SME1013 PROGRAMMING FOR ENGINEERS

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Problem Solving

- Recognise and understand the problem (what is it that needed to be solved?)
- List the parameters affecting the problem (input)
- Select the appropriate theory
- Make the necessary assumptions
- Solve the problem – may use a computer
- Verify the results

Computer Solution: Software Development Process

- List down the sequence of steps to solve the problem – algorithm
- Write these steps in a computer language – program coding
- Test the program to ensure it error-free and reliable – debugging
- Make the program easy to understand and use – documentation
- Save the program and improve it as one gathers experience

Computer Coding

- A program is a sequence of instructions to the computer for it to solve a particular problem. A set of programs is called code.
- Programs are written in some programming language – e.g. Fortran, Basic, C++, Pascal, Java, Matlab.
- Programs are stored in files – which are a sequence of bytes which is given a name and stored on a disk.

Computer Coding

- A bit or a binary digit is the smallest unit of data storage. It has the value of either 0 or 1 only.
- A byte is a sequence of 8 bits, representing 256 different values. E.g. of a byte is:

  0 1 0 1 1 1 0 1

  A byte could represent a character like a letter or a number or a symbol.
- A word is a larger group of bytes, maybe two bytes (16 bits).

Computer Coding

- A program is a file containing a sequence of "statements", each of which tells the computer to do a specific action.
- Once a program is run or executed the commands are followed and actions occur in a sequential manner.
- If the program is designed to interact with the outside world, then it must have input and output.

Computer Coding

- A program is said to have a bug if it contains a mistake or it does not function in the way it is intended to.
- Bugs can happen both in the logic of the program, as well as in the commands.
- In order that the program perform the exact actions it is intended to do, before the actual program is written an algorithm for solving the problem must first be outlined.

Computer Coding

- An algorithm is a general sequence of the logical steps in solving a specific problem.
- A flowchart is a graphical representation of the algorithm.
- A pseudocode gives a more detailed, step-by-step set of instructions required to solve the problem. It is normally written in everyday language.

Good Algorithms

- Each step must be deterministic – it cannot be ambiguous or leaving things to chance.
- The process must end after a finite number of steps – it must not be open-ended.
- The algorithm must be general enough to deal with any contingency.

Common Flowchart Symbols

Start/Stop

Decision

Process

Connector

Input/Output

Off-page Connector

Refers to a separate flowchart

Preparation (for loops etc)

Example Problem #1

- Given temperature in degrees Fahrenheit, the temperature in degrees Kelvin is to be computed and shown.
- Formula:

$$T_K = \left(\frac{T_F - 32}{1.8} \right) + 273.15$$

- T_K and T_F are temperatures in degrees Kelvin and Fahrenheit respectively

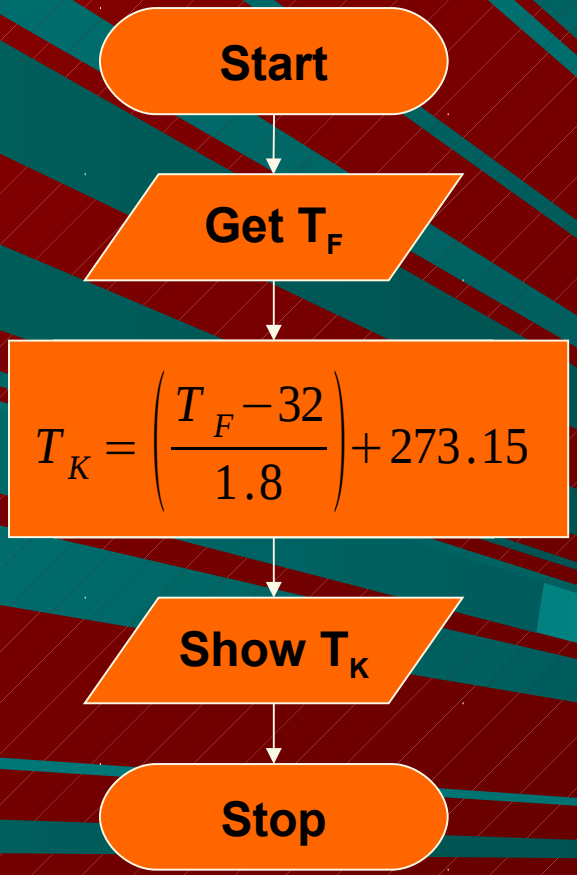
Algorithm

- Start
- Get the temperature in Fahrenheit
- Compute the temperature in Kelvin using the formula

$$T_K = \left(\frac{T_F - 32}{1.8} \right) + 273.15$$

- Show the temperature in Kelvin
- Stop

Flowchart



Pseudocode

- 1. Start
- 2. Get T_F
- 3. $T_K = (T_F-32)/1.8 + 273.15$
- 4. Show T_K
- 5. Stop

