Q: You're given an integer n ($3 <= n <= 10^{18}$)

You need to find the smallest 'K' such that N_K gives the result as all 1's.

$K \geq 2$

Ex N = 13

ans → 3

$13_3 = 111$

$1 \times 3^2 + 1 \times 3^1 + 3^0 \times 1 \rightarrow 9 + 3 + 1$

13

→ Try to think in recursive manner.

$$(\underbrace{1111\ldots\ldots1}_{i}) \longrightarrow N'_K$$

$$1\times K^{i-1} \text{ ------ } 1\times K^2 + 1\times K^1 + 1\times K^0 \longrightarrow N'$$

we already know this

$$\frac{K^i - 1}{K-1} \longrightarrow N'$$

if k' is my ans then k' is the smallest base.

Let's say there was some other base k'' also, that gave all ones. but $k'' > k'$

$(1111\ldots1)_{k'} \longrightarrow N_{k'} \rightarrow \frac{k'^{i}-1}{k'-1}$ (i ones)

$(1111\ldots1)_{k''} \longrightarrow N_{k''} \rightarrow \frac{k''^{j}-1}{k''-1}$ (j ones)

$i > j$

Actually we need to find a base that gives me the largest number of 1's

How many ones we can have at max. for any k.

$N \approx 10^{18}$ → max one will occur with min k.

min value of k can be 2.

→ $O(\log_2 N)$

We have the range of one → [1, 63]

for any value $i \in [1, 63]$
↳ no. of one

i 63 → T

(1111.....1) = N_K → we need to find K
i

K → { min → 2
max → N-1

K

$\frac{K^i - 1}{K-1} = N$

$\frac{K^i - 1}{K-1} > N$

$\frac{K^i - 1}{K-1} < N$

→ Max one → $O(\log_2 N)$ ↑

$i = [1, 63]$

$i \rightarrow \quad K \rightarrow 2 \quad \langle \longrightarrow \quad N-1$

mid

$O(63 \times \log N)$

$O(\log N)$

$mid^i - 1 = N \longrightarrow$ return mid

$mid - 1$

$mid^i - 1 > N \longrightarrow hi = mid - 1$

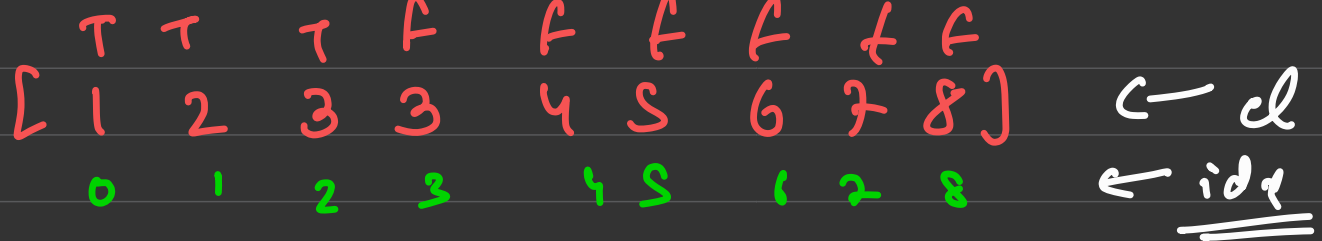
$mid + 1$

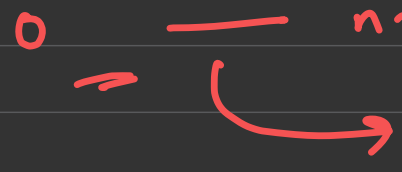
else $\longrightarrow lo = mid + 1$

Q) Given a sorted array of size N. We have elements ranging from 1 to N-1 only. that means any one element is repeated. Find the culprit element.

[1 2 3 4 4] n=5

Ans → 4





→ arr[mid] == mid

lo = mid + 1

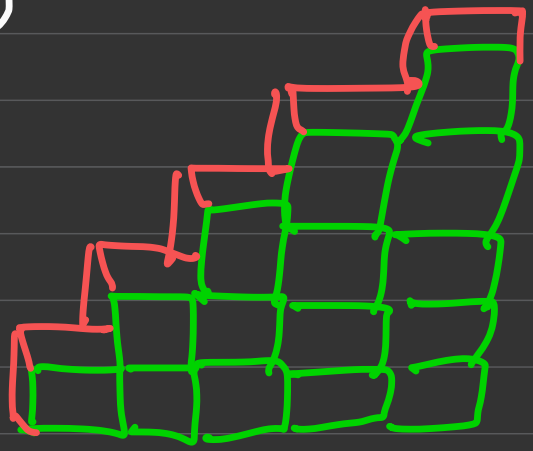
ans = mid

arr[mid] == mid - 1

hi = mid - 1

Q. You are given n bricks (1x1). find the max staircase step you can make using this n bricks.

n = 15



(1x1xN)

