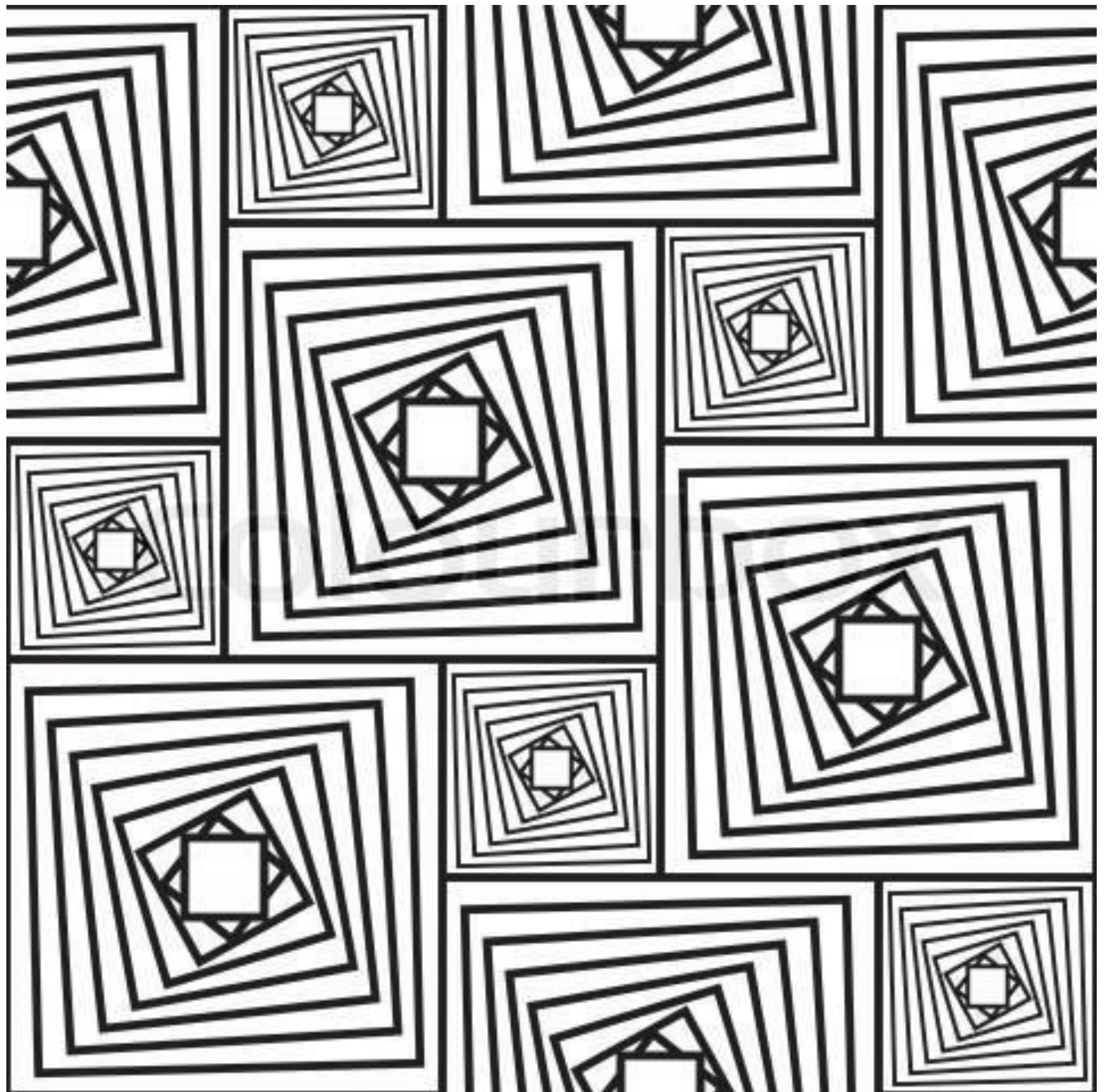


# A LOOP FOR LOOPS



# PUZZLE

There are 100 doors in a row, all doors are initially closed. A person walks through all doors multiple times and toggle (if open then close, if close then open) them in following way:  
On the first walk, the person toggles every door 1st, 2nd, 3rd, 4th..

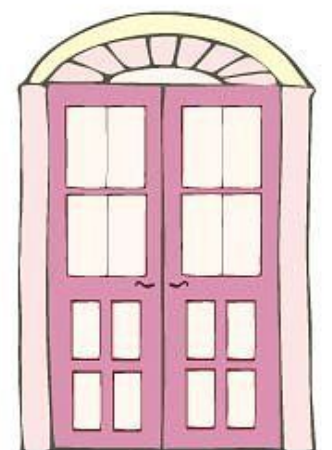
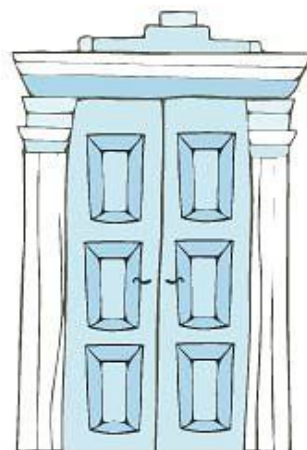
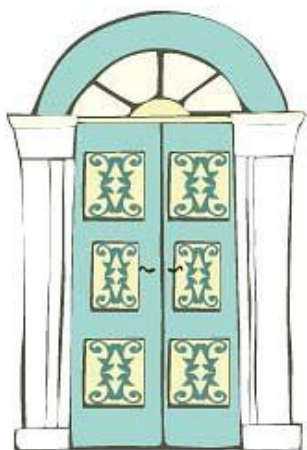
In the second walk, the person toggles every second door, i.e., 2nd, 4th, 6th, 8th, ...

In third walk, the person toggles every third door, i.e, 3rd, 6th, 9th, 12th,

.....

