Review

Program Design

- IPO
  - Input-process-output design
  - Separate each component from each other

1) Identify the input

2) Identify the output

Program Syntax

- Sequential
  - Work in order
  - Step-by-step execution
- Decision
  - Choose between alternatives based on a condition.
- Repetition
  - Repeat a set of statement based on a condition.
  - We use this when the solution involves with **range**.

Everything seems easy, right?

How to design a program

1) Analyze the problem
   - Understand the problem description
   - Search on the internet, read book, or ask some one.
2) Trial-and-Error Method
   1. Start from a small problem where you can clearly see the structure of the problem
   2. Develop a solution based on what you know
   3. Apply the solution
3) Extend the solution to a bigger problem
4) If 3) does not solve the problem, go back to 2)/

Case study

Receive a non-negative integer and calculate the factorial.

Analyze

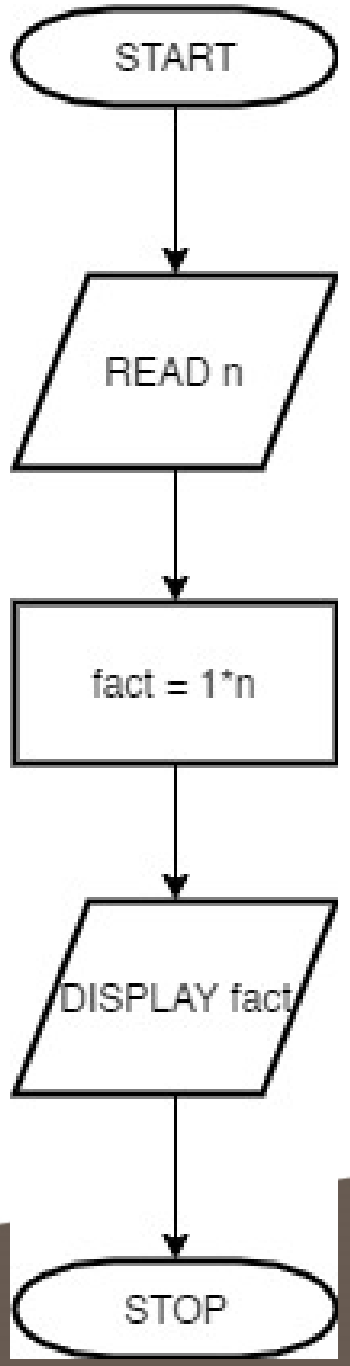
- A factorial of a number is the multiplication of all number from 1 of the to the number.

Everyone knows about this !!!!!!

Solution #0 - Flow chart

- Multiply the 1 and the number.

$$n! = 1 \times n$$

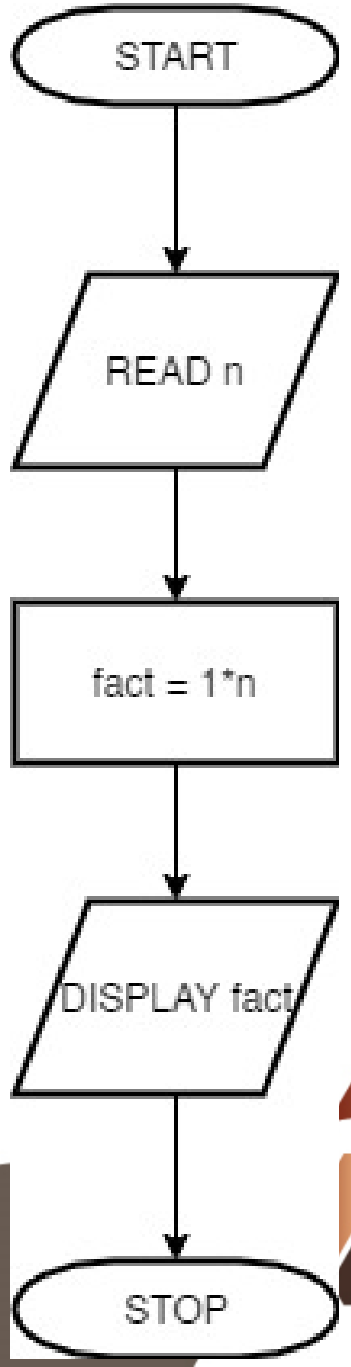


num : 2; We know that 2! = 2

- Apply the solution to 2

$$n! = 1 \times n$$
$$= 1 \times 2$$
$$= 2$$

Wow, it is correct!!!



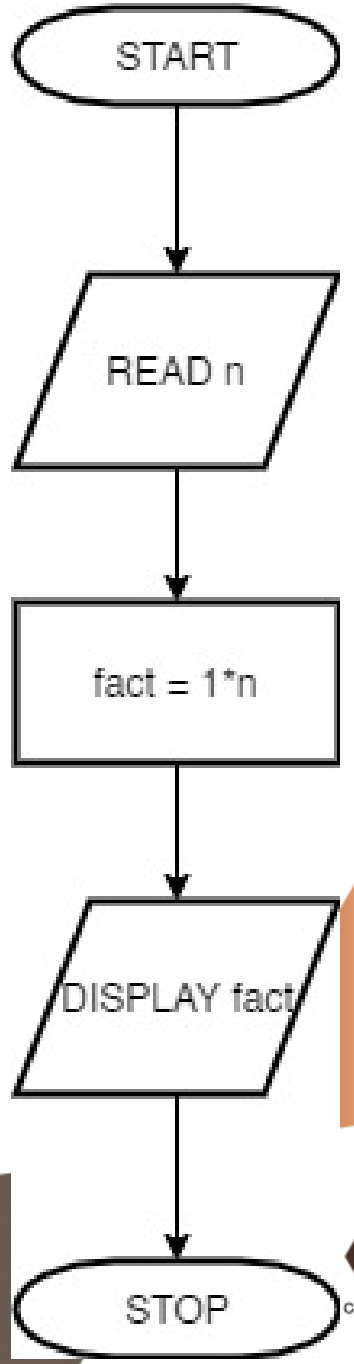
num : 7; We know that 7! = 5040

- Apply the solution to 2

$$n! = 1 \times n$$
$$= 1 \times 7$$
$$= 7$$

It is wrong !!!
This solution is failed.

