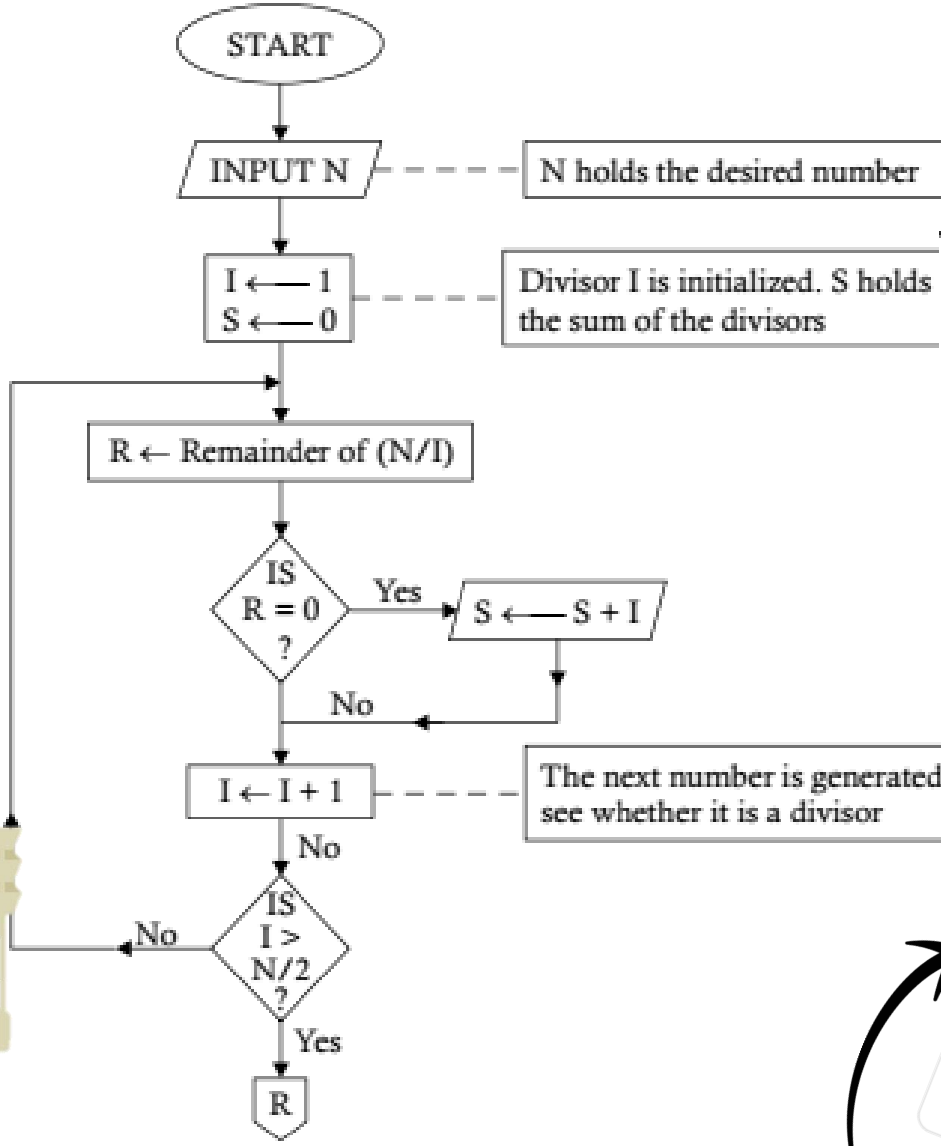
Quiz time!

```
Step 1. INPUT TO N
[ACCEPT THE DESIRED INTEGER AND STORE IT]
Step 2. [INITIALIZE THE DIVISOR LOCATION I & THE
LOCATION S TO CONTAIN THE SUM OF
THE DIVISORS]
Step 3. WHILE I <= Integer part of (N/2) DO
    (i) COMPUTE R ← REMAINDER OF (N/I)
    (ii) IF R = 0
        THEN COMPUTE S ← S + I
        [ACCUMULATE THE DIVISOR OBTAINED]
    END-IF
    (iii) COMPUTE I ← I + 1
    [INCREMENT I TO SEE WHETHER IT IS THE
    NEXT DIVISOR]
Step 4. If S = N
    THEN PRINT N, "IS A PERFECT NUMBER."
    ELSE
    PRINT N, "IS NOT A PERFECT NUMBER."
    END-IF
Step 5. STOP
```

Construct a flowchart to show how to determine whether a given number is a perfect number.



