

## # Tutorial 1 $\Rightarrow$

Ans 1  $\Rightarrow$  Asymptotic notations are mathematical tools to represent the time complexities of algorithms.

$\Rightarrow$  Following are the notations that are used  $\Rightarrow$

- ①  $O$   $\Rightarrow$  It defines an upper bound as an algo, it bounds a function only from above.
- ②  $\Omega$  notation  $\Rightarrow$  Big omega notation provides the lower bound of function.
- ③  $\Theta$  notation  $\Rightarrow$  It represents both upper and lower bounds function.

④ Eg  $\Rightarrow$  let's take eg. of Insertion Sort  $\Rightarrow$ .

$\Rightarrow$  It takes linear time in best case

and quadratic in worst case.  $\Rightarrow$

$$O(n^2)$$

$$\Theta(n^2)$$

$$\Omega(n)$$

Ans 2  $\Rightarrow$  Complexity  $\Rightarrow O(\log n)$

Ans 3  $\Rightarrow$  here  $T(n) = \begin{cases} 3T(n-1) & \text{if } n > 0 \\ 1 & \text{otherwise} \end{cases}$

$$T(n) = 3T(n-1)$$

$$\Rightarrow 3(3T(n-2))$$

$$\Rightarrow 3^2 T(n-2)$$

$$\Rightarrow 3^3 T(n-3)$$

$$\Rightarrow 3^n T(n-n) = 3^n$$

Ans 4.  $\Rightarrow$  here  $T(n) = \begin{cases} 2T(n-1)-1, & \text{if } n \rightarrow 0 \\ 1, & \text{otherwise} \end{cases}$

$$T(n) = 2T(n-1) - 1$$

$$\Rightarrow 2T(2T(n-2)-1) - 1$$

$$\Rightarrow 2^2(T(n-2)) - 2 - 1$$

$$\Rightarrow 2^2(2T(n-3)-1) - 2 - 1$$

$$\Rightarrow 2^3 T(n-3) - 2^2 - 2^1 - 2^0$$

$$\Rightarrow 2^n (2^n - 1)$$

$$\Rightarrow 2^n - 2^n + 1 = 1 \Rightarrow T(n) = 1$$

Ans 5.  $\Rightarrow$  here,  $s = s + i$

if  $k$  is total no. of iteration taken by the program,  
then while loop terminates.

$$1 + 2 + 3 + \dots + k \Rightarrow k[(k+1)/2] \gg n$$

$$\boxed{k = O(\sqrt{n})}$$

Ans 6.  $\Rightarrow O(\sqrt{n})$

Ans 7.  $\Rightarrow T.C \Rightarrow O(n \log n)$

Ans 8.  $\Rightarrow O(n^2)$

Ans 9.  $\Rightarrow O(n \log n)$

Ans 10.  $\Rightarrow$  here,  $n^k \cdot a^n \Rightarrow k \geq 1, a > 1$

$$\text{taking } k=a=2, \quad n^2 \cdot 2^n \quad n^2 = O(2^k) \quad \Rightarrow \quad n^k = O(a^n)$$