Minimax problems

Maximum of a minimum value
or
Minimum of a maximum value

Searching

Minimax problems in game theory

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?

Binary Search

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

t = 1
N → 5 3 ← C
S1 → 1
S2 → 2
S3 → 8
S4 → 4
S5 → 9

Output

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

C1 → S1 (1) S2 (2) C2 → S4 (4) S3 (8) S5 (9) ← C3

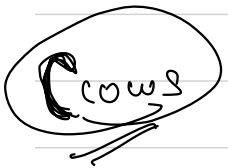
ans → 3

Variation of Binary Search on ans.

Generally maximum of a minimum

↓ BS

↓ good



we will try to arrange the cows such that the distance is atleast mid

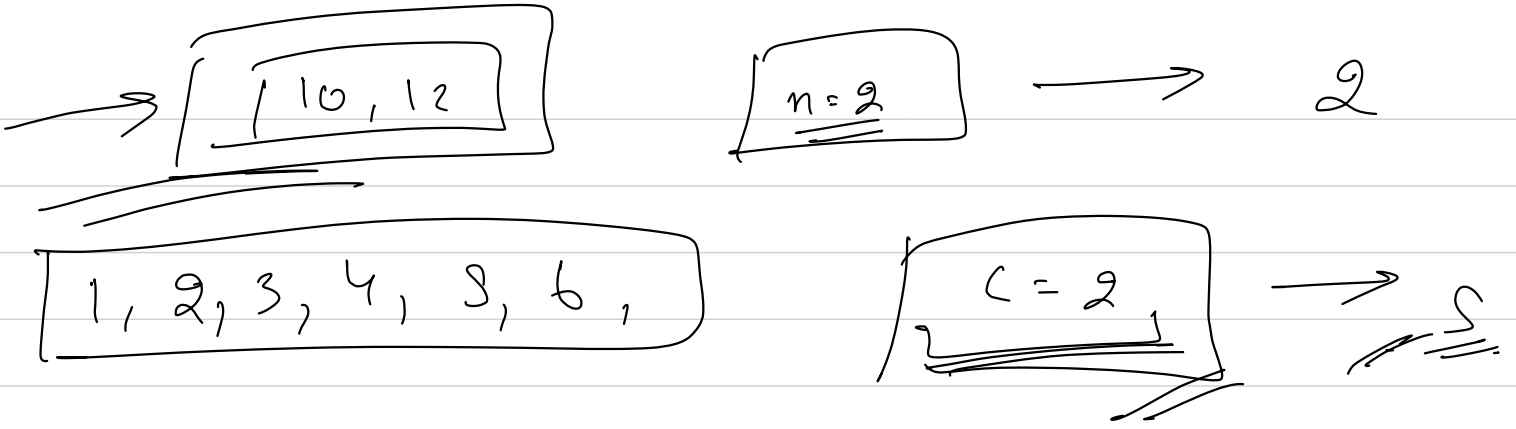
↳ True → lo = mid + 1

false → hi = mid - 1

the no of cows we are able to arrange with atleast mid distance

max pos of stall

min distance is mid btw 2 cows


10, 12
n = 2
2
1, 2, 3, 4, 8, 6,
c = 2
5

Q:» Given number of pages of n different books & m is the value of no. of students.

Books are arranged in increasing order of pages.

One student can read consecutive books only.

Assign books such that maximum no. of pages assigned to a student is minimum.

$n \leq 10^5$

$S_1 \rightarrow 12, 34$

$S_2 \rightarrow 67, 90$ (157)

$n \rightarrow$ books

$m \rightarrow$ students

ans (113)

