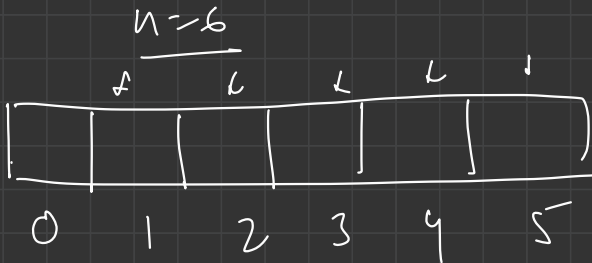


2. Array Partition ?

$x \in \underline{1-5}$

freq =



Array 100000 > X

X 1-1000000000

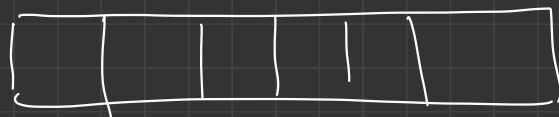
$x \rightarrow -10000 \text{ to } 10000$

freq of

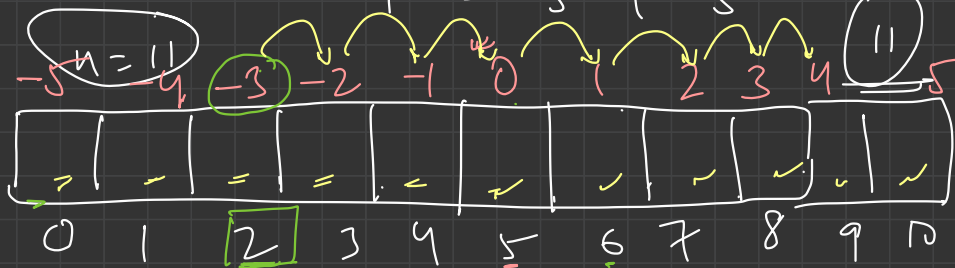
index

$x \rightarrow \underline{-5} \text{ to } 5$  ? -5, -4, -3, -2, -1, 0

0, 5



1, 2, 3  
4, 5



$$\text{shift} = 5$$

we want freq. of -3

freq[-3] ~~X~~

$$\text{freq}[\text{-3 + \text{shift}}] \\ \text{-3 + 5} = \text{2}$$

at index 0, there ~~is~~ is  
freq of 0 - shift : -5

at index 5, there is freq of  
5 - shift : 0

~~-5 to 5~~

0	1	2	3	4	5	-1	-2	-3	-4	-5
0	1	2	3	4	5					

~~X~~

↓  
 3 3 3  
 1 2 3  
 1 2 1  
 1 3 2  
 2 3 4  
 1 2  
 1 3  
 2 3

$a = \{1, 2, 3\}$

$n = 3$

$m = 8$

$k = 3$

$op = \{m\} [3]$   
 $\begin{matrix} l & r & d \end{matrix}$   
 $\begin{matrix} 0 \\ 1 \\ 2 \end{matrix}$

1	2	1
1	3	2
2	3	4

for ( $i = 0, i < k; i++$ ) { process all query

$cin >> n >> y;$

for ( $j = x; j <= y; j++$ ) {

perform  $op(j)$

}

3

for each query  
 we can perform all  
ops

- if I am performing multiple ops on an arr,
- their order doesn't matter,
  - we can club same operations and do them at once

instead of doing each op. → count their freq. and do it once, by changing  
 $d \rightarrow d \times \underline{\text{freq}}$

3 3 3  
1 2 3  
1 2 1  
1 3 2  
2 3 4  
1 2  
1 3  
2 3

a = 

1	2	3
---	---	---

  
1      2      3

op

l      o r      2      a

1	1	2	1
2	1	3	2
3	2	3	4

queries

op1, op2,  
op1, op2, op3  
op2, op3

op1

(l r)