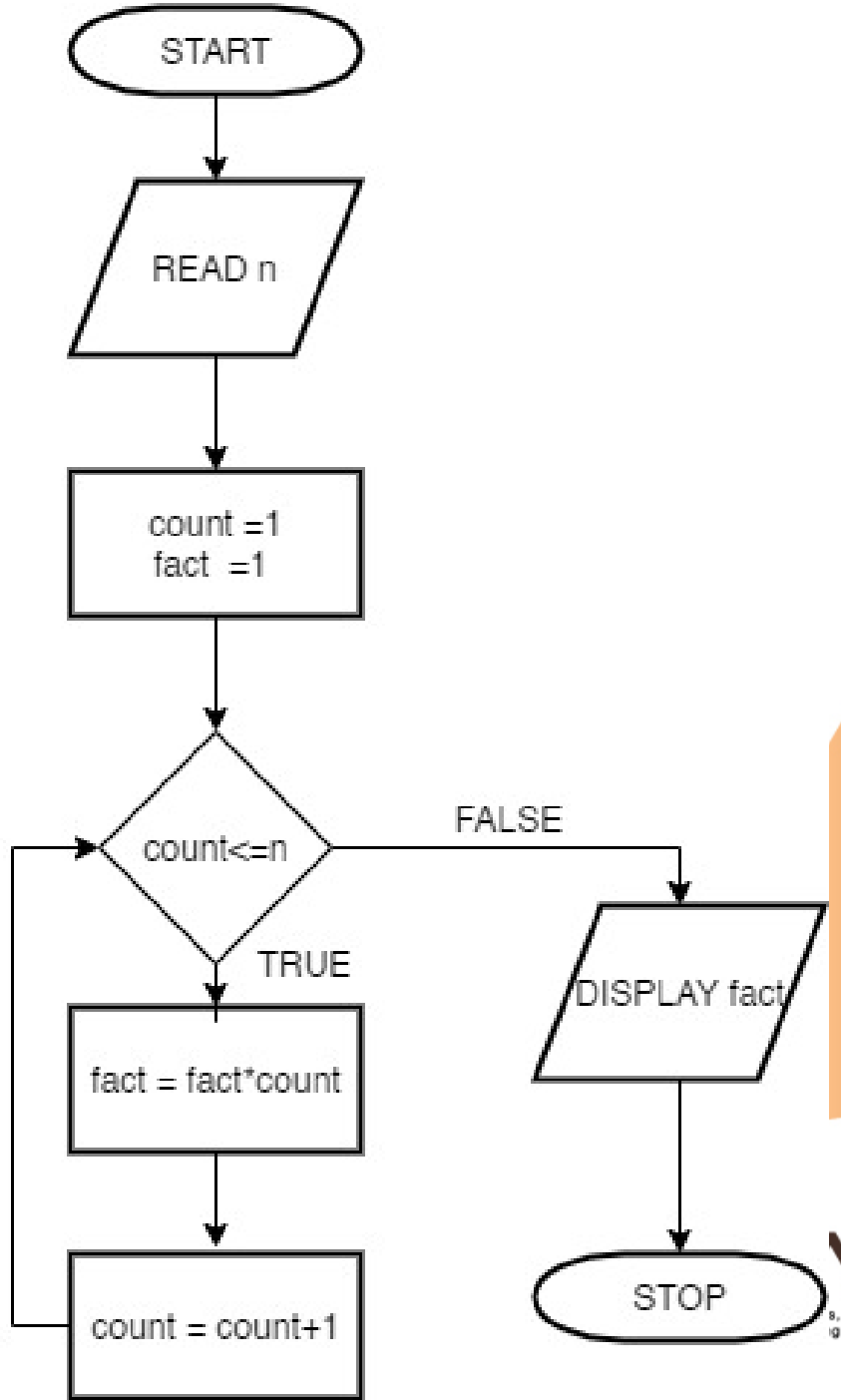
Hint: it has range. So, the repetition structure must be included.



Solution #1 - Flow chart

- Multiply the 1, 2, 3,… to the number.

$$n! = 1 \times 2 \times 3 \times \cdots \times n$$



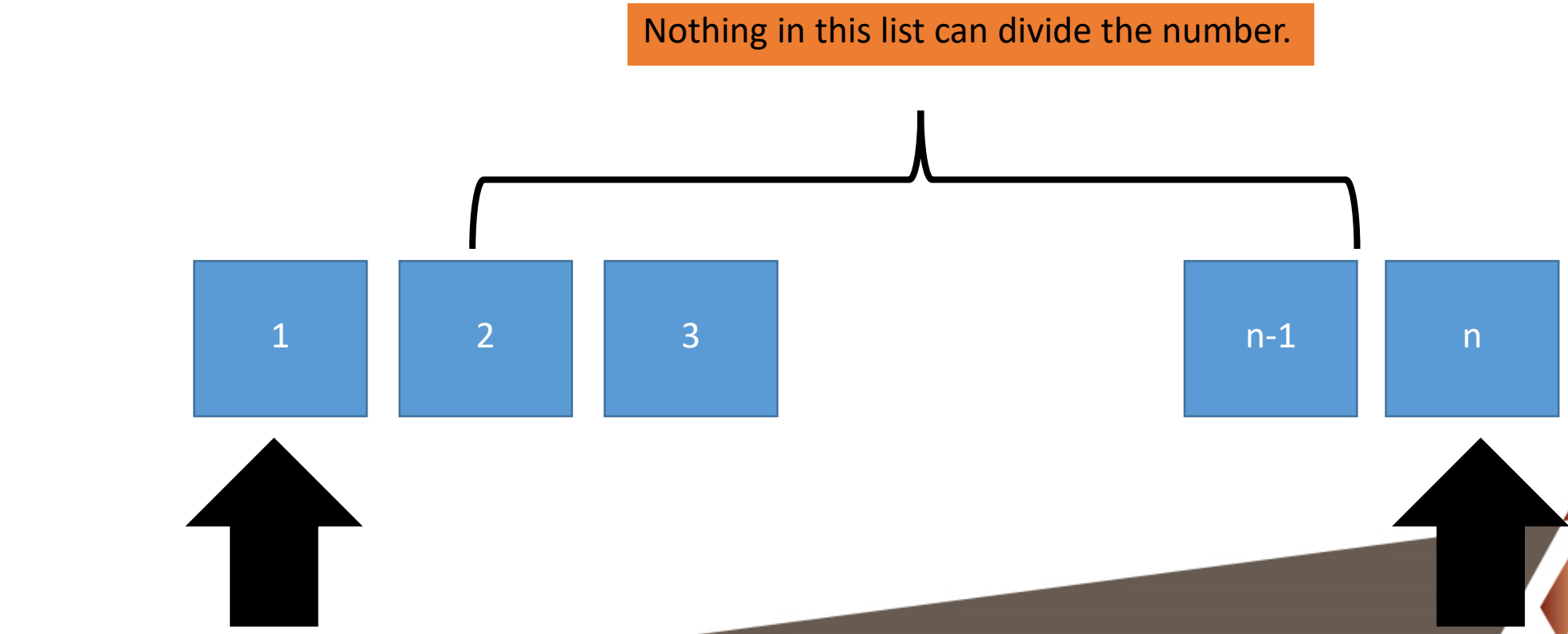
A more complex problem

Case study

Receive a non-negative integer and identify if the number is prime number or not.

