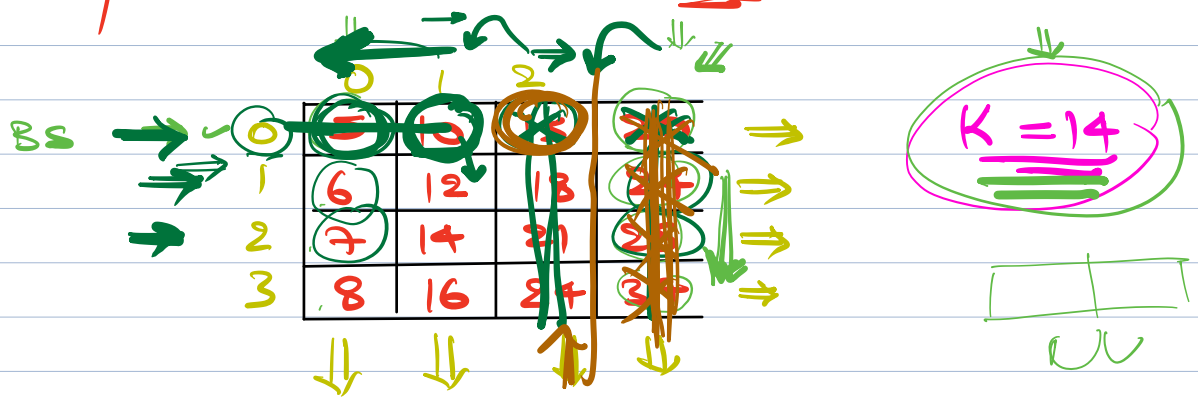
Q. Given a row-wise sorted & col wise sorted matrix. ⇒ N X M

Return true if an element K is present in the matrix



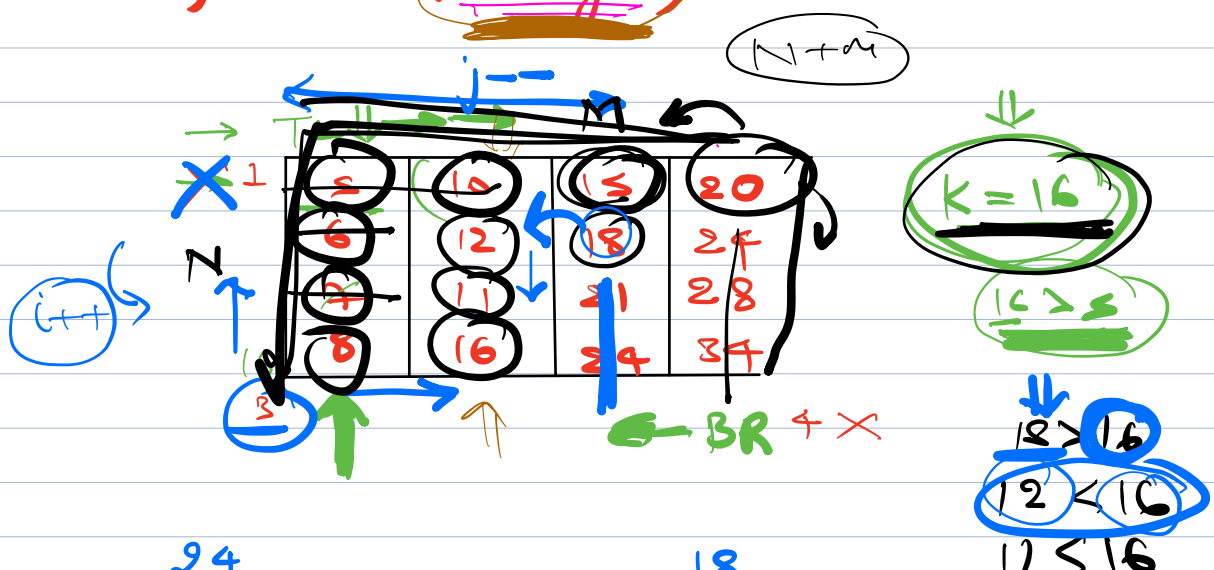
14 < 20

14 < 15

14 > 10

BF ⇒ BS

O(N x M) → O(N x log M)



