Algorithm & Flowchart

Credit: Mr Ainullotfi

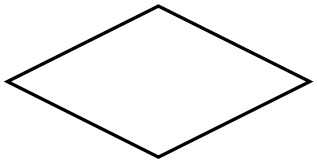
Common Flowchart Symbols

Start/Stop

Process

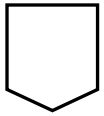
Input/Output

Refers to a separate flowchart



Decision

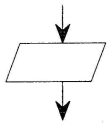
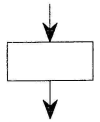
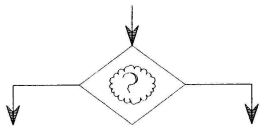
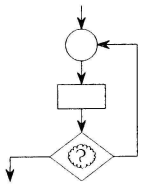
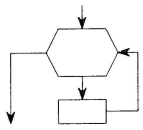
Connector



Off-page Connector

Comments

Preparation (for loops etc)

Block	Function	Flowchart Symbol
Sequential Execution	Unconditional Transfer	
	Input or Output	
	Processing	
Branching	Conditional Transfer	
Loops	Conditional Loop	
	Counted Loop	

Example Problem #1

- Given a set of numbers, calculate their sum and the average value (mean).
- Formula:

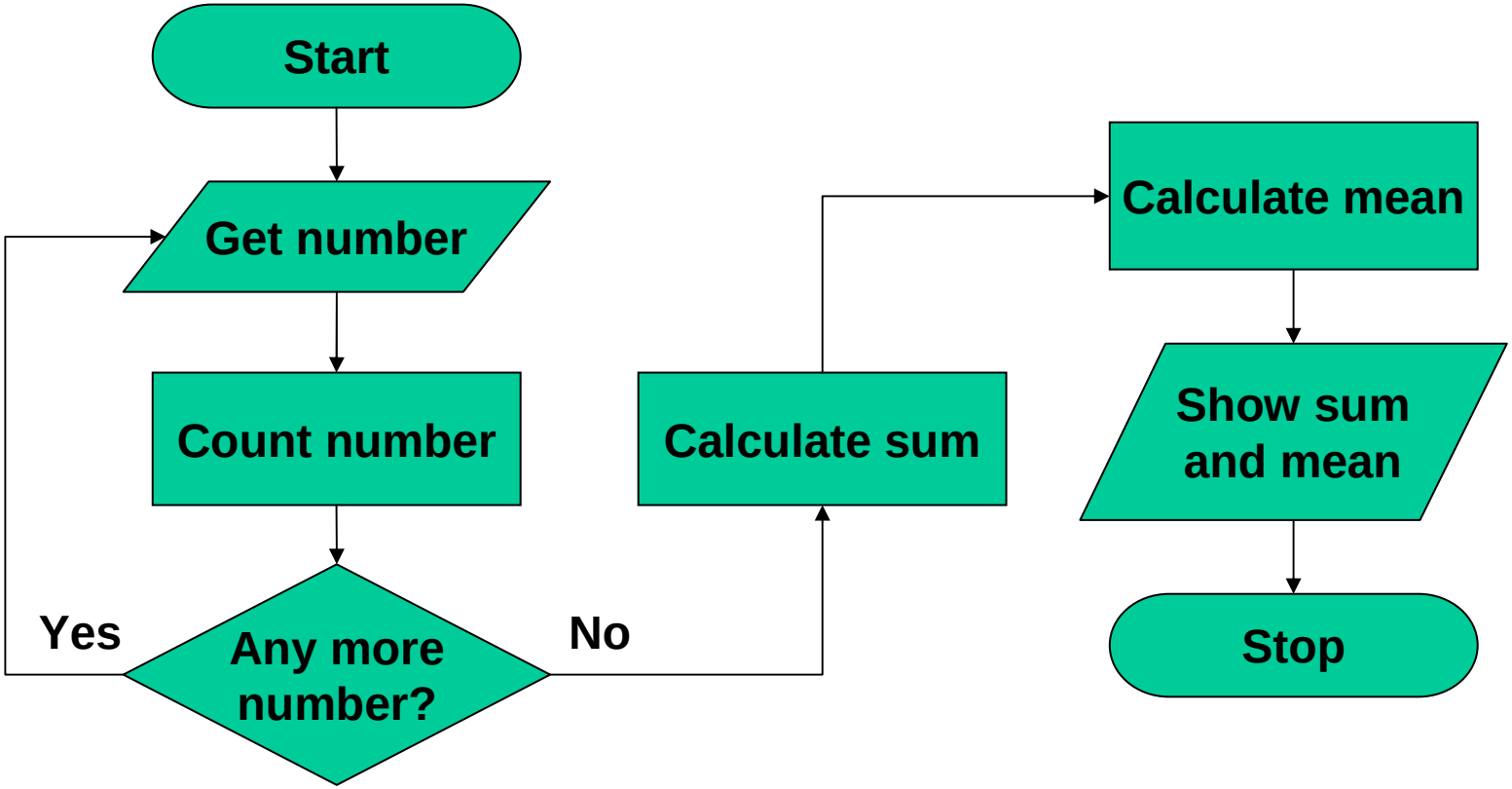
$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

