COMPUTER PROGRAMMING

LECTURE NOTES

CP115

Topic 3: Design Solutions

Learning Outcomes:

(a) Define algorithm, pseudocode and flowchart. (1st hour)

Example of algorithms

- Facial recognition algorithm
- Online advertisement recommendation
  - Often if you search for a product, more product of the same category will appear
- Social media recommendation

Example of algorithms in daily life

Waking up going to class
Preparing an instant noodle
Preparing a cup of coffee

*Note that there are varieties of ways in achieving the same output
*It can be very simple or super complex depending on how you think

Definition of an algorithm

An algorithm is a set of step-by-step instructions to solve a given problem.

Algorithm representation

An algorithm can be represented either
- Pseudocode
- Flowchart

Pseudocode vs Flowchart

• Informal language using English like language to design algorithms • A notation resembling a simplified programming language, used in program design	• A graphical representation of a algorithm in relation to its sequence of functions • Special-purpose symbols connected by arrows

LECTURE NOTES

- **Sequence Control Structure**
  - A series of actions that are **sequentially executed** in the order they are written.

    (***example*** : Calculate sum of two numbers)

- **Selection Control Structure**
  - Decide which statements to execute based on a condition
  - Defines two courses of action depending on the **outcome** of a **condition**.

    (***example*** : Determine "Pass" or "Fail" based on grade entered)

- **Repetition/ Looping / Iteration Control Structure**
  - used to tell a program to execute statements repeatedly
  - Specifies a block of one or more statements that are **repeatedly** executed until a condition is satisfied.

    (***example*** : Display "Hello" for 10 times)

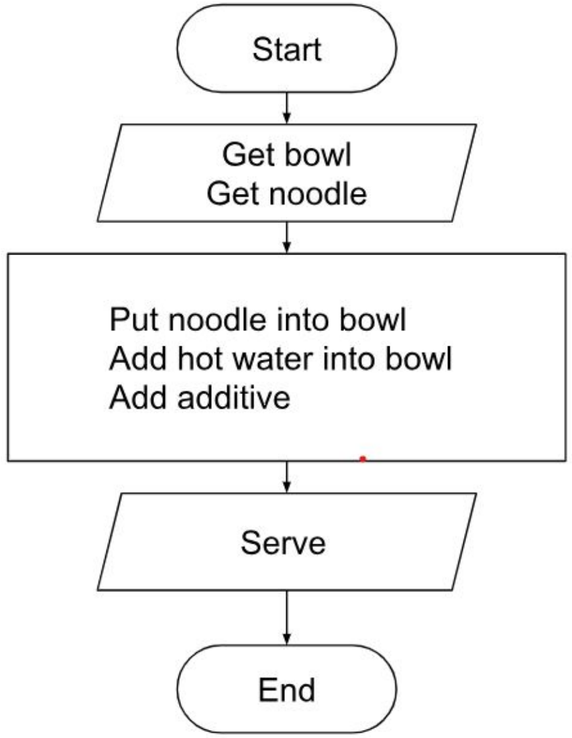
Example 1: Algorithm example in daily life

Problem statement: Preparing an instant noodle

Pseudocode

```
Start
    Get bowl
    Get noodle
    Put noodle into bowl
    Add hot water into bowl
    Add additive
    Serve
End
```

Flowchart



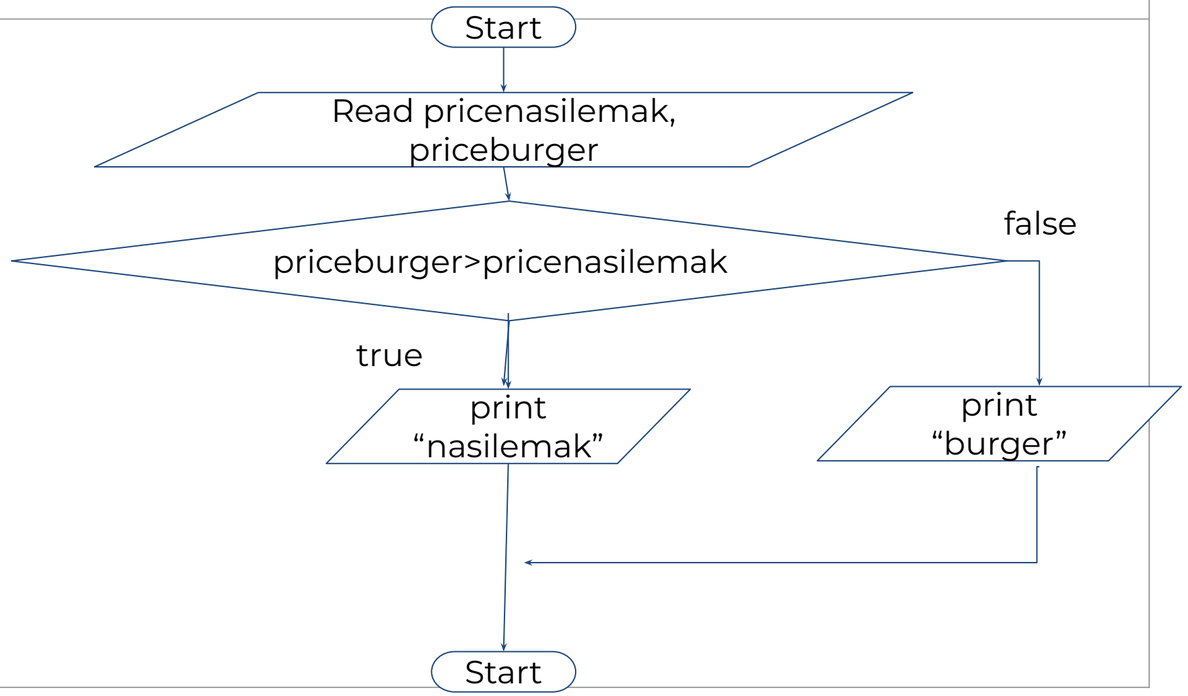
Example 2: Algorithm example in daily life

Problem statement: If burger is more expensive than nasi lemak, choose nasi lemak (selection)

Pseudocode

```
Start
    Get pricenasilemak
    Get priceburger
    if priceburger > pricenasilemak
      print “nasilemak’
    else
      print “burger”
End
```

