2.1 Extra class - Arrays and Bit Manipulation Questions

Friday, 14 June 2024 7:56 PM

Q1. Toggle bits :-

$l = 2, r = 5$

50 → 110010

→ 101100 → decimal

$32+8+4 = 44$

XOR

$0 \wedge \boxed{0} = 0$
$1 \wedge \boxed{0} = 1$

$0 \wedge \boxed{1} = 1$
$1 \wedge \boxed{1} = 0$

110010
XOR 011110
101100

0001111 0000

$\rightarrow (2^r - 1) - - 2^r - 2^{l-1}$

$(2^{l-1} - 1)$

000 11111111 → $2^r - 1$

$-$ 0000000 111 → $(l-1)$ → $2^{l-1} - 1$

$2^x - 1$

$7 = 111 = 2^3 - 1$

$15 = 1111 = 2^4 - 1$

$n \wedge m$ ← $m = 2^r - 2^{l-1}$

00001111110000

$n \wedge (2^r - 2^{l-1})$

$= n \wedge ((1<<r) - (1<<(l-1)))$

1<<r

1<<l-1

0000010000

Q (4, 8, 12, 16) → (4, 8) (4, 12) (4, 16)

0 4 0

(8, 16) (12, 16)

arr[i] & arr[j]

(8, 12) (8, 16) (12, 16)

8 0 0

→ $\boxed{\text{Think bit by bit}}$ → golden statement

arr[i] & arr[j]

1/0 1/0 1/0 1/0

0 1 1 0 6

ans → 1 1 1 1

1010 1000

0100 0101

1 _ _ _

0 1 _ _

→ 1 1/0 1/0 1/0

_ _ _ _ → 1

ans = $\underbrace{\text{arr[i] \& arr[j]}}$

_ 1 _ & _ 1 _

ith position → 1

then I need min 2 numbers which have 1 at ith position.

→ 1100 0100 1010 1011 → 4 numbers.

1 1 _ _

ans = 1 0 1 0

↑ ↑ ↑ ↑

1010 10

101_ 1011

101100

& 101101

101100

~~1010~~ → i

ans = 101 _ _ → ans = 1010 ?

ans = 101 _ _ → ans = 1010 ?   10110 0

poss_ans = 10110 → poss_ans = ans | 2^j

→ ans = 10110

10110 poss_ans
& 11110 arr[x]

10110

Q/.

a = 1 2 3 4 5 6

a = 6 1 5 2 4 3

b = 6 1 5 2 4 3
a = 6 1 5 2 4 3

Tricky → AS = O(1)

m

i + j m
initial final

m > a[i]

a = 1 2 3 4 5 6

→ 1+6m 2+1m 3+5m 4+2m 5+4m 6+3m

→ 6 1 5 2 4 3

$\frac{6m}{m} < \frac{1+6m}{m} < \frac{7m}{m}$ $6 < x < 7$

a = 1 2 3 4 5 6

$\boxed{m > a[i]}$

1+6m, 2+1m, 3+5m, 4+2m, 5+4m, 6+3m

(arr[i] = arr[i] + (arr[j] % m) * m);

$(arr[i] = arr[i] + (arr[j] \ldots$

$$3 + (5 \% m) * m$$

$$5 + (4 \% m) \times m$$

$$arr[i] = arr[i] + (arr[j] \% m) \times m$$

$$2 + ((1+6m) \% m) \times m$$

$$2 + 1m$$

a = 1 2 3 4 5 6

→ a = 1 2 3 4 5 6

$1+6m \quad 3+5m \quad 5+4m$

$$arr[j] \% m = 1 + 0 = 1$$

$$arr[i] = arr[i] + (arr[j]) \times m$$

$$= 2 + (1+6m) \times m$$

$$= 2 + 1m + 6m^2$$

$$\Rightarrow \underline{2 + 1m}$$

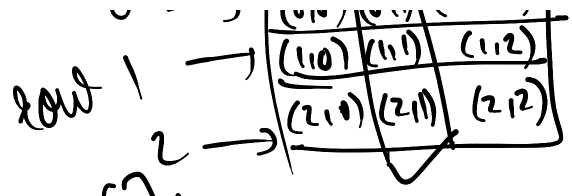
⇒ **2D Arrays:-**

int a[n];

int a[3][3] → row, column

0 →	(0,0)	(0,1)	(0,2)
1 →	(1,0)	(1,1)	(1,2)
	(2,0)	(2,1)	(2,2)

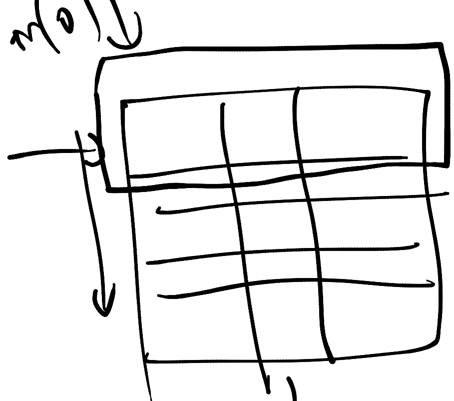
a[2][1] Memory

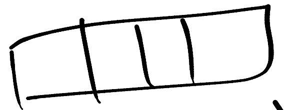


a[2][1]

row
Memory

100	(0,0)
104	(0,1)
108	(0,2)
112	(1,0)
116	(1,1)
	(1,2)
	(2,0)
	(2,1)
	(2,2)