Solution



START

INPUT N

N holds the desired number

I ⟵ 1
S ⟵ 0

Divisor I is initialized. S holds the sum of the divisors

R ← Remainder of (N/I)

IS R = 0 ?

Yes

S ⟵ S + I

No

I ← I + 1

The next number is generated to see whether it is a divisor

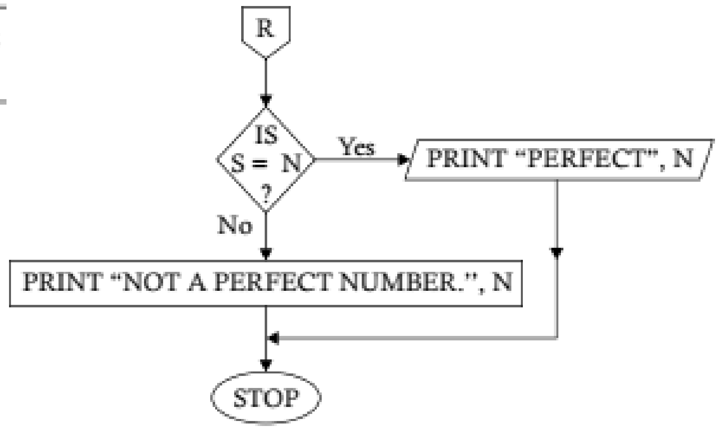
No

IS I > N/2 ?

No

Yes

R



R

IS S = N ?