T.C. = O(M + N)

1 step ⇒ removing 1 row (or) removing 1 col

N + M

Code

Ashwin

i = 0, j = M-1

H.W.

while (___) {

```
if (M[i][j] == k) {
    return True;
}
if (K < M[i][j]) {
    j--;
}
else {
    i++;
}
}
return false;
```

Q. Given an integer array of size N.

Google Microsoft Amazon

find the max value of f(i, j)

$$f(i,j) = |A[i] - A[j]| + |i - j|$$

→ |x| = abs(x)

$x = 7 \Rightarrow |7| = +7$

$x = -11 \Rightarrow |-11| = +11$

$x < 0 \Rightarrow -(x) \Rightarrow -(-11) = 11$

$\Rightarrow |x|$: $x > 0 \Rightarrow x$; $x < 0 \Rightarrow -(x)$

$f(i,j) = |A[i] - A[j]| + |i - j|$

$(i,j) = (j,i)$

Eg

A : { 1 3 -1 } (0 1 2)

i	j
0	0
0	1
0	2
1	0
1	1
1	2
2	0
2	1
2	2

$f(i,j)$

$|1-1| + |0-0| = 0$

$|1-3| + |0-1| = 3$

$|1-(-1)| + |0-2| = 4$

$|3-1| + |1-0| = 3$

$|3-3| + |1-1| = 0$

$|3-(-1)| + |1-2| = 5$

$|-1-1| + |2-0| = 4$

$|-1-3| + |2-1| = 5$

$|-1-(-1)| + |2-2| = 0$

Ans = 5

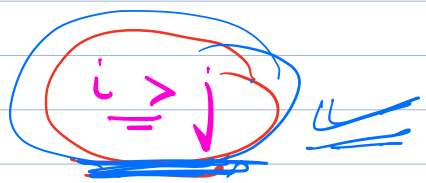
T.C. of Brute force = $O(N^2)$

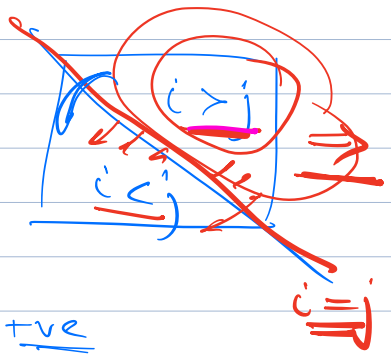
abs( )

Obs

1) $i = j$ ans = 0

2) $(i, j) = (j, i)$





$f(x) = |A[i] - A[j]| + |i - j|$ (+ve)

$i - j > 0$

$|(A[i] - A[j])| + (i - j)$

(+v; $A[i] - A[j]$: +ve, -ve)

$i > j$

A: [1, 3, 5, 9, 7] (indices 0, 1, 2, 3, 4)

$i = 1, \; j = 0$

$A[i] - A[j] = 3 - 1 \geq 0$

$i = 4, \; j = 3 = 7 - 9 = -2 < 0$

Case 1 : $A[i] > A[j]$

$$f(x) = A[i] - A[j] + (i - j)$$

$$= A[i] + i - A[j] - j$$

$$f(x) = (A[i] + i) - (A[j] + j)$$

(Max) (Min)