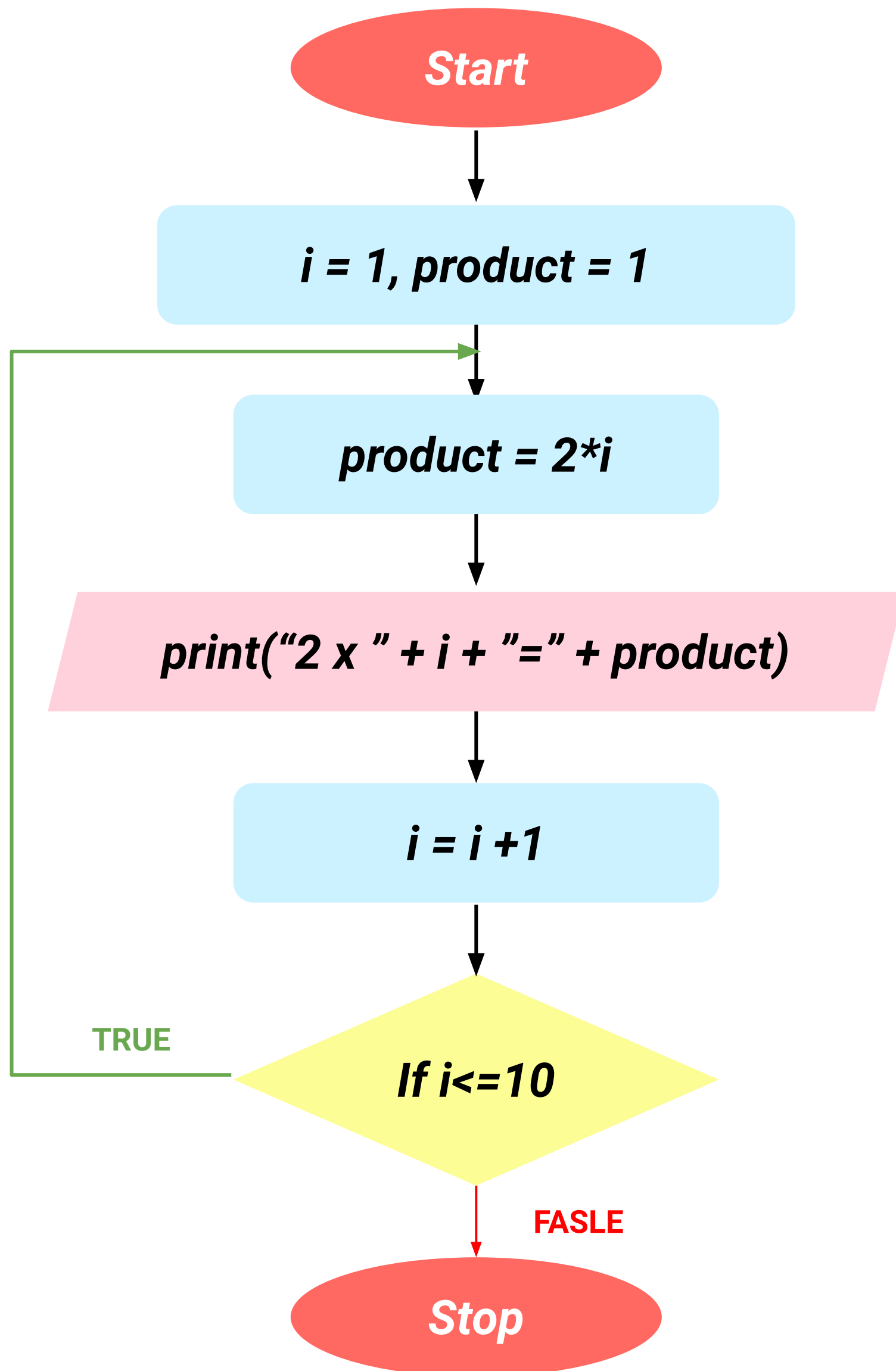
.....

On the 100th walk, the person toggles the 100th door.  
Which doors are open in the end?



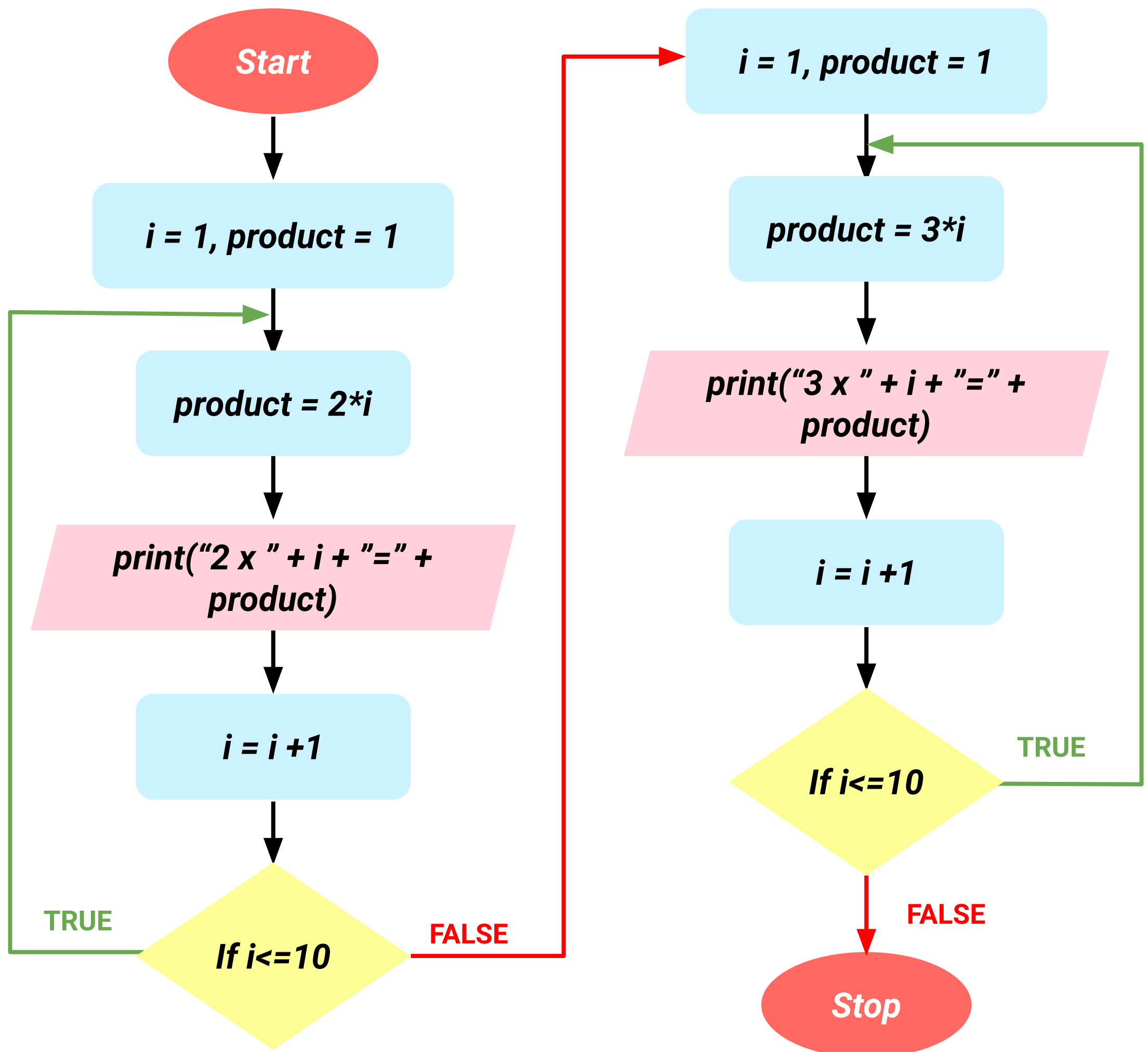
**Write a flowchart displaying the tables of 2 (till times 10) using loops.**

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**Now what if we want to print the table of 2 AND the table of 3? How will we do this?**

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**If we had to write the tables of all numbers till 20,  
by this method, how many loops will we require?**

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**20 seperate loops**

**But what to do if the loop itself is repeating 20 times throughout the flowchart?**



If we had to write the tables of all numbers till 20, by this method, how many loops will we require?

