IOI Training Camp 2010 – Test 3, 19 June, 2010

Problem 2 Substitution Ciphers

Our friend, the king has many enemies and worse, some of these enemies have spies in his government. To ensure that no sensitive information is leaked, the king encrypts his communication with his ministers and other officials.

Unfortunately, the art of cryptography is not highly developed in his kingdom and he uses *substitution ciphers*. In a substitution cipher, a message is encrypted as follows: let us suppose that a message is a sequence of letters from say `1,..., 9`. Fix a permutation of `1,..., 9`. Then the message is encoded by simply replacing each letter in the message with the corresponding letter in the permutation.

For example, if the message is `2 3 1 5 3 5 6` and the permutation is

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

then the encrypted message is `5 6 4 8 6 8 9` (where `1` is replaced by `4`, `2` by `5` and so on). The permutation used in the encryption is called the *key* and anyone who knows the key can decrypt the encrypted message and obtain the original message.

The King often sends large messages to his generals and these messages consist of many lines and each line consists of a sequence of integers in the range `1` $\ldots N$. So, he treats each number in this range as a letter and uses a permutation of `1...` N as a key. This key is known only to his loyal generals.

You have been hired by one the King's enemies to break this cipher. You will be given the encrypted message and asked to determine the key and decrypt the message. This seems hard, given that the number of possible keys is very large. But you have a rather useful bit of information that will help you crack this cipher. The original message was in lexicographic order (That is the dictionary ordering on sequences of integers. For example `345 39 10` comes after `200 890` since `200` is smaller than `345`, and `345 39` comes after `345 21 17` which in turn comes after `345 21` and so on.)

For example if N is 5 and the encrypted message reads as

```
3 4 5
2 4
1 5
4 4
4 4 3
4 4 1
4 5
```

Then, you can check that the only permutation of `1,...,5` that can produce such an encrypted message is

```
3 2 1 4 5
```

Suppose N is 4 and the encrypted message reads as

```
3 2 1
2 4
2 1
```

Then, there are many choices for the set of keys including

```
3 4 2 1
```

and

```
4 1 3 2
```

and others.

Input format

The first line of the input contains two integers N and M. Here $1, \ldots, N$ is the range from which the numbers in the message are drawn. M is the number of lines in the message. The next M lines describe the encrypted message. Line $i+1$ ($1 \leq i \leq M$) describes the ith line in the encrypted message. The first integer on this line (say n) indicates the number of integers in this line and this is followed by n integers in the range $1 \ldots N$.

Output format

If there is a way to break this cipher and obtain a unique key, the first line of the onput must contain the single word YES. In this case, the second line of output must contain a permutation of $1 \ldots N$.

If there are multiple possibilities for the key, then the first line of the output must contain the word NO. This must be followed by two lines of output. These two lines must describe any two different permutations of $1 \ldots N$ that are possible keys using which the encrypted message could have been obtained.

Test Data

You may assume that $1 \leq N \leq 1000$ and that $1 \leq M \leq 10000$. Each line may contain upto 100 integers. You may assume that in 20% of the inputs $N \leq 10$.

Examples

Here are the sample inputs and outputs corresponding to the example discussed above.

Sample input 1

```
5 7
3 3 4 5
2 2 4
2 1 5
2 4 4
3 4 4 3
3 4 4 1
2 4 5
```

Sample output 1

```
YES
3 2 1 4 5
```

Sample input 2

```
4 3
3 2 1
2 4
2 1
```

Sample output 2

```
NO
3 4 2 1
4 1 3 2
```

Time and memory limits

The time limit for this task is 2 seconds. The memory limit is 44 MB (actual limit 32 MB, plus 12 MB buffer for 64-bit compilation).