Case 2 if $(A[i] < A[j])$

$$A[i] - A[j] < 0$$

$$f(x) = |A[i] - A[j]| + (i - j)$$

(-ve)

$$f(x) = -(A[i] - A[j]) + (i - j)$$

$$= -A[i] + A[j] + i - j$$

$$= A[j] - j - A[i] + i$$

$$f(x) = (A[j] - j) - (A[i] - i)$$

$$f(x) = |A[i] - A[j]| + |i - j|$$

1) $i > j$ $\forall i, j$ s.t cal $f(i, j)$ & not

$i > j$ & max

Case 1 $A[i] > A[j]$

$$f(x) = (A[i] + i) - (A[j] + j)$$

Case 2 $A[i] < A[j]$

$$f(x) = (A[j] - j) - (A[i] - i)$$

$$\text{Max}\left(f(x)\right)$$

for Case 1

A → $O(N)$ → X

$$X[j] = A[j] + j$$

$$\Rightarrow X[i] = A[i] + i \quad , \forall i$$

$$f(i,j) = X[i] - X[j] \quad \forall i,j$$

$X[i]$: +ve, max; $X[j]$: -ve, min; $A[1]$

$O(N)$

for Case 2

$$f(x) = (A[j] - j) - (A[i] - i)$$

Y ← A → $O(N)$

$$Y[i] = A[i] - i$$

$Y[j] = A[j] - j$

$f(x) = Y[j] - Y[i]$ A2

$Y[j]$ ⇓ max $Y[i]$ ⇓ min

O(N)

$ans = \max(A_1, A_2)$

T.C. = O(N)

S.C = O(N) H.W. ⇒ O(1)

Nitik Kumar

Bit Manipulation

Bits Variable → 0, 1

Binary representation (Base = 2)

⇓ total no. of unique symbols in that no. system

bit a bits

0, 1 0, 1

a = 0 ~a = 1
a = 1 ~a = 0

	a	b	OR (1) (at least one)	AND (2) (both or 1)	XOR (exactly one is true)
1	0	0	0	0	0
2	0	1	1	0	1
3	1	0	1	0	1
4	1	1	1	1	0

bit = 0 (false, Not set)

bit = 1 (true, set)

INT ⇒ 4 bytes ⇒ 32 bits

int a = _

1) 0 1 1 1 1

2) 1 0 0 0 0

2 > 1

MSB Overpowers

MSB

LSB

2^{N-1} 2^{N-2} 2^{N-3} ..... 2^3 2^2 2^1 2^0

Max possible value ⇒ All bits 1

$2^0 + 2^1 + 2^2 \ldots\ldots 2^{N-1}$ ⇒ N terms

$a = 1$

$r = 2$

$$1\left(\frac{2^N - 1}{2 - 1}\right) = 2^N - 1$$

INT ⇒ 32

Max = $2^{32} - 1$

Min =

Min possible ⇒ zero

= 0

XOR

1) A^0 =

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

Set

A

2) $A \wedge A = 0$

3) $A \wedge 1 =$

Even

$0 \wedge 1 = 1$

$1 \wedge 1 = 0$

So

1 → 0 0 0 0 0 1

$2^0 = 1$

$-2^0 = 1$

```
 100        101
 001        001
 ---        ---
 101        100
```

A ⇒ Even ⇒ $A \wedge 1 =$ A+1 (odd)

A ⇒ Odd ⇒ $A \wedge 1 =$ A-1 (Even)