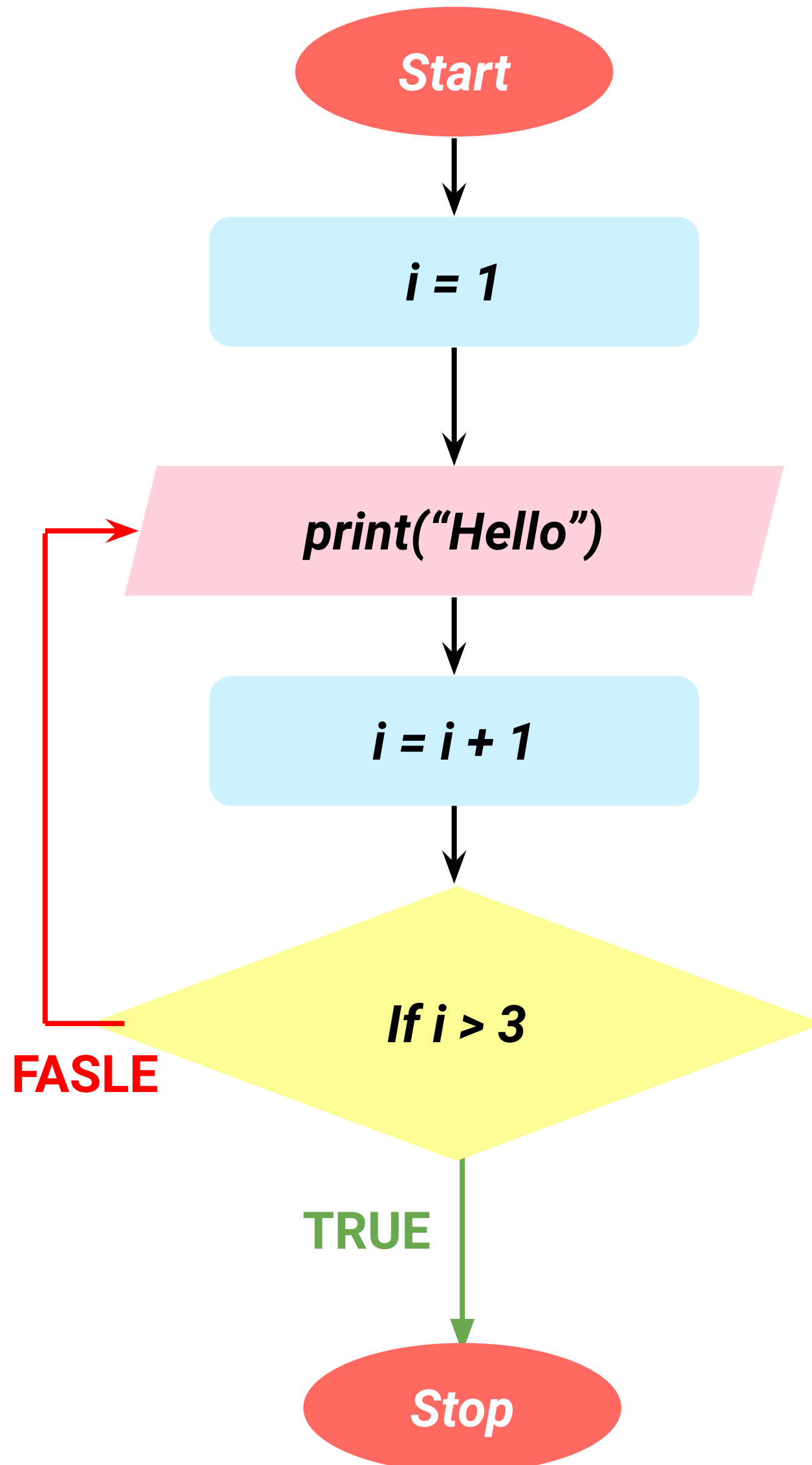
20 seperate loops

But what to do if the loop itself is repeating 20 times throughout the flowchart?

Design just one loop, and put it inside another-bigger-outer loop which will run 20 times

This method, where we maintain a loop inside another loop, is called **Nested Loops**. The loops are called - **inner loops**, and **outer loops**.

Perform a dry run of the following program and write down the output in your notebooks



Now, let's say we want to modify the same flowchart, but run the **ENTIRE** loop two times, by doing so, we are trying to achieve the output -

