Practice Problems – 2D array

1. Write a program to perform row-wise average of a 2D array. You should create a new 1D array with the row averages.

2. Write a program to find the column of a 2D array which have the second largest sum. You should print the index of the column having second largest sum.
   Example:
   $A = \begin{bmatrix} 5 & 8 & 1 & \mathbf{7} \\ -8 & 5 & 5 & \mathbf{1} \\ 8 & 3 & 1 & \mathbf{0} \end{bmatrix}$ Here, the column in index 3 has the second highest summation.

3. Write a program to sort a 2D array based on the column-wise sum in ascending order.
   $A = \begin{bmatrix} 5 & 8 & 1 & 7 \\ -8 & 5 & 2 & 1 \\ 8 & 3 & 1 & 0 \end{bmatrix}$ The resultant matrix will be: $\begin{bmatrix} 8 & 7 & 5 & 1 \\ 5 & 1 & -8 & 2 \\ 3 & 0 & 8 & 1 \end{bmatrix}$
   Explanation: In the resultant matrix, the first column has the highest sum, second column has the second-highest sum, and so on.

4. Write a program to determine whether a matrix is a skew symmetric matrix or not. A skew-symmetric (or antisymmetric or antimetric) matrix is a square matrix whose transpose equals its negative.
   Example: $A = \begin{bmatrix} 0 & 2 & -45 \\ -2 & 0 & -4 \\ 45 & 4 & 0 \end{bmatrix}$ is a skew symmetric matrix because $A^T = -A$.

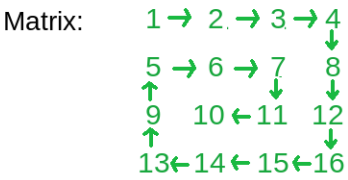
5. Write a program to rotate a square matrix by 90 (opposite of transpose).
   Example: $A = \begin{bmatrix} 5 & 8 & 9 \\ 2 & 0 & 5 \\ 6 & 1 & 7 \end{bmatrix}$, after rotation $\begin{bmatrix} 6 & 2 & 5 \\ 1 & 0 & 8 \\ 7 & 5 & 9 \end{bmatrix}$.

6. Write a program to determine whether a given matrix is a magic square or not. A Magic Square is a n x n matrix of the distinct elements from 1 to n^2 where the sum of any row, column, or diagonal is always equal to the same number.
   Example: $A = \begin{bmatrix} 2 & 7 & 6 \\ 9 & 5 & 1 \\ 4 & 3 & 8 \end{bmatrix}$ is a magic square because the sum of each row, column, and diagonal is 15.
   $A = \begin{bmatrix} 5 & 8 & 9 \\ 2 & 0 & 5 \\ 6 & 1 & 7 \end{bmatrix}$ is not a magic square.

7. Write a program to perform element-wise multiplication of two given matrices (Kronecker Product).
   $A = \begin{bmatrix} 5 & 8 & 9 \\ 2 & 0 & 5 \\ 6 & 1 & 7 \end{bmatrix}, B = \begin{bmatrix} 6 & 2 & 5 \\ 1 & 0 & 8 \\ 7 & 5 & 9 \end{bmatrix}$ after element-wise multiplication, the result is: $\begin{bmatrix} 30 & 16 & 45 \\ 2 & 0 & 40 \\ 42 & 5 & 63 \end{bmatrix}$

8. Given a Boolean matrix A[M][N] of size M × N, modify it such that if a matrix cell A[i][j] is 1 (or true) then make all the cells of i-th row and j-th column as 1.
   Example: $A = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ after making the changes $A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \end{bmatrix}$

9. Given a 2D array, print it in spiral form. See the following examples.



Output:
1, 2, 3, 4, 8, 12, 16, 15, 14, 13, 9, 5, 6, 7, 11, 10

10. Write a program to find all the common elements in all rows of a matrix.
    $\begin{bmatrix} 5 & 8 & 1 & 7 \\ 8 & 5 & 2 & 1 \\ 8 & 3 & 5 & 0 \end{bmatrix}$ in this matrix, 5 and 8 are common in all rows.