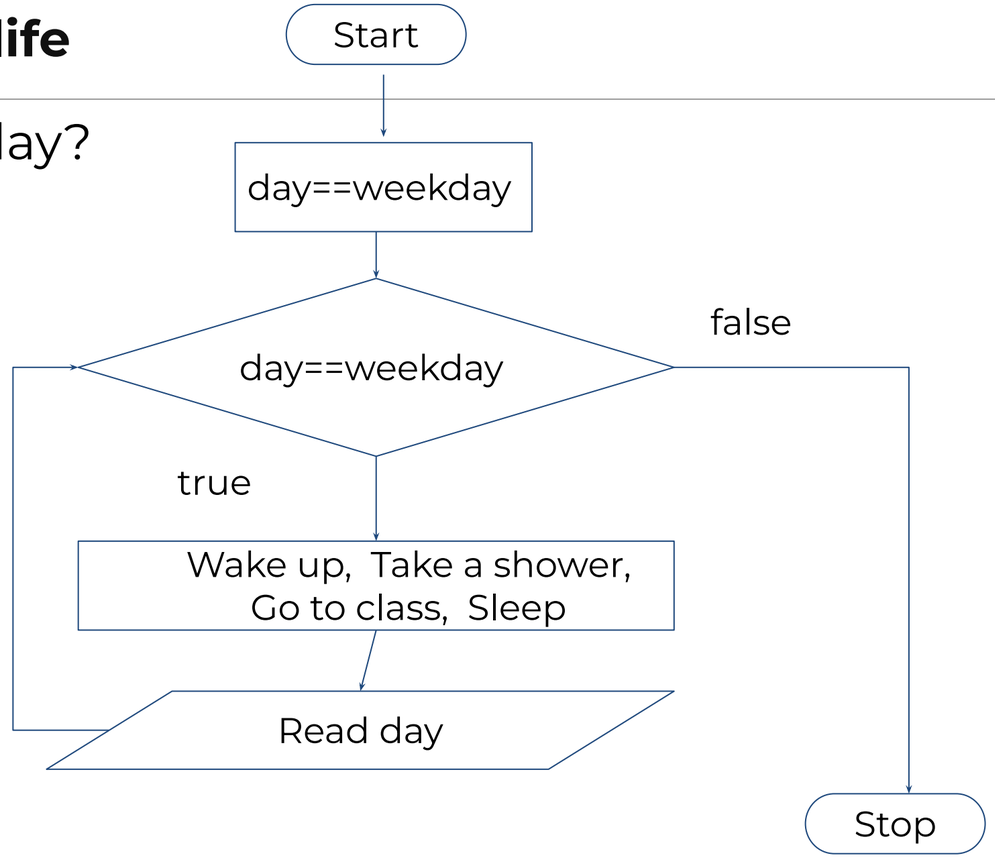
Flowchart



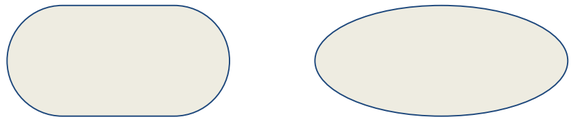
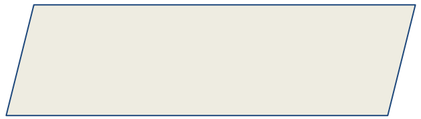
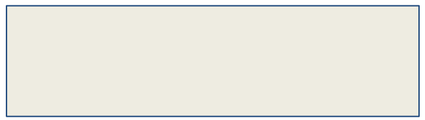
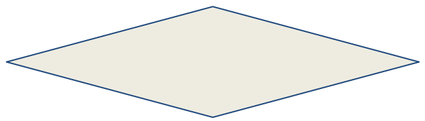
Example 3: Algorithm example in daily life

Problem statement: What do you do everyday?

```
Start
    while weekday
       Wake up
       Take a shower
       Go to class
       Sleep
       Repeat until end of weekday
End
```



Basic Flowchart component

	Capsule/Ellipse	Used to represent start-stop OR begin-end
	Arrow	Indicates the flow of the algorithm
	Parallelogram	Represents an input or output
	Rectangle	Represents a process
	Diamond	Indicates a decision

COMPUTER PROGRAMMING

LECTURE NOTES

CP115

Topic 3: Design Solutions

Learning Outcomes:

(a) Define algorithm, pseudocode and flowchart. (2nd hour)

Problem statement 1 (Sequence control structure)

Find the sum of three numbers.

IPO model

Problem statement 1 (Sequence control structure)

Find the sum of three numbers.

IPO model
Input: number1, number2, number3
Process: Calculate the sum based on number1, number2 and number3.
Output : sum

Pseudocode

Problem statement 1 (Sequence control structure)

Find the sum of three numbers.

IPO model

Input: number1, number2, number3
Process: Calculate the sum based on number1, number2 and number3.
Output : sum

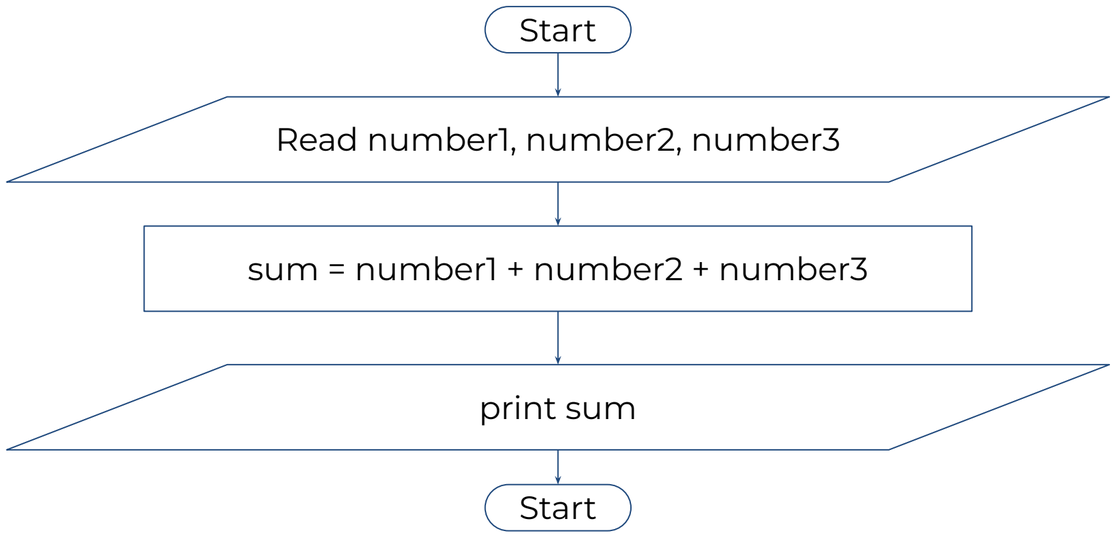
Pseudocode

```
Start
    Read number1, number2, number3
    sum = number1 + number2 + number3
    Print sum
Stop
```

Problem statement 1 (Sequence control structure)
Find the sum of three numbers.