Hello

Hello

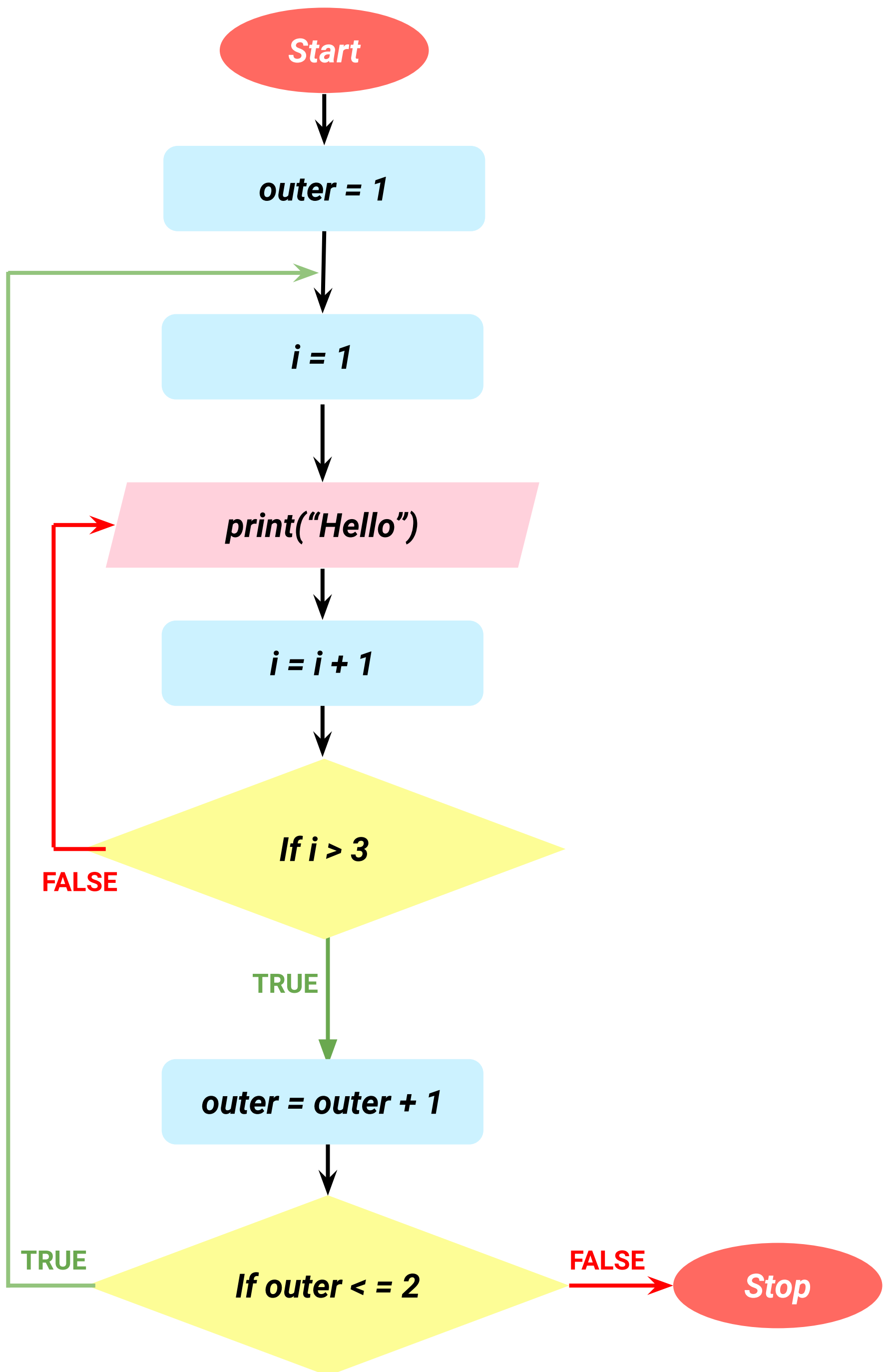
Hello

Hello

Hello

Hello

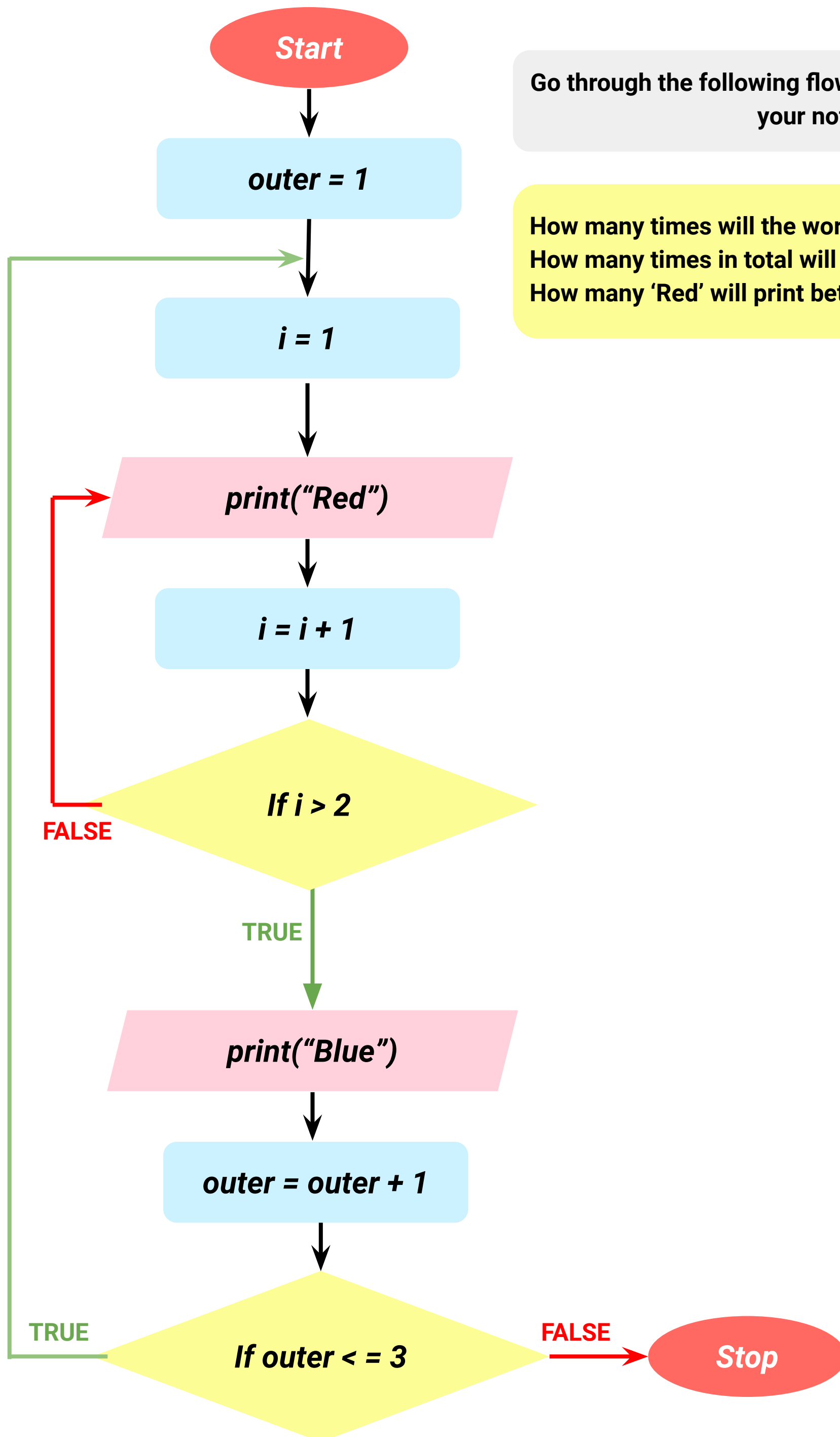
**How many times do we need to run the the 'Hello' Loop?**



**What is the counter for the inner loop?**

**What is the counter for the outer loop?**

**Let's say we want to print 'Hello' - 9 times (3x3)  
Will you make a change to the outer loop, or the inner  
loop?**



Go through the following flowchart and write the output in your notebooks.

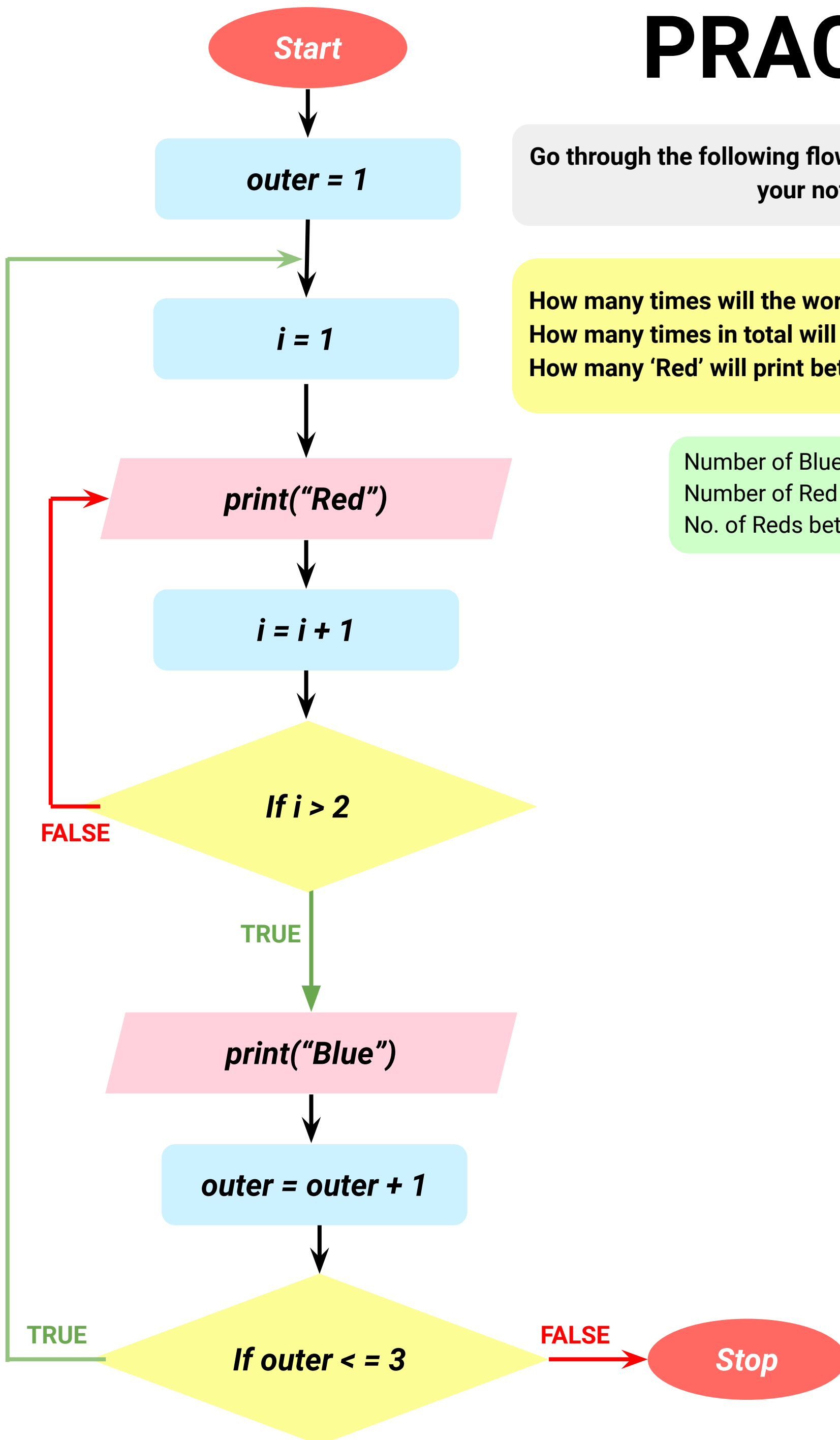
How many times will the word 'Blue' print?  
How many times in total will the word 'Red' print?  
How many 'Red' will print between two 'Blue'?

