Problem 99: 99 BALICO bricks in the wall
5 Points

Problem ID: `bricc`
Rank: `2`

Special Acknowledgement: This problem is not like the others! Rather than being written by a student at UC Berkeley, Narayan is a high school senior from the Bay Area who attended CALICO competitions in the past! The problem statement below (in addition to the problem's test cases) were written by Narayan, and is presented here with their permission—modified only as needed to fit within our format.

Introduction

99 BALICO bricks in the wall, 99 BALICO bricks. Mung Yooney takes one down, passes it around, 98 BALICO bricks in the wall.

The year is 20XX. The programming competition BALICO, having run out of bricks to loot from the blueberry river, has resorted to legally acquiring them from buildings in the fictional campus of CU Brickley. The leaders of BALICO: Mung Yooney and Beftaderp, decide that they will be the ones to coerce the bricks out of their grout laden homes. However, they want to minimize the damage to the wall so that their actions go unnoticed. Mung Yooney and Beftaderp know how many bricks they have time to take, and luckily for you, they snapped a quick picture of the wall they want to pilfer on their way to class! It's your job as the unpaid BALICO intern to figure out which bricks they should take!

Problem Statement

You are given a brick wall that is $\mathbf{H}$ spaces tall, $\mathbf{W}$ spaces wide, containing $\mathbf{B}$ bricks, where **each brick has a unique numerical ID** numbered from 1 to $\mathbf{B}$ (inclusive). A single brick is defined as all of the spaces on the wall that share a given numerical ID. **Spaces sharing the same numerical ID will always be connected**. In other words, all spaces with the same ID can be connected by other spaces with the same ID, excluding diagonals. The integer 0 represents air (I wonder what happened to all those bricks).

The damage done to the wall by removing a brick is denoted by the number of spaces that the brick occupies. In other words, the damage done to the wall by removing brick i is equivalent to the number of times i occurs in the wall. Find the minimum damage Mung Yooney and Beftaderp can do to the wall after removing $\mathbf{M}$ bricks.

Note that Mung Yooney and Beftaderp do not care about the size of the bricks, they just care about how many bricks they can gather.

*Note: This problem—alongside **no other problems in this contest**—does not have templates available in Python, Java, or C++! You cannot find them in the contest.zip not provided at the start of the contest. Templates parse the input into a neat function to fill out, so you can jump right into problem solving!*

Input Format

The first line of the input contains a positive integer $\mathbf{T}$ denoting the number of test cases that follow. For each test case:

- The first line contains four space-separated integers $\mathbf{W}$ $\mathbf{H}$ $\mathbf{B}$ $\mathbf{M}$, where:
  - $\mathbf{W}$ denotes the width of the wall, in spaces
  - $\mathbf{H}$ denotes the height of the wall, in spaces
  - $\mathbf{B}$ denotes the number of bricks in the wall
  - $\mathbf{M}$ denotes the amount of bricks that Mung Yooney and Beftaderp want to take
- The next $\mathbf{H}$ lines each contain $\mathbf{W}$ space-separated integers $\mathbf{X_1}$ $\mathbf{X_2}$ … $\mathbf{X_W}$, where $\mathbf{X}_j = i$ represents that column j of that row is occupied by brick i. If $\mathbf{X}_j = 0$, the space is instead occupied by air

Output Format

For each test case, output the minimum damage that Mung Yooney and Beftaderp can do to the wall after taking $\mathbf{M}$ bricks.

Problem Constraints

$1 \le \mathbf{T} \le 100$

$1 \le \mathbf{W}, \mathbf{H} \le 20$

$1 \le \mathbf{M} \le \mathbf{B} \le \mathbf{WH}$

Sample Test Cases

Sample Input *Download*

```
4
2 3 2 1
0 1
2 1
2 2
5 3 6 6
1 1 5 3 4
0 0 2 3 4
0 0 3 3 6
11 3 8 3
0 1 2 0 4 3 0 5 5 7 0
1 1 1 4 4 3 8 8 7 7 7
0 1 4 4 0 3 3 6 6 6 6
14 1 14 2
7 9 13 4 5 8 11 3 10 12 1 6 14
2
```

Sample Output *Download*

```
2
11
5
2
```

Sample Explanations

Test Case #1:

The wall is two spaces wide and three spaces tall, and looks like this:

```
0 1
2 1
2 2
```

Because $\mathbf{M}$ = 1, Yung Mooney and Beftaderp only want to take one brick from the wall. Removing brick i = 1 would deal 2 damage to the wall, while removing brick i = 2 would deal 3 damage. As a result, the minimum damage they can do to the wall after taking 1 brick is 2.

Test Case #2:

$\mathbf{M}$ = $\mathbf{B}$ = 6, so Yung Mooney and Beftaderp must take all bricks from the wall, dealing 11 damage in total.

Test Case #3:

Note that unlike bricks, air does not need to be connected to other air spaces.

Test Case #4:

Since all bricks occupy one space on the wall, taking any $\mathbf{M}$ = 2 will deal the minimum damage of 2 to the wall.