DSA → Why DS/Algo

LLD 101 → Why LLD

HLD 101 → Why HLD

Q Given a no. Check whether it is prime or not.

Prime Number : Any positive no. that has exactly 2 factors.

- 1
- The no. itself

is 1 a prime No ? ⇒ No

- Neither Prime
- Nor Composite

```
boolean checkPrime (N) {
    int c = 0;
    for (i = 1; i <= N; i++) {
        if (N % i == 0) {
            c++;
        }
    }
    if (c == 2)
        ret true;
    else ret false;
}
```

N iteration (Worst Case)

i = [1, N]

Assumption 10^8 iteration in 1 sec

$N \approx 10^9 \longrightarrow 10^9$ iteration

10^9 itr $\longrightarrow$ 10 sec

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

10^8 iteration $\longrightarrow$ 1 sec

10^{18} itr $\longrightarrow \frac{10^{18}}{10^8} = 10^{10}$ sec

$\approx$ 317 years.

You → Kids → Grand Kids → 4th Gen → 5th Gen → 6th Gen

Shoib Malik (Retained)

// Optimization

if a, b, N are three integers (+ve)

& if $a \times b = N \Rightarrow b = N/a$

$\{a, b\}$ are factors of N

$\Rightarrow \{a, N/a\}$ are factors of N

If a is a factor of N

$\Rightarrow N/a$ will also be a factor of N.

N = 24

i	N/i
1	24
2	12
3	8
→ 4	6
	√N
x 6	4
x 8	3
x 12	2
x 24	1

$i <= N/i$

N = 100

i	N/i
1	100
2	50
4	25
5	20
→ 10	10
√N	
20	5
25	4
50	2
100	1

<= , >=

if a <= 57

$a_{max} \rightarrow 57$

$a <= x$

$a_{max} \rightarrow x$

$i <= \frac{N}{i}$

$i_{max} \rightarrow \frac{N}{i}$

$i = \frac{N}{i}$

$i_{min} = 1$

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

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

$i * i = N$

$\Rightarrow \quad i = \sqrt{N}$

```
boolean checkPrime(N) {
    int c = 0; // No. of fact
    for (i = 1; i <= √N; i++) {
        // if i is a factor ⇒ N/i is also a factor.
        if (N % i == 0) {
            if (i*i == N)
                c++;
            else
                c = c+2;
        }
    }
    if (c == 2)
        ret true;
    else
        ret false;
}
```

i*i <= N

N = 24 → 4, 6 → c = c+2;

N = 100

i	c
1 →	2
2 →	4
4 →	6
5 →	8
10 →	10

1, 2, 4, 5, 10, 20, 25, 50, 100

No of iterations ⇒

i min → 1

i max → √N

[1, √N]

⇒ √N

N ≈ 10^{18} ⇒ $\sqrt{10^{18}}$ ⇒ 10^9

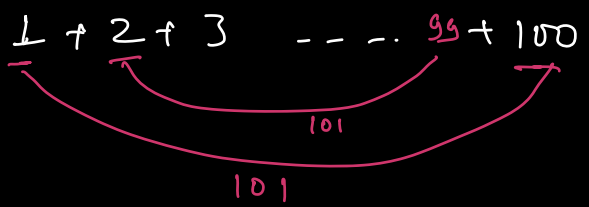
10^8 iter → 1s

10^9 iter → 10 sec ✓

Sum of first N natural No. $\Rightarrow \frac{N \times (N+1)}{2}$.

Carl Friedrich Gauss

(4th class)



$$S = 1 + 2 + 3 + 4 \text{ ---- } + 97 + 98 + 99 + 100$$
$$S = 100 + 99 + 98 + 97 \text{ ---- } + 4 + 3 + 2 + 1$$

$$2S = 101 + 101 + 101 + 101 \text{ ---- } + 101 + 101 + 101 + 101$$

$$\Rightarrow 2S = 100 \times 101$$

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

$$S = 1 + 2 + 3 \text{ ------ } N-2 + N-1 + N$$
$$S = N + N-1 + N-2 \text{ ------ } 3 + 2 + 1$$

$$2S = (N+1) + (N+1) + (N+1) \text{ --- } (N+1) + (N+1) + (N+1)$$

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

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

Q Given N. How many times we need to divide it by 2 till it becomes 1.

Integer div

$N = 7 \xrightarrow{7 \div 2} 3 \xrightarrow{3 \div 2} 1$

Ans = 2.