Pseudocode	Flowchart
Start Read number1, number2, number3 sum = number1 + number2 + number3 Print sum Stop	

Problem statement 1 (Sequence control structure)
Find the sum of three numbers.

Pseudocode	Flowchart
Start Read number1, number2, number3 sum = number1 + number2 + number3 Print sum Stop	

Problem statement 2 (Sequence control structure)
Find the average of three numbers.

IPO model

Problem statement 2 (Sequence control structure)
Find the average of three numbers.

IPO model
Input: number1, number2, number3
Process: Calculate the average based on number1, number2 and number3.
Output : average

Pseudocode

Problem statement 2 (Sequence control structure)
Find the average of three numbers.

IPO model
Input: number1, number2, number3
Process: Calculate the average based on number1, number2 and number3.
Output : average

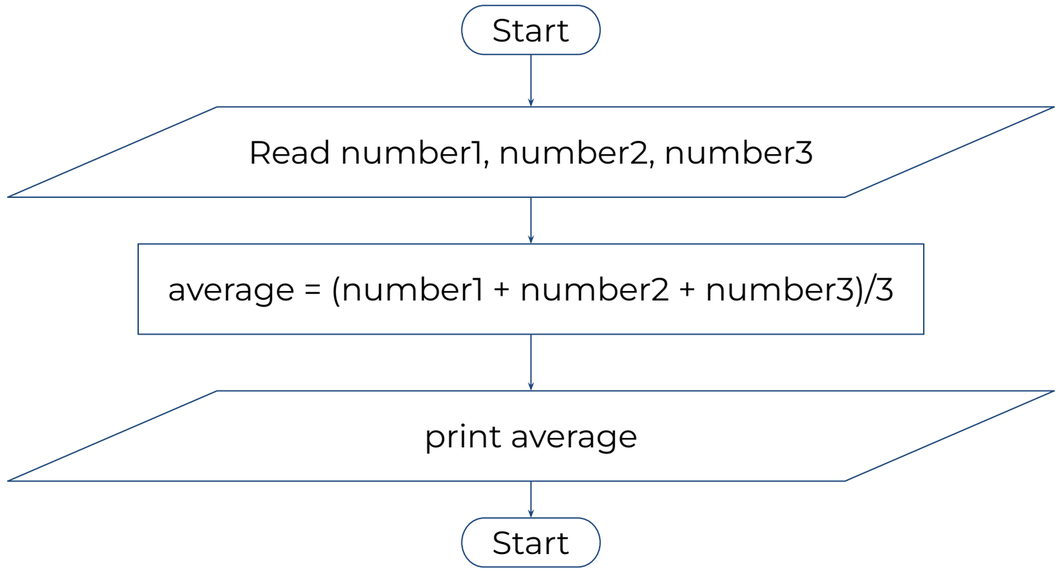
Pseudocode

```
Start
    Read number1, number2, number3
    average = (number1 + number2 + number3)/3
    Print average
Stop
```

Problem statement 2 (Sequence control structure)
Find the average of three numbers.

Pseudocode	Flowchart
Start Read number1, number2, number3 average = (number1 + number2 + number3)/3 Print average Stop	

Problem statement 2 (Sequence control structure)
Find the average of three numbers.

Pseudocode	Flowchart
Start Read number1, number2, number3 average = (number1 + number2 + number3)/3 Print average Stop	

Problem Statement 3

Identify the input, process and output for the given problem statement.

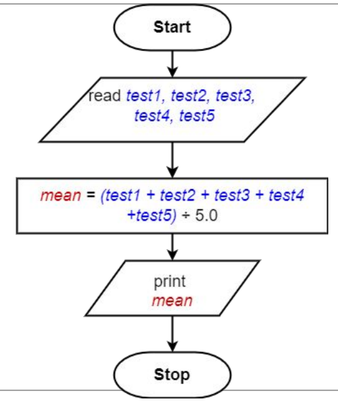
The program will calculate mean of 5 tests mark

Input : test1, test2, test3, test4, test5

Process :

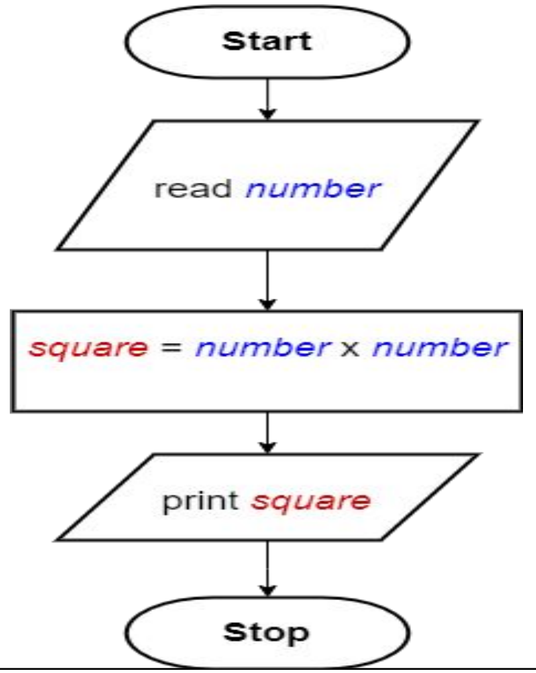
1. Calculate total based on test1, test2, test3, test4, test5
2. Calculate mean based on test1, test2, test3, test4, test5

Output : mean

Example Sequence Pseudocode	Example Sequence Flowchart
Start Read test1, test2, test3, test4, test5 mean = (test1 + test2 + test3 + test4 +test5) ÷ 5.0 Print mean Stop	

Problem Statement 4

The program will find the square of a given number.

Problem Analysis/ IPO Model	Example Sequence Pseudocode	Example Sequence Flowchart
Input : *number* ✔️ Process : Calculate *square* based on *number* Output : *square*	**Start** read *number* *square* = *number* x *number* print *square* **Stop** **the formula must be a written in full, without superscript* ^{y}	

Problem statement 5 (Selection control structure)
Determine the smaller number between two numbers.

IPO model

Problem statement 5 (Selection control structure)
Determine the smaller number between two numbers.

IPO model
Input: number1, number2
Process: Determine the smaller number based on number1 and number2.
Output : smaller

Pseudocode

Problem statement 5 (Selection control structure)
Determine the smaller number between two numbers.

