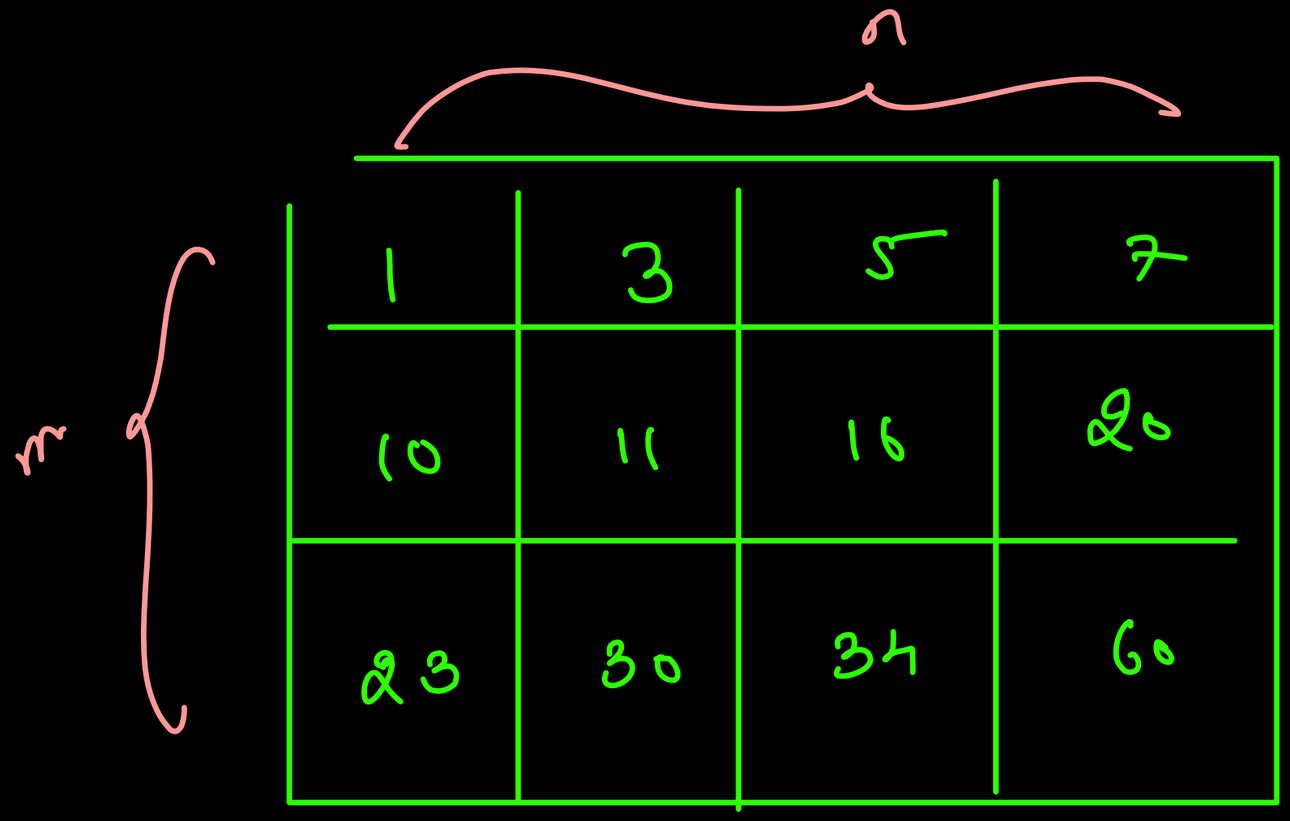

target = 3

1 3 5 7 10 11 16 20 23 ....

Brute force → to traverse & read the whole matrix

↳ $O(m\,n)$

Optimization → to apply Binary Search on every sorted row

↳ $O(m \log n)$

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Optimization 2: You can take extra space & store all the elements of the matrix in a (m×n) length 1d array. & apply B.S: $O(m \times n + \log(mn))$

↳ $O(mn)$ space = $O(mn)$

Optimization 3: what if we can apply BS directly on the 2d array.