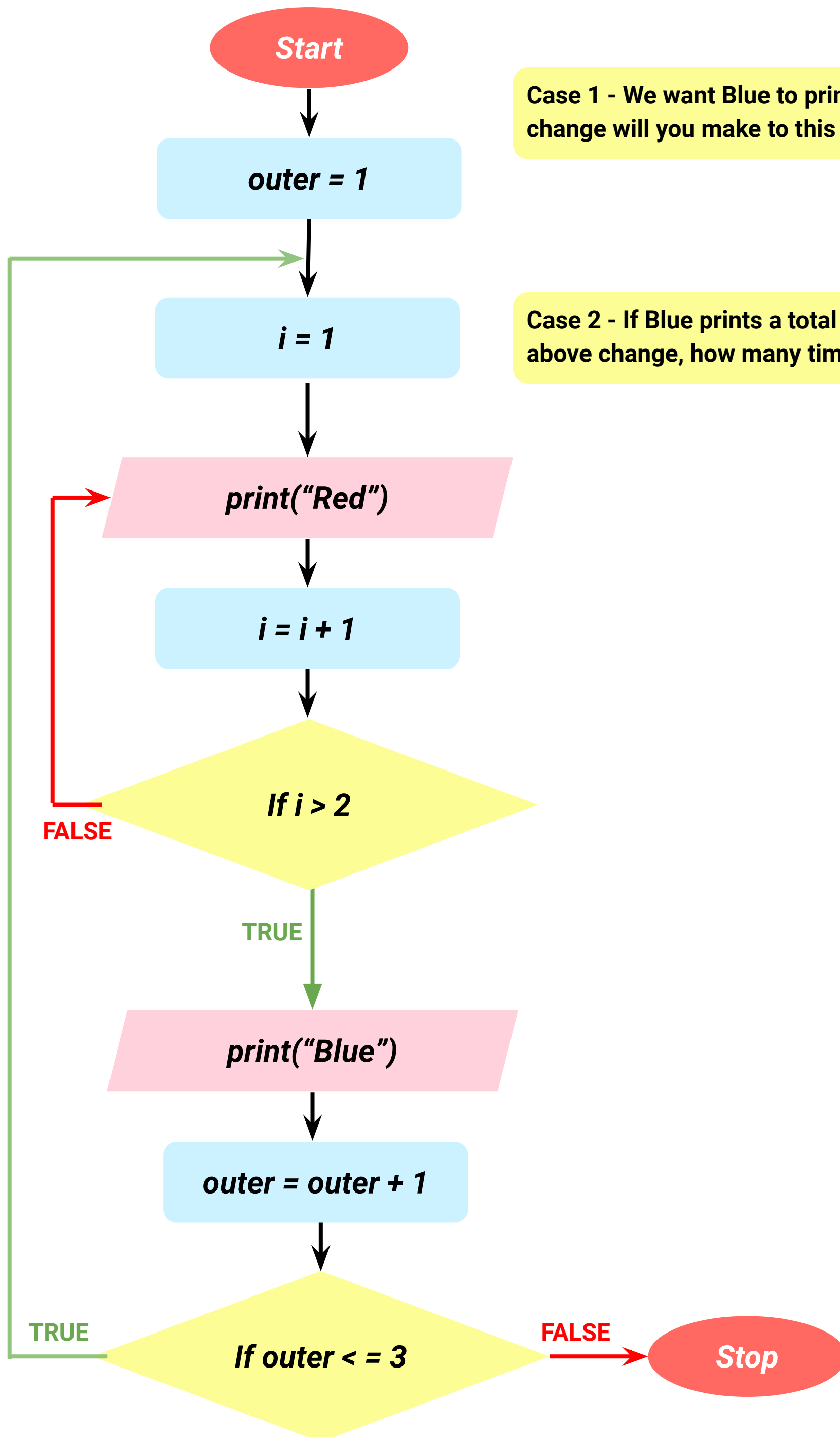
# PRACTICE

Go through the following flowchart and write the output in your notebooks.

How many times will the word 'Blue' print?  
How many times in total will the word 'Red' print?  
How many 'Red' will print between two 'Blue'?

