8357 Equivalence of Sudoku

A Sudoku solution is one 9×9 matrix in which each digit from 1 to 9 occurs only once every row, every column and every 3×3 square. Given one Sudoku solution, S, it is easy to generate many other equivalent solutions, by performing one or more of the elementary transformations: 'R' for a rotation by 90, 180 or 270 degrees, 'M' for a mirror image by flipping along the horizontal or vertical axis, 'B' for a bijective substitution of each of the digits 1 to 9 being mapped to another set of digits 1 to 9. It can be seen that S_1, S_2, and S_3 are all equivalent to S in the following example.

S Sudoku matrix

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

S_1 Rotation of S by 180 degrees

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

S_2 Mirror image of S (flip along y)

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

S_3 Bijection of S: 1↔2,3↔4,5↔6,7↔8

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

A partial Sudoku is one in which not all of the 81 cells are filled up. We say that a partial Sudoku P_1 is subsumed by (less than) another one P_2 if there exists P which is equivalent to P_2, and P is obtained from P_1 by filling in one or more cells. In the following example, P_1 is subsumed by P_2 with respect to P, where P can be obtained from P_2 via a bijective mapping $\{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ $\{2, 9, 3, 7, 8, 6, 1, 5, 4\}$, after rotating P_2 clockwise by 90 degrees. Similarly, we say that P_2 subsumes P_1 or P_2 is greater than P_1 with respect to P. Note that it is not necessary that one of the matrices is completely filled.

P_1

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

P_2

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

P

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

To summarize, between every two Sudoku matrices S_1 and S_2 , there are four possible relationships: S_1 is equivalent to S_2 (`E`), S_1 is less than S_2 (`L`), S_1 is greater than S_2 (`G`), S_1 is incomparable to S_2 (`I`).

Write a program to read in a list of n Sudoku matrices and determine the pairwise relationship between them. The output is an $n \times n$ matrix showing the relationships (`E`, `L`, `G`, `I`). It is obvious that the diagonal elements are all '`E`' (every matrix is equivalent to itself trivially).

Input

The first line contains the number of matrices n.

Each subsequent set of 9 lines corresponds to a (partial) Sudoku matrix. An unfilled cell is represented as '`0`' (instead of blank). Assume that $2 < n \leq 400$, all inputs are correct and all matrices are correct (partial) Sudoku matrices.

Output

For each pair of input matrices, determine the relationship between them and output that relationship as a single letter `O` $\in$ {`E, L, G, I`}, one line for each input matrix.

Sample Input

```
0 7 4 5 2 3 0 9 8
0 0 0 7 9 8 1 4 0
5 9 8 0 4 0 2 3 7
6 3 0 2 7 9 5 8 0
8 4 7 0 5 6 9 2 3
0 2 5 0 8 4 0 0 1
4 8 6 9 1 0 3 5 2
2 1 9 8 3 5 0 7 6
0 5 3 4 0 2 8 0 0
0 0 8 0 5 0 4 7 0
6 1 5 2 0 0 9 8 0
0 3 0 9 0 0 5 0 2
0 0 0 6 7 1 0 9 0
4 6 0 8 9 2 0 0 0
9 0 0 0 0 0 0 0 1
1 0 2 0 8 9 7 6 5
8 0 6 5 1 4 2 3 9
0 0 9 7 2 0 1 4 0
1 7 4 5 2 3 0 9 8
3 0 2 7 9 0 1 4 5
5 9 8 0 4 0 2 3 7
6 3 0 0 7 9 5 8 4
8 4 7 0 5 6 9 0 3
9 2 5 3 8 4 7 6 0
4 8 6 9 0 0 3 5 2
2 1 9 0 3 5 4 7 6
0 5 3 4 0 0 8 1 9
```

Sample Output

```
EGI
```

```
LEL
IGE
```