Group A: 8 An m x n matrix is said to have a saddle point if some entry a[i][j] is the smallest value in row i and the largest value in j. Write C/ C++ function that determines the location of a saddle point if one exists.

//PROBLEM:WRITE A PROGRAM TO FIND THE SADDLE POINT OF A MATRIX, IF IT EXISTS

**#include** <stdio.h>

**#define** M 3

**#define** N 3

**int** **findMin**( **int** a[][N], **int** row )

{

/\*

\* find min value in row of a.

\* return the value.

\*/

**int** min = a[row][0];

**int** j;

**for**( j=1; j<N; ++j )

**if**( a[row][j] < min )

min = a[row][j];

**return** min;

}

**int** **findMax**( **int** a[][N], **int** col )

{

/\*

\* find max val in col of a.

\* return the value.

\*/

**int** max = a[0][col];

**int** i;

**for**( i=1; i<M; ++i )

**if**( a[i][col] > max )

max = a[i][col];

**return** max;

}

**void** **saddle**( **int** a[][N] )

{

/\*

\* finds ALL saddle points of a if exist.

\*/

**int** i, j;

**for**( i=0; i<M; ++i )

{

**int** min = findMin( a, i );

**for**( j=0; j<N; ++j )

{

**int** max;

max = findMax( a, j );

**if**( min == max )

**printf**( "Saddle : (%d,%d).\n", i, j );

}

}

}

**int** **main**()

{

//int a[M][N] = {5,7,3,7,7,9,7,1,2};

**int** a[M][N] = {1,2,3,4,5,6,7,8,9};

**int** row, col;

saddle(a);

**return** 0;

}

output:

Saddle : (1,0).

Saddle : (1,1).

/\*Explanation

An M × N matrix is said to have a saddle point if some entry a[i][j] is the

smallest in row i and the largest in column j. In the following example matrix, 7 is the saddle point.

| 1 2 3 |

a = | 4 5 6 |

| 7 8 9 |

The program is simple and could be completed in O(M × N × M) time by using

nested for loops. The algorithm is as follows:

for i=0 to M-1 {

min = minimum value in row i. // findMin().

for j=0 to N-1 {

max = maximum value in column j. // findMax().

if (min == max)

print "saddle found at row ", i, "and column ", j.

}

}

Finding the minimum in a row is O(N) and finding the maximum in a column is O(M). Thus the complexity of the algorithm becomes O(M\*(N+N\*M)), or O(M\*N\*M).

Points to Remember

A saddle point is the value which is minimum in the row and maximum in the column.

There can be more than one saddle point in a matrix.

There may be no saddle point in a matrix.

The complexity of the algorithm is O(M × M × N), where M × N is the size of the matrix.\*/