Analyze

- A prime number is divisible by the 1 and the number itself.



Solution #0 - Flow chart

- Check from the 1 to the number and count the dividable number. If the number of dividable number is 2, it is prime number.

- Range : Loop !!!!!!!!!

- Check if the number is divisible by a number, or not.
  - Decision structure !!!!!!!!!

Flowchart

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num : 7

1	2	3	4	5	6	7
Can divide 7.	Cannot divide 7.	Cannot divide 7.	Cannot divide 7.	Cannot divide 7.	Cannot divide 7.	Can divide 7.

There are 2 numbers that can divide 7.

7 is prime number!!!

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num : 8

1	2	3	4	5	6	7	8
Can divide 8.	Can divide 8.	Cannot divide 8.	Can divide 8.	Cannot divide 8.	Cannot divide 8.	Cannot divide 8.	Can divide 8.

There are 4 numbers that can divide 8.

8 is not a prime number!!!

Solution #1 - Flow chart

- Check from the 2 to the number-1 and count the dividable number. If the number of dividable number is 0, it is prime number.

- Range : Loop !!!!!!!!!

- Check if the number is divisible by a number, or not.
  - Decision structure !!!!!!!!!

num : 7

2	3	4	5	6
Cannot divide 7.	Cannot divide 7.	Cannot divide 7.	Cannot divide 7.	Cannot divide 7.

There are 0 numbers that can divide 7.

7 is prime number!!!

num : 8

2	3	4	5	6	7
Can divide 8.	Cannot divide 8.	Can divide 8.	Cannot divide 8.	Cannot divide 8.	Cannot divide 8.

There are 2 numbers that can divide 8.

8 is not a prime number!!!

Case study

- A special variable stores many value in a single variable.

Value	11	19	14	12	11	…	100
Variable	a[0]	a[1]	a[2]	a[3]	a[4]	…	a[n]

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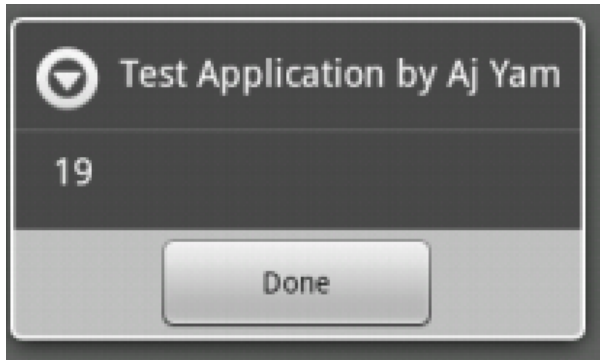
Example

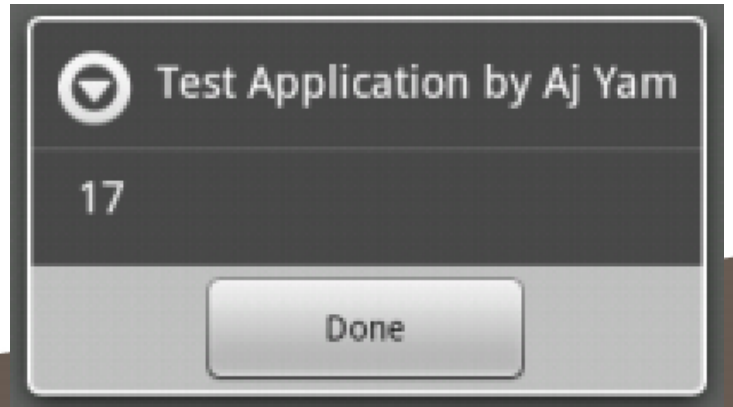
Value	11	19	14	12	17	…	100
Variable	a[0]	a[1]	a[2]	a[3]	a[4]	…	a[n]

DISPLAY a[2]



I = 4

DISPLAY a[i]



Case study

Find the maximum number from the following list.

Value	11	14	100	12	11
Variable	a[0]	a[1]	a[2]	a[3]	a[4]

Analyze

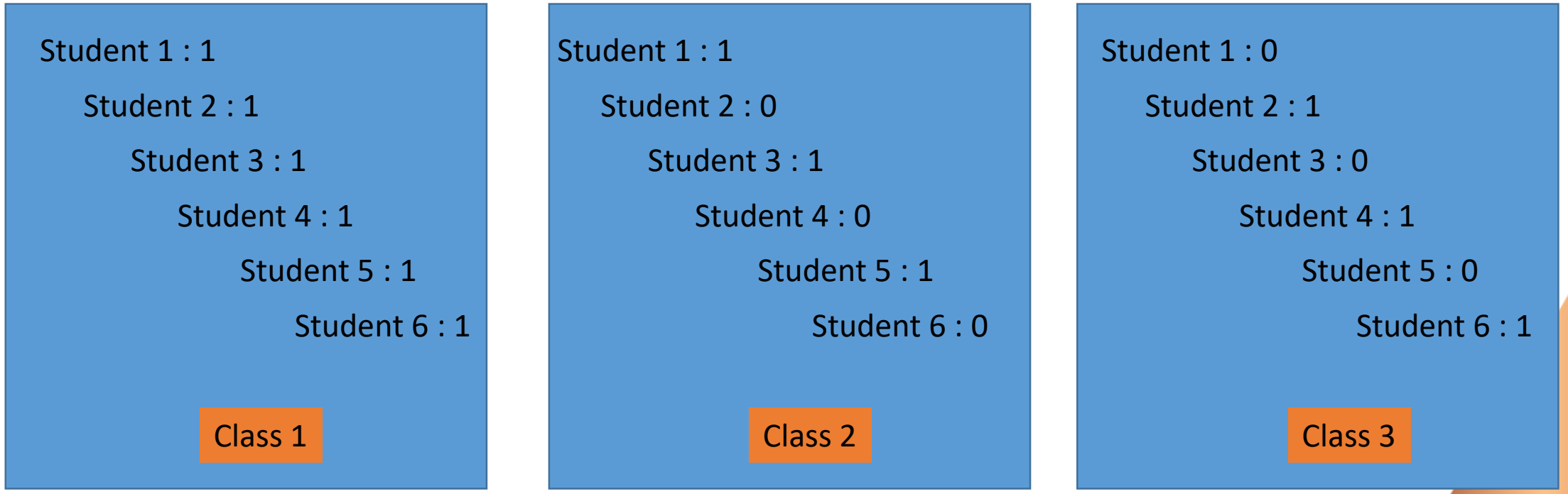
1) Set the max variable to the first number

