

1. The runtime complexity of algorithm mathematically.

A: let's count the no. of basic operations in terms of the input size 'n'.

- alg. - contains nested loops

innermost loop contains the operation  $x = x + 1$   
 $\downarrow$   
executed  $n \times n$  times

$$\therefore \text{runtime } T(n) = 1 + \sum_{i=1}^n \sum_{j=1}^n 1$$

$$T(n) = 1 + \sum_{i=1}^n \left( \sum_{j=1}^n 1 \right)$$

$\therefore$  inner summation  $\Rightarrow$  constant

$$T(n) = 1 + \sum_{i=1}^n n$$

$$T(n) = 1 + n \sum_{i=1}^n 1 \quad \because \sum_{i=1}^n 1 \Rightarrow n$$

$$T(n) = 1 + n \times n$$

$$T(n) = 1 + n^2$$

$\therefore$  Runtime of given algorithm is  $O(n^2)$