n bricks → max stairs

min → 1

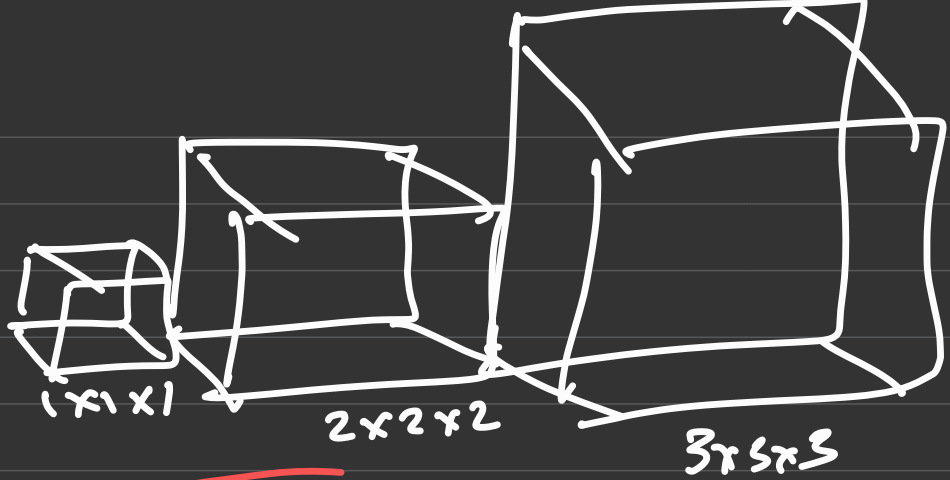
mid

max → n

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

$1+2+3+\cdots+mid \rightarrow$

$$\sum_{i=0}^{K} i$$



4x4x4

n cuboids

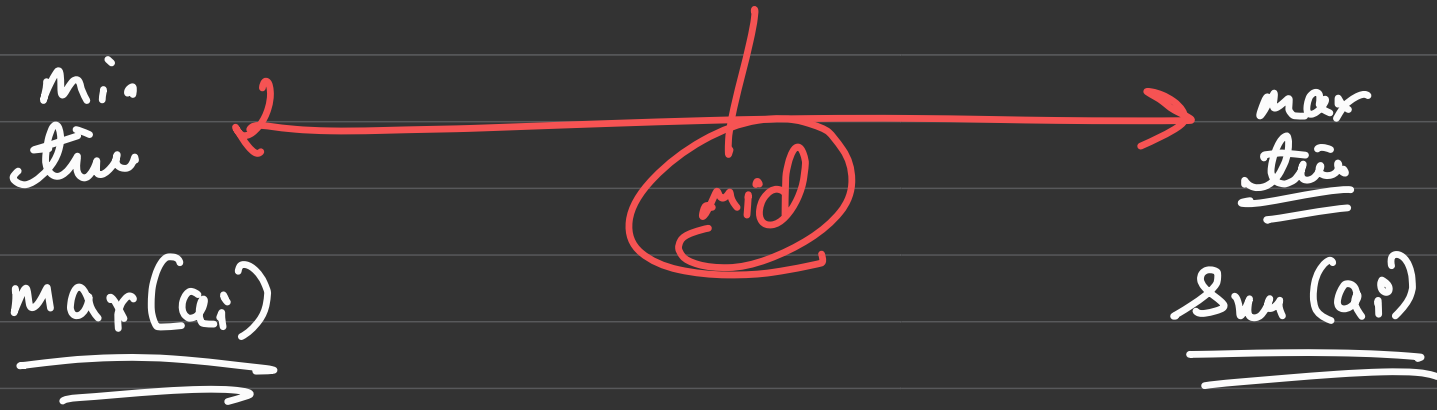
$$\sum_{i=1}^{k} i^3 \rightarrow \left(\frac{n \times (n+1)}{2}\right)^2$$

Q. You've n boards of len [a1, a2 ---- an]
There are K painters and each take 1 unit time to paint 1 unit board. Given the constraint that one painter only paints continuous section of boards. Find the minimum time reqd to paint all Boards.

