Todays Content.

1. Rotate 90°
2. Matrin Multiplicatim
3. Set zero

1Q: Rotate mat[N][N] rotate by 90° Clockwise

	0	1	2	3	4
0	1	2	3	4	5
1	6	7	8	9	10
2	11	12	13	14	15
3	16	17	18	19	20
4	21	22	23	24	26

$\xrightarrow{\text{Rotate } 90^\circ}$

	0	1	2	3	4
0	21	16	11	6	1
1	22	17	12	7	2
2	23	18	13	8	3
3	24	19	14	9	9
4	25	20	15	10	5

Approach:

Expected TC: $O(N^2 + N^2) = O(N^2)$

1. Take transpose of mat[][]. ✓
2. Reverse each row. ✓

	0	1	2	3	4
0	1	6	11	16	21
1	2	7	12	17	22
2	3	8	13	18	23
3	4	9	14	19	24
4	5	10	15	20	25

$\xrightarrow{\text{Reverse each row}}$

	0	1	2	3	4
0	21	16	11	6	1
1	22	17	12	7	2
2	23	18	13	8	3
3	24	19	14	9	9
4	25	20	15	10	5

```
vector<vector<int>> Rotate90(vector<vector<int>> A){ TODO

}
```

Matrix Multiplication.

A[3 4] * B[4 2] = R[3 2]

A[2 5] * B[5 3] = R[2 3]

A[3 4] * B[5 2] = Not multiply

Rule1: A * B = R

$r_1 * c_1 == r_2 * c_2$ $\quad$ $r_1 \; c_2$

$r_1 \; c_1 \quad r_2 \; c_2$ = R

A[3 4] B[4 2] $\quad$ 3 * 2

A : 3*4 $\qquad$ B : 4*2 $\qquad$ C : 3*2

$$\begin{array}{c|cccc} & 0 & 1 & 2 & 3 \\ \hline 0 & 1 & 2 & 0 & 1 \\ 1 & 3 & 2 & 1 & 4 \\ 2 & -1 & 0 & 1 & 2 \end{array} \qquad \begin{array}{c|cc} & 0 & 1 \\ \hline 0 & 2 & 1 \\ 1 & 1 & 0 \\ 2 & -1 & 1 \\ 3 & 2 & -1 \end{array} = \begin{array}{c|cc} & 0 & 1 \\ \hline 0 & 6 & 0 \\ 1 & 15 & 0 \\ 2 & 1 & -2 \end{array}$$

C[0][0] = Multiply 0^{th} row in A * 0^{th} col in B

C[0][1] = Multiply 0^{th} row in A * 1^{th} col in B

C[1][0] = Multiply 1^{st} row in A * 0^{th} col in B

C[1][1] = Multiply 1^{st} row in A * 1^{st} col in B

C[2][0] = Multiply 2^{nd} row in A * 0^{th} col in B

C[2][1] = Multiply 2^{nd} row in A * 1^{st} col in B

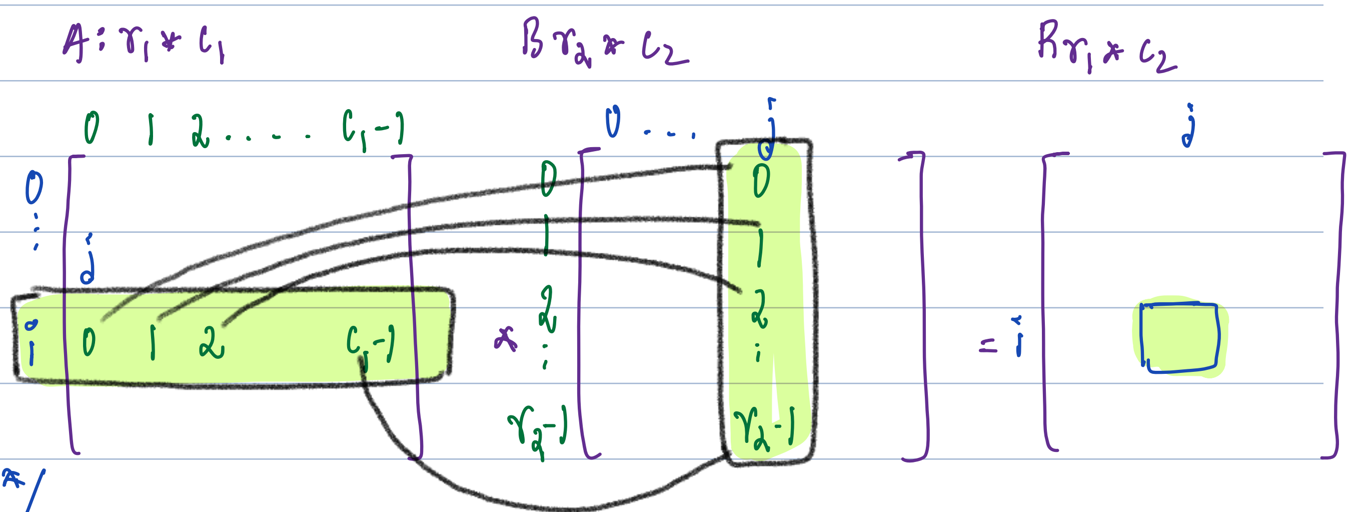
$$\boxed{\# \; C[i][j] = \text{Multiply } i^{th} \text{ row in A * } j^{th} \text{ col in B}}$$

TC: $O(r_1 c_2 * c_1)$ SC: $O(1)$ → Neglect input & output space.

```
vector<vector<int>> mul(vector<vector<int>> A, vector<vector<int>> B){
    int r1 = A.size(), c1 = A[0].size();
    int r2 = B.size(), c2 = B[0].size();

    # A r1 c1 * B r2 c2 , given c1 == r2 we can multiply = R r1 c2

    vector<vector<int>> R(r1, vector<int>(c2)); # mat r1 c2;
    for(int i=0; i<r1; i++){
        for(int j=0; j<c2; j++){
            # R[i,j] = Multiply i^th row in A * j^th col in B
            /*
```




```
            */
            long prod = 0;
            for( int k=0; k<c1; k++){
                prod = prod + A[i][k] * B[k][j];
            }

            R[i][j] = prod;
        }
    }
    return R;
}
```

Tracing:

k	
0	A[i][0] * B[0][j]
1	A[i][1] * B[1][j]
2	A[i][2] * B[2][j]
:	
c_1-1	A[i][c_1-1] * B[c_1-1][j]

#Note: $B[c_1-1][j] = B[r_2-1][j]$, $c_1 == r_2$