(+2)

op1 → 2  
op2 → 3

op3 → 2

a → 

1	2	3
<hr style="border-top: 1px solid red;"/>		
+1		

→ 

2	3	3
<hr style="border-top: 1px solid red;"/>		
+2		

7	8	7
<hr style="border-top: 1px solid red;"/>		
+4		

7	12	11
<hr style="border-top: 1px solid red;"/>		
+2		

9	14	13
<hr style="border-top: 1px solid red;"/>		
+4		

9	18	17
---	----	----

→ 

4	5	5
<hr style="border-top: 1px solid red;"/>		
+1		

5	6	5
<hr style="border-top: 1px solid red;"/>		
+2		

7	8	7
---	---	---

queries

freq  
op1 → 2

op2 → 3

op3 → 2

$$(+a +a +a +a) \times \text{freq} \text{ op}$$

$$\begin{array}{cc} l & r \\ +a(l) & +a(r) \end{array}$$

$$a \rightarrow \begin{array}{ccc} 1 & 2 & 3 \\ \hline \end{array}$$

$$(+1) \times 2$$

$$\begin{array}{ccc} 3 & 4 & 3 \\ \hline \end{array}$$

$$(+2) \times 3 = +6$$

$$\begin{array}{ccc} 9 & 10 & 9 \\ \hline \end{array}$$

$$(+4) \times 2 = +8$$

$$\begin{array}{ccc} 9 & 18 & 17 \end{array}$$

1	2	1
1	3	2
2	3	4

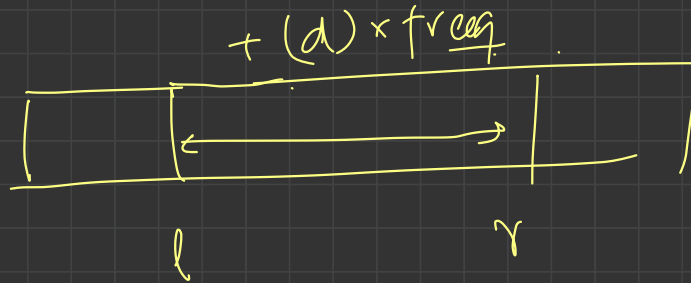
✓ (op1) x2

✓ (op2) x3

✓ (op3) x2

no of operations  $\times$  (n)

frequency



operation  
↓  
f times

q →

$\overset{x}{1} \rightarrow \overset{y}{3}$   
 $\underline{\underline{2 \rightarrow 5}}$   
 $\underline{\underline{1 \rightarrow 4}}$   
 $\underline{\underline{3 \rightarrow 6}}$