Number of Blue - 3  
Number of Red - 6  
No. of Reds between Blues - 2

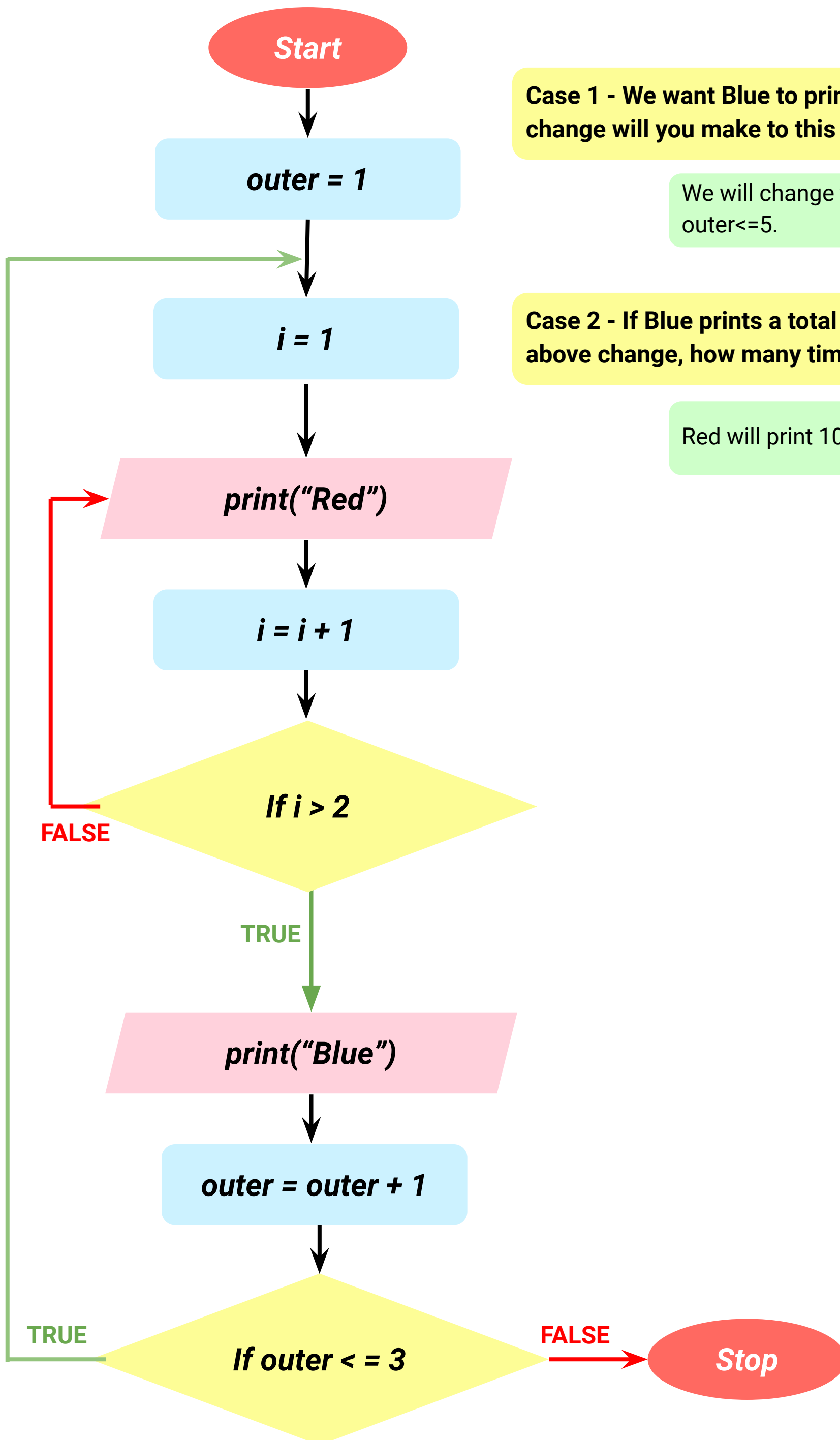




Case 1 - We want Blue to print five times. What one change will you make to this flowchart?

Case 2 - If Blue prints a total of five times as per the above change, how many times will Red print?





**Case 1 - We want Blue to print five times. What one change will you make to this flowchart?**

We will change the second decision box to  $outer \leq 5$ .

**Case 2 - If Blue prints a total of five times as per the above change, how many times will Red print?**

Red will print 10 times.

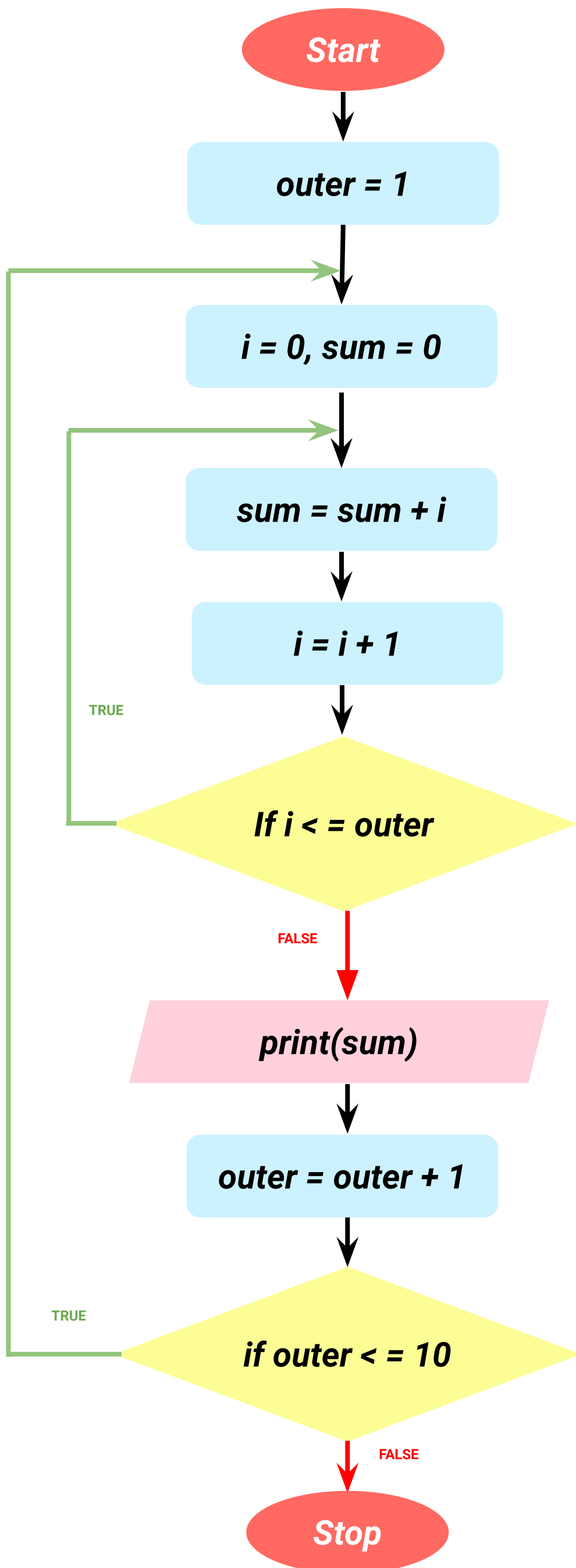
Modify the above flowchart to print get this output

