

CS102A Spring 2020 Assignment 3

Problems

- Problem 1: A Strange Love Letter [Easy, 20 marks]
- Problem 2: Roman numerals [Medium, 20 marks]
- Problem 3: Serpentine matrix [Hard, 20 marks]
- Problem 4: Flat a Sub-matrix and sort it [Medium, 20 marks]
- Problem 5: Sudoku [Medium, 20 marks]

Notes for this lab

1. Use the language specified (Java) in the lab / problem description.
Use **Main** as the class name, and **DO NOT** include package in your submission.
2. Submit solutions before deadline, and **don't wait until the last minute**. The server might be overloaded and your submission will wait a long time before getting judged.
3. The required method of **problem 4** must be implemented, otherwise it will affect your score.
4. Finish problems by yourself ($\geq \forall \leq$)
5. enjoy!

Problem 1. A Strange Love Letter [Easy, 20 marks]

Description

Yanyan received a love letter today, but when he opened the envelop to read the letter, he found that the content was just some unreadable words. Then he found a small piece of paper with code table written on it.

However, Yanyan is not good at decoding, so he asks you to decode the letter for him.

Input

Using `System.in`

The first line contains a string with 26 characters which displays the the corresponding original message from 'a' to 'z'.

The second line contains a string which is part of the content from the letter.

Remind: ONLY the English letters should be decoded. The case of the letters remains the same after decryption.

Output

The original message of the part of the content from the letter indicating the result.

Sample Input

```
fg hijklm nopqrst uvwxyz abcde  
Tjp vmz ocdifdib kvxc!
```

Sample Output

```
You are thinking peach!
```

Explanation

The first line indicates the following code table:

Cipher-text(密文字母): a b c d e f g h i j k l m n o p q r s t u v w x y z

Translation(译文字母): f g h i j k l m n o p q r s t u v w x y z a b c d e

And notice that upper case English letters satisfies the same rule:

Cipher-text(密文字母): A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Translation(译文字母): F G H I J K L M N O P Q R S T U V W X Y Z A B C D E

The rest characters, such as ' ', '!', '?' and so on, should always remain the same after decoding.

Problem 2. Roman numerals [Medium, 20 marks]

Description

Roman numeral, any of the symbols used in a system of numerical notation based on the Roman system. The symbols are I, V, X, L, C, D, and M, standing respectively for 1, 5, 10, 50, 100, 500, and 1,000 in the arabic numeral system.

| Symbol | I | V | X | L | C | D | M |
|--------|---|---|----|----|-----|-----|-------|
| Value | 1 | 5 | 10 | 50 | 100 | 500 | 1,000 |

For instance, The number 2 is represented by II in roman numerals, 12 is expressed by XII meaning X + II , and 27 is denoted by XXVII , which is equal to XX + V + II.

In the Roman numeral system, The smaller number usually on the right of the bigger one, yet existing some exceptions. The number 4 is not denoted by IIII , but IV. The I on the left of V means V minus I (5-1). In the same way, the number 9 can be represented by IX. This special rule only applies to the following situations:

- I can be on the left of V (5) or X (10), to denote 4 or 9.
- X can be on the left of L (50) or C (100), to denote 40 or 90.
- C can be on the left of D (500) or M (1000), to denote 400 or 900.

In this problem, we want you to transform a roman number (corresponding Arabic number range is from 1 to 3999) to Arabic number.

Input

Using `System.in`

One line contains a string with a roman number (corresponding Arabic number range is from 1 to 3999)

Output

The corresponding Arabic number(in decimal).

Sample Input

```
IX
```

Sample Output

```
9
```

hint

Following this rule:

If the value represented by a symbol is greater than or equal to the value represented by its next character, it is "added";

If it is less than the value represented by its next symbol, it is "minus".

Note that the last symbol has no "next", it must be plus.

Problem 3. Serpentine matrix [Hard, 20 marks]

Description

Serpentine matrix is a kind of matrix made up by sequence of consecutive positive integers. You are asked to generate a $m \times n$ sized Serpentine matrix (m rows, n columns) according to the following rules:

- The elements used to build the matrix are **1, 2, 3,, $m \times n - 1, m \times n$**
- **1** (the first element) is at the upper right corner. Because the diagonally layer of 1 now is full, you are asked to put **2** (the second element) downside of **1**.
- To fill up the second diagonally layer, **3**'s position is at the top left corner of **2**.
- Go downward/leftward when countering the border.
- Keep filling up the matrix until all the position are filled with numbers (it also means the order you get there).