IPO model
Input: number1, number2
Process: Determine the smaller number based on number1 and number2.
Output : smaller

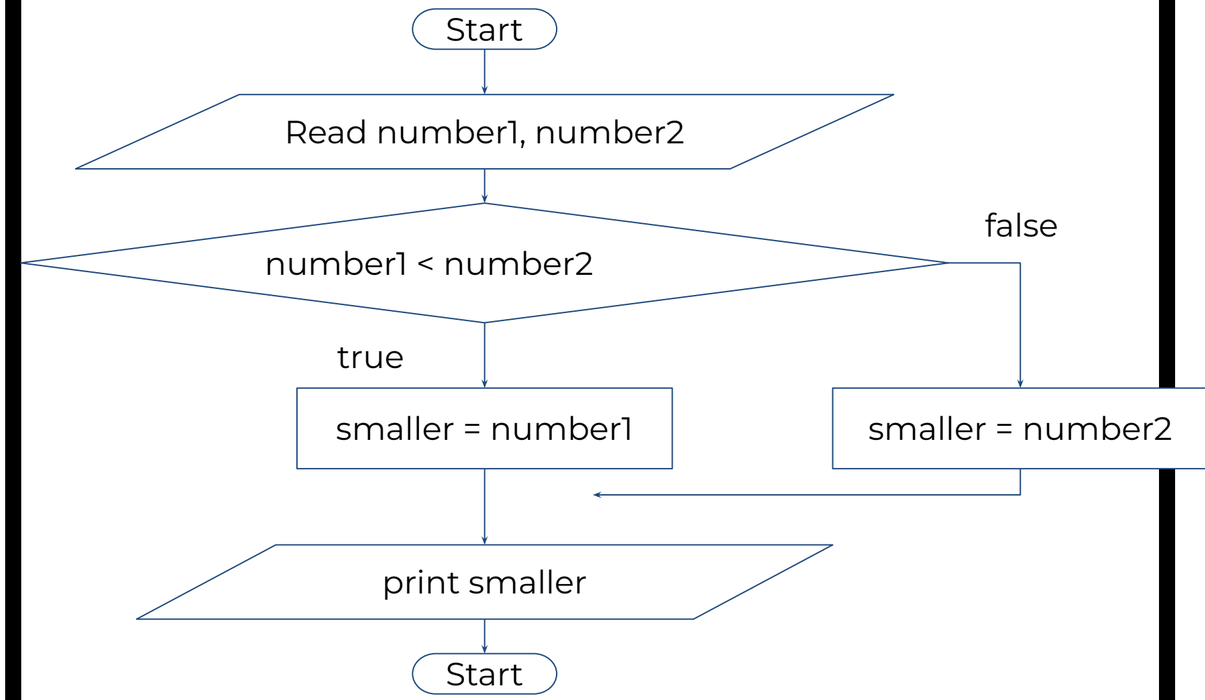
Pseudocode

```
Start
    Read number1, number2
    if number1 < number2
        smaller = number1
    else
        smaller = number2
    Print smaller
Stop
```

Problem statement 5 (Selection control structure)
Determine the smaller number between two numbers.

Pseudocode	Flowchart
Start Read number1, number2 if number1 < number2 smaller = number1 else smaller = number2 Print smaller Stop	

Problem statement 5 (Selection control structure)
Determine the smaller number between two numbers.

Pseudocode	Flowchart
Start Read number1, number2 if number1 < number2 smaller = number1 else smaller = number2 Print smaller Stop	

Problem statement 6 (Selection control structure)
Determine whether the number is positive or not positive.

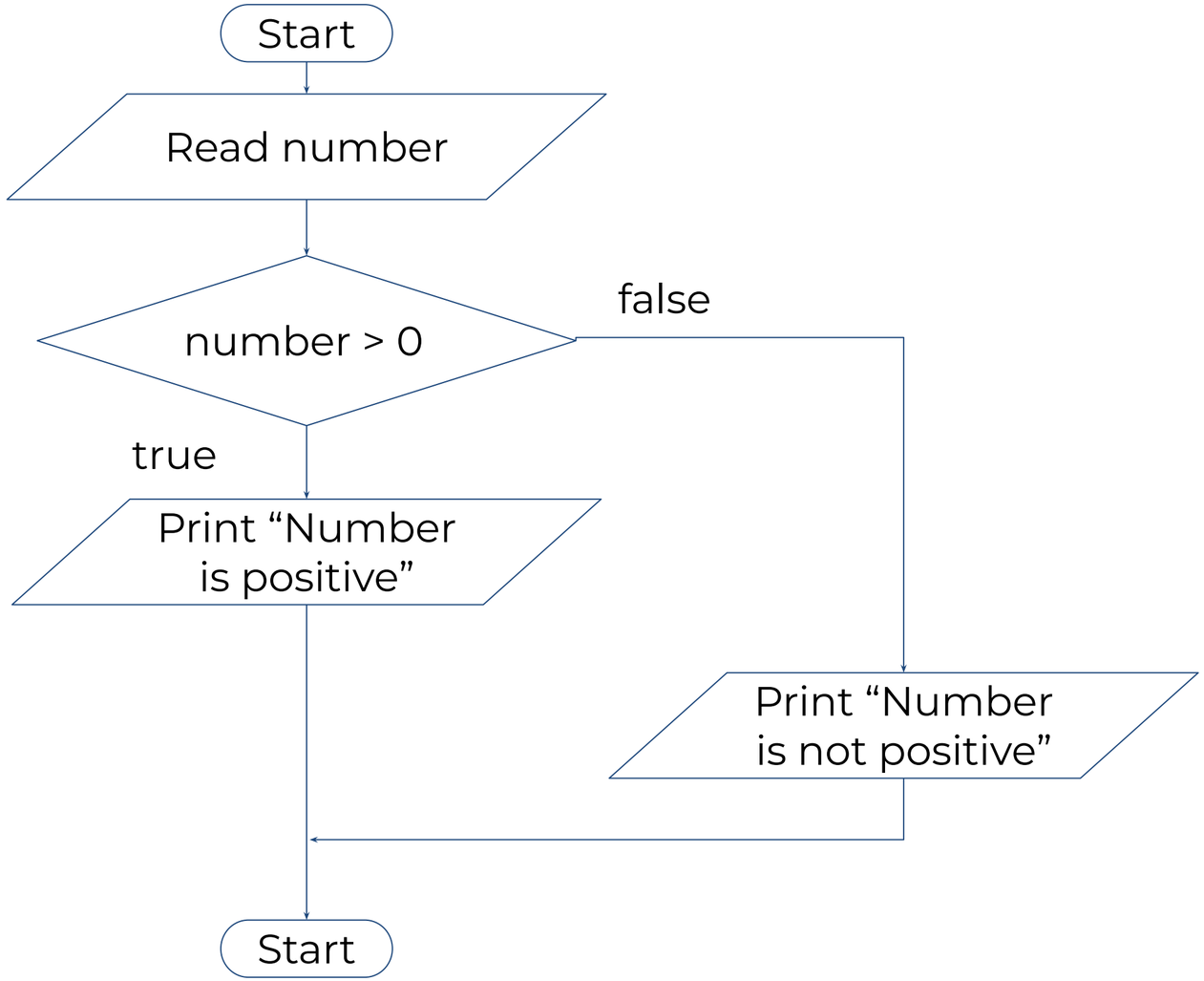
IPO model
Input: number
Process: Determine the message “Number is positive” or “Number is not positive” based on number.
Output : “Number is positive” or “Number is not positive”