Ans	N
$N = 1 \longrightarrow$ 0	2^0
$N = 2 \longrightarrow$ 1	2^1
$N = 4 \to 4/2 \to 2/2 \longrightarrow$ 2	2^2
$N = 8 \to 8/2 \to 4/2 \to 2/2 \to$ 3	2^3
$N = 32 \longrightarrow$ 5	2^5

$N = 15 \to 15/2 \to 7/2 \to 3/2 \to 1$ — 3 — $2^3 = 8$

$N = 27 \to 27/2 \to 13/2 \to 6/2 \to 3/2 \to 1$ — 4 — $2^4 = 16$

$\uparrow\uparrow$

$\log_2 N$

$\log_2 4 \Rightarrow 2$

$\log_2 32 \Rightarrow 5$

$\log_2 1024 \Rightarrow 10$

$\log_2 27 = 4.xyz$

$\log_2 15 \approx 3$

* The no. of times we can divide N by 2 till it becomes 1 $\Rightarrow \log_2 N$

$\log_2 N$ → Integer Part / Floor

$11 \longrightarrow \frac{11}{2} \longrightarrow \frac{5}{2} \longrightarrow \frac{2}{2} \rightarrow 1 \Rightarrow 3$

$2^3 = 8$

$\log_2 11 = 3.xxy$

Break till 10:33 pm

Amazon Q Given a perfect sq. Find the sq root of it.

Perfect sq

N is a perfect sq if $\sqrt{N}$ is integer

i.e there exist an integer x

$x \times x = N$

N = 25 → 5

N = 100 → 10

$\sqrt{N} \Rightarrow [1, N]$

↳ > N ✗

< 1 ✗

$i \times i <= N$ ✓

```
int Sqrt(N) {
    for (i=1; i<=N; i++) {
        if (i*i == N)
            ret i;
    }
}
```

$\sqrt{N}$

$N = 36$

i	$i \times i$
1	1
2	4
3	9
4	16
5	25
⇒ 6	36

$N = 100$

i	$i \times i$
1	
2	
3	
⋮	
10	— 100

$N = 2^{32}$ ⟶ 2^{16} iterations

10^8 iterations ⟶ 1 sec

2^{16} iterations ⟶ $\frac{2^{16}}{10^8}$

$2^{10} = 1024 \approx 10^3$

$2^{10} \approx 10^3$

$N = 2^{64}$ ⟶ $\frac{2^{10} \times 2^6}{10^8} = \frac{10^3 \times 2^6}{10^8}$

⟶ $\frac{10^3 \times 10^3 \times 10^3 \times 2^2}{10^8} = 40_3$

Binary Search

Ans → [1, N] // the sq is always present in this range.

N = 100

[1, 100]

≈ 100

50 x 50 > 100

1, 2, 3 --- 49, 50, 51, 52, ---- 100

[1, 49]

≈ 50

25 x 25 > 100

1, 2, 3 ---- 24, 25, 26, ---- 49

[1, 24]

≈ 25

12 x 12 > 100

1, 2, 3 --- 11, 12, 13, --- 24

[1, 11]

≈ 12

6 x 6 < 100

1, 2, --- 6, 7, --- 11

[7, 11]