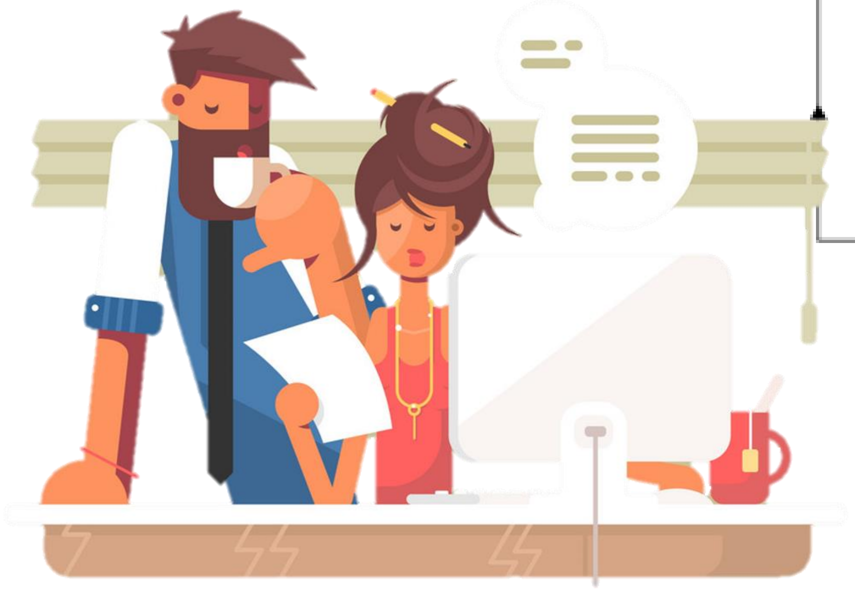
Yes

PRINT “PERFECT”, N

No

PRINT “NOT A PERFECT NUMBER.”, N

STOP



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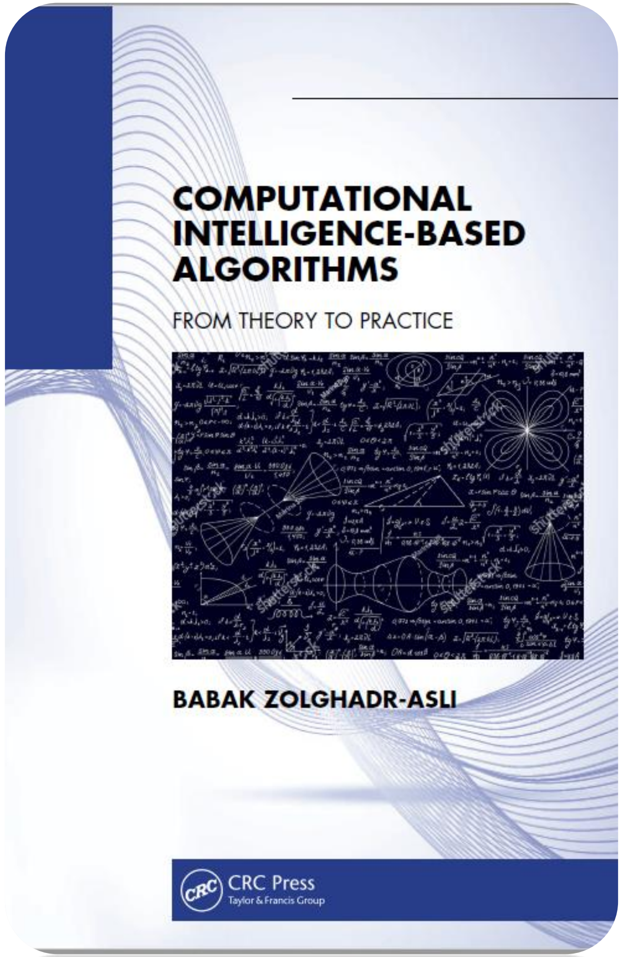
Coming out soon … HOPEFULLY!!!!



COMPUTATIONAL INTELLIGENCE-BASED ALGORITHMS

FROM THEORY TO PRACTICE

BABAK ZOLGHADR-ASLI

CRC Press
Taylor & Francis Group

Chapter 9: Harmony Search Algorithm

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RESEARCH AREA

o Water resources planning and management
o Climate change
o Sustainable development
o Decision-Making paradigms
o Deep Uncertainty
o Optimization
o Machine Learning
o Data Mining

AWARDS & HONORS

Outstanding researcher award in "the 26th Research Festival", University of Tehran (2017); Outstanding student award in "the 8th International Festival and Exhibition", University of Tehran (2018); Outstanding M.Sc. thesis award in "the 5th National Festival of Environment", Tehran Iran (2018); Winner of the "Prof. Alireaz Sepaskhah" 1st Scientific Award in water engineering [Shiraz University] (2019); Excellent Reviewer, Journal of Hydro Science & Marine Engineering (2020).

SELECTED PUBLICATION

1. Zolghadr-Asli, B., Naghdyzadegan Jahromi, M., Wan, X., Enayati, M., Naghdizadegan Jahromi, M., Tahmasebi Nasab, M., Pourghasemi, H.R., & Tiefenbacher, J.P. (2023). "Uncovering the Depletion Patterns of Inland Water Bodies via Remote Sensing, Data Mining, and Statistical Analysis." Water, 15(8), 1508.
2. Zolghadr-Asli, B. (2023). "No-free-lunch-theorem: A page taken from the computational intelligence for water resources planning and management." Environmental Science and Pollution Research, DOI: 10.1007/s11356-023-26300-1.
3. Zolghadr-Asli, B. (2023). "Computational intelligence-based optimization algorithms: From theory to practice," CRC Press, (Typesetting and finalizing the publisher requirements).

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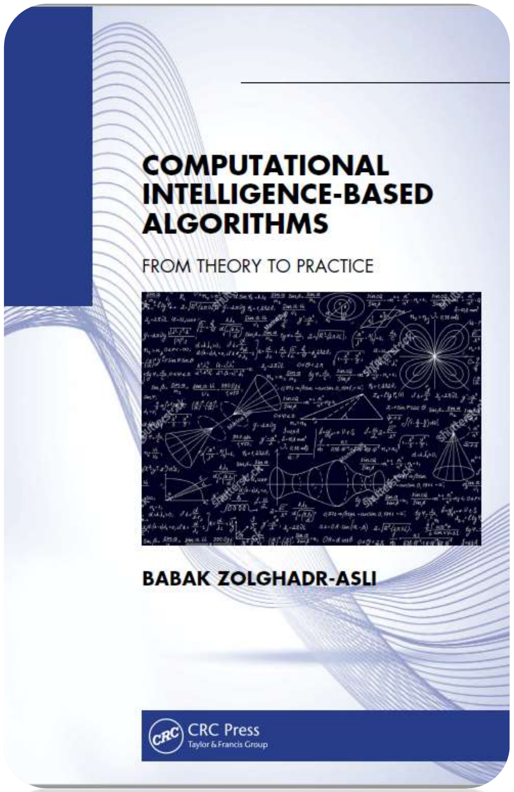

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