Hello Everyone :)

→ Welcome to intermediate module of DSA

→ Nipun Mittal Googler

→ BTech - 2019, MTech - 2021 (IIT Bombay)

→ ~1 year of part-time teaching experience

FAQ's

→ Notes will be uploaded after the class

→ Assignments will be unlocked after the class ends.

→ No deadline for assignments.

→ Classes will be recorded.

→ During doubt session, attendence not counted.

→ Language Independent {only Pseudo code}

Agenda

→ factors count

→ Prime number

→ Sum of N natural no.

→ log basics

→ Sqrt() of a number

Number of factors

if N = 24 , is 4 a factor of 24 ? → YES

24 % 4 = 0

find the factor count of 12 ?

$12 \rightarrow \{1, 2, 3, 4, 6, 12\} \Rightarrow 6$

```
countFactors(N):
    c=0
    for( i=1; i<=N; ++i ){
        if(N%i==0)
            // i is a factor of N
            c+=1
    }
    return
```

Assumption: 10^8 iteration/sec

10^8 iterations → 1 sec

1 iteration → $1/10^8$

N iteration → $N/10^8$ sec

say $N = 10^9$ → $N/10^8 \rightarrow 10^9/10^8$ → 10 sec

say $N = 10^{18}$ → $10^{18}/10^8 = 10^{10}$ sec

~ 316 yrs

you → build → gc → 3/4/5 → 6/7

if $i \times j = N \Rightarrow$ i & j are factors of N

$j = N/i \Rightarrow \{i, N/i\}$ are factors of N

> if i is a factor of N
> N/i is also a factor of N

if $a <= x$

max value of $a = x$

i	N = 24 N/i		c=0
1	≤ 24	24/1	c=c+2
2	≤ 12	24/2	c=c+2

N = 100

1	≤ 100	c=c+2
2	≤ 50	c=c+2

3	≤	8	24/3	C=C+2
4	≤	6	24/4	C=C+2
6		4	24/6	
8		3	24/8	
12		2	24/12	
24		1	24/24	

~~5*5 ≤ 24~~

count = 8

4	≤	25	C=C+2
5	≤	20	C=C+2
10	≤	10	~~C=C+1~~ ~~C=C+2~~
20		5	
25		4	
50		2	
100		1	

count = 9

$i \le N/i$

$i_{max} = N/i$

$i * i = N$

$i_{max} = \sqrt{N}$

$i = [1, \sqrt{N}]$

```
countFactors(N):
    C = 0                          // i * i <= N   ← simple
    for (i = 1; i <= √N; i = i + 1)
        if (N % i == 0)
            // i is a factor, N/i is a factor
            if (i == N/i) { C = C + 1 }
            else { C = C + 2 }
    return C
```

$i = [1 \ldots \sqrt{N}]$ → $\sqrt{N}$ iterations

for $N = 10^{18}$ → $\sqrt{10^{18}}$ iterations
$= 10^9$ iterations

10^8 iterations → 1 sec

10^9 " → 10 sec

Prime Numbers

↳ if a no. divisible by 1 & itself only ✗
exactly 2 factors ✓

for N = 1 [NOT PRIME].

Check whether a number is Prime or Not ?

```
IsPrime (N) :
    if ( countfactors(N) == 2)
        return true
    else
        return false
```

Story of 4th class boy

find the value of

$1 + 2 + 3 + 4 + \dots \rightarrow 100$

$S = 1 + 2 + 3 + 4 + \dots + 98 + 99 + 100$

$S = 100 + 99 + 98 + 97 + \dots + 3 + 2 + 1$

$2S = 101 + 101 + 101 + \dots + 101 + 101 + 101$

$2S = 100 \times 101$

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

find the sum of N natural numbers ?

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

$$= \frac{N \times (N+1)}{2}$$

```
SumOfNnaturalNo(N):
    ans = (N*(N+1))/2
    return ans
```

10:20 – 10:30 PM BREAK

---

find a sqrt() of a number ?

Given a perfect-square N, find the sqrt(N).

N = 16
25
64
100

```
Sqrt(N):
    for(i=1; i<=N; ++i)
        if(i*i == N)
            return i
```

$\sqrt{N}$ iterations

$N = 16$ $i = 1, 2, 3, 4$ → 4 iterations

$N = 25$ $i = 1, 2, 3, 4, 5$ → 5 "

$\sqrt{N}$ iterations

If a number is not perfect-square ?

$\sqrt{10} = ?$ $= 3.xxx$

$\text{floor}(\sqrt{10}) = 3$

$\text{floor}(x)$ = largest integer $\leq x$

Given a number N, find $\text{floor}(\sqrt{N})$?

$\sqrt{17} = 4.xxx$ $= 4$

$\sqrt{17}$ $i = 1$

$1 \times 1 \leq 17$ ans = 1

$2 \times 2 \leq 17$ ans = 2

$3 \times 3 \leq 17$ ans = 3

$4 \times 4 \leq 17$ ans = 4

~~$5 \times 5 \leq 17$~~

```
Sqrt(N):
    ans = 0
    for(i=1; i*i <= N; ++i)
        ans = i
    return ans
```

$\sqrt{N}$ iterations

Log Basics

$\log_a b = c$

$a^c = b$

for what power should we raise to a s.t. it becomes equal to b.

$\log_2 64 = 6$, $2^6 = 64$

$\log_3 27 = 3$ $\quad 3^3 = 27$

$\log_2 10 = 3.xxx$ $\quad 2^c = 10$

$\text{floor}(\log_2 10) = 3$

$2^3 = 8$

$2^{3.xxx} = 10$

$2^4 = 16$

$\log_2 2^6 = 6$ $\quad 2^c = 2^6$

$\log_a a^c = c$

$\log_3 9^2 = 4$

$3^c = 9^2$

$= (3^2)^2$

$3^c = 3^4$

Homework:

How many times we need to divide N by 2 till it reaches 1?

$N = 9 \xrightarrow{/2} 4 \xrightarrow{/2} 2 \xrightarrow{/2} 1 \Rightarrow$ 3 times

Expectations

1. Attend session
2. Revise Notes
3. Solve assignments
   - Classwork
   - Homework
4. Doubts
   - Content
     - ask in class
     - stay back for doubt session after class
   - Assignment
     - debug on your own
     - raise TA request
     - once in 2-3 weeks
     - Problem Solving Session
       - ↳ recorded
       - ↳ optional
5. Join on Time
6. If you miss the class
   - ↳ watch recording
   - ↳ At least revise notes