- n is the number of numbers in the set

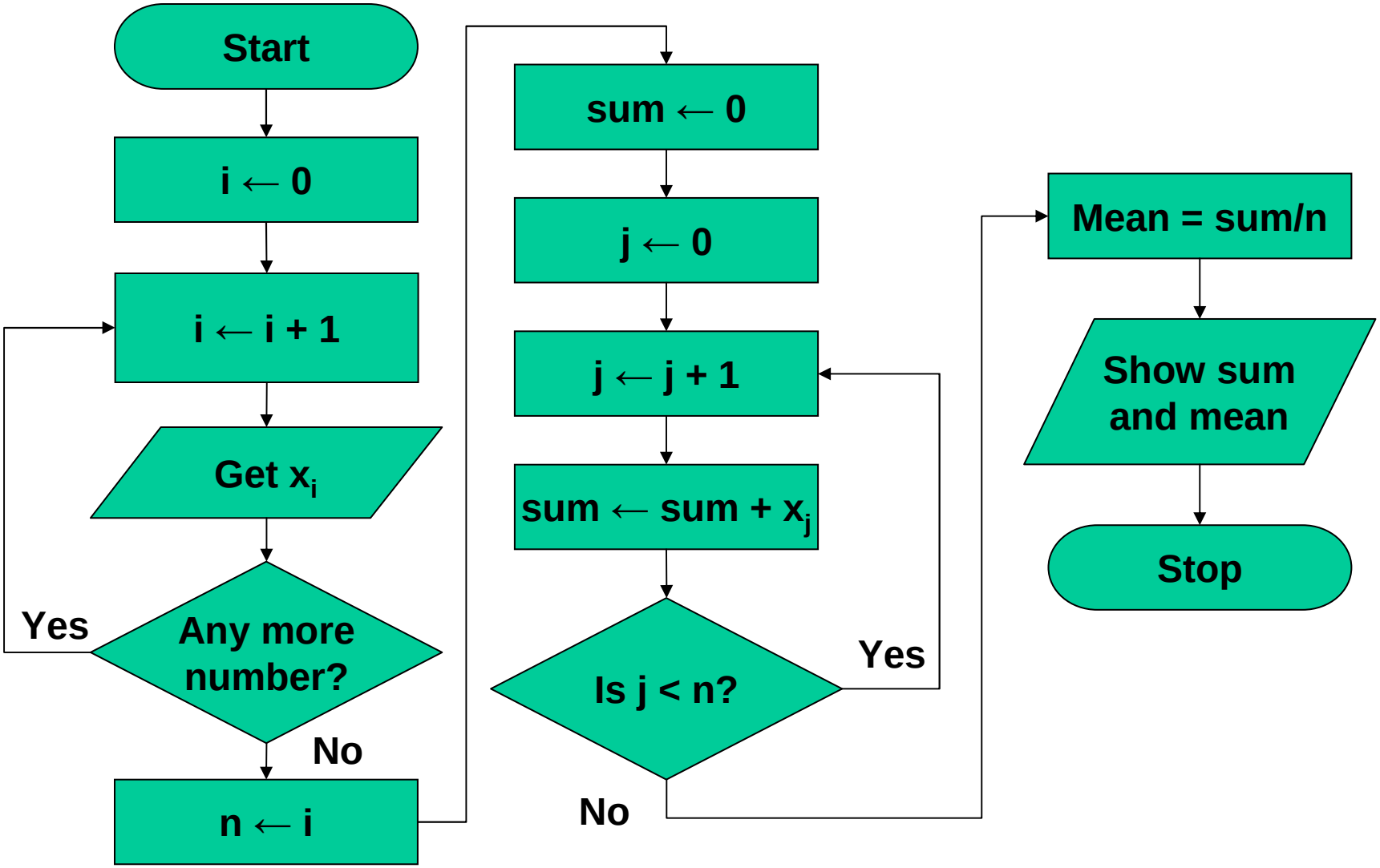
Algorithm

- 1. Start
- 2. Get one number in the set
- 3. Count the numbers as it is obtained
- 4. If there are still numbers to be obtained,
  go back to step 2.
- 5. Sum the numbers in the set
- 6. Divide the sum by the number of numbers in the set to get the average
- 7. Show the sum and the average
- 8. Stop

Flowchart


Start
Get number
Count number
Any more number?
Yes
No
Calculate sum
Calculate mean
Show sum and mean
Stop

Detailed Flowchart



Pseudocode

- 1. Start
- 2. i ← 0
- 3. i ← i + 1
- 4. Get x_i
- 5. If there more numbers repeat from 3.
- 6. n ← i
- 7. sum ← 0
- 8. j ← 0

Pseudocode

- 9. $j \leftarrow j + 1$
- 10. $sum \leftarrow sum + x_i$
- 11. If $j < n$ repeat from step 9
- 12. $mean \leftarrow sum / n$
- 13. Show sum and mean
- 14. Stop

Variables

- A **variable** is a location in the computer memory which is given a specific name and can hold a single value at a time
- A variable can be compared to a box or a container that is given a label – and the box can hold one content at a time
- In the last example, i, j, n, sum, mean and x_1, x_2, x_3... etc are all variables

Variable Assignments

- Variables are given values either directly by the user through the input statements (e.g. Get x_i) or by assignments statements
- i ← 0 is an assignment expression meaning 'assign the value 0 to variable i'
- n ← i means 'assign the value equivalent to that in variable i to variable n' (the value in variable i is not changed)
- j ← j + 1 means 'add 1 to the value in j'

Variable Types

- Variables can be of several types depending of the kind of data it stores
- In general variables can be classified into:
  - (a) Numeric type
  - (b) String type
  - (c) Logical type
- Assignment expressions would involve similar type of variables only

Numeric Variables

- **Numeric variables** store numerical data which can be used in mathematical calculations
- Examples of numeric expressions are:

```
i ← 0
j ← j + 1
mean ← sum / n
y ← x*x
z ← sin(x) + 3
```

String Variables

- String variables store alphanumeric data, symbols and control characters
- Although strings may store numbers, they are of the type not used for calculations e.g. phone numbers, addresses etc
- String variables are useful for labels, names and comments
- name ← 'lotfi' is a string expression