Shift Operators

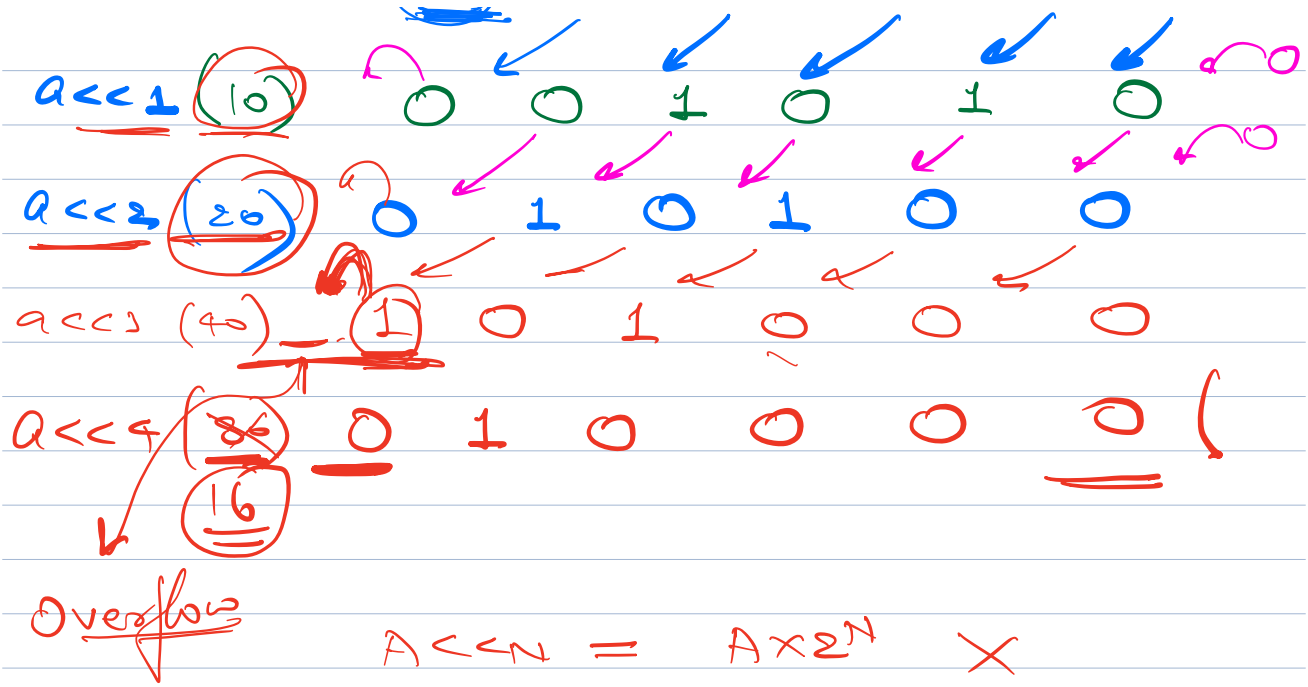
Left (<<)

Right (>>)

```
int x
x = x >> 2;      // temp
x = x + 5;       // temp   (x = 10)
```

(6 bits)

a = 5 = 0 0 0 1 0 1

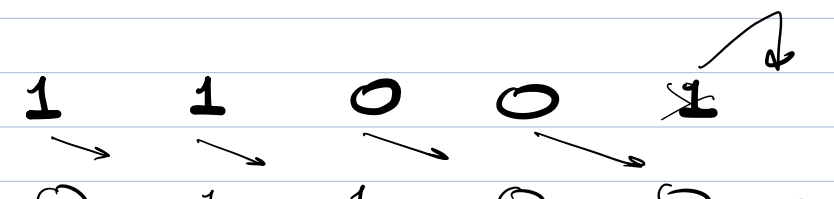


$A << N = A \times 2^N$ ✗

Right Shift

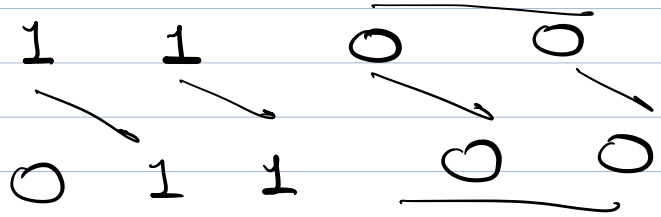
$a = 25/2$

$= 12$



$a = 24/12$

$= 12$



N >>N 0 (N-1) $0/2 = 0$

$A >> N = A / 2^N$

Even no N $N/2 = (N+1)/2$

Mist 0 1 2

Y:

A: {1, 3, -1}

X [1, 4, 1] ⇒ 4 − 1 ≠ 3

Y [1, 2, −3] ⇒ 2 − (−3) = 5

Thought

5