Pseudocode

```
Start
    Read number
    if number > 0
        Print “Number is positive”
    else
        Print “Number is not positive”
Stop
```

Flowchart example 6

```
Start
    Read number
    if number > 0
        Print “Number is positive”
    else
        Print “Number is not positive”
Stop
```



Repetition: Counter controlled

In **Counter-Controlled Repetition**, the number of loops that need to be executed is known (either specified in the question or determined by the user), and it depends on the value specified in the condition.

IPO Analysis General Format		*Pseudocode General Format*
Input	**input for ____ times**	**Start** counter initialization **while (condition)** statement block counter increment/decrement **end while** next action (after the loop has ended) **Stop** ***The statement(s) will be executed repeatedly until the condition is False (F)*** **Use correct **indentation**. Avoid writing actions from the same starting line of Start and Stop.* *Note: end while is used to indicate the end of an if block. The condition (Boolean expression) must be written in bracket( ).*
Process	**Repeat calculate *output* based on input for ____ times**	
Output	***output* for ____ times**	

Repetition: Counter controlled (Other approach for IPO)

In **Counter-Controlled Repetition**, the number of loops that need to be executed is known (either specified in the question or determined by the user), and it depends on the value specified in the condition.

<table>
<tr><th colspan="2">IPO Analysis General Format</th><th>Pseudocode General Format</th></tr>
<tr><td>Input</td><td>input</td><td rowspan="3">Start
counter initialization
while (condition)
statement block
counter increment/decrement
end while
next action (after the loop has ended)
Stop

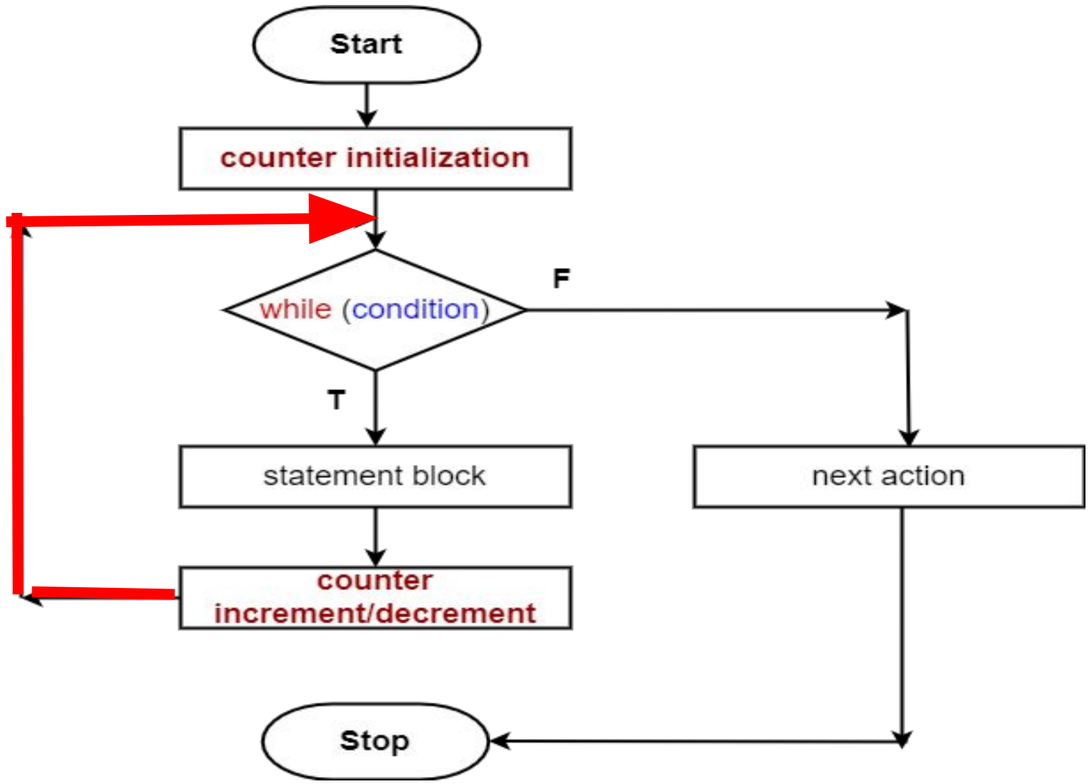
The statement(s) will be executed repeatedly until the condition is False (F)

*Use correct indentation. Avoid writing actions from the same starting line of Start and Stop.

Note: end while is used to indicate the end of an if block. The condition (Boolean expression) must be written in bracket( ).</td></tr>
<tr><td>Process</td><td>Repeat calculate output based on input for ____ times</td></tr>
<tr><td>Output</td><td>output</td></tr>
</table>