Input

Using `System.in`

The only line contains two integers **m, n** denoting the matrix has **m** rows and **n** columns.

It is guaranteed that $0 < n < 100$, $0 < m < 100$, $0 < m * n < 100$

Output

An $m * n$ Serpentine matrix.

m lines represent m rows of the matrix.

Each line, n numbers are asked to be separated by white spaces

Note: To make the matrix look beautiful, you are asked to print each number using **%3d**.

Sample Input

```
3 4
```

Sample Output

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

Problem 4. Flat a Sub-matrix and sort it [Medium, 20 marks]

Description

Definition for Sub-matrix:

Given a $m * n$ matrix X ($m * n$ means m rows and n columns), then given two elements $X[x1][y1]$ and $X[x2][y2]$ ($0 \leq x1 \leq x2 < m$, $0 \leq y1 \leq y2 < n$). Please write a program to sort all the integers in the sub-matrix determined by the two elements.

A sub-matrix means a matrix inside of the origin matrix X which left-up element is $X[x1][y1]$, and right-down element is $X[x2][y2]$.

Here is an example:

Matrix $X(4 * 5)$:

```
1 2 3 9 5
6 7 8 11 10
11 12 13 14 15
16 17 18 19 20
```

Sub-matrix S , from $X[0][2]$ to $X[1][4]$, is:

```
3 9 5
8 11 10
```

Flat a sub-matrix S line by line to an array A .

Output array **A**:

```
3 9 5 8 11 10
```

Sort array **A** and output it:

```
3 5 8 9 10 11
```

In this question you must design 2 methods:

1. Method to flat the sub-matrix:

```
public static int[] flatSubMatrix(int[][] matrix, int x1, int x2, int y1, int y2)
//Inputs are Matrix X and the indexes of elements X[x1][y1] and X[x2][y2].
//Return the flated array A.
```

2. Method to sort the array:

```
public static int[] Sort(int[] array).
//Inputs is the flated array A.
//Return the sorted array.
```

note:

The required method must be implemented, otherwise it will affect your score.

Input

Using `System.in`

There are **m+2** lines in total.

The first line contains two integers **m, n**, denoting the matrix has **m** rows and **n** columns.
0<m<250, 0<n<250.

The following **m** lines have **n** integers each line, denoting the elements of the matrix.

The last line have four integers **x1, x2, y1, y2** (**0<=x1<= x2<m, 0<=y1<= y2<n**), denoting indexes of left-up element **X[x1][y1]** and right-down element **X[x2][y2]**.

Output

The sorted array.

Sample Input

```
4 5
1 2 3 9 5
6 7 8 11 10
11 12 13 14 15
16 17 18 19 20
0 1 2 4
```

Sample Output

hint

You can use bubble sort to sort the array. Search "Bubble sort" on the Internet and realize it by yourself.

Problem 5. Sudoku [Medium, 20 marks]

Description

Sudoku is a famous mathematical game in which players fill numbers 1-9 in a 9×9 square. The square satisfies that every row and every column contain 1-9 only once. Specially, the square is divided into 9 sub-squares (as shown below), and every sub-squares also contains 1-9 only once. Following is a valid Sudoku square (Notice that the sub-squares are separated by red lines).

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2 | 9 | 3 | 7 | 1 | 5 | 4 | 8 | 6 |
| 8 | 6 | 1 | 2 | 4 | 9 | 5 | 3 | 7 |
| 7 | 4 | 5 | 8 | 6 | 3 | 1 | 9 | 2 |
| 6 | 7 | 8 | 9 | 2 | 1 | 3 | 4 | 5 |
| 1 | 3 | 9 | 5 | 7 | 4 | 2 | 6 | 8 |
| 4 | 5 | 2 | 6 | 3 | 8 | 7 | 1 | 9 |
| 9 | 2 | 4 | 3 | 8 | 7 | 6 | 5 | 1 |
| 3 | 8 | 6 | 1 | 5 | 2 | 9 | 7 | 4 |
| 5 | 1 | 7 | 4 | 9 | 6 | 8 | 2 | 3 |

Write a program to judge whether a 9×9 square is a Sudoku square.

- If it is a Sudoku square, print **"Yes"**;
- If it is not a Sudoku square, print **"No"**.

Input

Using `System.in`

There are 9 lines in total denoting the 9×9 square.

Each line has 9 integers separated by whitespace.

Output

- If input is a Sudoku square, print **"Yes"**;
- If input is not a Sudoku square, print **"No"**.

Sample Input

```
1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1
```

Sample Output

No