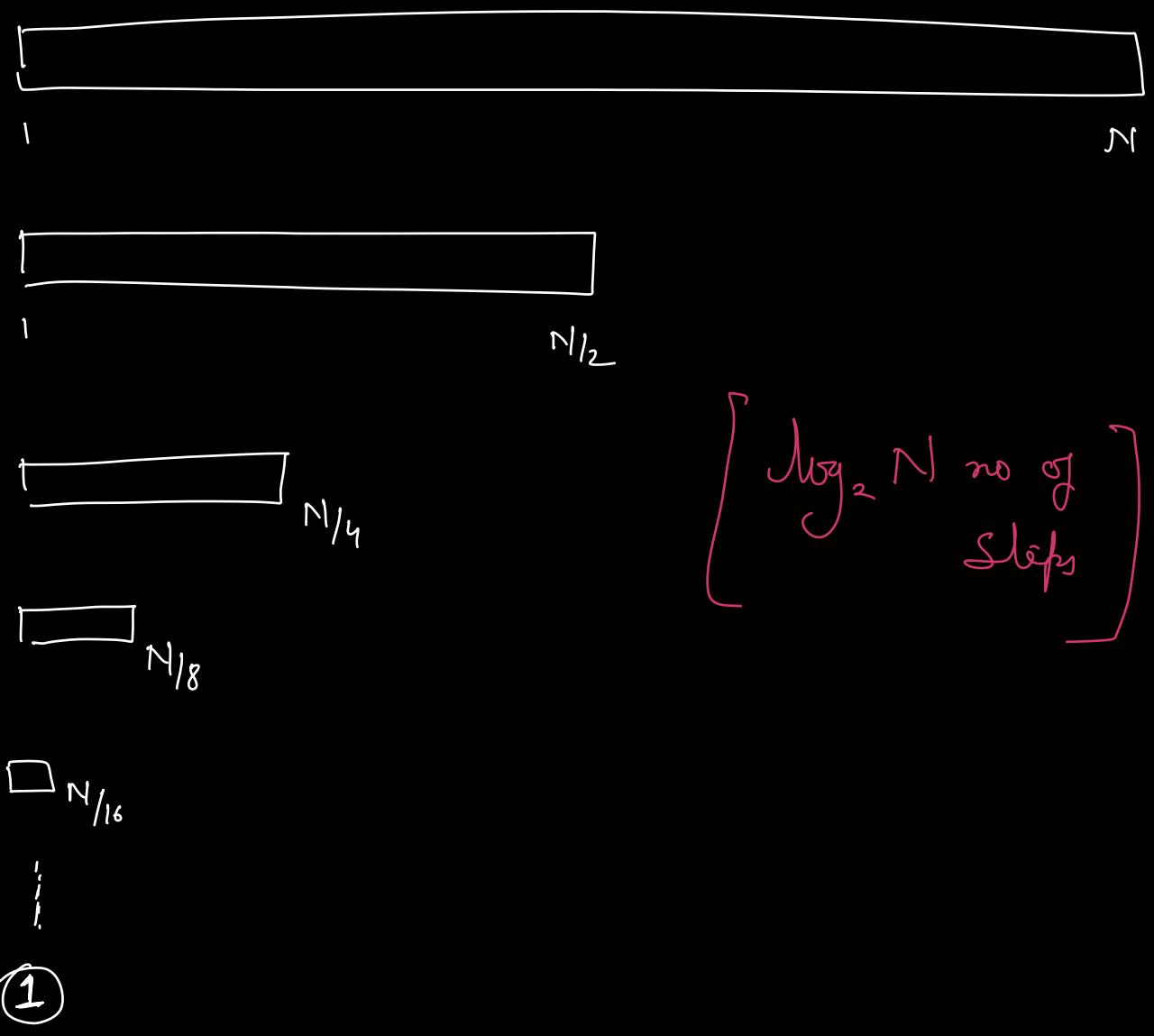
≈ 6

9 x 9 < 100

7, 8, 9, 10, 11

[10, 11]

$10 \times 10 = 100 \Rightarrow 10$

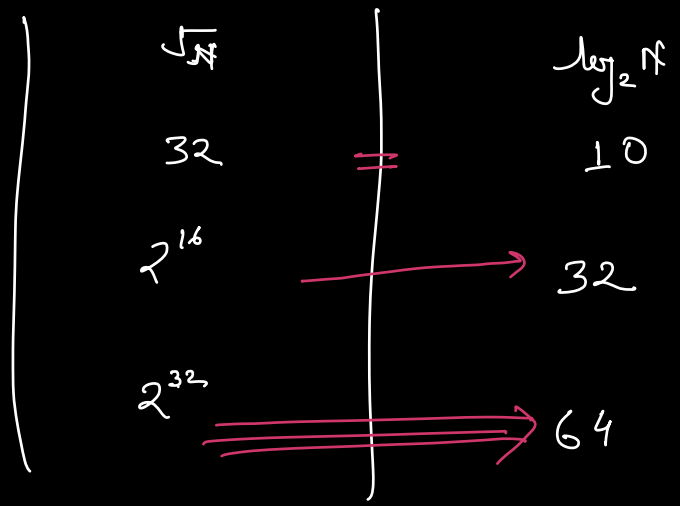


$\log_2 N$ no of steps

$N = 1024$

$N = 2^{32}$

$N = 2^{64}$



$\sqrt{2^{64}} = 2^{32}$

2 classes on BinarySearch

Binary ⟶

Online Judge (OJ)

- Accepted ✓ optimal
- Wrong Ans
- TLE
- MLE

→ optimal

Content of Intermediate Module

Per week ≈ 20 Problems
8 Weeks = 160 Problems

(Intuition of Problem Solving)