Logical Variables

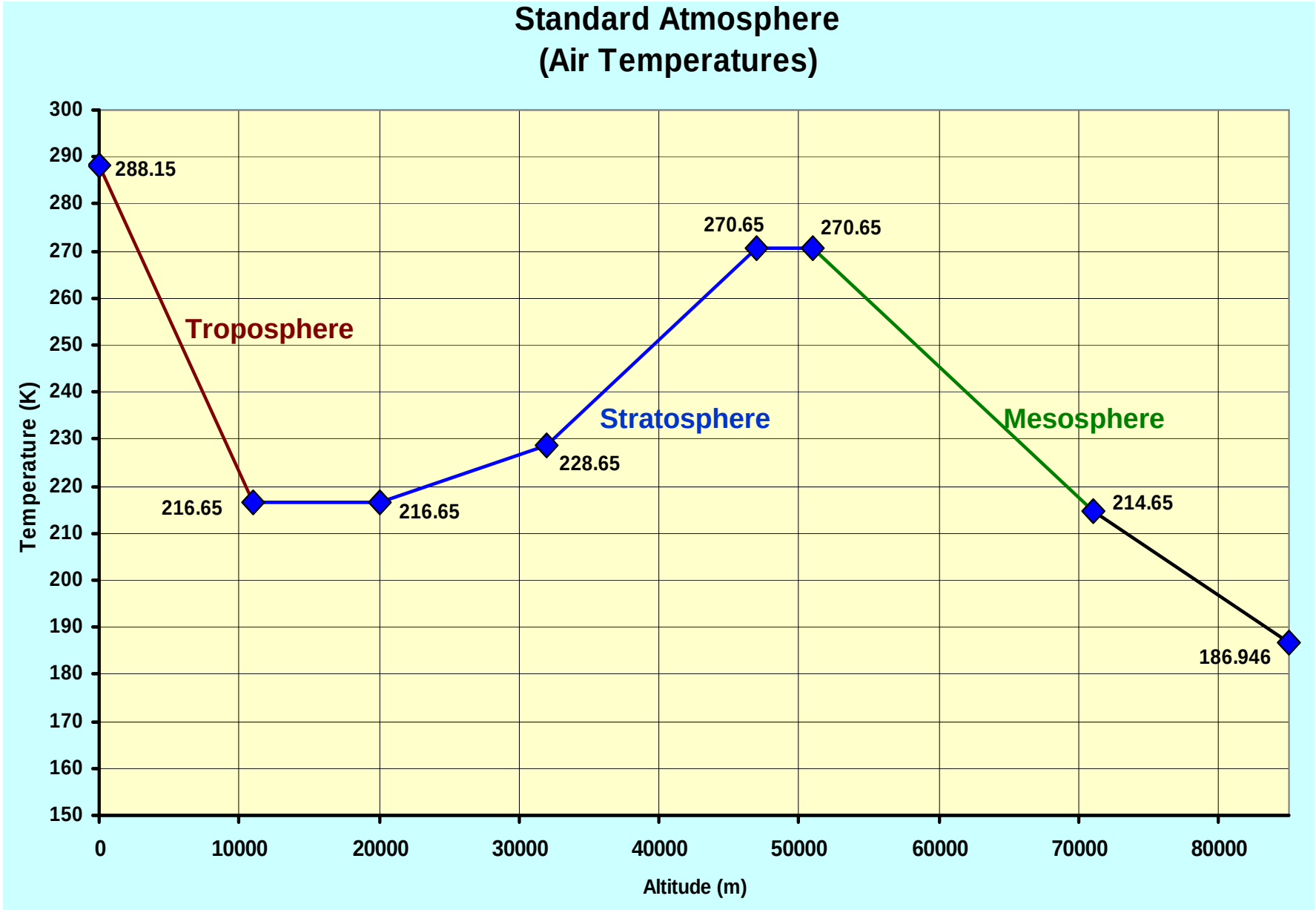
- **Logical variables** store only either a 'True' or a 'False' value
- k ← (3 > 4) is an example of a logical expression – in this case k has the value 'False' since it is not true that 3 is greater than 4
- Logical expressions are useful for tests and decision making algorithms

Example Problem #2

- Atmospheric temperature vary with altitude according to the following tables

Alt h (m)	Temp T (K)
0	288.15
11000	216.65
20000	216.65
32000	228.65
47000	270.65
51000	270.65
71000	214.65
85000	186.946

Alt h (m)	dT/dh (K/m)
0-11000	-6.5×10^{-3}
11000-20000	0
20000-32000	1×10^{-3}
32000-47000	2.8×10^{-3}
47000-51000	0
51000-71000	-2.8×10^{-3}
71000-85000	-2.0×10^{-3}


Standard Atmosphere
(Air Temperatures)
Temperature (K)
Altitude (m)
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
150
0
10000
20000
30000
40000
50000
60000
70000
80000
288.15
216.65
216.65
228.65
270.65
270.65
214.65
186.946
Troposphere
Stratosphere
Mesosphere

