Binary Search on Minimax

Minimize the maximum

or

Maximize the minimum

Farmer John has built a new long barn, with N (2 <= N <= 100,000) stalls. The stalls are located along a straight line at positions x1,...,xN (0 <= xi <= 1,000,000,000).

His C (2 <= C <= N) cows don't like this barn layout and become aggressive towards each other once put into a stall. To prevent the cows from hurting each other, FJ wants to assign the cows to the stalls, such that the minimum distance between any two of them is as large as possible. What is the largest minimum distance?

Input

t – the number of test cases, then t test cases follows.
* Line 1: Two space-separated integers: N and C
* Lines 2..N+1: Line i+1 contains an integer stall location, xi

Output

For each test case output one integer: the largest minimum distance.

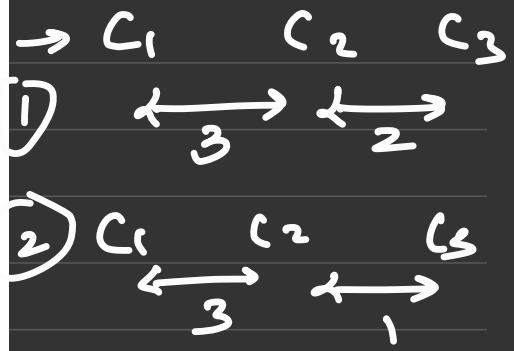
Example

Input:

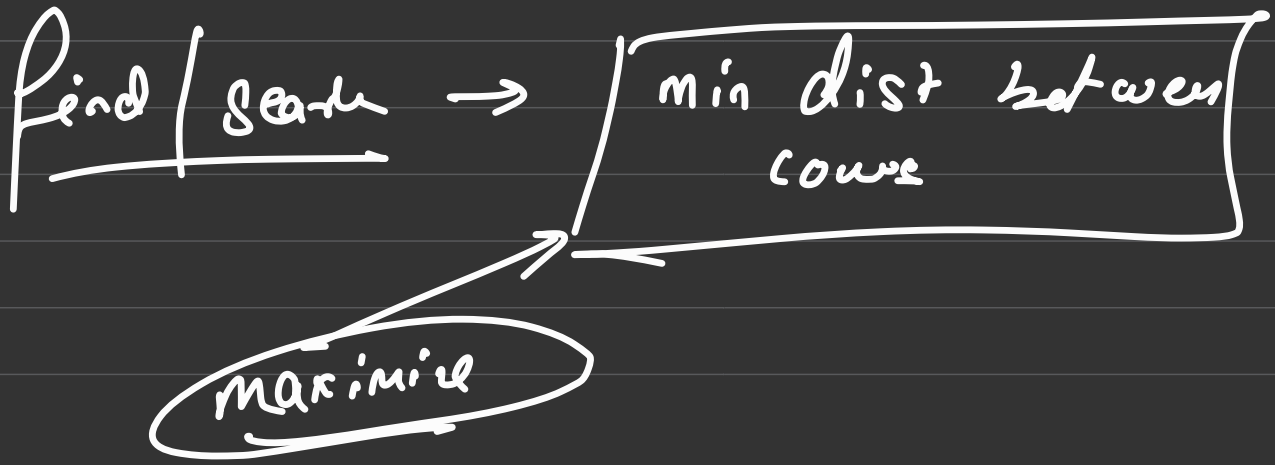
```
1
5 3
1
2
8
4
9
```

Output:

```
3
```



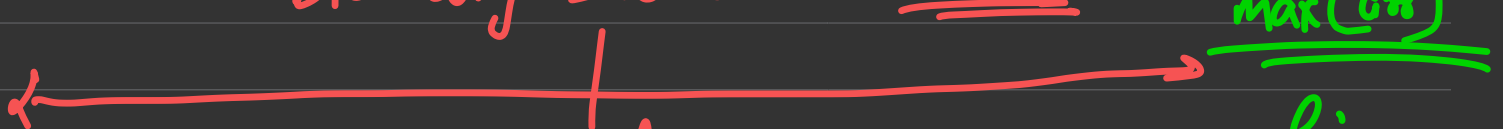
We have to calculate minimum dist btw any 2 cows. Then maximize this min dist so that every cow is as far as possible