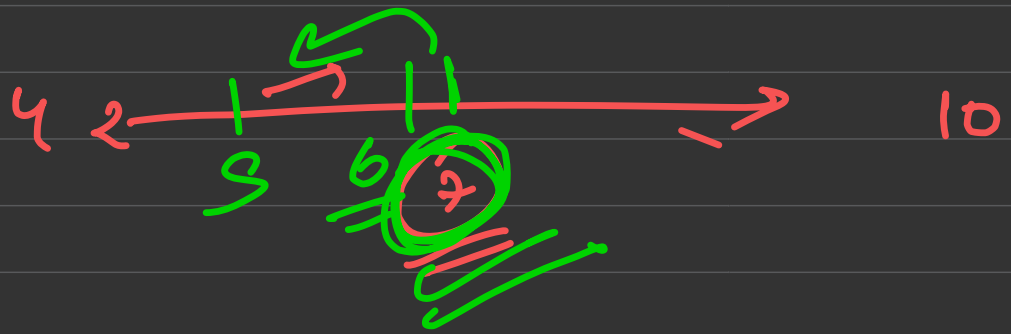
[1, 2, 3, 4] K = 2

ans - 6

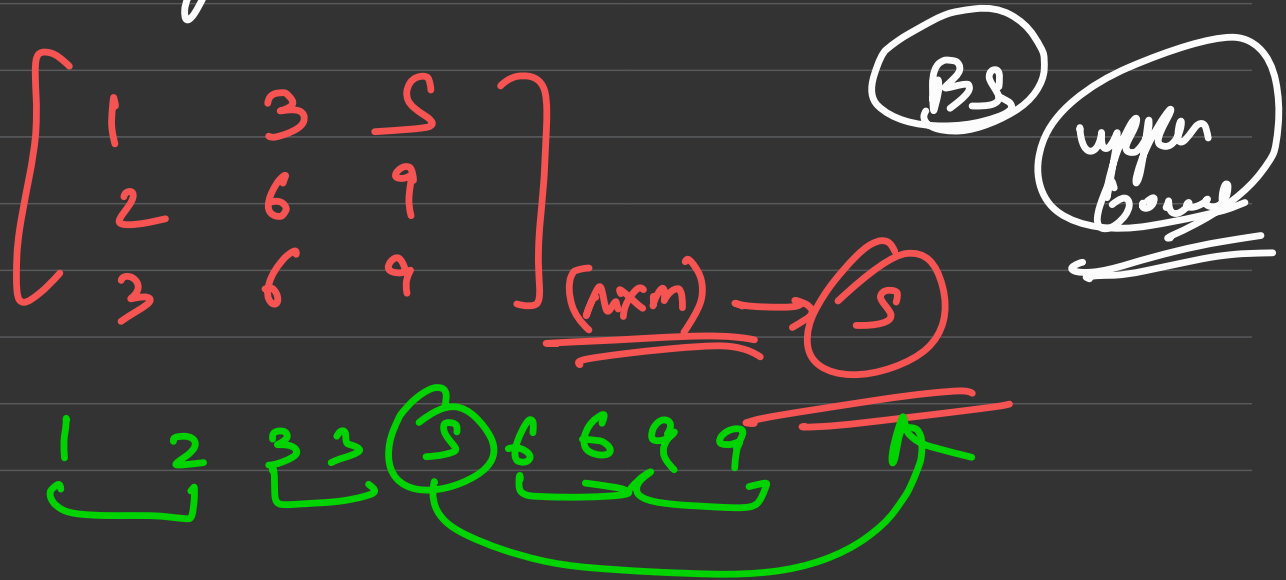
min time ← search space → involve time

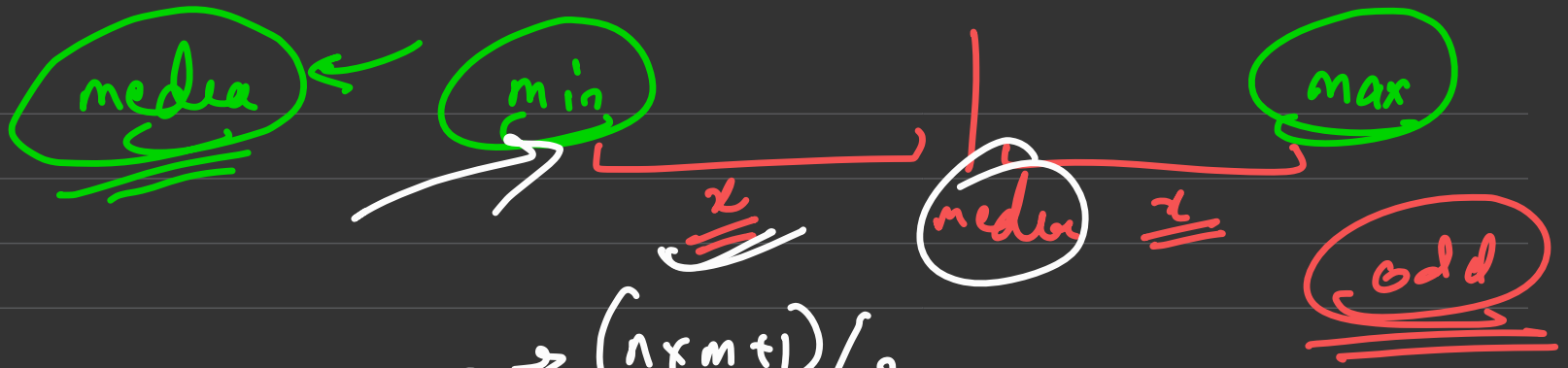


$k = 2$



Q) Given a row wise sorted matrix of $n \times m$ dimension (assume $n \times m$ is odd) find median of the matrix elements.





$$q \rightarrow (n \times m + 1)/2$$

min $\rightarrow O(n)$

max $\rightarrow O(n)$

BS $\rightarrow$ min + max $\rightarrow$ mid

↳ all rows & BS

$O(\log(max - min) \times n \times \log m)$