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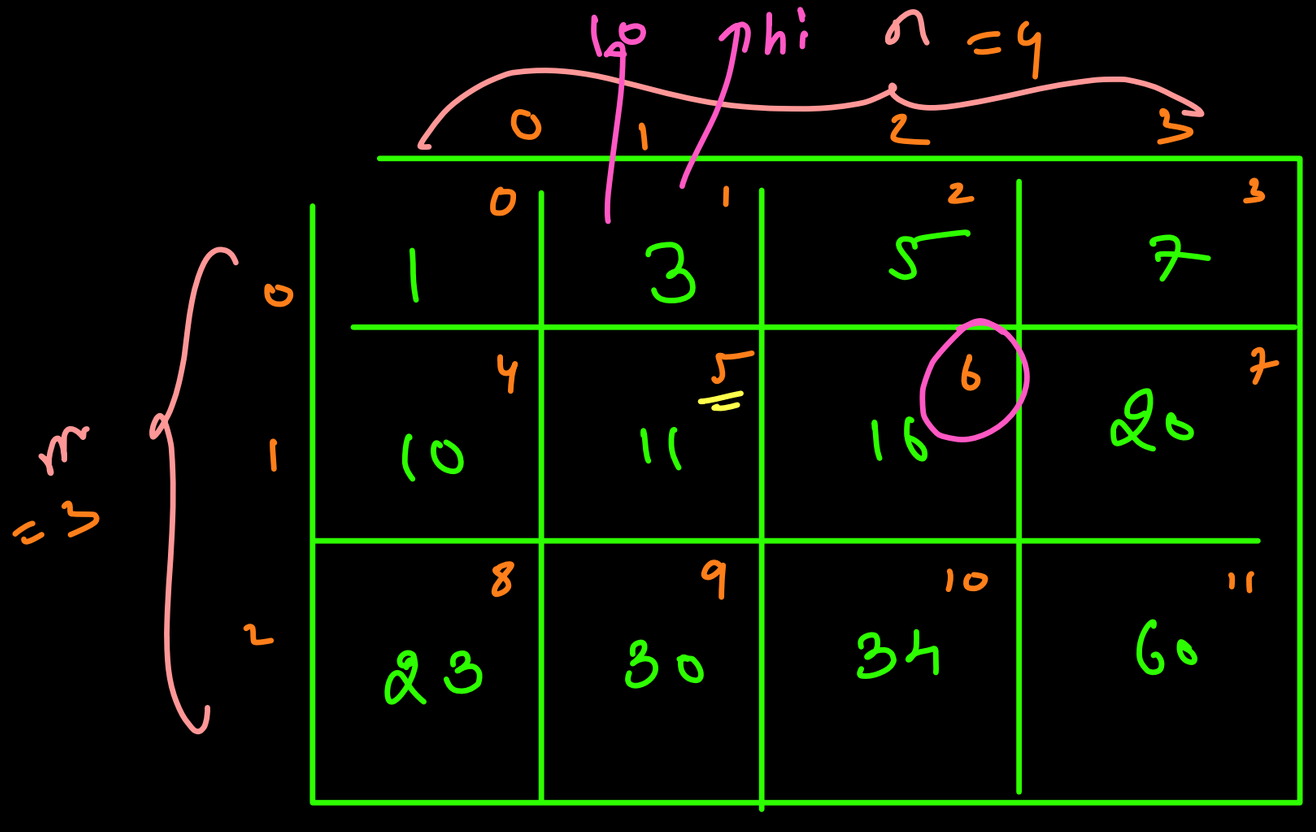

Search Space → O(log mn)

[0, mxn - 1]

lo = 0 hi = 11 mid = 5

lo = 0 hi = 4 mid = 2

lo = 0 hi = 1 mid = 0

lo = 1 hi = 1 mid = 1

i

row = (idx / n)

col ⇒ (idx % n)

Ex → idx = 6

row ⇒ 6/4 → 1

col → 6%4 → 2

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leetcode 374

$n \rightarrow$ guess value

B.S on ans

the final ans is going to be btw $[1-n]$

logical range of ans

$[\ 1 \quad \text{———} \quad n\ ]$

Search for the no. which has been picked

Search space $\rightarrow$ $1-n$

$-1 \leftarrow x$

$0 \leftarrow$ guess(x)

1

Brute force

to go to each and every value in the ray $[1-n]$ &

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check if we guessed the right no.

TLE

```
for (i=1; i<=n; i++) {
    if (guess(i) == 0) {
        return i;
    }
}
```

linear search

1 sec → $\approx 10^8$

How to optimize ??