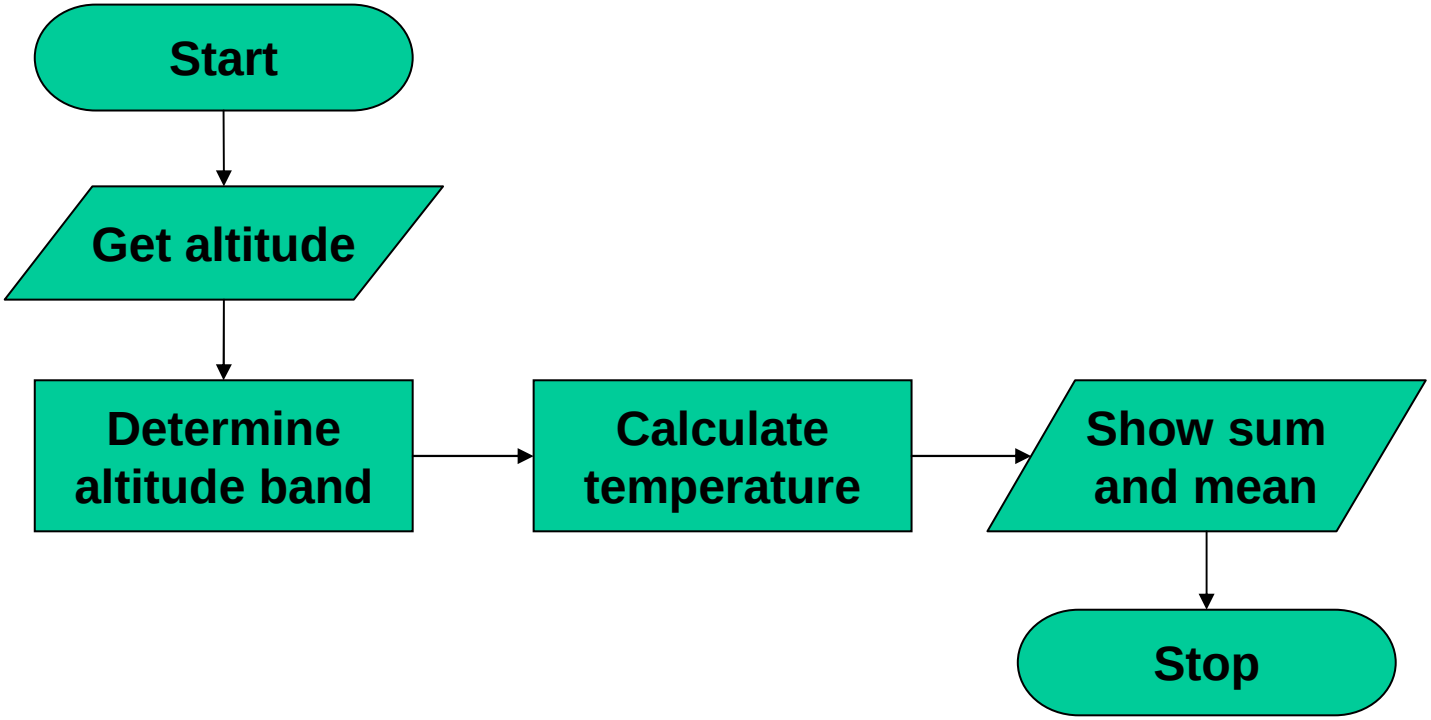
Example Problem #2

- The Troposphere is the layer from sea level up to 11000 m
- The Stratosphere is between 11000 to 51000m
- The Mesosphere is between 51000 to 71000m
- Given an altitude, the temperature of the atmosphere need to be calculated

