<table>
<thead>
<tr>
<th>Block</th>
<th>Function</th>
<th>Flowchart Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequential Execution</td>
<td>Unconditional Transfer</td>
<td>![Symbol]</td>
</tr>
<tr>
<td></td>
<td>Input or Output</td>
<td>![Symbol]</td>
</tr>
<tr>
<td></td>
<td>Processing</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Branching</td>
<td>Conditional Transfer</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Loops</td>
<td>Conditional Loop</td>
<td>![Symbol]</td>
</tr>
<tr>
<td></td>
<td>Counted Loop</td>
<td>![Symbol]</td>
</tr>
</tbody>
</table>
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
Start

Get number

Count number

Any more number? Yes No

Calculate sum

Calculate mean

Show sum and mean

Stop
Start

i ← 0

i ← i + 1

Get x

Any more number?

Yes

n ← i

No

sum ← 0

j ← 0

j ← j + 1

sum ← sum + x

Is j < n?

Yes

Mean = sum/n

Stop

No

Show sum and mean
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. \( \text{sum} \leftarrow \text{sum} + x_i \)
11. If \( j < n \) repeat from step 9
12. \( \text{mean} \leftarrow \text{sum} / n \)
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.

- $i \leftarrow 0$ is an assignment expression meaning ‘assign the value 0 to variable i’

- $n \leftarrow i$ means ‘assign the value equivalent to that in variable i to variable n’ (the value in variable i is not changed).

- $j \leftarrow j + 1$ means ‘add 1 to the value in j’
Variable Types

- Variables can be of several types depending on 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:
  
  \[ i \leftarrow 0 \]
  \[ j \leftarrow j + 1 \]
  \[ \text{mean} \leftarrow \text{sum} / \text{n} \]
  \[ y \leftarrow x \times x \]
  \[ z \leftarrow \sin(x) + 3 \]
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

- \( k \leftarrow (3 > 4) \) 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:

<table>
<thead>
<tr>
<th>Alt h (m)</th>
<th>Temp T (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>288.15</td>
</tr>
<tr>
<td>11000</td>
<td>216.65</td>
</tr>
<tr>
<td>20000</td>
<td>216.65</td>
</tr>
<tr>
<td>32000</td>
<td>228.65</td>
</tr>
<tr>
<td>47000</td>
<td>270.65</td>
</tr>
<tr>
<td>51000</td>
<td>270.65</td>
</tr>
<tr>
<td>71000</td>
<td>214.65</td>
</tr>
<tr>
<td>85000</td>
<td>186.946</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alt h (m)</th>
<th>dT/dh (K/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-11000</td>
<td>-6.5 x 10^{-3}</td>
</tr>
<tr>
<td>11000-20000</td>
<td>0</td>
</tr>
<tr>
<td>20000-32000</td>
<td>1 x 10^{-3}</td>
</tr>
<tr>
<td>32000-47000</td>
<td>2.8 x 10^{-3}</td>
</tr>
<tr>
<td>47000-51000</td>
<td>0</td>
</tr>
<tr>
<td>51000-71000</td>
<td>-2.8 x 10^{-3}</td>
</tr>
<tr>
<td>71000-85000</td>
<td>-2.0 x 10^{-3}</td>
</tr>
</tbody>
</table>
Standard Atmosphere
(Air Temperatures)

Troposphere

Stratosphere

Mesosphere
Example Problem #2

- The Troposphere is the layer from sea level up to 11000 m
- The Stratosphere is between 11000 to 51000 m
- The Mesosphere is between 51000 to 71000 m
- 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
Start

Get altitude

Determine altitude band

Calculate temperature

Show sum and mean

Stop
Start

Get altitude $h$

$h < 11000$?
- Yes: $T \leftarrow 288.15 - 6.5h \times 10^{-3}$
- No: $h < 20000$?

$h < 20000$?
- Yes: $T \leftarrow 216.65$
- No: $h < 32000$?

$h < 32000$?
- Yes: $T \leftarrow 216.65 + h \times 10^{-3}$
- No: A

Yes

B
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}

Show h and T

Stop
Pseudocode

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


Pseudocode

9. Else if h < 47000 then
10. \[ T \leftarrow 228.65 + 2.8h \times 10^{-3} \]
11. Else if h < 51000 then
12. \[ T \leftarrow 270.65 \]
13. Else if h < 71000 then
14. \[ T \leftarrow 270.65 - 2.8h \times 10^{-3} \]
15. Else \[ T \leftarrow 214.65 + 2h \times 10^{-3} \]
16. Show h and T
17. Stop
Types of Algorithms

• Sequential algorithm
• Looping algorithm
• Decision algorithm
• Link algorithm