CS29003 ALGORITHMS LABORATORY
ASSIGNMENT 8
Date: 12th Sep, 2019

Important Instructions

1. **Output Files to be submitted:** ROLLNO_A8.c/.cpp
2. You are to **stick to the file input output formats strictly** as per the instructions.
3. Submission through **.zip files are not allowed**.
4. Write your name and roll number at the beginning of your program.
5. Do not use any global variable unless you are explicitly instructed so.
6. Use proper indentation in your code.
7. Please follow all the guidelines. Failing to do so will cause you to lose marks.
8. **There will be part marking.**

The Game House

Problem Statement

The game house consists of rooms arranged in the form of a rectangular grid. Each room has a game with certain difficulty level. You can play the games in the rooms you visit. In general, you want to play the maximum number of games as per the constraints given in various parts. The movements between the rooms is restricted as per the grid (thus, in the grid below, you can not go from (0,0) to (1,1) ever but can go to (0,1) or (1,0), if allowed by the constraints). Each of the parts below provide further constrains for the movement.

Part 1.

In this part, you can start from any room and allowed to move from room i to room j if the following conditions are satisfied :
1. Room j is adjacent to room i and
2. Difficulty level of the game in room i is less than difficulty of room j and
3. Room j is either to the right of room i or below room i.
Under these constraints, what is the maximum number of games you can play?

Eg: In the house shown below (Example for Part 1), you can play a maximum of 5 games, the maximum is obtained when started from the room at top left corner, i.e, the room at location (0,0).

Part 2.

In this part, you need to start from the room at top left corner and are allowed to move from room i to room j if the following conditions are satisfied :
1. room j is adjacent to room i, and
2. Difficulty of room i is less than difficulty of room j.

What is the maximum number of games you can play?

Hint : Treat each room in the House as a node in the graph, the graph has an edge from room i to room j if you can move from room i to room j. The maximum no. of games you can play will be the no. of nodes in the longest path starting from the room at (0,0). Use DFS to find the no. of nodes on the longest path. **However, note that there is no need to create the graph explicitly.**

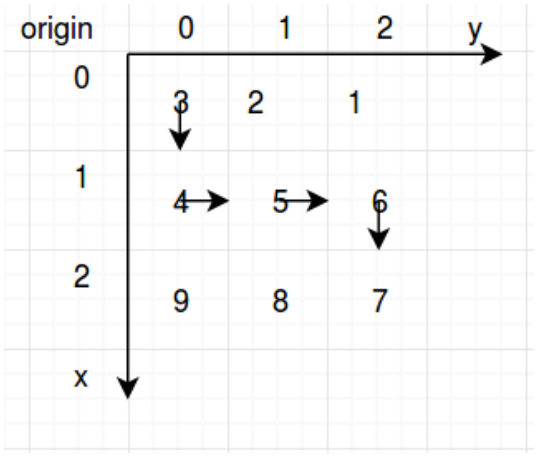

Figure 1: Example: Part 1

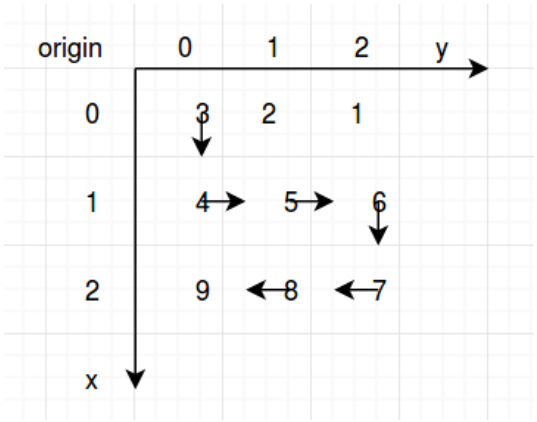

Figure 2: Example: Part 2

Eg: In the house shown below (example for part 2), you can play a maximum of 7 games when started from top left corner.

Part 3.

In this part, you can start from any room and allowed to move from room i to room j if the following conditions are satisfied :
1. room j is adjacent to room i and
2. Difficulty of room i is less than difficulty of room j
What is the maximum number of games you can play?
Hint: In this case as well, we can treat the house as a graph as described in part 2 and find the longest path from each of the nodes and take the maximum. But this takes O((no.of rooms)*(no.of rooms)). Can you reduce this to O(no.of rooms)?

Eg: In the house shown below (example for part 3) you can play a maximum of 9 games, the maximum is obtained when started from (0,2).

Note

Expected time complexity is **O(no.of rooms)** for all the parts.

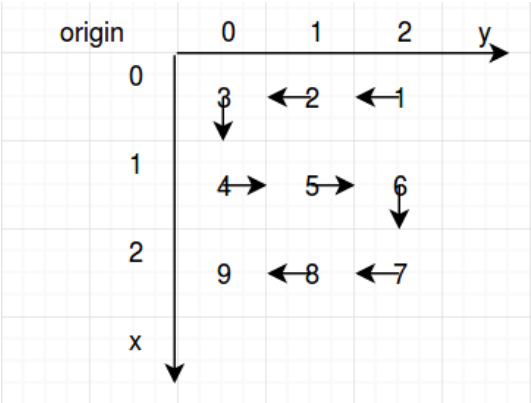

Figure 3: Example: Part 3

Input format

1. The first line of the input contains a single integer T denoting the number of test cases. The description of T test cases follows.
2. The first of each test case contains two space-separated integers N (no.of rows) and M (no.of columns).
3. Each of the next N lines contains M space separated integers denoting the difficulty level of the rooms in that row.

Output format

1. For each test case, print a single line containing three space separated integers in the format : answer1 answer2 answer3
2. Where answer1 is the answer for part 1
3. If you did not solve any part, print the value as -1.

Sample Input - “input.txt”

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

Sample Output - “output.txt”

```
5 7 9
4 4 5
```

File Naming Convention

Submit a single file with the naming convention : <ROLLNO(IN CAPS)>_A<Assign_No>.c/cpp