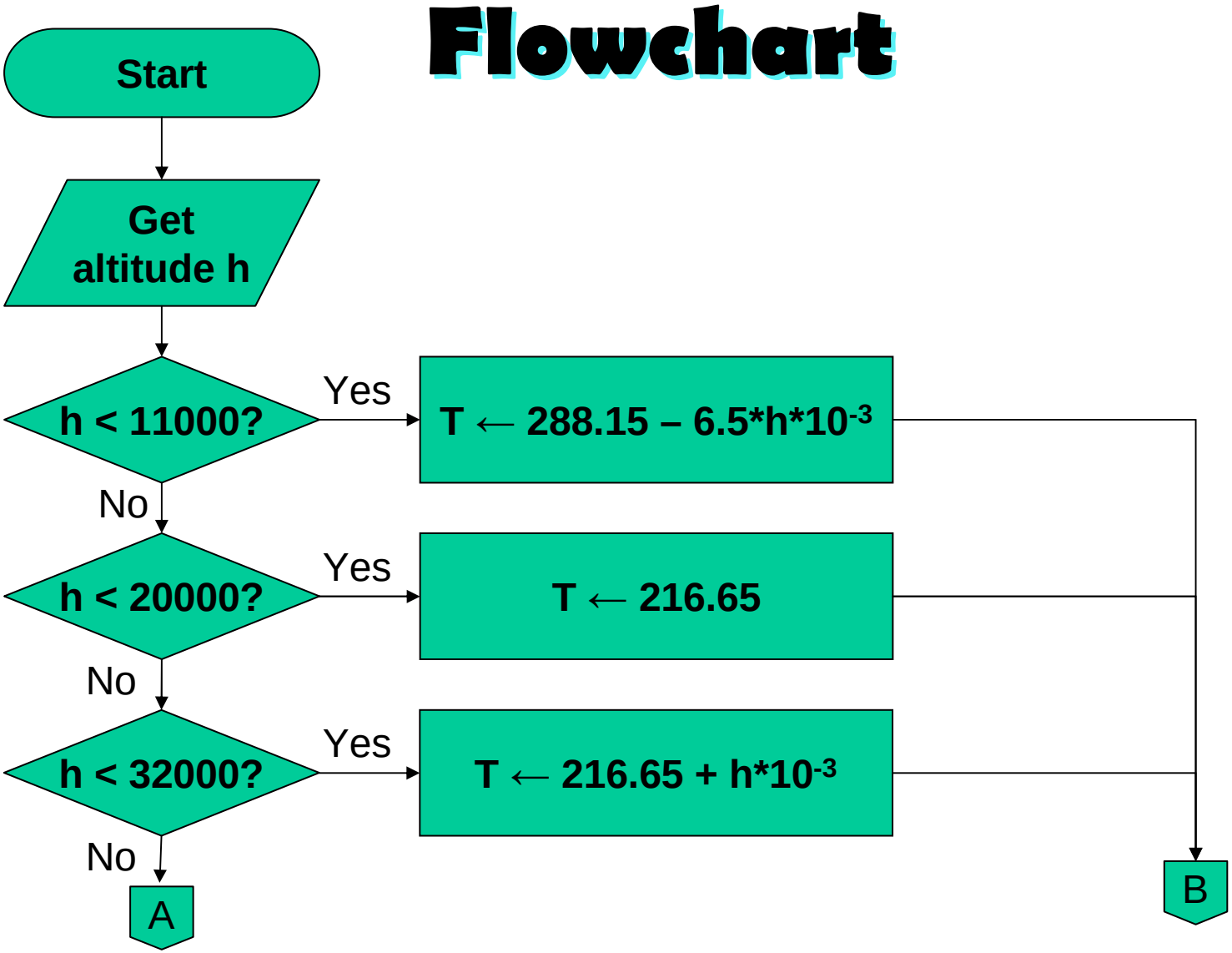
Algorithm

- 1. Start
- 2. Get altitude
- 3. Determine which altitude band it is in
- 4. Calculate the temperature using the equation associated with that band
- 5. Show the altitude and the temperature
- 6. Stop

