9PM 9:05

Welcome !!!

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Intermediate module ⟹
Covers basics like Time Complexity, Arrays, Sorting, Hashing etc

Today ⟹ Basic Math & Problem Solving.

Expectation:

1) Interactive Class (Doubts, Thumbs up/down)
2) Assignments are a MUST
   Non-negotiable
3) Contests are a good way to gauge yourself
   Timed test 90 mins 3 ques
   ≥ 2 ques
4) - TA (Teaching Assistant)
   - Talk to your batchmates.

After every 6 classes → contest

Q Factorise given number

What is factor ? 20 divisible by 4

If x is a factor of n

$\Rightarrow$ n is divisible by x

$n \% x == 0$

- Count the no of factors

- 24 1, 2, 3, 4, 6, 8, 12, 24 → 8
- 10 1, 2, 5, 10 → 4

All factor between 1 and n

```
int factors (int n) {
    int count = 0
    for (int i=1 ; i<=n ; i++) {
        if ( n % i == 0 )
            count ++
    }
    return count
}
```

No of iterations = n

Assumption:

1 sec $\Rightarrow 10^8$ ops. // remember

$n = 10^9$

iter $= 10^9 = 10 \times 10^8 \Rightarrow 10$ sec

$n = 10^{18}$

iter $= 10^{18} = 10^{10} \times 10^8 \Rightarrow 10^{10}$ sec

$\Rightarrow 317$ years

optimized iter $= \sqrt{10^{18}} = 10^9 \Rightarrow 10$ sec

Way forward $\longrightarrow$ optimize

Observation for factor counting :

$i \times j = N$ $\qquad$ $j = N/i$

$N = 24$

i	j
1	24
2	12
3	8
4	6
6	4
8	3
12	2
24	1

$i \leq j$

$i \leq N/i$

$i \times i \leq N$

$i^2 \leq N$

$i \leq \sqrt{N}$

$N = 100$

i	j
1	100
2	50
4	25
5	20
10	10
20	5
25	4
50	2
100	1

Code

```
int count_factors (int N){
    int count = 0
    for(i=1; i*i <= N ; i++){
        if (n%i == 0){
            if ( i == n/i)
                count += 1
            else
                count += 2
        }
    }
    return count
}
```

Iter = $\sqrt{N}$

01) Given a no, find if it is prime

a no that has exatly 2 factors

Eg - 5 ✓ 6 ✗

Eg - 13 ✓

10 ✗ 11 ✓ 23 ✓ 2 ✓ 25 ✗ 27 ✗ 31 ✓

ans = 4

if (count == 2) prime

else not prime

Seive of Eratosthenes

Carl Friedrich Gauss

Q2 Find the sum of no.s from 1 to 100

$S = 1 + 2 + 3 + 4 + \dots + 99 + 100$

$S = 100 + 99 + 98 + 97 + \dots + 2 + 1$

$2S = \underbrace{101 + 101 + 101 + 101 + \dots + 101}_{100 \text{ times}}$

$2S = 101 \times 100$

$S = \frac{101 \times 100}{2} = 5050$

N numbers

$S = 1 + 2 + 3 + \dots + N$

$S = N + N-1 + N-2 + \dots + 1$

$2S = (N+1) * N$

$S = \frac{N(N+1)}{2}$ Sum of first N natural numbers.

Ranges

$[a,b]$ $\quad a, a+1, a+2, a+3 \ldots\ldots b$

(a,b) $\quad a+1, a+2, a+3 \ldots\ldots b-1$

Q $\quad [3,10]$ $\quad 3\ 4\ 5\ 6\ 7\ 8\ 9\ 10$

ans = 8

Q $\quad [a,b]$

$1, 2, 3, 4 \ldots\ldots a-1$

$a, a+1, a+2 \ldots\ldots b$

$b-(a-1)$

$b-a+1$

Iteration

No of times loop runs

Q
```
for (i = 1 ; i <= N ; i++) {
    ;
    if ( i == N )
        break
}
```

$1\ 2\ 3\ 4 \ldots\ldots n-2\ n-1\ n$

ans = N

Q `for (i=0 ; i<=100; i++) {`

```
:
y
```

0 1 2 3 ---- 100

$[0,100] \Rightarrow 100-0+1 = 101$

Q `for (i=1 ; i<=N; i++) {`

```
:
y
```

N

```
for (i=1 ; i<=M ; i++) {
:
y
```

M

ans = N+M

- Geometric Progression

a → first term r → ratio

5 10 20 40 80 160 ----

$a \quad ar \quad ar^2 \quad ar^3 \quad ar^4 \quad ar^5 \quad ----$

Sum of first N terms of GP =

$a \quad ar \quad ar^2 \quad ------ \quad ar^{n-1}$

$$Sum = \frac{a\,(r^n - 1)}{r - 1} \qquad r != 1$$

a a a a a

Sum = a*n

- How to compare 2 algos

A
Praveen
15 sec
(Windows XP)
↓ Mac
7 sec
C++

B
Santhosh
10 sec
Mac
10 sec Python
↓ C++
5 sec

7 sec

Conclusion ⇒ Need to be independent of external factors
→ Number of iterations

Next Class

- Time Complexity
- Big O notation
- Space Complexity
- TLE (Time Limit Exceeded)

{done}

- Interview enb

i=1 i≤N ;i++

1 2 3 ... N

1 ... a-1 a ..... b

b - (a-1)