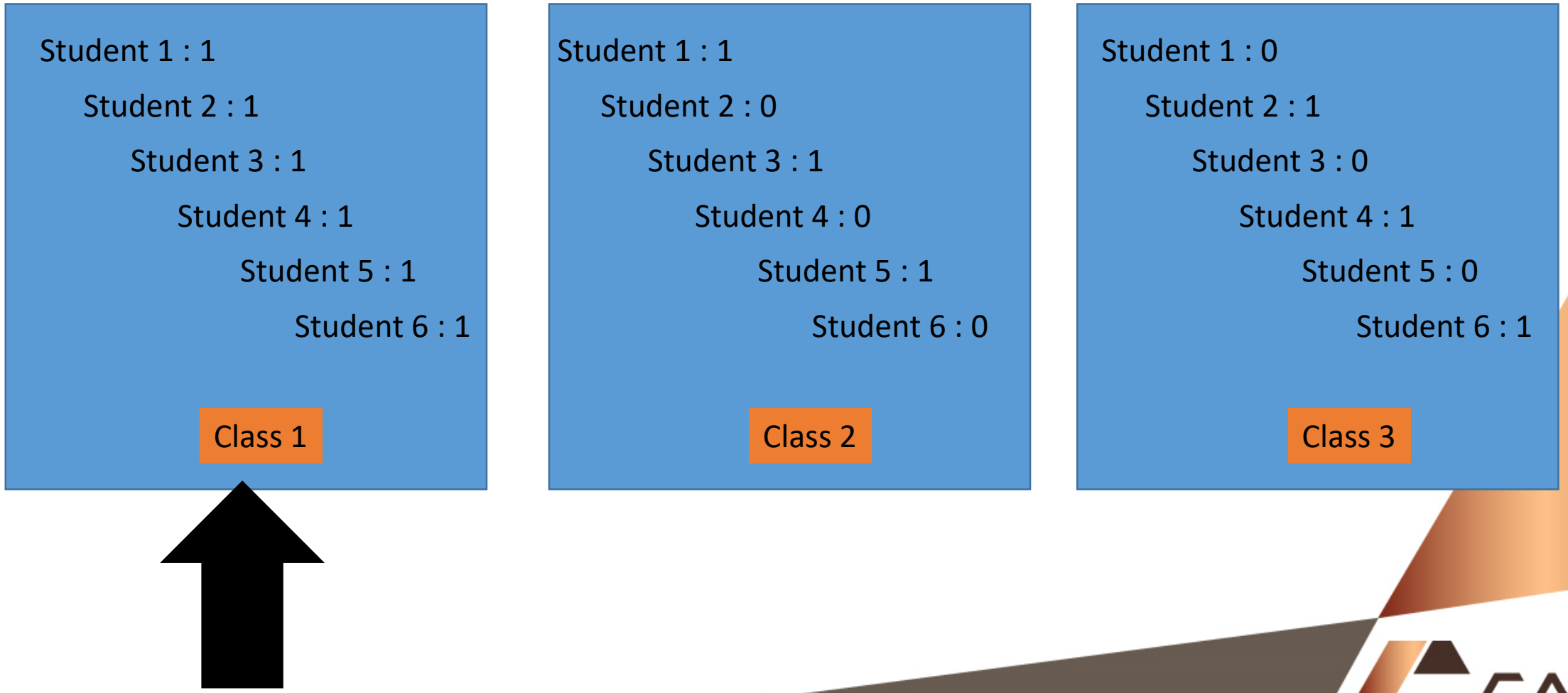
2) Check each element of the variable. (Range !!!)

    2.1) If the current element is larger than max variable, set the max to the variable.

Case Study

3 classrooms has a list of test results (1 = pass, 2 = fail) of the whole class. Write a program that analyzes the results. If more than 80 percent of the class, that class will receive a reward. Develop a program for the task.





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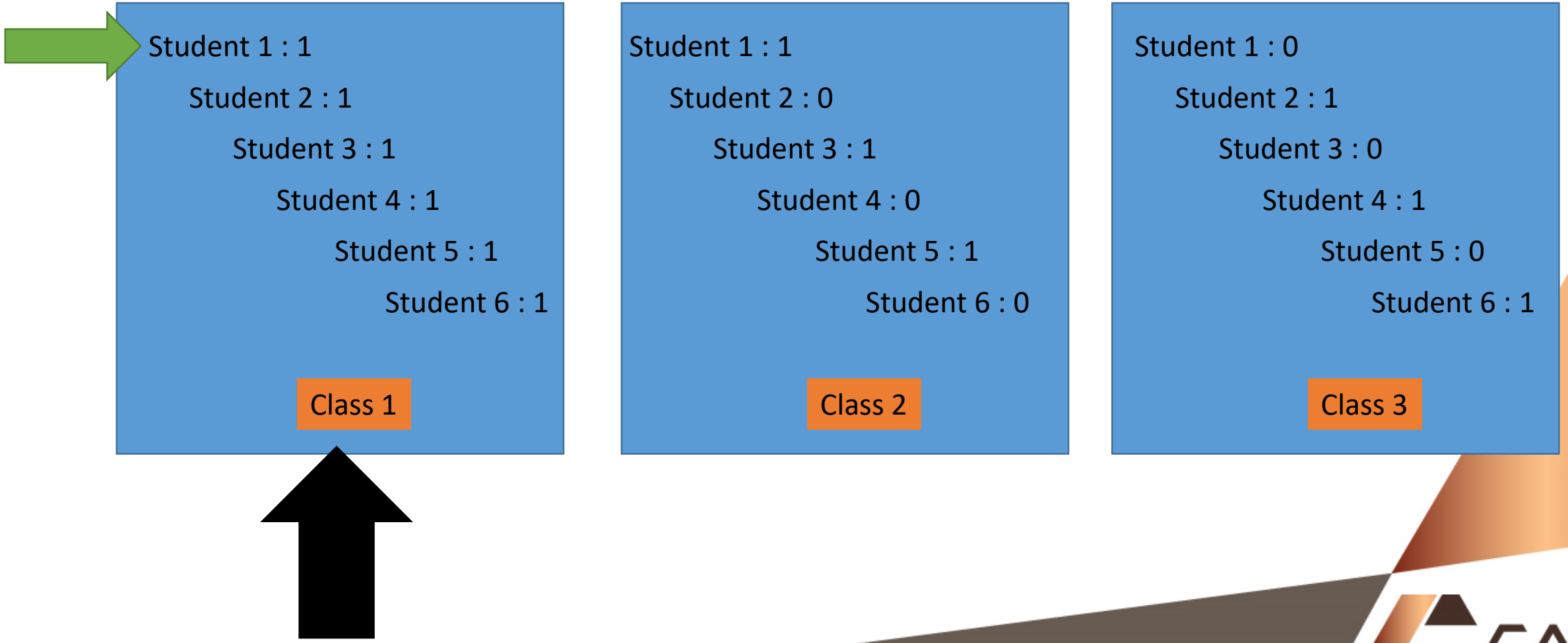