Flowchart

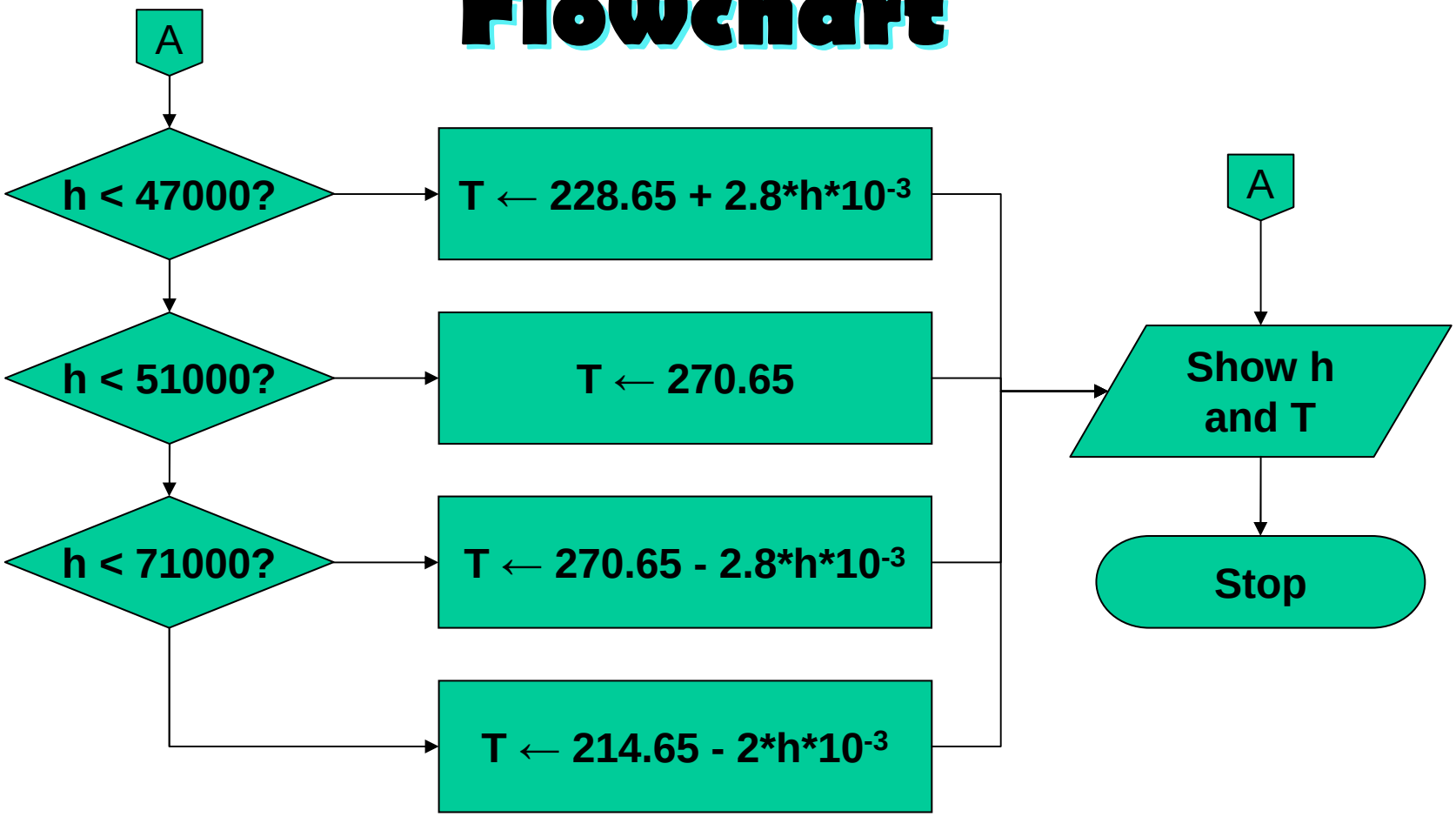

Start
Get altitude
Determine altitude band
Calculate temperature
Show sum and mean
Stop

Flowchart



Yes

Flowchart


A
h < 47000?
T ← 228.65 + 2.8*h*10-3
h < 51000?
T ← 270.65
h < 71000?
T ← 270.65 - 2.8*h*10-3
T ← 214.65 - 2*h*10-3
A
Show h and T
Stop

Pseudocode

- 1. Start
- 2. Get h
- 3. If h < 11000 then
- 4. T ⟵ 288.15 – 6.5*h*10^{-3}
- 5. Else if h < 20000 then
- 6. T ⟵ 216.15
- 7. Else if h < 32000 then
- 8. T ⟵ 216.15 + *h*10^{-3}

Pseudocode

- 9. Else if h < 47000 then
- 10. T ⟸ 228.65 + 2.8*h*10^{-3}
- 11. Else if h < 51000 then
- 12. T ⟸ 270.65
- 13. Else if h < 71000 then
- 14. T ⟸ 270.65 – 2.8*h*10^{-3}
- 15. Else T ⟸ 214.65 + 2*h*10^{-3}
- 16. Show h and T
- 17. Stop

Types of Algorithms

- **Sequential** algorithm
- **Looping** algorithm
- **Decision** algorithm
- **Link** algorithm