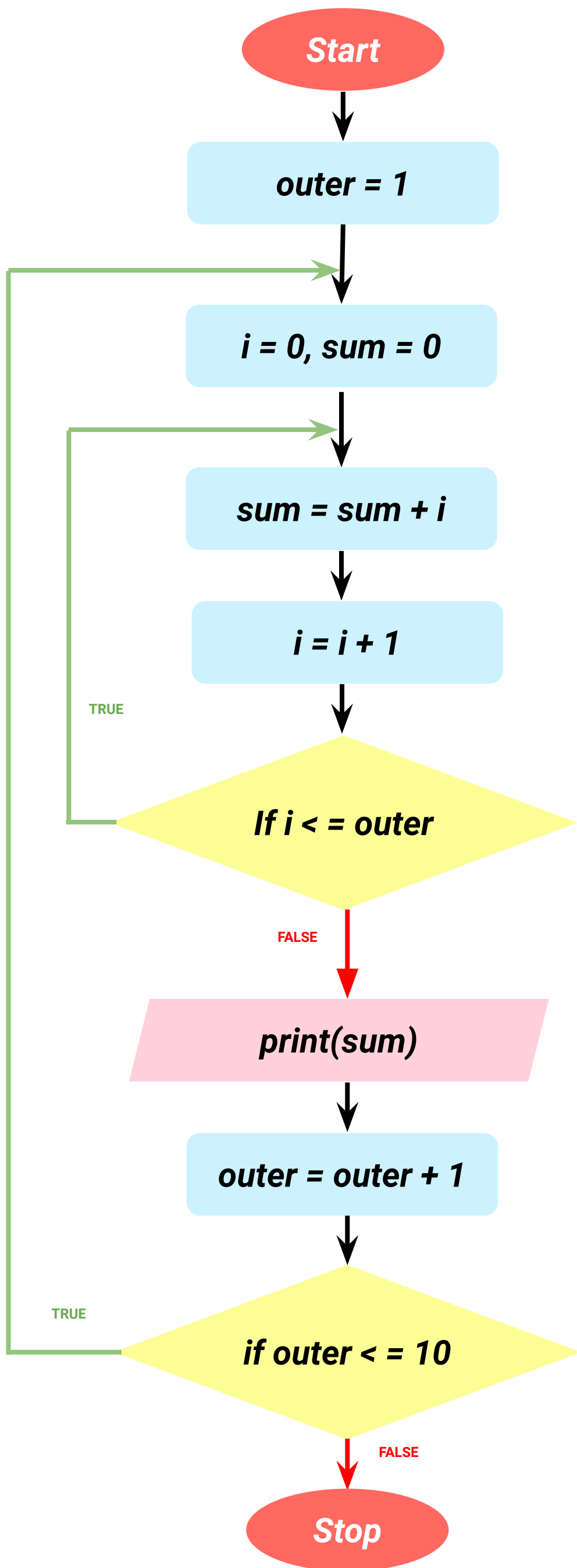
+ + + + - + + + + - + + + + -

# PRACTICE

Based on the given flowchart, complete the given output

1 \_ 6 \_ 15 \_ 28 36 \_ \_





What change will you make to the program if we wanted to print an 11th term of the series?

What change(s) would you make if you wanted to print the factorial of all numbers from 1 to 10?

# INDEPENDENT PRACTICE

**Draw a flow chart to take an input N and print first N prime numbers.**

**Draw a flowchart to print the first N digits of the following series.**

Sample Input:

9

Sample Output:

10 2 20 4 30 6 40 8 50

**Draw a flowchart to take N as input and print numbers from 1 to N, 5 times.**

**Draw a flowchart to print the first 10 numbers of the following series -**

1, 2, 4, 7, 11,...

1, 11, 31, 61, 101,...

1, 3, 7, 13, 21,...

# SPECIAL PROBLEMS

## STRONG NUMBERS

A strong number is a special number whose sum of the factorial of digits is equal to the original number.

For example, 145 is a strong number. Since,  $1! + 4! + 5! = 145$

Draw a flowchart to check if the given number is a strong number or not.

## ARMSTRONG NUMBERS

An Armstrong number is an integer such that the sum of the cubes of its digits is equal to the number itself.

For example, 371 is an Armstrong number since  $3^3 + 7^3 + 1^3 = 371$ .

In programming, to conduct cube we use the `**` operator.

Draw a flowchart to check if the given number is an Armstrong number or not.

# SPECIAL PROBLEMS

## PRIME NUMBERS

**Using Nested loops, we need to find all the prime numbers between 1 to 1000 -**

1. The outer loop will be to iterate from 1 to 1000 one by one.
2. For each number, we will run an inner loop which checks if it has any factors, print it if it has no factors.

Can you write a flowchart to do so?

## The difference between `print("Hello")` and `print("Hello,end =' ')`

In `print("Hello", end="")`, The word Hello is printed and the program stays on the same line. The next print function will write the text next to Hello and not in the next line.

In `print("Hello")`, The word Hello is printed and the program moves to the next line. Any further print operations will happen on the next line.

### What would be the final output of below statements?

```
print("Hi,", end=' ')
```

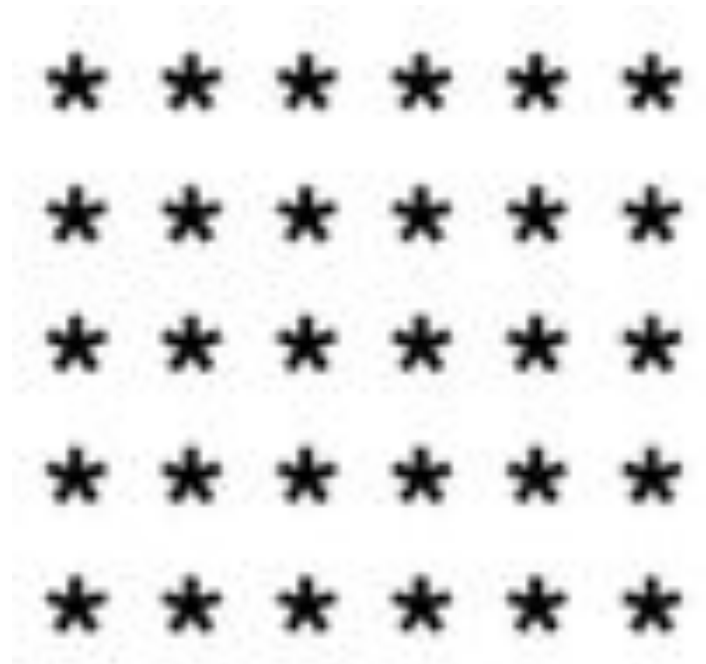
```
print("I am a student at")
```

```
print("P. S. Laxmi High School ")
```

Hi, I am a student at  
P. S. Laxmi High School



Now, we wish to print the following pattern



Now, we wish to print the following pattern



| Row = 1                 | Row = 2                 | Row = 3                 | Row = 4                 | Row = 5                 |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| print (" * ") - 6 times | print (" * ") - 6 times | print (" * ") - 6 times | print (" * ") - 6 times | print (" * ") - 6 times |

**Steps to display - To make such patterns in flowcharts and nested loops**

**1. The outer loop will be for the number of rows.** If there are 20 horizontal rows, the outer loop will run 20 times.

**2. The inner loop is to print the content of each row.** If there are 5 stars in EACH row, the inner loop will run 5 times.



**How many times do you want the outer loop to run(number of rows)?**

**For each outer loop, how many times do you want the inner loop to run(printing individual stars for each row)?**



**How many times do you want the outer loop to run(number of rows)?**

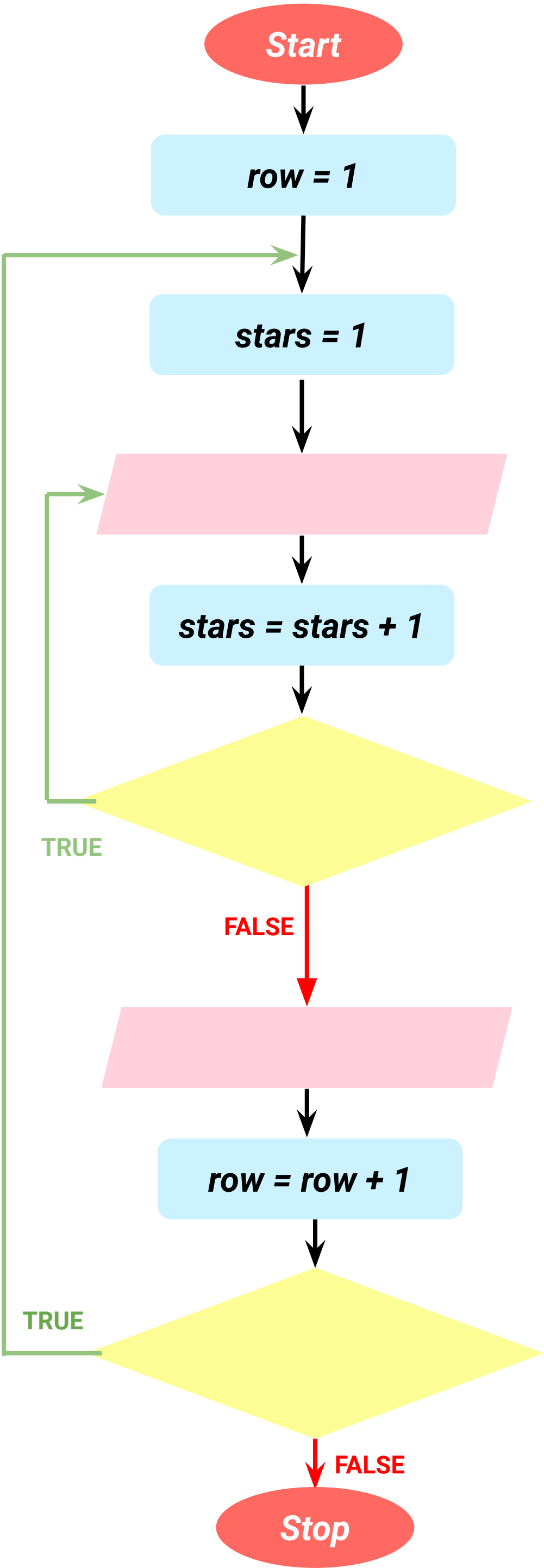
We know we want to print five rows, so the outer loop should run five times.

