**Basics of Time & Space Complexity**

* **Time Complexity:**

**🡪**Rate at which the time taken increases with respect to the input size

🡪Time Complexity != Time Taken

🡪It can’t be represented in terms of seconds. Instead it is represented in terms of **Big O Notation**

* **Three Rules while calculating Time Complexity:-**

1. Always calculate TC in terms of worst case scenario

2. Avoid constants

3. Avoid lower values

* **Just for the knowledge remember this:-**

🡪Big-Oh (O) Complexity 🡪 Worst Case [Upper Bound]

🡪Theta (θ) Complexity 🡪 Average Case

🡪Omega (Ω) Complexity 🡪 Best Case [Lower Bound]

* **Space Complexity:-**

**🡪Auxiliary Space:** Space that you take to solve the problem

**🡪Input Space**: Space that you take to store the input

* **GCD/HCF:-**

**Euclidean Algorithm**: gcd(a, b) = gcd(a % b, b), where a > b

**Example**: let a = 20, b = 15

gcd(20, 15) = gcd(5, 15)

gcd(15, 5) = gcd(0, 5)

So, when any of the no. becomes 0, the other no. will be the gcd/hcf

* **Recursion:-**

🡪When a function calls itself until a specified condition is met.

🡪**Segmentation Fault (Stack Overflow):** When the numerous functions calls waiting in the stack memory due to recursion

* **Hashing:-**

🡪In layman language, hashing means prestore something and fetch when required

🡪Inside main() method, the maximum size the array we can declare is 106. However, if we try to create a array of larger size than 106, we will get the segmentation fault error (It will not be able to allocate that much memory).

🡪However, If I declare globally i.e., outside the main method, the maximum size the array we can declare is 107

**Inside main() 🡺 int[] arr = new int[106]**

**Globally 🡺 int[] arr = new int[107]**

🡪If we want to store the size greater than 107, then go for ordered\_map/unordered\_map in STL(in C++) or HashMap in Collections (in java)

🡪For character, if there are only lowercase letters just create the 26 size character array, if there are only uppercase letters just create the 26 size character array. But if there is nothing mention, then it’s good to create 256 size character array.

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|  | **Time Complexities for Insertion and Retrieval** | | |
| **Hashing Data Structures** | **Best Case** | **Average Case** | **Worst Case** |
| Map(C++) | O(logN) | O(logN) | O(logN) |
| Unordered\_map(C++) | O(1) | O(1) | O(N) |
| HashMap(Java) | O(1) | O(1) | O(1) |

**🡪Hashing Methods:-**

1. Division Method
2. Folding Method
3. Mid Square Method