# Time Complexity

- Multiple O(N)
  $= O(N) + O(N) \approx O(N)$

- $O(K * N)$
  $K << N \quad = \quad O(N)$

- $O(3), O(4), O(5) \approx O(1)$ {

* Number of iterations in 1sec - $10^7 - 10^8$

$10^7 \rightarrow$ 1sec
$10^8 \rightarrow$ 10sec
$10^9 \rightarrow$ 100sec
⋮

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1) `int n; cin>>n; int ct=0;`
`while (n>0)`
`{ n = n/2; ct++; }`

$2^a = N$.
$\log_2(2)^a = \log_2 N$
$a = \log_2(N)$

Complexity = $O(\log(N))$

2)
```
for(int i=0; i<=n; i++){
  for(int j=0; j<i; j++){
    ct++;
  }
}
```

| i | j |
|---|---|
| 0 | 0 |
| 1 | 1 |
| ⋮ | ⋮ |
| n | n |

$\frac{n(n+1)}{2}$

TO : $O\left(\frac{n^2}{2} + \frac{n}{2}\right)$

$n^2 >> n$

$= O\left(\frac{n^2}{2}\right) + O\left(\frac{n}{2}\right)$

$= O(n^2)$ Ans

③ Sum of N over all test cases is $< 10^9 + 7$

$1 \le T \le 10^5$
$1 \le N \le 10^5$

while (t--)
{
for (int i=0; i<n; i++)
{ ct++; }
}

$O(n_0) + \cdots + O(n_n) \le 10^7$

↳ $ct < 10^7$

↳ runs accord. to value of n.

Print Answer Modulo

$(a+b) \% M = ((a \% M) + (b \% M)) \% M$.

$(a * b) \% M = ((a \% M) * (b \% M)) \% M$

$(a-b) \% M = ((a \% M) - (b \% M) + M) \% M$.

$(a/b) \% M = ((a \% M) * (b^{-1}) \% M) \% M$.

↳ Multiplicative inverse

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Eg.
```
int main()
{
int M = 47;
for (int i=0; i<=n; i++)
{ fact = (fact * i) % M; }
cout << fact;
}
```

1. $10^9 + 7$ → very close to integer maximum.