**For each outer loop, how many times do you want the inner loop to run(printing individual stars for each row)?**

Now for every row, we want to print six stars. So the inner loop should run six times.

# PRACTICE

Can you place the following blocks in the correct location to make the patterns given above?



*print(, end="")*

*print("\*")*

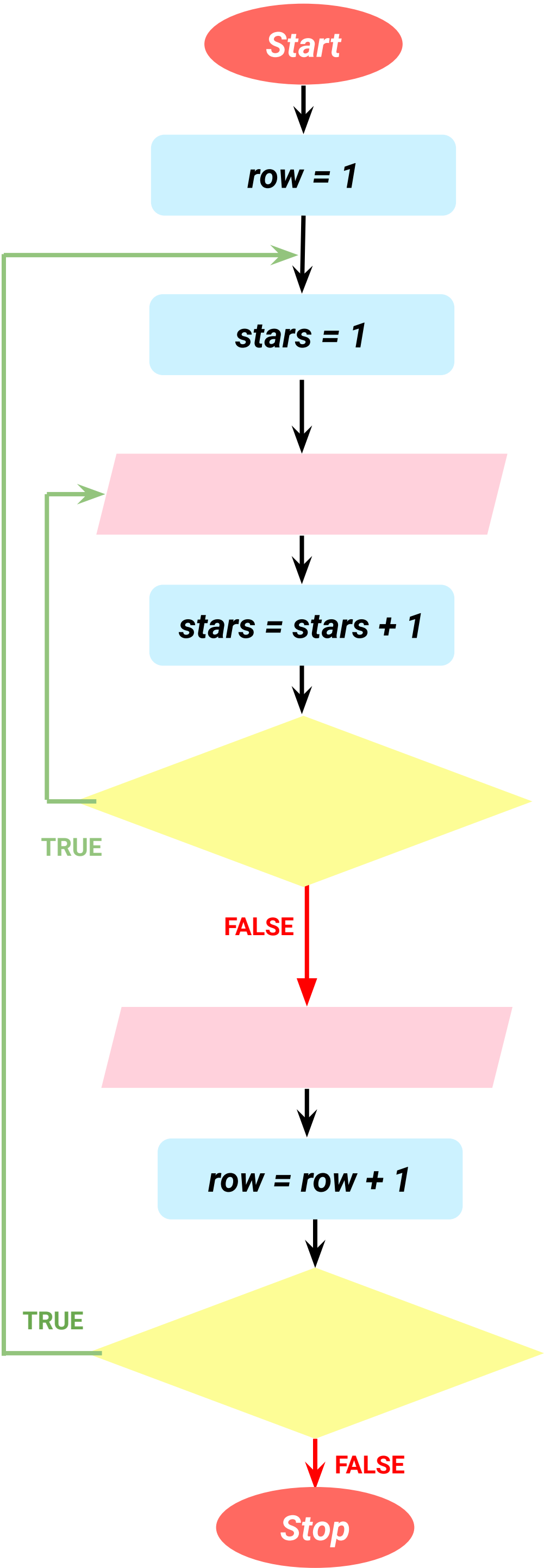
*if row < = 5*

*If stars < = 6*

# PRACTICE

Modify the given flowchart to print the following pattern -

!!!!?  
!!!!?  
!!!!?  
!!!!?



# SPECIAL PATTERNS

\*

\*\*

\*\*\*

\*\*\*\*

\*\*\*\*\*

Problem - The number of stars in each row should be equal to the Row number.

| Row = 1                   | Row = 2                    | Row = 3                    | Row = 4                    | Row = 5                    |
|---------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| print (" * ") - 1<br>time | print (" * ") - 2<br>times | print (" * ") - 3<br>times | print (" * ") - 4<br>times | print (" * ") - 5<br>times |



# SPECIAL PATTERNS

Steps to display - To make such patterns in flowcharts and nested loops

**1. The outer loop will be for the number of rows.** If there are 20 horizontal rows, the outer loop will run 20 times.

**2. The inner loop is to print the content of each row. The inner loop will run 'RowNumber' variable times.** If RowNumber is 4, innerloop will run 4 times.

# SPECIAL PATTERNS

What will be the condition of the outer loop(number of rows)?

\*

\*\*

\*\*\*

\*\*\*\*

\*\*\*\*\*

What will be the condition of the inner loop(number of stars)?

# SPECIAL PATTERNS

\*

\*\*

\*\*\*

\*\*\*\*

\*\*\*\*\*

**What will be the condition of the outer loop(number of rows)?**

The condition of outer rows will be the same as per the above flowchart - if rows  $\leq 5$

**What will be the condition of the inner loop(number of stars)?**

Here the number of stars need to be printed depending on the row number. Hence stars  $\leq$  rows will be our condition.

# PRACTICE

```
      *
     **
    ***
   ****
  *****
```

How many rows are present? What will be the condition of the outer loop?

Now in this example, we need two inner loops. If you notice each and every row, they are divided into two parts -

**1. First part is the empty gaps. We have to print some empty gaps and then start printing the content**

**2. Second part is the stars. After printing some amount of empty space, we have to print the stars.**

# INDEPENDENT PRACTICE

Draw a flowchart to print following pattern -

```
  *
 **
***
****
*****
```

Draw a flowchart to print following pattern -

```
  1
 1 2 1
1 2 3 2 1
1 2 3 4 3 2 1
1 2 3 4 5 4 3 2 1
```

Draw a flowchart to take an input N and print the following sequence.

Sample Input

5

Sample Output

5 4 3 2 1

10 9 8 7 6

15 14 13 12 11

20 19 18 17 16

25 24 23 22 21

# INDEPENDENT PRACTICE

Draw a flowchart to print the following pattern -

```
1 2 3
8 9 4
7 6 5
```

Draw a flowchart to print following pattern.

```
1
2 3 2
3 4 5 4 3
4 5 6 7 6 5 4
5 6 7 8 9 8 7 6 5
```

Print the following patterns using nested loops only.

```
1 2 3 4 5
10 9 8 7 6
11 12 13 14 15
20 19 18 17 16
21 22 23 24 25
```