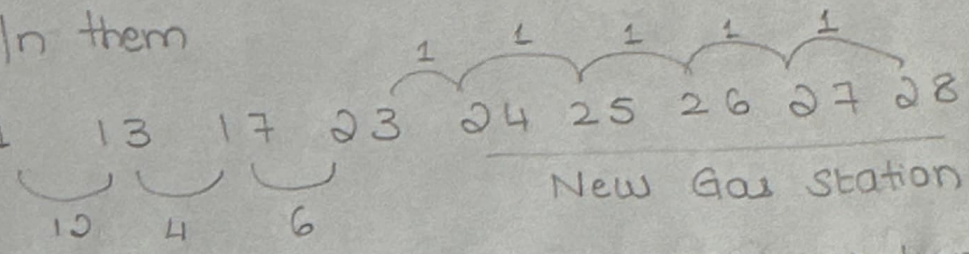
ⓐ 774: Minimize Max distance to gas station

Eg: [1 13 17 23] K = 5

If we place gas station before or after the first or last location, there would still be gas stations that have maximum distance b/n them



12 → is the max distance b/n 2 gas station

So inorder to reduce the distance, the ideal situation is to place the new gas stations, in b/n the already existing gas station.

Idea:

We have to minimize the distance b/n 2 gas station.
In order to do that we choose the gas stations that have largest distance b/n them & then place a new gas station in between

Eg: [1 _ 13 _ 17 _ 23] K = 5

↓1 ↓2 ↓3

There are 3 gaps or places initally where the gas station can be place

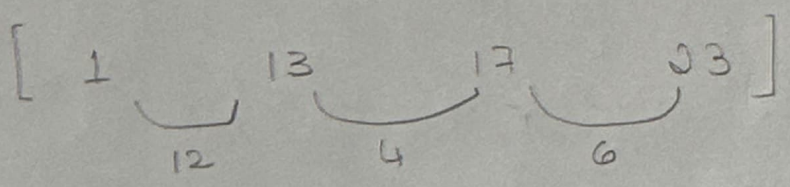
for a array of size n, we will have n placements

[0, 0, 0] → fill with 0, since initially no new gas station are placed.

Eg: [1 13 17 23]

[0 0 0] → No of gas station placed in b/n previous station

lets start by placing 1st new gas station



Current 12 is the max distance & we need to reduce it
So we place new gas station in between 1 - 13

We also need to check if we have already placed a gas station in b/n them

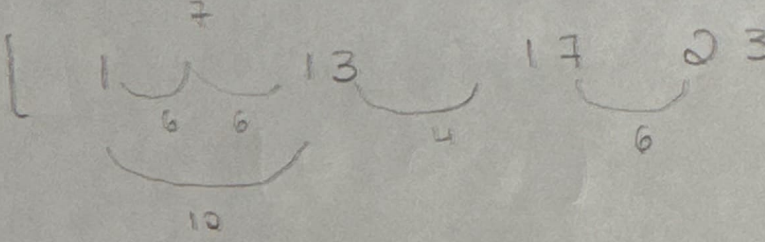
If we have already placed, then we need to take that into Consideration, But since this was first placment we didint

after K=1 we will have

[1 13 17 23] [1 0 0]

this means a new gas station was placed b/n 1 - 13

so distance b/n 1 & 13 reduces



- 12 is broken into 2 → $\frac{12}{2} = 6$ of each
- If we have One placment, then we have 2 slot for 'n' we have 'n+1' slot