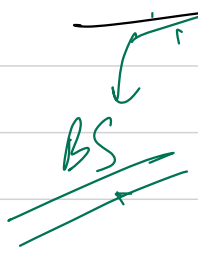
→ 12, 34, 67, 90

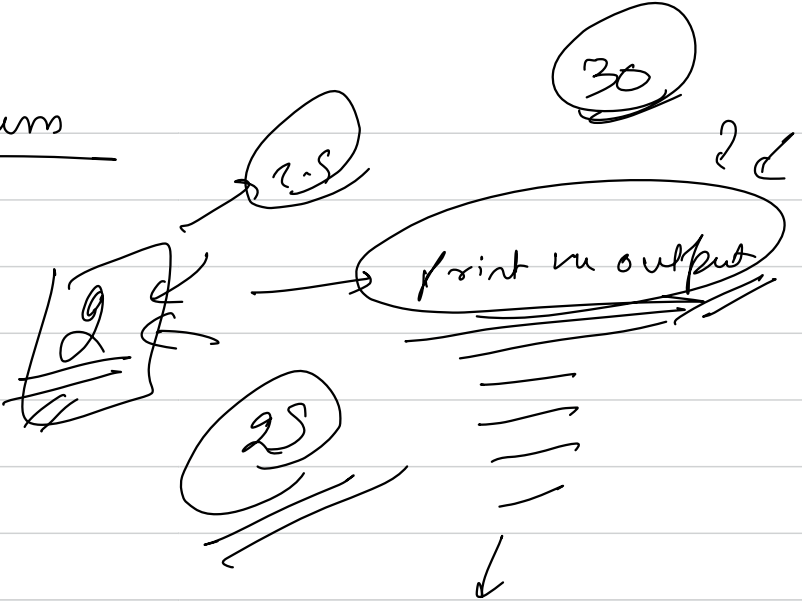
$m = 2$

$S_1 \rightarrow 12, 34, 67$ (113)

$S_2 \rightarrow 90$

minimum of maximum





→ allocate Books to students → allocate pages to a student

no of stude > m

B → inc order of page

search space

0 (pages) ←——— mid ———→ sum of pages

→ try to allocate books such that the no. of students required to read atmost mid pages ≤ m

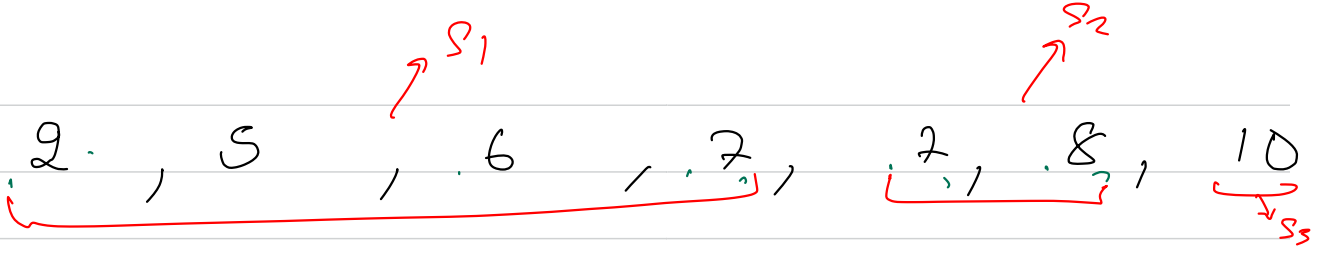
if no of students > m

↳ one student is already less pages
↳ increase the count of pages read by one student

