Solution Review: Nested Loop with Multiplication (Intermediate)

This review provides a detailed analysis of the different ways to solve the nested loop with multiplication in an advanced problem!

We'll cover the following

Solution

```
n = 10  # can be anything, this is just an example
sum = 0
pie = 3.14
for var in range(1, n, 3):
    j = 1
    print(pie)
    while j < n:
        sum += 1
        j *= 3
print(sum)  # O(1)

```

- Outer Loop: $1 + 3 + 6 + 9 + \cdots + n = \frac{n}{3}$
- Inner Loop: $1 + 3 + 9 + 27 + \cdots + n = log_3 n$

Statement	Number of Executions
n = 10	1
sum = 0	1
pie = 3.14	1
for var in range(1,n,3):	$\frac{n}{3}$
j=1	$\frac{n}{3}$
print(pie);	$\frac{n}{3}$

Statement	Number of Executions
while j < n:	$\frac{n}{3} \times \log_3(n)$
sum+=1	$\frac{n}{3} \times \log_3(n)$
j*=3	$\frac{n}{3} \times \log_3(n)$
print(sum)	1

Time Complexity

Running Time Complexity

$= 1 + 1 + 1 + \frac{n}{3} + \frac{n}{3} + \frac{n}{3} + \frac{n}{3} \times \log_3(n) + \frac{n}{3} \times \log_3(n) + \frac{n}{3} \times \log_3(n) + 1$

$= 4 + \frac{3n}{3} + 3 * \frac{n}{3} log_3(n)$

$= 4 + n + nlog_3(n)$

Now to find the Big O complexity,

1. Drop the leading constants $\Rightarrow n + nlog_3(n)$
2. Drop lower order terms $\Rightarrow nlog_3(n)$

Hence, Big O time complexity: $O(nlog_3(n))$

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