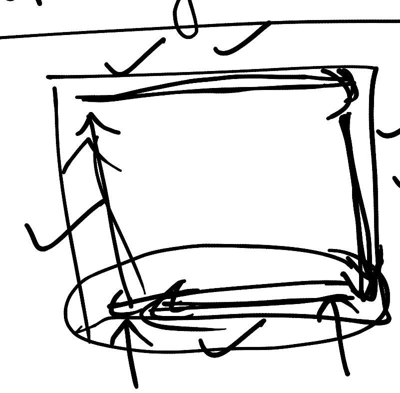


a.size()
↓
4

m.size() → 5
m[0].size() → 3

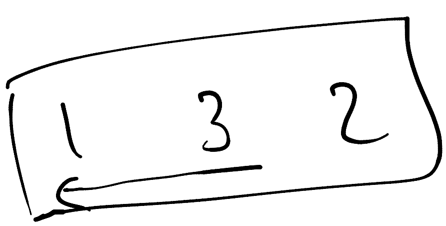
m[i][j]
↓ ith row

Q/ Boundary Traversal :-



index

0 row → 0 to m-1 ~~n-1~~ col
n-1 col → 1st → n-1 row
n-1 row → m-2 col → 0 col
0 col → n-2 row → 1 row



1 3 2 3 1

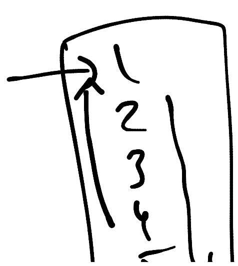
→ 1 2 3 4 5

1 2 3 4 5 4 3 2 1

if(n>1)

(1,n-1)

n-1=0

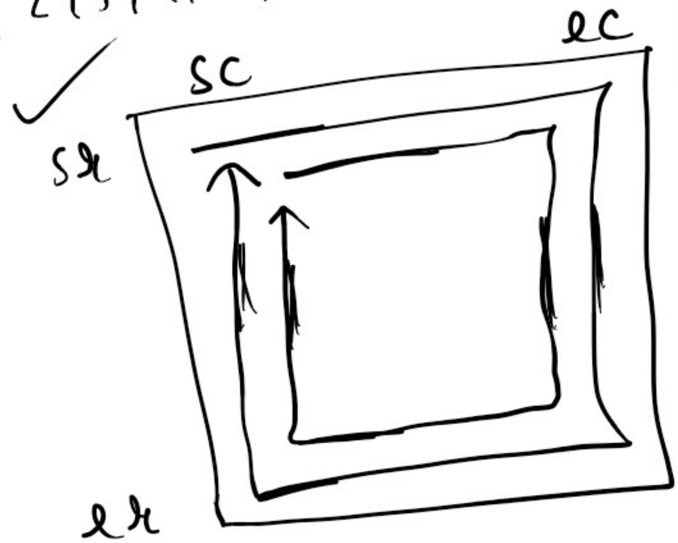


1 2 3 4 5 4 3 2 1

Q/ Spiral traversal :

1	2	3	4	5
1	2	3	4	5
1	2	3	4	5
1	2	3	4	5

1, 2, 3, 4, 5, 5, 5, 5, 4, 3, 2, 1,
1, 1, 2, 3, 4, 4, 3, 2



sr, er, sc, ec → BT

BT → 1

sr = sr+1

er = er-1

sc = sc+1

ec = ec-1

sr = 0, er = n-1, sc = ~~0~~ 0, ec = m-1

while (sr <= er && sc <= ec)

{

Boundary Traversal.

}

Q/. Freq. of limited range of elements

$a = [2, 3, 1, 1, 7, 10]$ $n = 6$

$1 \leq a[i] \leq P$

$P = 11$

$a = [2 \ 1 \ 1 \ 0 \ 0 \ 0]$

$a = [2\ 1\ 1\ 0\ 0\ 0]$

ith → freq of (i+1) in original array.

TC = O(n), AS = O(1)

$$\begin{array}{cccccccc} & 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ a = & 2, & 3, & 1, & 1, & 8, & 10, & 4 \end{array} \qquad \boxed{n=7}$$

→ 3, -1

→ 1 -1 -1

→ -2 -1 -1 0 0 0 ?

0

→ -2 -1 -1 -1 0 0 0

→ 2 1 1 1 0 0 0

Q/. [l, r]

$a[l] + 2a[l+1] + 3a[l+2] + \text{———} (r-l+1)\,a[r]$

$$\begin{array}{ccccccc} 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ a[0] & 2\times a[1] & 3a[2] & 4a[3] & 5a[4] & 6a[5] & 7a[6] \end{array}$$

→ Prefix sum PS1

→ PS2

$a[3] + 2a[4] + 3a[5]$

$S1 = \cancel{PS1} = PS1[5] - PS1[2]$

$[\ ] \ldots 5a[4] + 6a[5]$

$$S1 \; \cancel{pft} = ps1[5] - ps1[2]$$
$$= 4a[3] + 5a[4] + 6a[5]$$

$$S2 = ps2[5] - ps2[2]$$
$$= \underline{a[3] + a[4] + a[5]}$$

$$\underline{S1 - lS2}$$
$$4a[3] + 5a[4] + 6a[5] - 3a[3] - 3a[4] - 3a[5]$$
$$= \underline{a[3] + 2a[4] + 3a[5]}$$