

Welcome Everyone! :)

Paridhi Gupta

2+ years  
/ instructor → developer

MCA from IGDTUW

D2D → Problem solving is imp.

LLD 101 →

HLI 101 →

important skill for a problem solver?

logic  
analysis  
observations

Q1. You are given  $N$ , find count of factors of  $N$ .

$n$  is called a factor of  $N$  if  $n$  completely divides  $N$

$$\% \Rightarrow N \% n = 0$$

$$N=10 \\ = 1, 2, 5, 10 \\ \text{4 ans}$$

$$N=36 \\ = 1, 2, 3, 4, 6, 9, 12, 18, 36 \\ 9 \text{ ans.}$$

To : Everyone ✓  
 Type message

Brute Approach / Simple Approach

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



General Assumption

$$N \approx 10^9$$

$10^8$  iterations  $\rightarrow$  1 second  
 $10^9$  "  $\rightarrow$   $\left(\frac{1}{10^8}\right) \times 10^9$   
 $\Rightarrow$   $= 10$  seconds.

$$\begin{aligned} 5 \text{ apples} &\rightarrow 50 \text{ Rs} \\ 10 \text{ apples} &\rightarrow \left(\frac{50}{5}\right) \times 10 \\ &= 100 \text{ Rs} \end{aligned}$$

$$N \approx 10^{18}$$

$10^8$  iterations  $\rightarrow$  1 sec  
 $10^{18}$  iterations  $\rightarrow$   $\frac{1}{10^8} \times 10^{18}$   
 $= 10^{10}$  seconds  
 $\approx 317$  years.

You → Kids → Grand Kids → Uter → 5th Generation

### Optimisation

Given  $i, j$  and  $N$  [vet]

$$\text{given } i * j = N ; \quad j = N/i$$

$\{i, j\}$  are the factors of  $N$

$\{i, N/i\}$  are the factors of  $N$

\* Factors occur in pair.

\* If we already know one factor, we will be able to get the second factor.

		$i \rightarrow [1, \sqrt{N}]$	$N=100$
		$i$	$N/i$
$N=24$			
	$N/i$		
1	24		
2	12		
3	8		
4	6		
6	4 X		
8	3 X		
12	2 X		
24	1 X		
		$i^2 \leq N$	
		$i \leq \sqrt{N}$	
		$i \leq N/i$	
		first pair $\leq$ second pair	
		$i \leq N/i$	
		$i^2 \leq N$	
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### Optimised Code

```

int factors ( int N ) {
    int count = 0
    for ( int i=1 ; i <=  $\sqrt{N}$  ; i++ ) {
        if ( N % i == 0 ) {
            if ( i == N / i ) {
                count = count + 1
            } else {
                count = count + 2
            }
        }
    }
    return count
}

```

$i \rightarrow [1 \dots \sqrt{N}]$   
Iterations  $\rightarrow \sqrt{N}$

$N = 36$	$i \rightarrow [1 \dots \sqrt{36}]$	count
1, 36		2
2, 18		4
3, 12		6
4, 9		8
6, 6		9

$$N = 10^{18}$$

$$\sqrt{N} = \sqrt{10^{18}} = \underline{\underline{10^9}} = 10 \text{ sec}$$

Sum of first  $N$  natural numbers :

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

Rajiv

$$\begin{aligned}
 S &= 1 + 2 + 3 + 4 + \dots + 100 \\
 + S &= 100 + 99 + 98 + 97 + \dots + 1 \\
 \hline
 2S &= 101 + 101 + 101 + 101 + \dots + 101 + 101 + 101 + 101
 \end{aligned}$$

$$2S = 101 \times 100$$

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

sum of  $N$  natural nos.

$$S = 1 + 2 + 3 + 4 + \dots + (N-2) + (N-1) + N$$
$$S = (N) + (N-1) + (N-2) + (N-3) + \dots + 3 + 2 + 1$$
$$2S = (N+1) + (N+1) + (N+1) + (N+1) + \dots + (N+1) + (N+1) + (N+1)$$

$$2S = N \times (N+1)$$

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

sum of first  
10 natural nos.

Gauss.

$$\frac{5 \times 10 \times 11}{2} = 55$$

Q. sum of first  $\underline{\underline{60}}$  whole nos.

whole nos. starts from  $\rightarrow 0$

$$0, 1, 2, 3, 4, \dots, 59$$

sum of 59 natural nos.