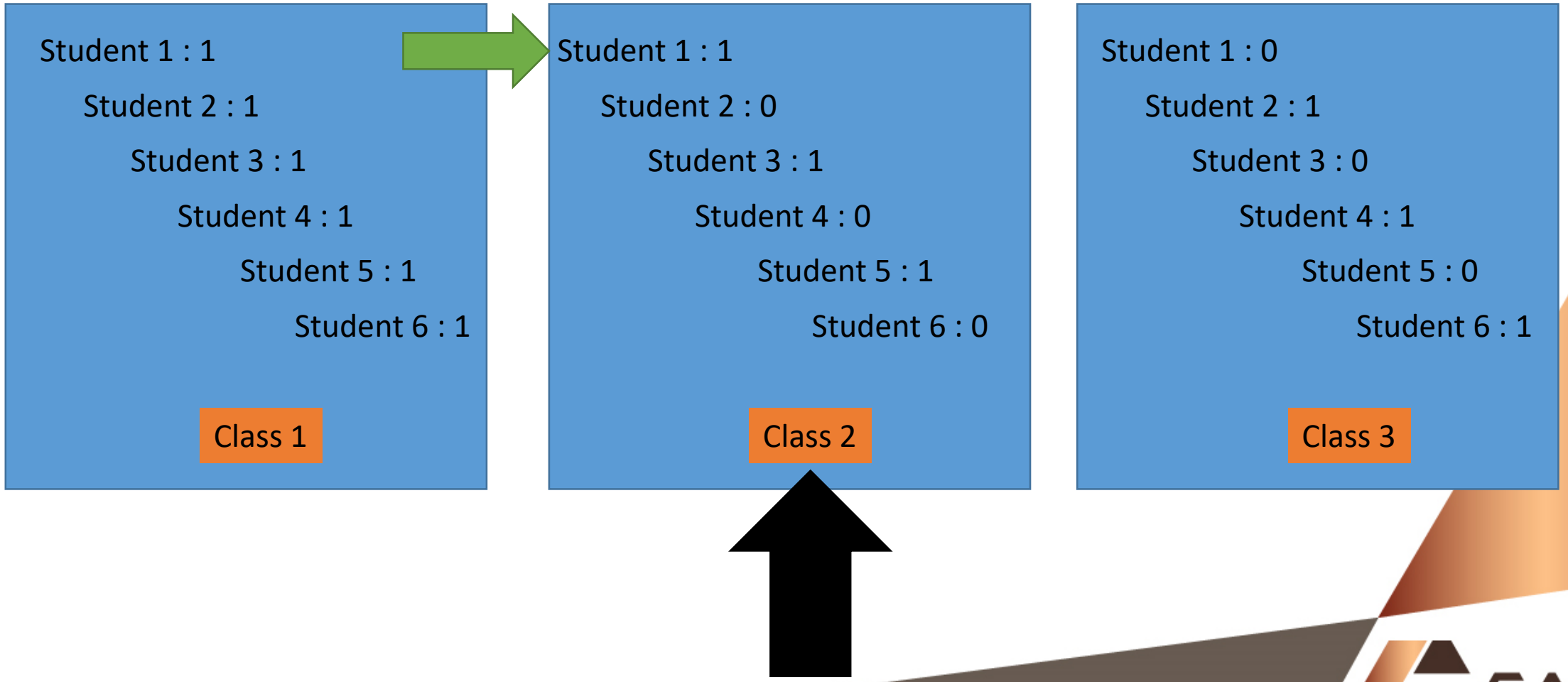

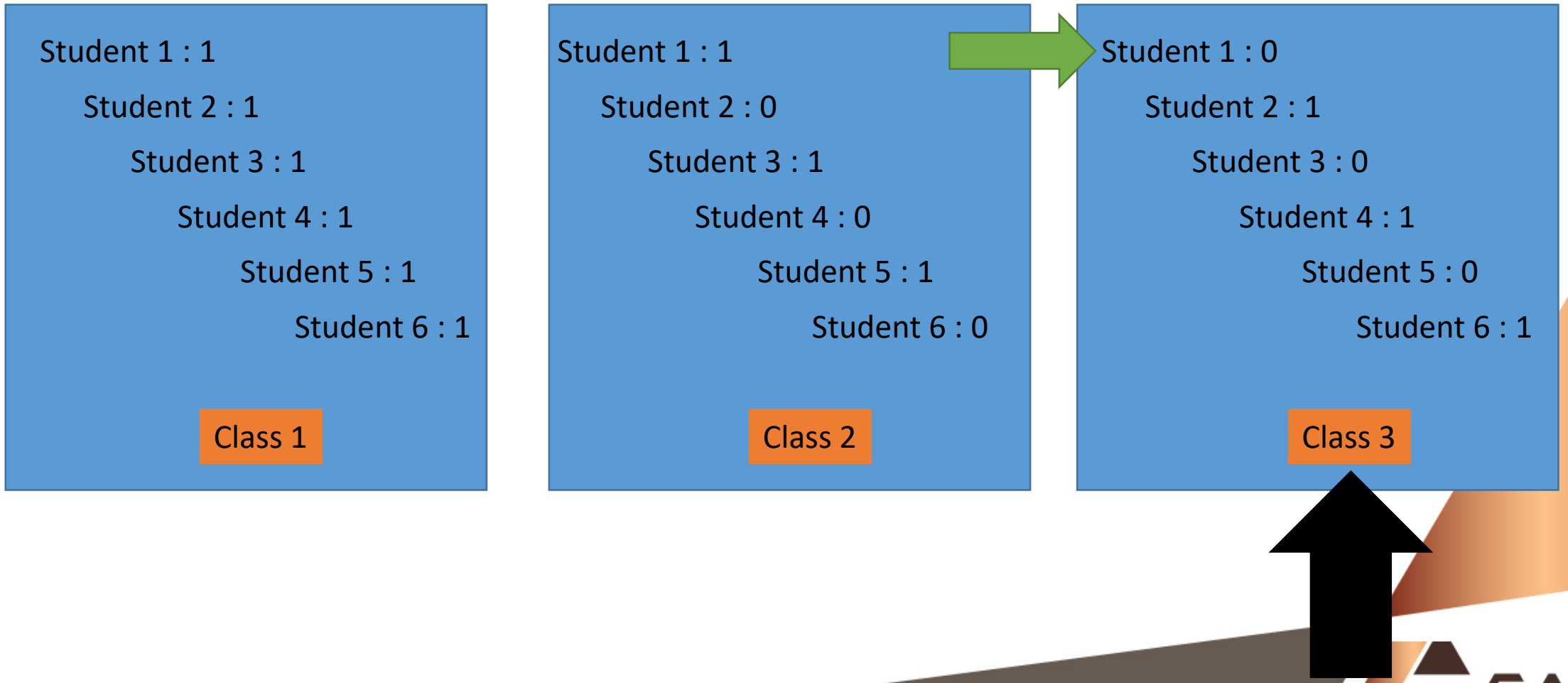

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Analyze

- Black-arrowed loop

- Green-arrowed loop
  - Inside the black-arrowed loop

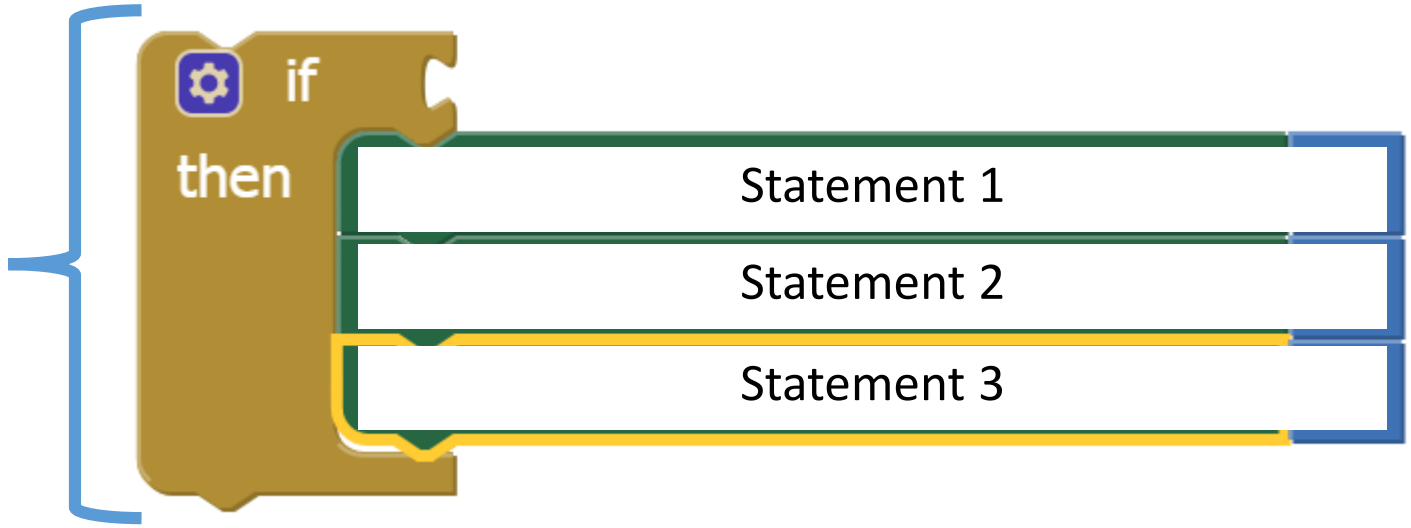
Draw a flowchart

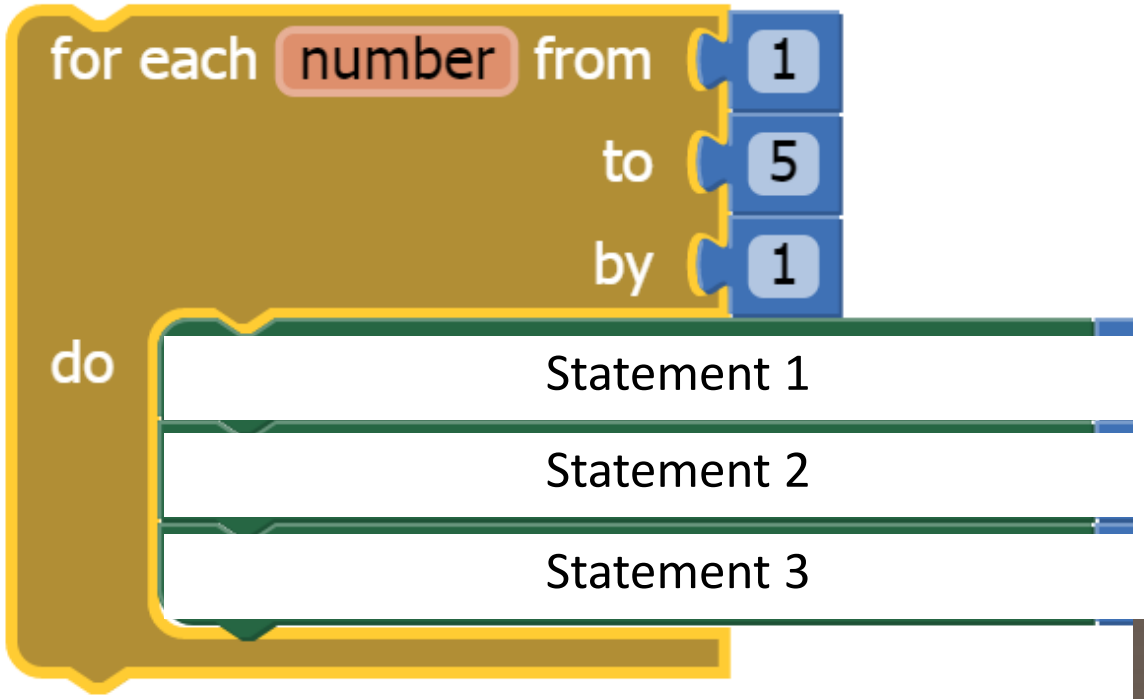
Nested Structure

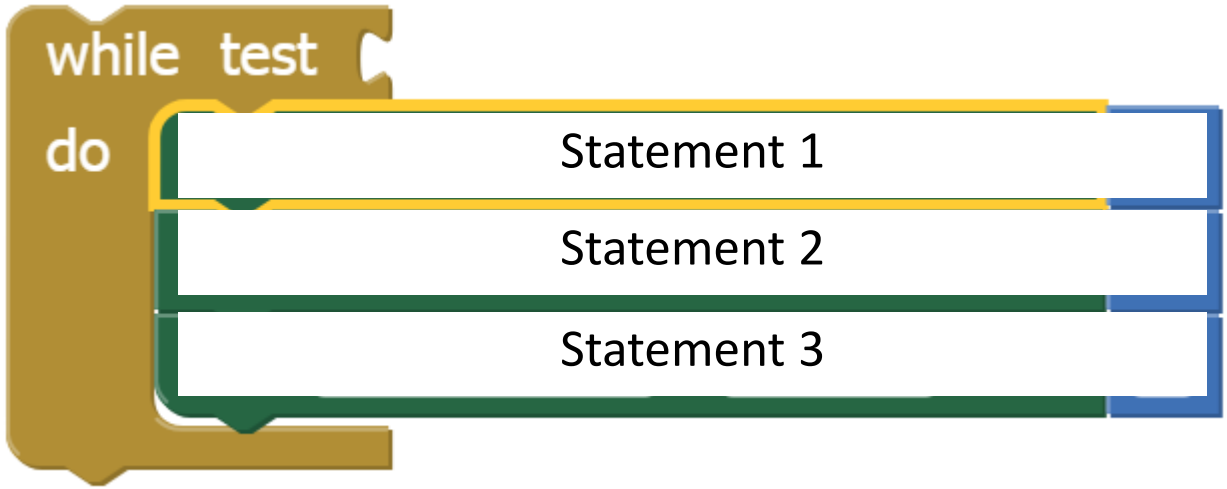
Nested Structure

- The nested structure is a concept in programming language that allows a control structure to be embedded in other structure.
- The selection structure and the repetition structure are considered to be a single statement.
- Remark: The token of processing will only move to the next statement when the current statement is complete.

