

Topics to discuss

Solve $T(n) = \begin{cases} n + T(n-1) , & n > 1 \\ 1 & , n = 1 \end{cases}$

by substitution Method

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Problem : 4

$$T(n) = \begin{cases} n + T(n-1) & , n > 1 \\ 1 & , n = 1 \end{cases}$$

Solution :- $T(n) = n + T(n-1)$ — (1)
 $n \rightarrow n-1$, $T(n-1) = (n-1) + T(n-2)$
 $n \rightarrow n-2$, $T(n-2) = (n-2) + T(n-3)$

Substitute in eqn. — (1)

$$\begin{aligned} T(n) &= n + T(n-1) \\ &= n + (n-1) + T(n-2) \\ &= n + (n-1) + (n-2) + T(n-3) \\ &\vdots \end{aligned}$$

$$= n + (n-1) + (n-2) + \dots + (n-k) + T(n-k+1)$$

$$T(n) = 1 \quad , n = 1$$

$$T(1) = 1$$

$$\text{assume, } n-(k+1) = 1$$

$$n-k-1 = 1$$

$$k = n-2$$

$$\begin{aligned} T(n) &= n + (n-1) + \dots + (n-k) + T(n-k+1) \\ &= n + (n-1) + \dots + (n-(n-2)) + T(1) \\ &= n + (n-1) + \dots + 2 + 1 \\ &= 1 + 2 + 3 + \dots + (n-1) + n \\ &= \frac{n(n+1)}{2} \end{aligned}$$

$$T(n) = O(n^2)$$

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