

# ChatGPT - Trailing Zeroes in Factorial

Give short notes for this DSA question. Given an integer  $n$ , return the number of trailing zeroes in  $n!$ .

Note that  $n! = n * (n - 1) * (n - 2) * \dots * 3 * 2 * 1$ .

## Short Notes: Count Trailing Zeroes in $n!$

### Key Concept:

Trailing zeroes in  $n!$  are created by the factors of 10 in the factorial. Each 10 is formed by a pair of 2 and 5. Since there are always more factors of 2 than 5 in  $n!$ , the count of trailing zeroes is determined by the number of factors of 5 in  $n!$ .

### Steps to Solve:

1. Count the multiples of 5 in  $n!$ , as each contributes at least one factor of 5.
2. Include higher powers of 5 (e.g., 25, 125) since they contribute additional factors of 5.

### Formula:

$$\text{Trailing Zeroes} = \left\lfloor \frac{n}{5} \right\rfloor + \left\lfloor \frac{n}{25} \right\rfloor + \left\lfloor \frac{n}{125} \right\rfloor + \dots$$

### Explanation:

- $\left\lfloor \frac{n}{5} \right\rfloor$ : Counts numbers divisible by 5.
- $\left\lfloor \frac{n}{25} \right\rfloor$ : Counts numbers contributing an extra factor of 5 (like 25, 50, etc.).
- Continue until  $5^k > n$ .

### Example:

Input:  $n = 100$

Calculation:

$$\left\lfloor \frac{100}{5} \right\rfloor = 20, \quad \left\lfloor \frac{100}{25} \right\rfloor = 4$$

Total =  $20 + 4 = 24$  trailing zeroes.

### Time Complexity:

$O(\log_5 n)$ , as we repeatedly divide  $n$  by 5.

### Space Complexity:

$O(1)$ , as no extra space is used.