

Case study - 2

Finding stolen desks elections
ballot box.

Solution - I

Assumptions Ballot box will not be placed in the same block from where they are stolen

Total blocks = 100

After assumption = $100 - 2 = 98$
blocks

Search space:

Search space = $100 - 2 = 98$
blocks

to be searched.

Analysis:

- Best case ~~is~~ is when we find the stolen box in the first block we search

$$T(-) = 1 \text{ hour}$$

- Worst case is when the stolen box is present in first block we check

$$O(\cdot) = 98 \text{ hours}$$

- Average case = $\frac{98}{2} = 49$ hours
- Ballot box will be destroyed as it takes more than 24 hours to find the box in the worst case.

Solution #2

Assumption 1: Ballot boxes will not be placed in the same block from where they were stolen.

$$\text{Total blocks} = 100$$

$$= 100 - 2 = 98 \text{ blocks}$$

Assumption 2: As the live streaming is going on, the ballot boxes are not placed in blocks where internet connectivity is poor.

let says 20 blocks where internet is poor:

$$\text{remaining blocks} = 98 - 20 = 78 \text{ blocks}$$

Search space:

$$\text{Total blocks} = 100$$

20 with poor internet

2 ~~as~~ ballot box are not placed in the same location

$$\begin{aligned} \text{Search space} &= 100 - 20 - 2 \\ &= 78 \end{aligned}$$

			a				a		a
	a				a			a	
			b						
		a				a			a
a				a			b		
						a		a	
	a								a
a				a					a
		a				a		a	

let

a represents blocks with poor connectivity
b represents blocks where the blocks are not placed

Analysis:

- Best case is when we find the ballot boxes at the first location we search

$$Q(\cdot) = 1 \text{ hour}$$

- Worst case is when we find the ballot boxes at the last location we search

$$O(\cdot) = 78 \text{ hours}$$

- Average case = 39 hours

Ballot boxes will be destroyed in the worst-case, as the 78 hours are required while we have 24 hours. Therefore this solution will not work.

Solution 3#

- ① Turn off electricity and internet of half city for (20 mins) i.e 50 blocks, if the live streaming does not stop, it means stolen ballot box is in those 50 blocks where light is not turned off and vice versa
- ② Now ^{divide} ~~divided~~ the 50 blocks into two 25 blocks, and check if the live streaming stops or not. Note if the live streaming stops, it means ballot box is in the those 25 areas where electricity and internet were cut off.
- ③ Now divide 25 by two, and turn off electricity of one half part and check the live streaming.
- ④ Now 12 blocks left, divide them into half, cut off the electricity of 6 blocks, check if the streaming stops, if the streaming stops then it means ballot box is in those 6

blocks.

- ⑤ Now divide those 6 blocks by 2, check if the streaming disconnects by turning off all internet and electricity.
- ⑥ Check manually what in those 3 blocks where the streaming was stopped

Search space:

In first step, 100 blocks were reduced to 50 blocks, search space was reduced by half

In 2nd step, ~~search~~ search space was 25 blocks

In 3rd step, remaining search space was 12 blocks

In 4th step, search space was only 6 blocks

In 5th step, search space was only 3 blocks

①

[illegible]

②

[illegible]

3

	X			

9

	X			

5

	X

6

X

Analysis:

- Each iteration Binary search algorithm divides the search space in half.
- Time taken for binary search, with 5 iterations = $20 \times 5 = 100 \text{ mins}$
- **Best case** is when we get the ballot box from the first block from last 3 remaining blocks

$$O(\cdot) = (20 \times 5) + 1(\text{hour}) = 100 + 60 \text{ mins} \\ = 160 \text{ mins} = 2.66 \text{ hours}$$

- Average case when we get the ballot box from the second block we check

$$\text{Average case} = 100 + 120 \text{ mins} = 220 \text{ mins} \\ = 3.66 \text{ hours}$$

- Worst case when if we get the stolen box from last location among the 3 locations

$$O(\cdot) = 100 \text{ mins} + 180 \text{ mins} = 280 \text{ mins} \\ = 4.66 \text{ hours}$$

$$4.66 < 24 \text{ hours}$$

So solution 3 is only applicable solution that works