↳ lo = mid + 1

else

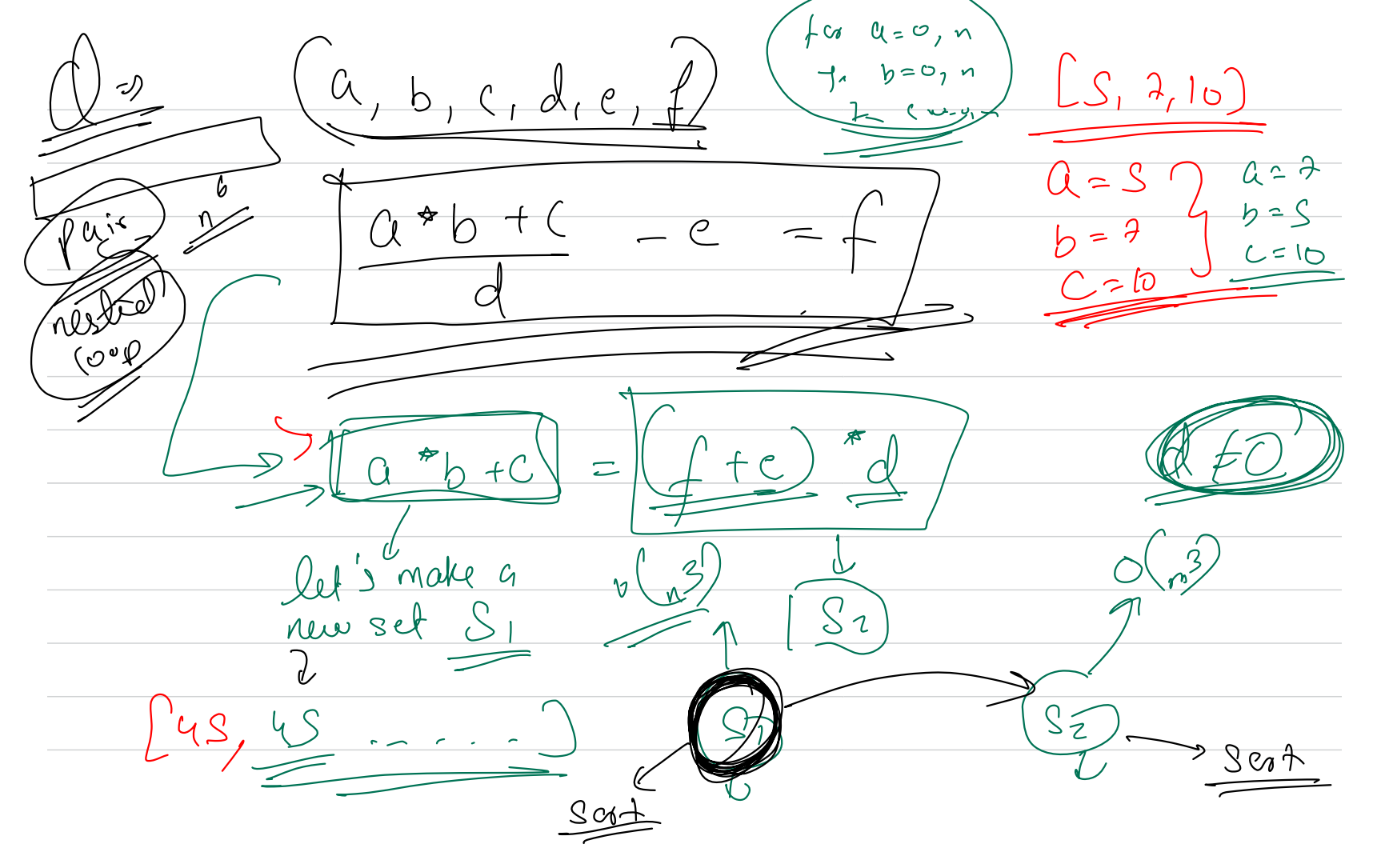
↳ hi = mid - 1

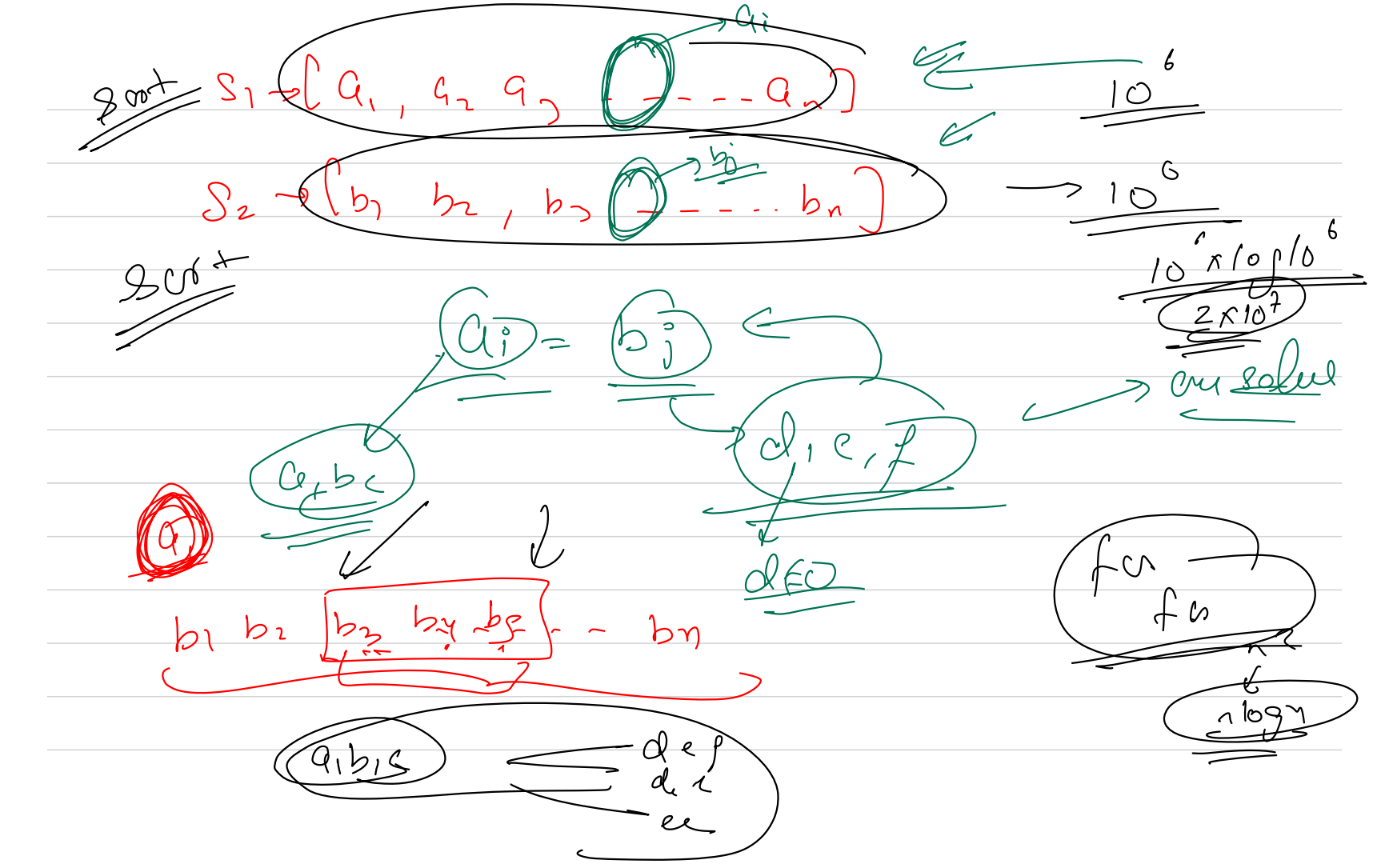


↳ stud → almost 20

The distribution is such that 1 student got less pages than required

↳ So inc no. of pages assigned to on stu


(a, b, c, d, e, f)
for a=0, n
for b=0, n
[5, 7, 10)
a = 5
b = 7
c = 10
a = 7
b = 5
c = 10
pair
nested loop
n
6
a*b+c / d - e = f
a*b+c = (f+e)*d
d ≠ 0
let's make a new set S1
O(n^3)
O(n^3)
S1
S2
S2
sort
sort
[45, 45 . . . . .]


Sort
$S_1 \to [a_1, a_2, a_3 \ldots a_n]$
a_i
10^6
$S_2 \to [b_1, b_2, b_3 \ldots b_n]$
b_j
10^6
$10^6 \times 10 \cap 10^6$
2×10^7
Sort
$a_i = b_j$
a, b, c
d, e, f
ou soluc
a_1
b_1 b_2 b_3 b_4 b_5 b_n
$a_1 b_1 5$
def
d e
e
dED
fct
fct
$n \log n$