Example Problem #2

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

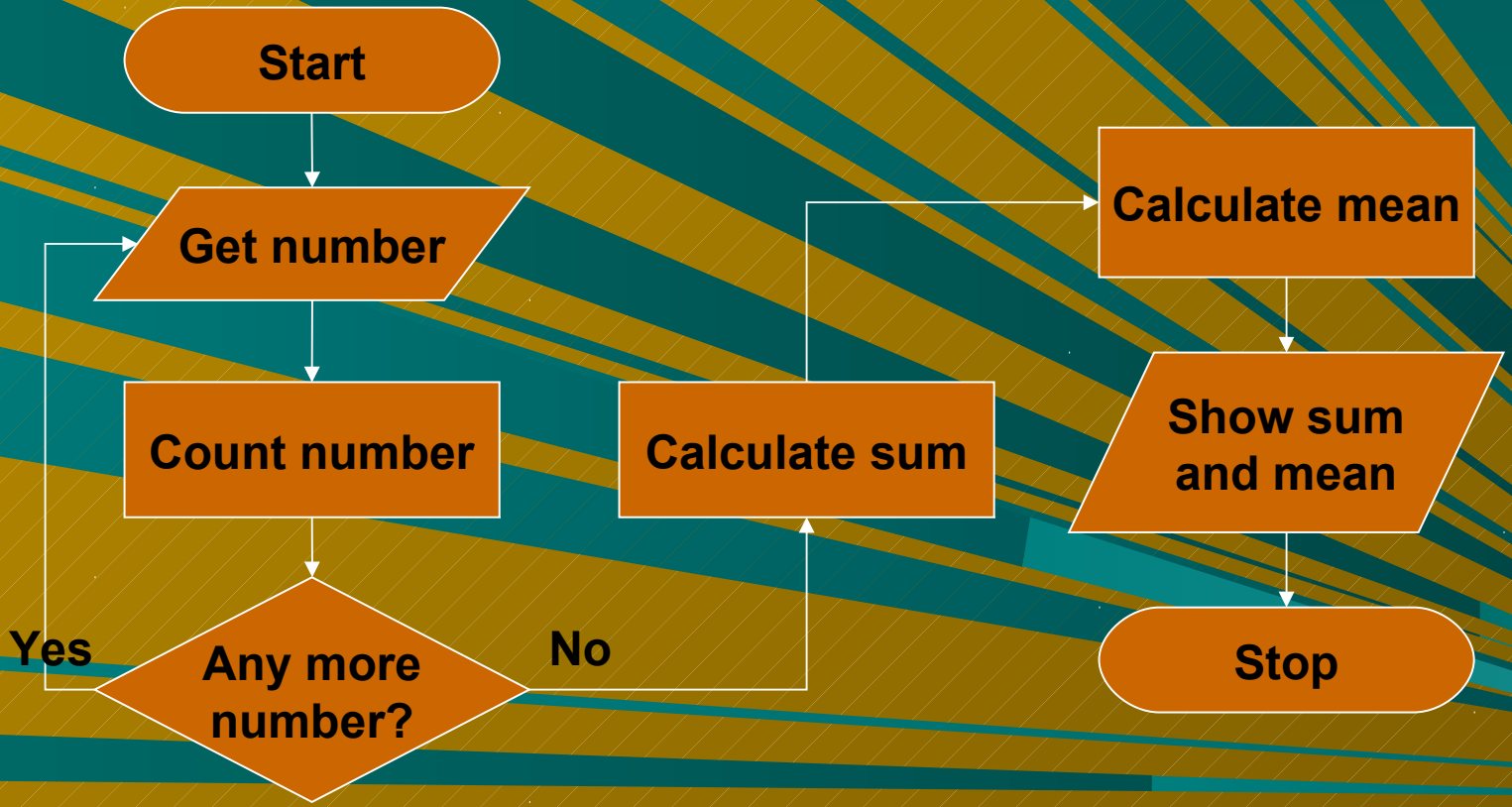
$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

- 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