Problem Solving by Computer – Logical Thinking

Tech Capsule 1 – Number based problems

In almost all computational problems we deal with numbers. While using numbers we may do operations like addition, subtraction, multiplication etc.
Numbers are stored in memory and during computation they are accessed by using specific names (something like X or Y or N) called as **Variable Names**. They are called Variables as the value held by them may vary from time to time.

Problem –
Design an algorithm that accepts 2 numbers X and Y from the user and exchanges the value assigned to it.

For example,
Consider Input to be X = 10 and Y = 20

Then the output would be X = 20 and Y = 10

Solution –

Let us look at how we can build logic here. Our first thought will be to copy content of X to Y.
So by doing so
X=10 and Y = 10.

As a result we overwrite the earlier value of Y with the value of X and both variables have the same value. A variable can hold only one value at a time and so the previous value (or original/actual) of Y which was 20 is lost. Now there is no way we can write that to variable X.

Clearly this approach is not correct and cannot be used.

So now let us look at another way or approach. Let us this time copy content of variable Y to another variable T (something else but not X or Y). Now we copy the content of variable X to Y. Then the actual value of Y which is presently saved in variable T is copied to X. This will be as shown below –

Step 1 – X = 10 Y = 20 and T
Step 2 – X = 10 Y = 20 and T = 20
Step 3 – X = 10 Y = 10 and T = 20
Step 4 – X = 20 Y = 10 and T = 20

So by step 4 we have exchanged values assigned to variables to X and Y which is the correct expected solution.

In this example we can observe the following –

1) A variable holds (or has) the most recent value written in it. If it is changed (or overwritten) with something else the previous value cannot be retrieved.
2) We have here used a variable T to hold the value of variable Y during the swapping operation. In computing we refer (or call) such variables as **TEMPORARY variables**. Such TEMPORARY variables are used only to facilitate/help completion of a specific task and in this case it was swapping of numbers.

The algorithm for the problem would now look as below.

STEP 1: Save the value of Y in T
STEP 2: Copy value of X to Y
STEP 3: Copy value saved in T to X

Try by yourself

Activity 1:
Design an algorithm that performs the following operations –

Consider we have 3 variables a, b and c.

Data movement to be done as below

Move original content of a -> to b
Move original content of b -> to c
Move original content of c -> to a

Example –
If initial values of a, b and c is as below
a = 10, b = 20, c = 30

After change
a = 30, b = 10, c = 20

Activity 2:
Given a set of 3 student's examination marks (in the range from 0 to 100), make a count of the number of students that have passed the exam. A pass is awarded if the students mark is greater than or equal to 35.

Activity 3:
Design an algorithm that reads a list of 5 numbers (both +ve and –ve) and makes a count of the number of negative and non-negative numbers in the list.
Note – 0 must be considered as a +ve number in this algorithm.

Activity 4:
Design an algorithm that reads a number from the user and tells if it is even or odd or a zero.

Activity 5:
Given a set of 3 numbers, design an algorithm that adds these numbers and returns the resultant sum