Repetition: Counter controlled - Counter controlled

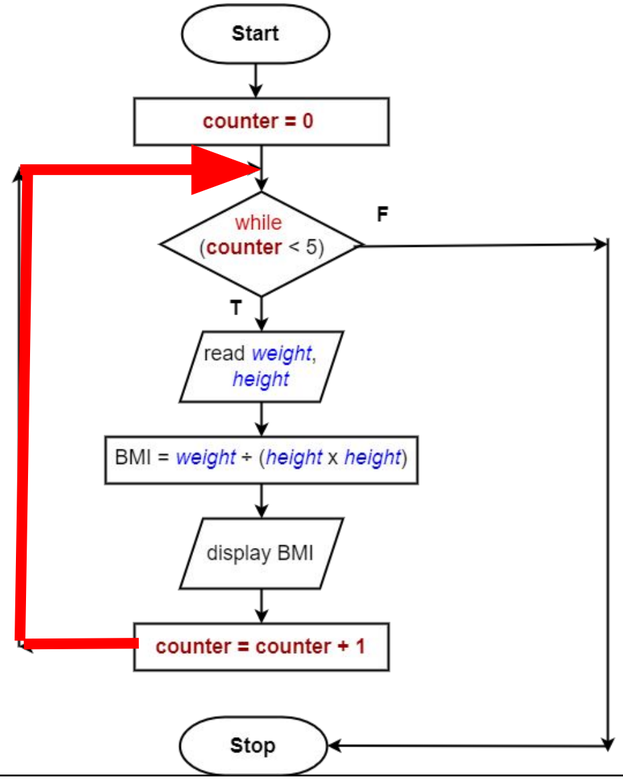
Flowchart General Format



Problem statement 7 (Repetition control structure) - Counter controlled

The program calculate BMI for 5 persons

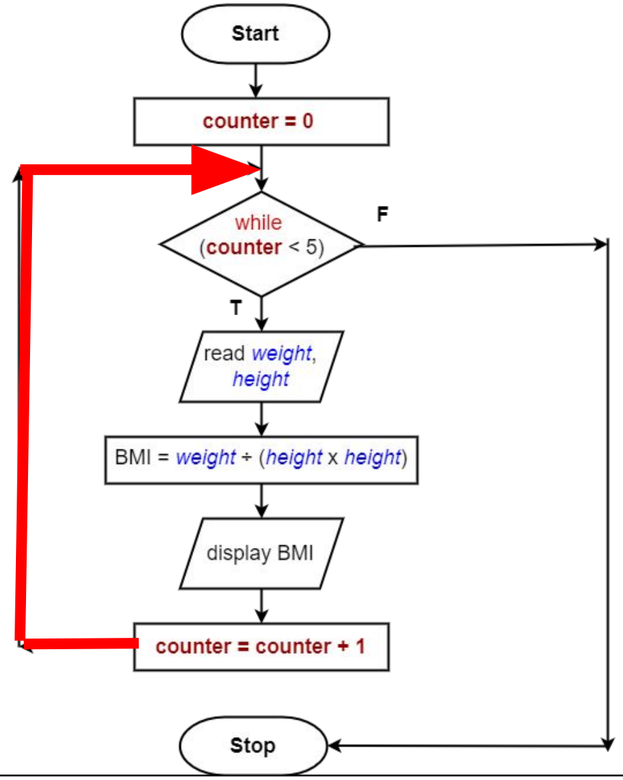
IPO Analysis	Pseudocode	Flowchart

Input :
weight, *height* **for 5 times**
 	
Process :
Repeat calculate BMI based on *weight* and *height* **for 5 times**
 	
Output :
BMI for 5 times
	Start
	counter = 0
	while (counter < 5)
	read weight, height
	BMI = weight ÷ (height x height)
	display BMI
	counter = counter + 1
	end while
	Stop
	
	Note: *To ensure the loops are repeated for 5 times:*
	-if the counter starts with 0, the condition is while (counter < 5)
	-if the counter starts with 1, the condition is while (counter ≤ 5) @ while (counter < 6)
		

Problem statement 7 (Repetition control structure)(Other approach for IPO)

The program calculate BMI for 5 persons

IPO Analysis	Pseudocode	Flowchart

Input :
weight, *height*
 	
Process :
Repeat calculate BMI based on *weight* and *height* **for 5 times**
 	
Output :
BMI
 	
standard penulisan : penggunaan input dalam proses dengan pernyataan "based on (input)"
	Start
	counter = 0
	while (counter < 5)
	read weight, height
	BMI = weight ÷ (height x height)
	display BMI
	counter = counter + 1
	end while
	Stop
	
	Note: *To ensure the loops are repeated for 5 times:*
	-if the counter starts with 0, the condition is while (counter < 5)
	-if the counter starts with 1, the condition is while (counter ≤ 5) @ while (counter < 6)
		

Problem statement 8 (Repetition control structure) - Counter controlled

Calculate the **average** BMI of five students.

