Hello Everyone :)

→ Welcome to intermediate module of DSA

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

→ ~1 year of part-time teaching experience

FAB'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(n) 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 = c + 1
    return c
```

Assumption : 10^8 iterations per sec.

10^8 iterations → 1 sec

1 iteration → $1/10^8$ sec

N iterations → $\frac{N}{10^8}$ sec.

say $N = 10^9$ → $N/10^8$ sec $= \frac{10^9}{10^8} =$ 10 sec

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

~ 316 yrs

yoo → children → go → 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 then
> N/i is also a factor of N .

$N = 24$

i		N/i		
				$c = 0$
1	<	24	24/1	$c = c+2$
2	<	12	24/2	$c = c+2$
3	<	8	24/3	$c = c+2$
4	<	6	24/4	$c = c+2$
				$c = 8$
6	X	4	24/6	
8	:	3	24/8	
	:			
12	:	2	24/12	
	:			
24	:	1	24/24	

iterate till :

$i <= N/i$

$i = N/i \Rightarrow i \times i = N$

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

$i = [1, 2, \cdots, \sqrt{N}] \Rightarrow \sqrt{N}$ iterations

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

$= 10^9$ iterations

10^8 iterations $\rightarrow$ 1 sec

10^9 iterations $\rightarrow$ 10 sec

if $a <= x$

max value of $a = x$

$N = 100$ $c = 0$

1	<=	100	$c = c+2$
2	<=	50	$c = c+2$
4	<=	25	$c = c+2$
5	<=	20	$c = c+2$
10	<=	10	$c = c+1$
			$c = 9$
20		5	
25		4	
50		2	
100		1	

```
countfactors (N) :
    c=0                          ixi<=N  ← simple
    for(i=1; i<=√N; ++i) :   for i=1 to √N
        if (N%i==0)
            //i is a factor of N & N/i is also factor
            if (i == N/i) { c=c+1 }
            else { c=c+2 }
    return c
```

Prime Numbers

↳ 1. if a no. is divisible by 1 & itself ~~only~~ ✓

2. 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

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

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

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

$= 101+101+101+\dots+101+101+101$

$2S = 101 \times 100$

$S = \frac{101 \times 100}{2} = 101 \times 50$

find the sum of first N natural nos. ?

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

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

Sum of N Natural No (N) :

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

10:18 - 10:28 BREAK

Find a sqrt() of a number ?

Given a perfect-square N, find sqrt(N) ?

N = 16, 25, 64, 100

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

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

N = 25 : i = 1, 2, 3, 4, 5 → 5 iterations

: i = 1, 2, 3, ... , $\sqrt{N}$ → $\sqrt{N}$ iterations

If a number is not perfect-square ?

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

floor($\sqrt{10}$) = 3 floor(x) = (largest integer <= x)

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

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

i = 1	1*1 <= 17	ans = 1
2	2*2 <= 17	ans = 2
3	3*3 <= 17	ans = 3

4	4 x 4 <= 17	ans = 4
5	5 x 5 <= 17	

```
sqrt(N) :
    ans = 1
    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.

$\log_2 64 = 6$ $\quad 2^c = 64 \quad [c=6]$

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

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

$2^3 = 8$ $\quad 2^4 = 16$

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

$\log_2 2^6 = 6$

$\log_a a^c = c$

$\log_3 9^2 = 4$ $\quad 3^c = 9^2 = (3^2)^2 = 3^4$

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. Revice Notes
3. Solve Assignments
   - Classwork
   - Homework
4. Doubts
   - Content
     - ask in class
     - stay back for doubt session after class
   - Assignments
     - debug on your own
     - raise a TA request
     - once in 2-3 weeks
     - Problem Solving Sessions
       - ↳ recorded
       - ↳ optional
5. Join on Time
6. If you miss few class
   - ↳ watch the recording

↳ at least revise notes