1) Time Complexity & Space Complexity (2)
2) Array (Problem Patterns) —— (6)
   - → Into of Arrays
   - → Prefix Sum
   - → Carry forward
   - → Subarray / Sliding Window / Contribution technique
   - → 2D Matrix
   - → Interview Problems
3) Bit Manipulation —— (2)
4) Math & Array —— (2)
5) Sorting / String / HashMaps —— (4)
6) Recursion —— (2)
7) Subsets / Subseq

8) Linked list (Basic)

9) Stack (Basic)

10) Binary Trees — (2)

Doubt

TA

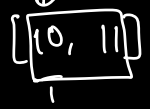
↳ HR (Dosth)

↳ CHR (UC)

Advanced Syllabus

Seive

$[a, b] \Rightarrow mid = \frac{a+b}{2}$



$\Rightarrow mid = \frac{21}{2} = 10$

$\frac{4+1}{2} = 2$

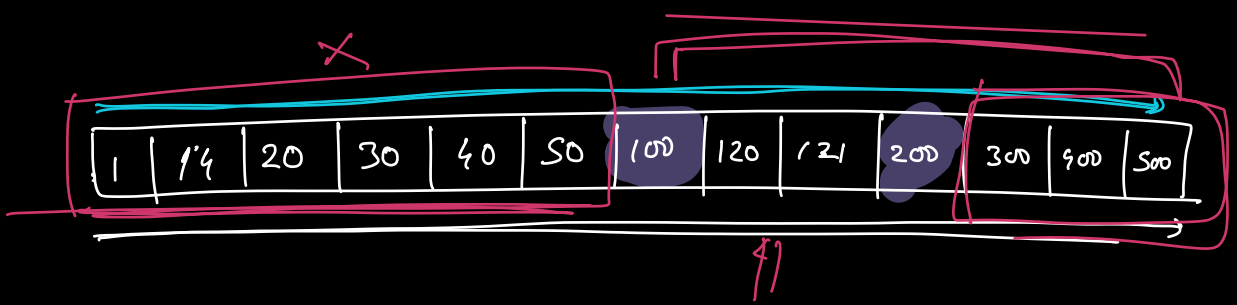
$N = 625$

$i = 1 \quad ; \quad i <= N/i \quad ; \quad i + 1$

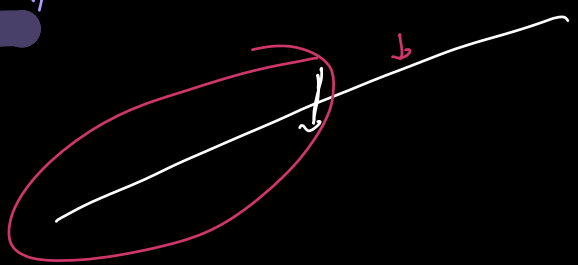
$$i <= \frac{N}{i}$$

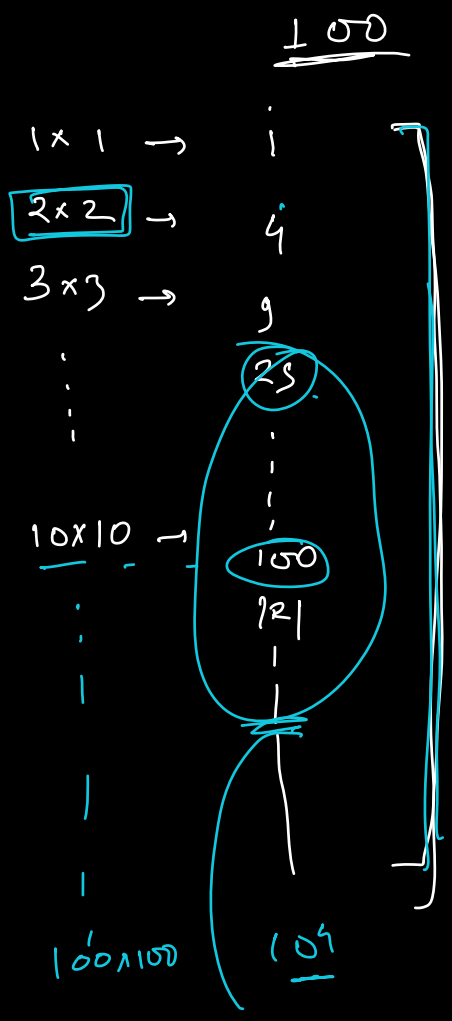
$$i * i <= N$$

$$i <= \sqrt{N}$$



$N = 121$





$a \times a > N$

$\forall\ i > a$

$i \times i > N$

→ Assignment / I/O

→ Interview Bit

→ Leetcode