

## **1.8 ALGORITHM COMPLEXITY**

Suppose **X** is an algorithm and **n** is the size of input data, the time and space used by the algorithm **X** are the two main factors, which decide the efficiency of **X**.

- **Time Factor** – Time is measured by counting the number of key operations such as comparisons in the sorting algorithm.
- **Space Factor** – Space is measured by counting the maximum memory space required by the algorithm.

The complexity of an algorithm **f(n)** gives the running time and/or the storage space required by the algorithm in terms of **n** as the size of input data.

### **1.8.1 Space Complexity**

Space complexity of an algorithm represents the amount of memory space required by the algorithm in its life cycle. The space required by an algorithm is equal to the sum of the following two components –

- A fixed part that is a space required to store certain data and variables, that are independent of the size of the problem. For example, simple variables and constants used, program size, etc.
- A variable part is a space required by variables, whose size depends on the size of the problem. For example, dynamic memory allocation, recursion stack space, etc.

Space complexity **S(P)** of any algorithm **P** is  $S(P) = C + SP(I)$ , where **C** is the fixed part and **S(I)** is the variable part of the algorithm, which depends on instance characteristic **I**. Following is a simple example that tries to explain the concept –

Algorithm: SUM(A, B)

Step 1 - START

Step 2 -  $C \leftarrow A + B + 10$

Step 3 - Stop

Here we have three variables **A**, **B**, and **C** and one constant. Hence  $S(P) = 1 + 3$ . Now, space depends on data types of given variables and constant types and it will be multiplied accordingly.

### **1.8.2 Time Complexity**

Time complexity of an algorithm represents the amount of time required by the algorithm to run to completion. Time requirements can be defined as a numerical function **T(n)**, where **T(n)** can be measured as the number of steps, provided each step consumes constant time.