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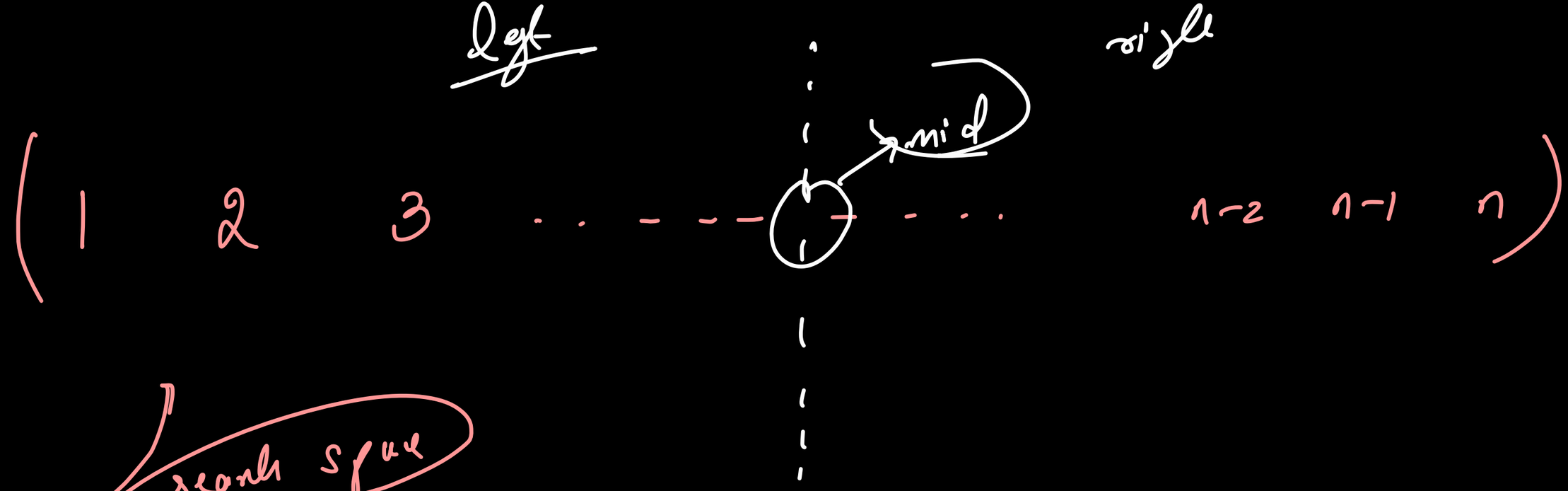

search space

```
lo = 1      hi = n
while (lo <= hi)
    mid = lo + (hi-lo)/2
    if (guess(mid) == 0)   return mid;
    else if (guess(mid) == -1)  hi = mid-1
```

O(log n) → time

O(1) → space

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else lo = mid + 1

>

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leetcode - 441

$n \le 10^9$

no. of coins

i^{th} row of staircase → i coins

how many complete rows we can make.

B.S on ans

C

C C

C C C

C C C C

⋮

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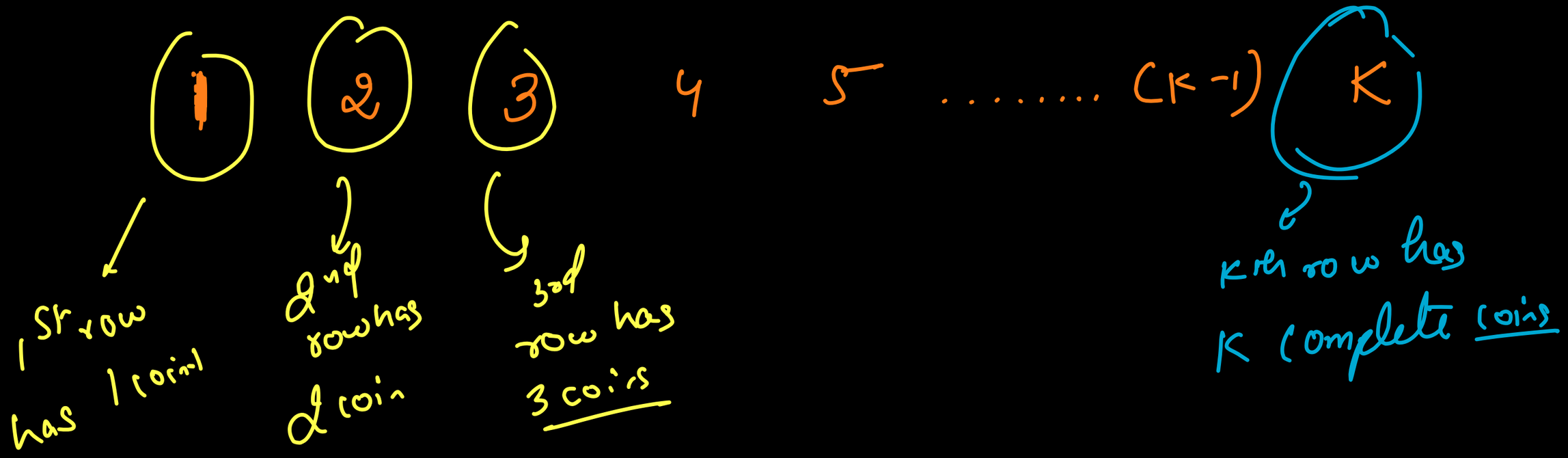