For k = 2

$[1 \quad 13 \quad 17 \quad 23]$ $\quad [\overset{r}{1} \; 0 \; 0]$

① → $13-1 = 12 \rightarrow \frac{12}{1+1} = 6$

r+1 slot

② → $17-13 = \frac{4}{1} = 4$

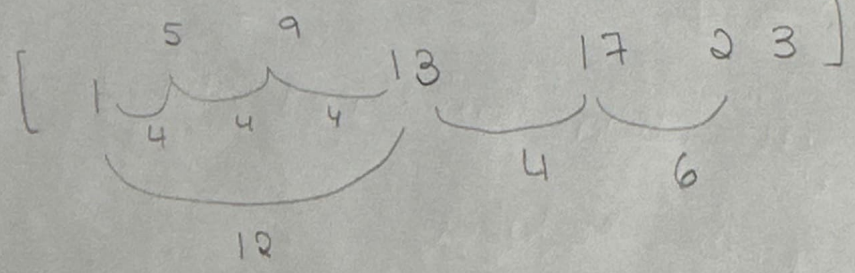
r+1 slot

③ → $23-17 = \frac{6}{1} = 6$

6 is Max distance
we can take either

$[1 \quad 13 \quad 17 \quad 23]$ $\quad [\overset{r}{2} \; 0 \; 0]$

we will place it b/n 1-13,
Now 1-13 have 2 gas station in b/n them &
it would look like



→ For k = 3

$[1 \quad 13 \quad 17 \quad 23]$ $\quad [2 \; 0 \; 0]$

① $13-1 = 12 \rightarrow \frac{12}{2+1} = 4$

② → $17-13 = \frac{4}{1} = 4$

③ → $23-17 = \frac{6}{1} = 6$,

6 is Max, so we place gas station there

K=4

[1 13 17 23] [2 0 1]

① $13-1 = \frac{12}{2+1} = 4$

② $17-13 = \frac{4}{1} = 4$

③ $23-17 = \frac{6}{1+1} = 3$

4 is Max, Let place a new gas station b/n 1-13

K=5

[1 13 17 23] [3 0 1]

① → $13-1 = \frac{12}{4} = 3$

② → $17-13 = \frac{4}{1} = 4$

③ → $23-17 = \frac{6}{1+1} = 3$

Max = 4, We need to reduce the dist, so we place in b/n

17 - 13

[1, 13, 17, 23] [3 1 1]

After placing 5 gas station

[1 13 17 23] [3 1 1]

distances =

① 13 - 1 = 12

3 gas station were placed in between

[1 _ 4 _ 7 _ 10 _ 13]
  1   2   3   4

= $\frac{12}{4}$ = ③

② 17 - 13 = 4

1 gas station was placed in b/n

[13 _ 15 _ 17]

= $\frac{4}{2}$ = ②

③ 23 - 17 = 6

1 gas station was placed

[17 _ 20 _ 23]

= $\frac{6}{2}$ = ③

so the max distance is ③ //

Heap → [dist, idx]

↳ We do not consider this distance for calculating new distance, we use (i+1 − i)

K = 0

12	0
6	2
4	1

0	0	0

* Pop (12 0)
* place gas station there | 1 | 0 | 0 |
* new distance = $\frac{12}{1+1}^{(13-1)} = 6$
* (6, 0) to heap

K = 1

6	2
6	0
4	1

1	0	0

* pop (6, 2)
* place new gas station | 1 | 0 | 1 |
* new distance = $\frac{6}{1+1}^{(23-17)} = 3$
* push (3, 2) to heap

K = 2

6	0
4	1
3	2

1	0	1

* pop (6, 0)
* place new gas station | 2 | 0 | 1 |
* new distance = $\frac{13-1}{3} = \frac{12}{3} = 4$
* push (4, 0) to heap

K = 3

4	1
4	0
3	2

2	0	1

* pop (4, 1)
* place new gastation | 2 | 1 | 1 |
* new dist = $17-13 = \frac{4}{2} = 2$
* push (2, 1) to heap

$k = 4$

4,0
3,2
2,1

2	1	1

* pop (4,0)
* place new gas station

3	1	1

* new dist = $13 - 1 = \frac{12}{4} = 3$
* push (3,0) to heap

After add 5 new gas station, Heap will look like

3,2
3,0
2,1

→ we return (3, 2), 3 as that is our max distance b/n 2 gas station