Ques Range Sum queries 1D array

q queries

0	1	2	3	4
1	2	3	4	5
e0	e1	e2	e3	e4

1 query

s = 2
e = 4

→ 12

```
for(i=s; i<=e; i++)
    sum += arr[i];
```

3

TC → O(n * q)

psum	0	1	2	3	4
	1	3	6	10	15

Sum of all the elements from 0 to 3

What
Why
how

→ psum[e] - psum[s] + arr[s]

(e0+e1+e2+e3+e4) - (e0+e1+e2)

+e2

e0+e1+e2+e3+e4 - e0 - e1 - e2

+e2

⇒ e2+e3+e

TC ⇒ O(n+q)

```
for(i=1; i<n ;i++)
    psum[i] = psum[i-1] + arr[i];
```

$\Rightarrow O(n)$

answer 1 query $\Rightarrow$ TC $\Rightarrow O(1)$

q $\Rightarrow$ TC $\Rightarrow O(n)$

TC $\Rightarrow O(n+q)$

Query Submatrix Sum Queries 2D array

q queries

1 query {

tr r = 1

tr c = 2

br r = 2

br c = 3

}

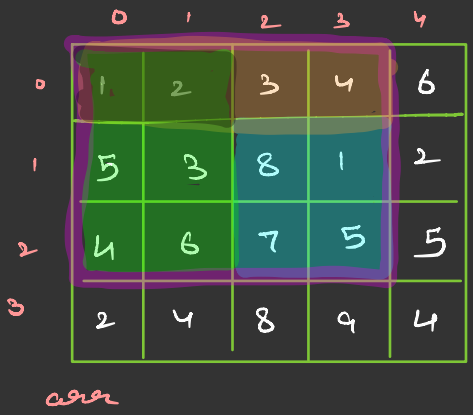
3

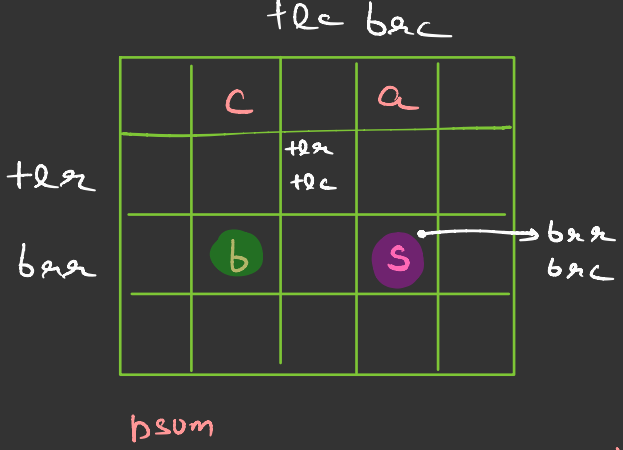
	0	1	2	3	4
0	1	2	3	4	6
1	5	3	8	1	2
2	4	6	7	5	5
3	2	4	8	9	4

```
for( r = tlr; r <= brr; r++) {
    for( c = tlc; c <= brc; c++) {
        sum += arr[r][c];
    }
}
```

$$TC \Rightarrow O(n \times m \times q)$$

1 query





what
why
how

$tlr = 1$ $\quad tlc = 2$ $\quad brr = 2$ $\quad brc = 3$

$a(tlr-1, brc)$

$b(brr, tlc-1)$

$c(tlr-1, tlc-1)$

$s(brr, brc)$

$ans = S - extra$ area

$= S - a - b + c$

TC ⇒ O(n*m + q)

	0	1	2	3	4
0	1	2	3	4	6
1	5	3	8	1	2
2	4	6	7	5	5
3	2	4	8	9	4

matrix

	0	1	2	3	4
0	1	3	6	10	16
1	6	11	22	27	35
2	10				
3	12				

sum

```java
public void fillPrefixSum() {
    sum[0][0] = matrix[0][0];

    // filling first row
    for(int i= 1; i < sum[0].length; i++)
        sum[0][i] = sum[0][i - 1] + matrix[0][i];

    // filling first column
    for(int i = 1; i < sum.length; i++)
        sum[i][0] = sum[i-1][0] + matrix[i][0];

    for(int r = 1; r < sum.length; r++) {
        for(int c = 1; c < sum[0].length; c++) {
            sum[r][c] = sum[r - 1][c]
            + sum[r][c-1]
            - sum[r - 1][c - 1]
            + matrix[r][c];
        }
    }
}
```