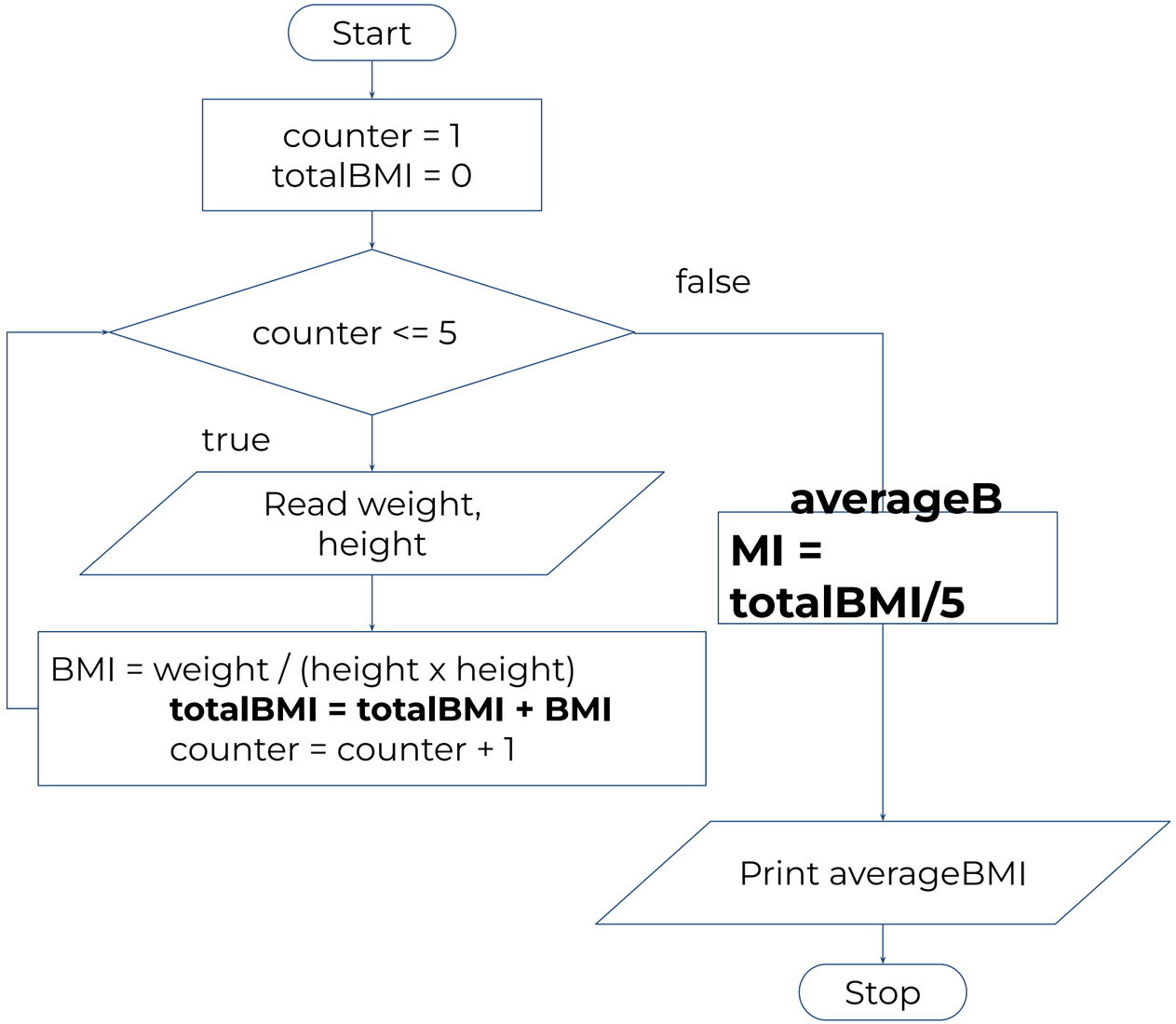
IPO model

Input: weight, height
Process: Repeat to calculate total BMI for five students based on weight and height. Calculate the average BMI based on total BMI.
Output : average BMI of five students

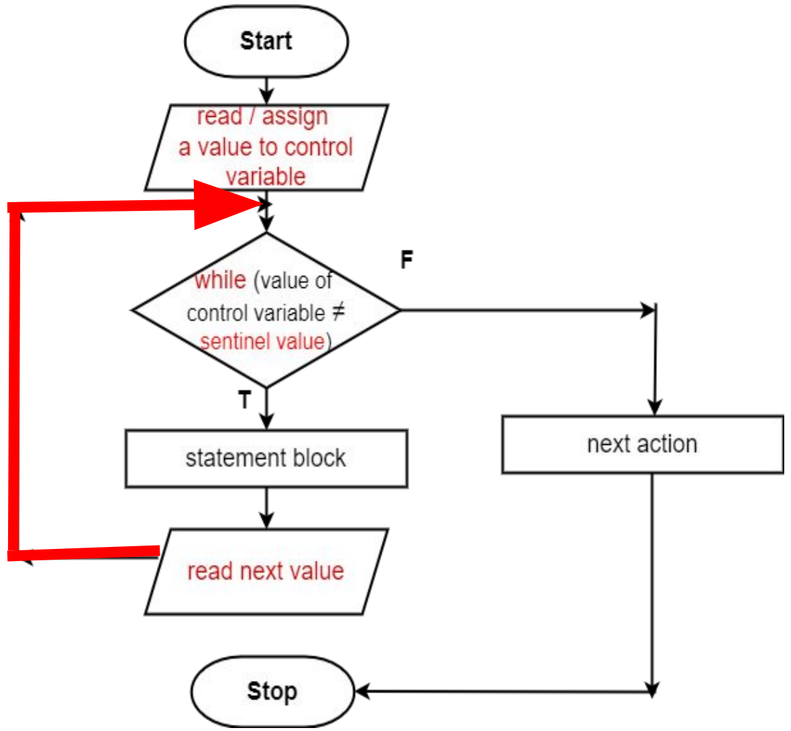
```
Start
    counter = 1
    totalBMI = 0
    while (counter <= 5)
        Read weight, height
        BMI = weight / (height x height)
        totalBMI = totalBMI + BMI
        counter = counter + 1
    end while
    averageBMI = totalBMI/5
    Print averageBMI
Stop
```

Flowchart example 8

```
Start
    counter = 1
    totalBMI = 0
    while (counter <= 5)
        Read weight, height
        BMI = weight / (height x height)
        totalBMI = totalBMI + BMI
        counter = counter + 1
    end while
    averageBMI = totalBMI/5
    Print averageBMI
Stop
```



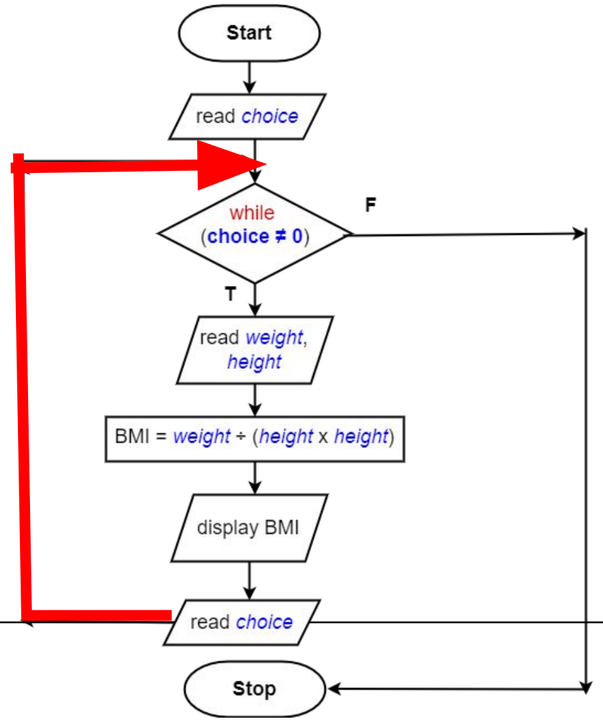
Repetition: Sentinel controlled

Pseudocode General Format	*Flowchart General Format*
Start **Read / Assign a value to control variable** **while (value of control variable is not sentinel value)** statement block **read next value** **end while** next action **Stop** **Note:The statement(s) will be executed repeatedly until the condition is False (F)**	

Problem statement 9 (Sentinel controlled)

The program calculates BMI of persons and stops when the user enters 0.

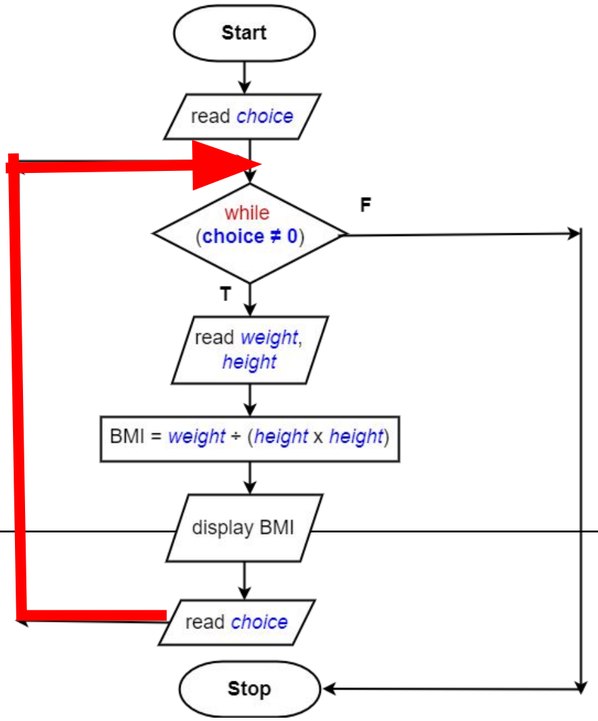
IPO Analysis	Pseudocode	Flowchart

Input :
option*, *weight, height* for *x times* *until option equal to 0
 	
Process :
Repeat calculate **BMI** for ***x times*** **until option equal to 0**
 	
Output :
BMI for *x times* until option equal to 0
	Start
	read option
	while (option ≠ 0)
	read weight, height
	BMI = weight ÷ (height x height)
	display BMI
	read option
	end while
	Stop
		

Problem statement 9 (Sentinel controlled) (Other approach for IPO)

The program calculates BMI of persons and stops when the user enters 0.