Statement

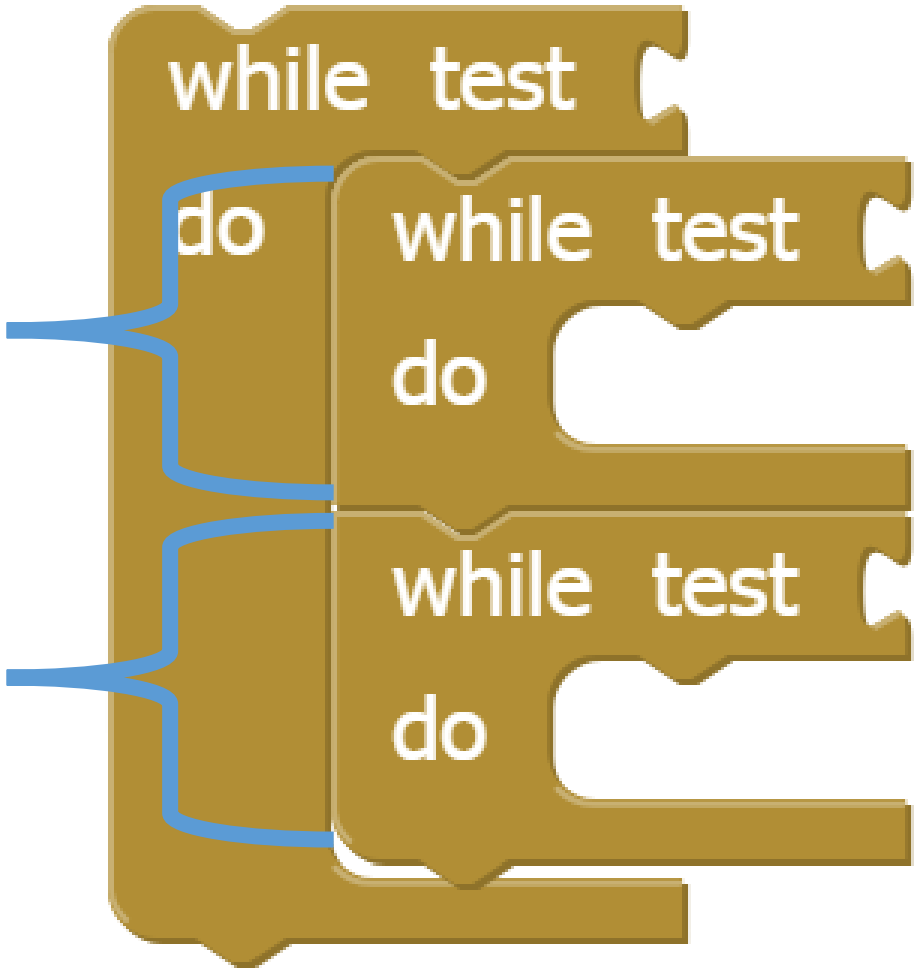

if
then
Statement 1
Statement 2
Statement 3


for each number from 1
to 5
by 1
do
Statement 1
Statement 2
Statement 3

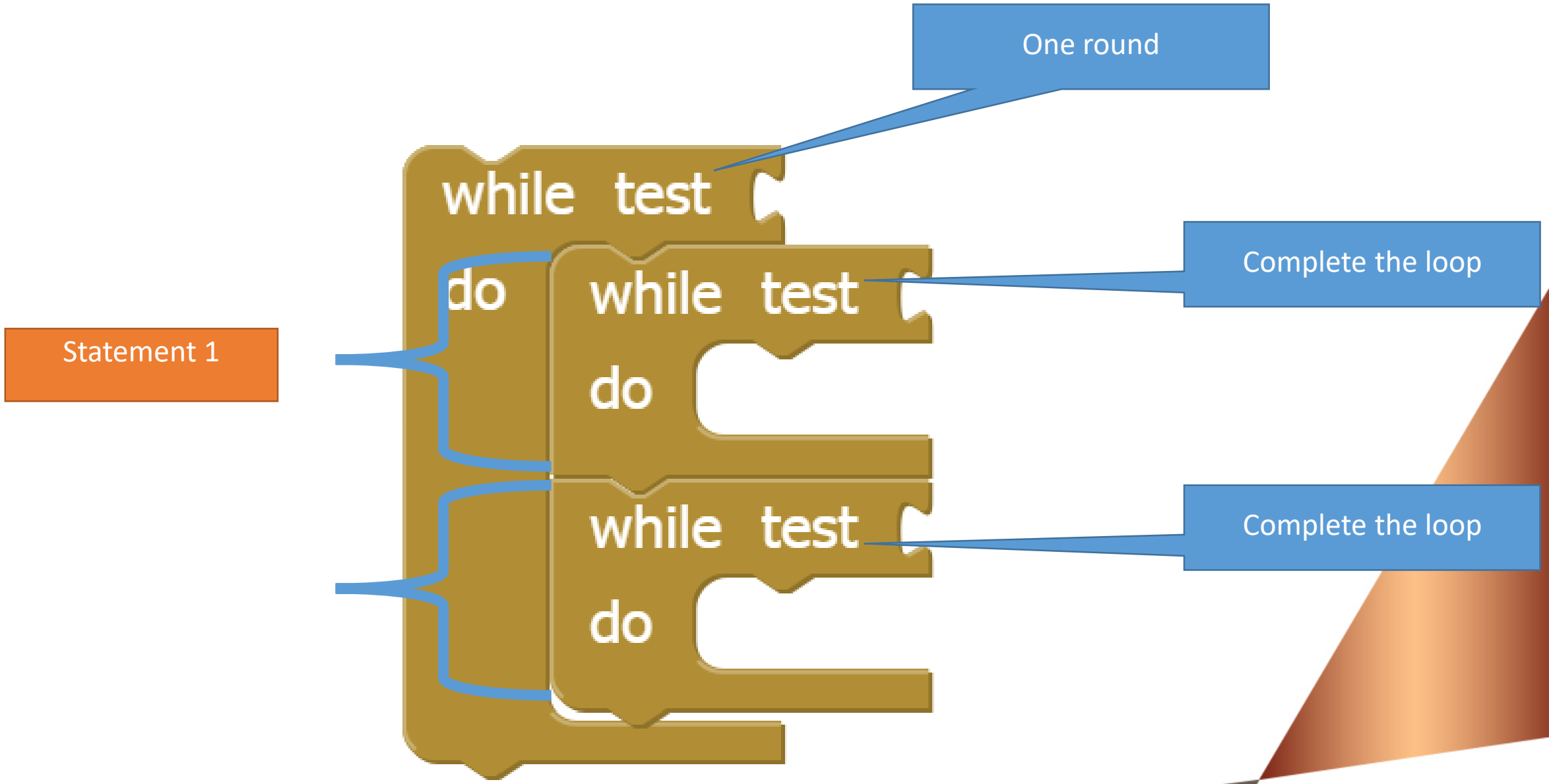

while test
do
Statement 1
Statement 2