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

$$\frac{59 \times 60}{2} = 1770$$

## Integer Division

$$\frac{7}{2} = 3 \cdot 5$$

↓  
3

$$\frac{9}{3} = 3$$

$$\frac{10}{4} = 2 \cdot 5$$

= 2.

log basic

$$\log_2 2^5 = 5$$

$$\log_7 7^{10} = 10$$

$$\log_a a^x = x$$

Ques: Given N, tell no. of times we need to divide N by 2 till it reaches 1.

$$\frac{7}{2} \rightarrow \frac{3}{2} \rightarrow 1 : 2 \quad 2^2$$

$$N=0 \text{ or } N=1 \\ 0 \text{ steps.}$$

$$\frac{9}{2} \rightarrow \frac{4}{2} \rightarrow \frac{2}{2} \rightarrow 1 : 3 \quad 2^3$$

max power of no. x  
less = N

$$\frac{2}{2} \rightarrow 1 : 1 \quad 2^1$$

$$\frac{4}{2} \rightarrow \frac{2}{2} \rightarrow 1 : 2 \quad 2^2$$

$$\frac{8}{2} \rightarrow \frac{4}{2} \rightarrow \frac{2}{2} \rightarrow 1 : 3 \quad 2^3$$

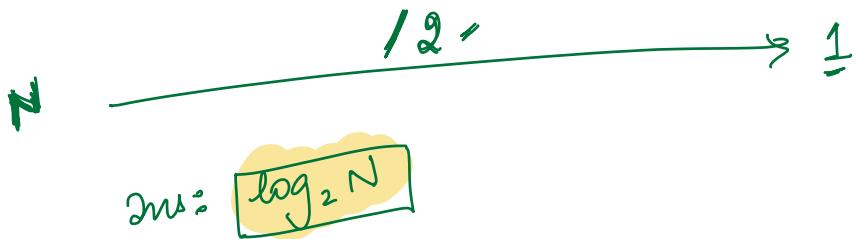
$$\frac{16}{2} \rightarrow \frac{8}{2} \rightarrow \frac{4}{2} \rightarrow \frac{2}{2} \rightarrow 1 : 4 \quad 2^4$$

$$\boxed{\log_2 N}$$

$$N=15 \quad x=3$$

$$\log_3 15 = 2 \cdot x \\ 3^2 = 9$$

$$\frac{27}{2} \rightarrow \frac{13}{2} \rightarrow \frac{6}{2} \rightarrow \frac{3}{2} \rightarrow 1 : (4) \quad 2^4$$



Break  
7 minutes

10:21 PM.

Quiz which of the following is perfect sq?

35, 24, 49, 50

Amazon

MCQ

Given a perfect square ( $N \geq 1$ ), find the  $\sqrt{N}$ .

$$N = 25 \rightarrow 5$$

$$N = 100 \rightarrow 10$$

$$N = 40 \leftarrow X \text{ invalid i/p.}$$

```
int sqrt (↑N) {
    for (i = 1; i <= N; i++) {
        if (i * i == N) {
            return i
        }
    }
}
```

Iterations

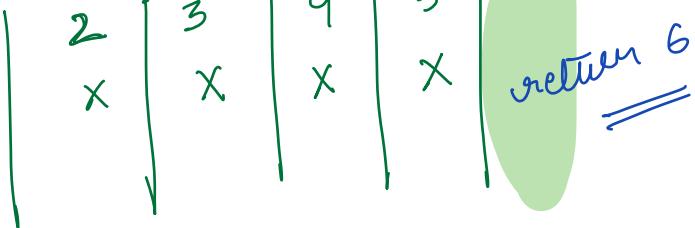
$\sqrt{N}$

( 3 )

$$N = 36$$

$$i = 1$$

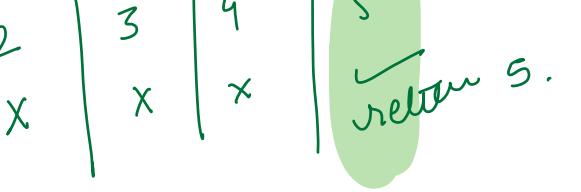
$$1 \times 1 = 36$$



$$N = 25$$

$$i = 1$$

$$\times$$



$\textcircled{N} \rightarrow$  perfect square.