IPO Analysis	Pseudocode	Flowchart

Input :
option*, *weight, height
 	
Process :
Repeat calculate **BMI** **based on weight and height until option equal to 0 (remove for statement)**
 	
Output :
BMI
	Start
	read option
	while (option ≠ 0)
	read weight, height
	BMI = weight ÷ (height x height)
	display BMI
	read option
	end while
	Stop (indentation)
		

PENULISAN CONDITION

**statement while (option not equal 0) dalam bentuk ayat juga boleh diterima dalam pseudocode

** statement coding !=, ==, “A” boleh diterima

Pseudocode example 10 (Repetition control structure) - Sentinel controlled

Calculate the total of several numbers entered by the user and end the calculation when the user enters 0.

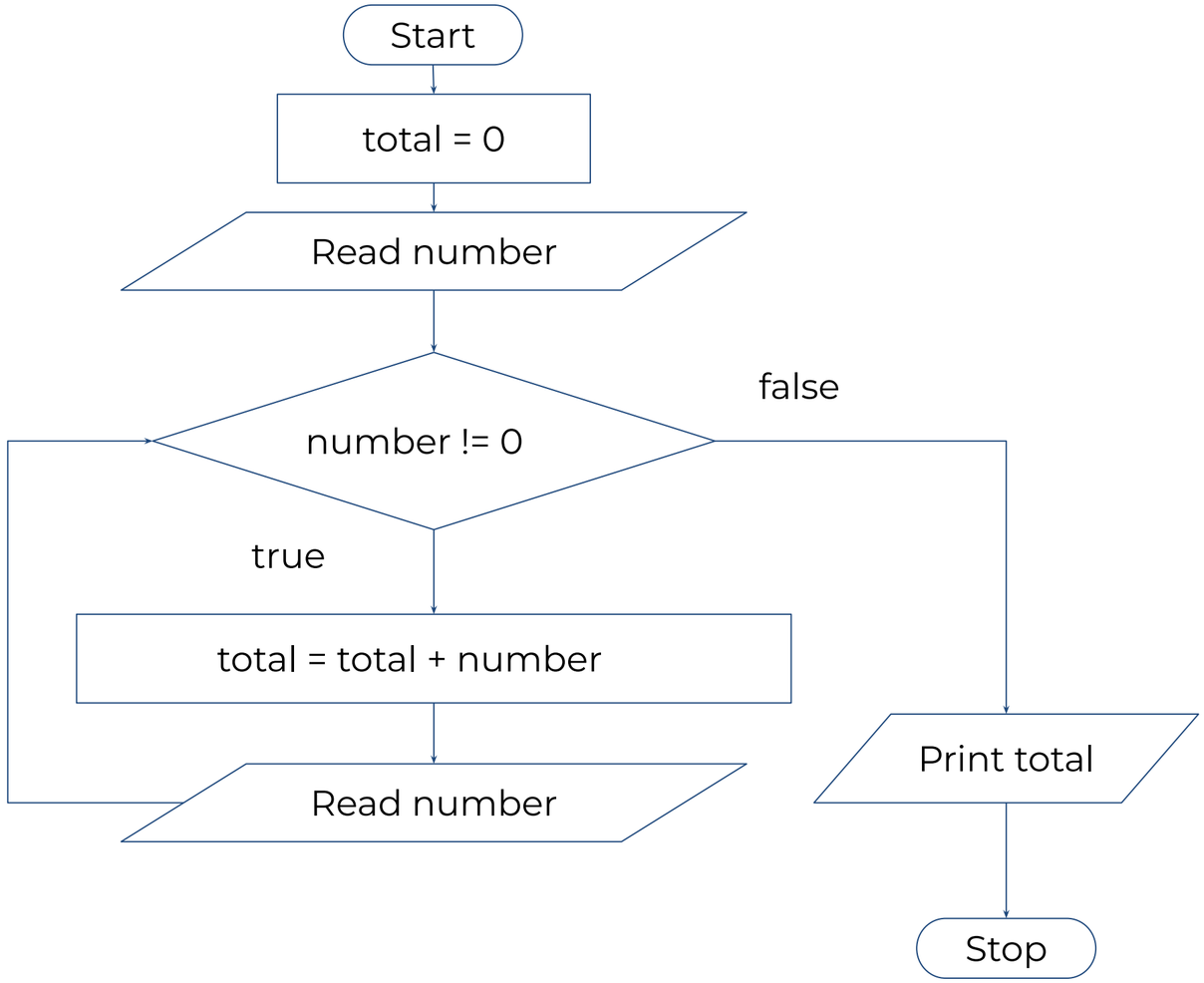
```
Start
    total = 0
    Read number
    while (number != 0)
        total = total + number
        Read number
    end while
    Print total
Stop
```

IPO model

Input: number
Process: Repeat to calculate total of several numbers based number until number entered is 0.
Output : total

Flowchart example 10

```
Start
    total = 0
    Read number
    while (number != 0)
        total = total + number
        Read number
    end while
    Print total
Stop
```



Topic 3: Define algorithm, flowchart and pseudocode

Based on the definition of pseudocode and flowchart, identify the type of control structure based on the following statements.

Statement	Control Structure?
i) Sam wants a program that displays the number of seconds it takes for a baseball to travel a specified distance at a specified speed.	
ii) Mr. Tan has a car rental business in Langkawi. Customers will pay a base fee according to the size of car rented. Small size (S) is RM50, medium size (M) is RM80 and large size (L) is RM100 per day.	
iii) The staff of HEP Unit need to find the total of module 1, module 2 and module 3 students who have attended the Local Rule Seminar. The program should also find the percentage of attendent for each module. The total of the participants are 100 students.	