①  
②  
③  
④

2 3 4 3 2 1

1 2 3 4 5 6

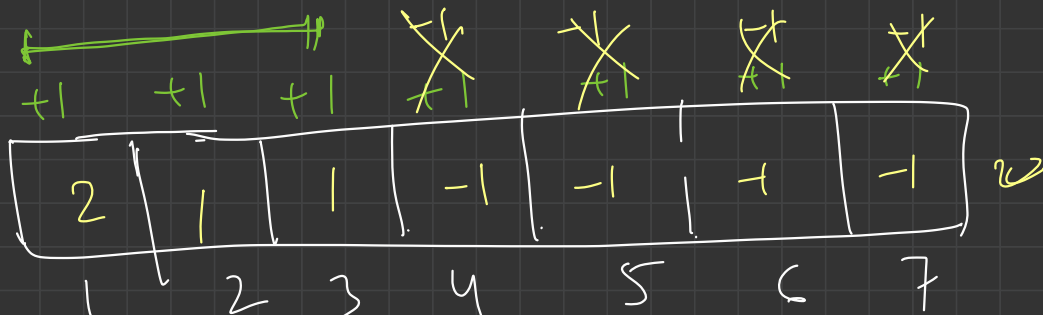
+1 +1 +1

+1 +1 +1 +1

+1 +1 +1 +1

+1 +1 +1 +1

$$\begin{array}{l} l \rightarrow +1 \\ \hline r+1 \rightarrow -1 \end{array}$$



$$\begin{array}{l} 1, 2, 3 \\ \hline +1 +1 +1 \end{array}$$

①

+1 ✓

-1 ✓

-1 ✓

4 ②

+1 ✓

③

+1

-1

④

+1

-1

queries x 2

+ m



$f[i] += f[i-1]$  → add the value of last index,

2	3	4	3	2	1	0
---	---	---	---	---	---	---

1 2 3 4 5 6 7  
 $1+2$   $1+3$   $-1+3$   $-1+1$

op1 → 2  
 op2 → 3  
 op3 → 2

(m)

8	16	14	
---	----	----	--

1 2 3 4  
 $+2$   $+2$   
 $+6$   $+6$   $+6$   
 $+8$   $+8$

1	2	<u>2</u>
1	3	<u>2</u>
2	3	<u>4</u>

$$\begin{array}{r} +2 \\ \hline \end{array}$$

$$\begin{array}{r} +6 \\ \hline \end{array}$$

$$\begin{array}{r} +8 \\ \hline \end{array}$$

$$\begin{array}{r} -2 \\ \hline \end{array}$$

$$\begin{array}{r} -6 \\ \hline \end{array}$$

$$\begin{array}{r} -8 \\ \hline \end{array}$$

20

22

19

89

if i need sum of values to have 3 at ones place, do i need all the numbers?

$$\begin{array}{r} \cancel{2} \\ \cancel{1} \\ \cancel{1} \\ 2 \\ 5 \\ 6 \end{array}$$

So, i only need unit-digit of all numbers  
 $\% 10$

$d_1$   $d_2$   $d_3$   
 $\downarrow$   $\downarrow$   $\downarrow$   
 $0-9$   $0-9$   $0-9$

$\Rightarrow$  sum ends with 3

3, 13, 23

$i: 0 \rightarrow 9$

$j: 0 \rightarrow 9$

$k: 0 \rightarrow 9$

$$i + j + k = 3$$

$\left\{ \begin{array}{l} 0, 0, 0 \\ 0, 0, 1 \\ 0, 0, 2 \\ . \\ 9, 9, 9 \end{array} \right\}$

12 34 56 78 90

✓ ✓ ✓  
1 1 4

① ✓

{2, 4, 6, 8, 0}

③

sum does not ends with 3

Linear Recursion

1 2 3 4 5 6 - - - -  
| a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u |  
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

hello

$$0 + |7-4| + |4-11| + |11-11| + |11-14|$$

$$0 + 3 + 7 + 0 + 3 = \textcircled{13}$$

keyboard

qwertyuiopasdfghjklzxcvbnm

0 2 8 11 15 18

worst

hello

$$0 + |15 - 2| + |18 - 2| + |18 - 18| + |18 - 8|$$

$$0 + 13 + 16 + 0 + 10$$

$$= \underline{\underline{39}}$$

a →  
b →  
c →  
d →  
e →  
.

h → 15  
e → 2  
l → 18  
o → 8

u.

15 → h

~~h~~ 15

array search

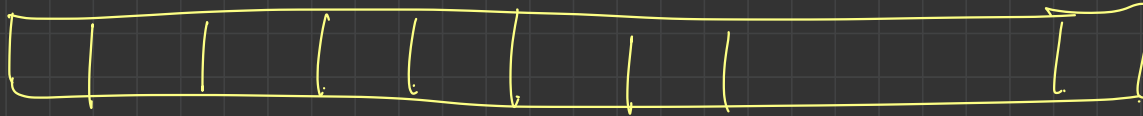
how to store the positions?

position['a'] = 10

a b c a

position[26]

abs (position['c'] - position['a'])



a	b	c	d	e	f	g	---	z
0	1	2	3	4	5	-	-	25
97	98	99	100	-	-	-	-	122

shift →

- 97