$$[1 \quad N]$$

100

$$[1 \quad 100]$$

$$[1 \quad 49]$$

$$[1 \quad 24]$$

$$[1 \quad 11]$$

$$[7 \quad 11]$$

mid

50

$$50 \times 50 > 100$$

$$1, 2, \dots, 48, 49, \textcolor{brown}{50, 51, 52, 53, \dots, 100}$$

25

$$25 \times 25 > 100$$

$$1, \dots, 23, 24, \textcolor{brown}{25, 26, 27, 28, \dots, 49}$$

12

$$12 \times 12 > 100$$

$$1, \dots, 10, 11, \textcolor{brown}{12, 13, \dots, 24}$$

6

$$6 \times 6 < 100$$

9

$$9 \times 9 < 100$$

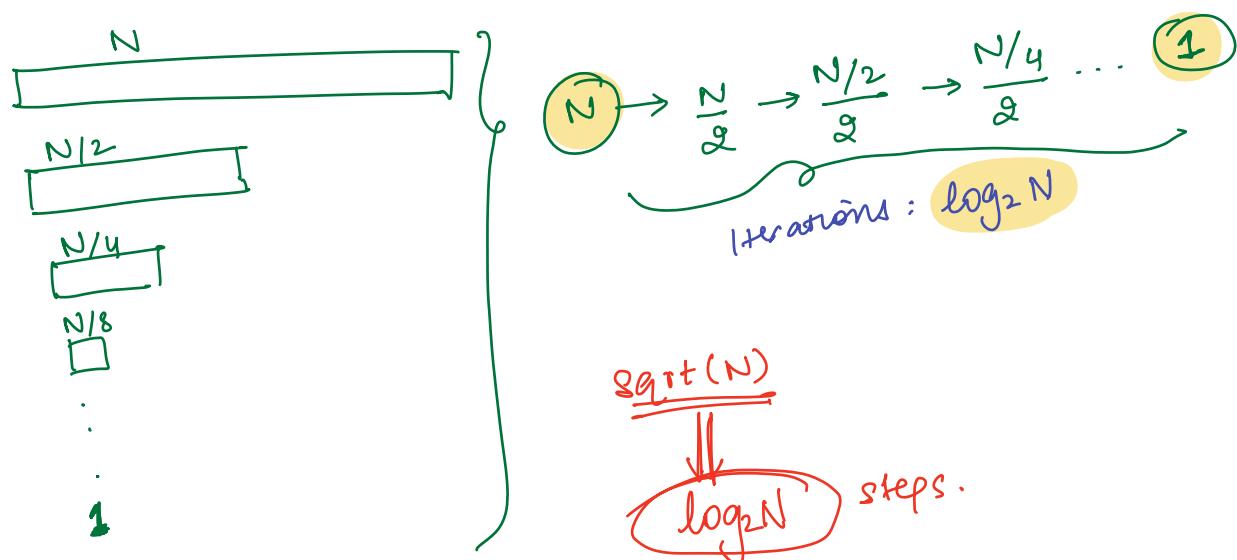
$$7, 8, 9, \textcolor{brown}{10, 11}$$

$$[10 \quad 11]$$

10

$$\textcircled{10} \times 10 = 100$$

Every time we are reducing the space into half



$$\begin{aligned}
 N &= 2^{30} \\
 N &= 2^{60} \\
 \sqrt{N} &= 2^{15} \\
 \log_2 2^{30} &= 30 \\
 \log_2 2^{60} &= 60
 \end{aligned}$$

↑  
Binary Search

## Intermediate Content

Time complexity & Space complexity → 2 classes

- Arrays = 6 sessions
  - ↳ Intro
  - ↳ Prefix Sum
  - ↳ Carry Forward
  - ↳ Subarray / Sliding window
  - ↳ 2D matrices
  - ↳ Interview Problems

Bit Manipulation : 2 sessions

Maths & Arrays : 2 sessions

Sorting / String / Hashmap : 4 sessions

Recursion : 3

Subset / Subsequences

Linked List Basic

8 months ⇒ 24 sessions<sup>0</sup>

4.5 months

9:00 - 9:05

11:30 content .

Doubt .

Conceptual Doubts

Lecture Notes .

Per week → 20 problems

1 month → 80 "

2 " → 160 "

Doubts

① 2-3 hrs.

② TA request .

③ community

④ Ask Me .

⑤ Problem Solving  
→ Assignment / HW