Statement 3

Statement 1

Statement 2



One round of outer loop is a completion of the inner loop.



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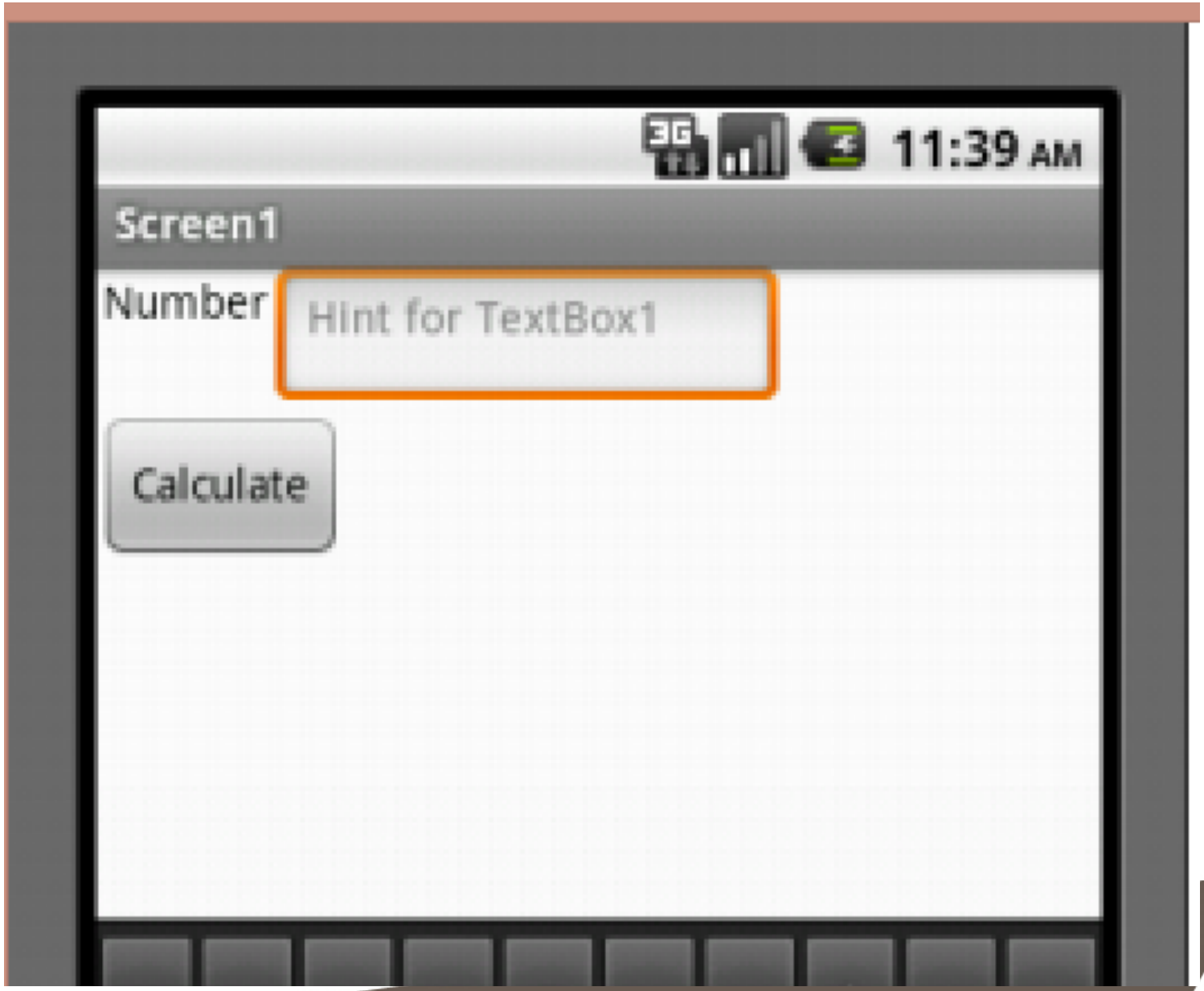
Example


11:39 AM
Screen1
Number
Hint for TextBox1
Calculate