1 2 3 4 5 ..... (K-1) K

1st row has 1 coin

2nd row has 2 coin

3rd row has 3 coins

Kth row has K complete coins

Total coins → $\underbrace{1 + 2 + 3 + 4 + 5 + \ldots\ldots (K-1) + K}_{\text{Sum of first K natural no.}}$

to make K complete rows we need atleast these coins

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

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$\frac{(K)(K+1)}{2}$ atleast coins are need to make K complete rows.

Total gem coins $\rightarrow n$

$K * (K+1) <= n$

$\frac{}{2}$

$n = 5$

$K \rightarrow 1 \rightarrow \frac{(1)(1+1)}{2} \Rightarrow 1 <= 5$

$K \rightarrow 2 \quad \frac{(2)(2+1)}{2} \rightarrow 3 <= 5$

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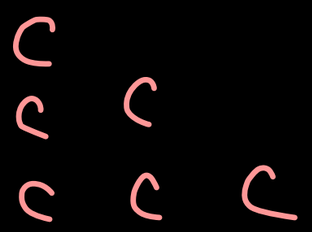
$k > 3 \qquad \frac{(3)(3+1)}{2} \to 6 > 5$

$n = 8$



$k = 1 \longrightarrow \frac{(1)(2)}{2} \to 1 \quad < 8$

$k = 2 \longrightarrow \frac{(2)(2+1)}{2} \to 3 \quad \leq 8$

$k = 3 \longrightarrow \frac{(3)(3+1)}{2} \to 6 \quad \leq 8$

$k = 4 \longrightarrow \frac{(4)(4+1)}{2} \to 10 > 8$

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We need to search for biggest value of k such that

$$\frac{(k)(k+1)}{2} \leq n$$

$k \in [1, n]$

Can we make mid no. of rows?

$$\frac{(mid)(mid+1)}{2} > n \rightarrow \text{Cannot make mid rows}$$

$$\frac{(mid)(mid+1)}{2} \leq n$$

Yes

value = ((mid) (mid+1)) / 2

if (value <= n) {

potential ans = value;

lo = mid + 1

}

else {

hi = mid - 1

}

(1 - n)

O(log n)

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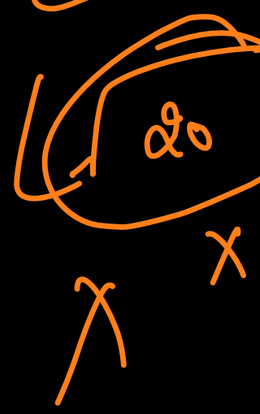
perfect sq → $(\sqrt{n})^2 \Rightarrow n$

floor

$\lfloor \sqrt{16} \rfloor \rightarrow 4$ 4×4

$\lfloor \sqrt{20} \rfloor \rightarrow 4 \rightarrow$



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$x \rightarrow$ perfect square or not ??

$(2 \underbrace{\quad\quad}_{} x-1)$

Think what will be the time complexity of the Brute

Brute force $\rightarrow$ D.S force

Hint $\rightarrow$

$\times O(n)$

$\times$

$y^2 == x$

$[2, 15]$

$x = 10$

2 3 4

$4^2 == x$

Binary Search

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2 | mid

$x-1$

$O(\log n)$

$(mid * mid == x)$

$x = 16$

2 | mid → 8 15

$mid * mid < x$

$lo = mid + i$

$mid * mid > x$

$hi = mid - 1$

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