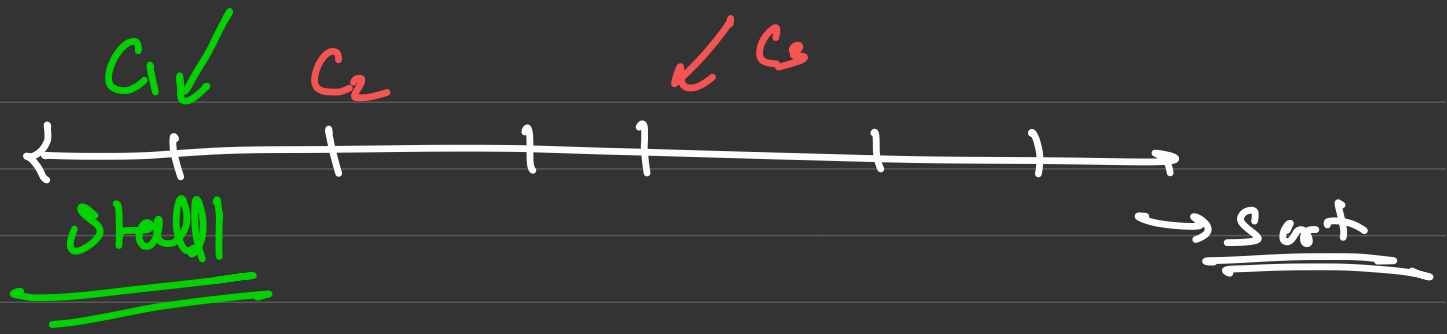
What can be in the worst case min dist btw 2 cows.

stall pos

I will check can I arrange the cows such that min dist btw any 2 cows is mid.



if possible go right else go left.


C1
C2
C3
Stall!
Sort

Q1 You're given no. of pages in n books and we have m students. Books are arranged in sorted order based on no of pages. Divide the book among m students such that maximum pages a student has to read is minimized.

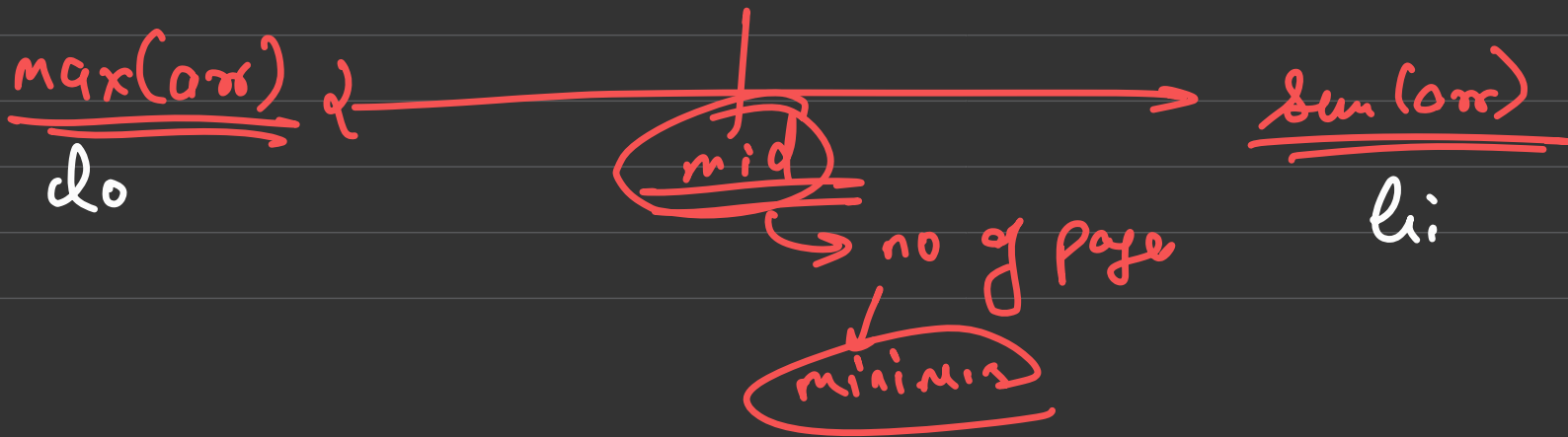
12, 34, 67, 90 → 113

90

m = 2

minimize the maximum no. of pages read.

Search space
will denote → maximum no of pages for a student



mid denotes what is the maximum no. of pages any student can read.

$O(n \times \log(\text{sum} - \text{max}))$

Q: You've a list of n integers, You need to divide them into K segments such that max sum on a segment is minimum possible.

[1, 3, 2, 4, 10, 8, 4, 2, 5, 3]

ans: 12

K = 4

Q3

minimize the max candies

max candies → search space

0

lo

mid

T

10^{12}

$\max(a_i * b_i)$

a_i

if you decide that max candles you'll give to anyone won't be more than mid.

possible → M balloon

max candies any one will get is → mid

sum → actual balloons given

→ for any ith day

q_i — mid/bio

x = balloon reqd — balloon compensate

sum += max(x, 0)

$\sum x \leq M$ → true

bi ⟶ 1 balloon

1 candy → $\frac{1}{bi}$ balloon

mid candies → $\frac{mid}{bi^0}$ balloons