

Problem C. Equivalence of Sudoku

Input file: standard input
 Output file: standard output
 Time limit: 1s

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	S_1	Rotation of S by 180 degrees
	6 7 8 5 3 2 4 9 1		5 7 8 9 6 3 4 2 1
	3 1 5 9 4 7 6 8 2		9 3 1 4 2 8 6 5 7
	9 4 2 6 1 8 7 5 3		6 4 2 5 7 1 9 3 8
	2 8 3 7 9 6 5 1 4		7 2 9 3 8 4 1 6 5
	4 9 7 2 5 1 3 6 8		8 6 3 1 5 2 7 9 4
	5 6 1 4 8 3 9 2 7		4 1 5 6 9 7 3 8 2
	8 3 9 1 7 5 2 4 6		3 5 7 8 1 6 2 4 9
	7 5 6 8 2 4 1 3 9		2 8 6 7 4 9 5 1 3
	1 2 4 3 6 9 8 7 5		1 9 4 2 3 5 8 7 6
S_2	Mirror image of S (flip along y)	S_3	Bijection of S : $1 \leftrightarrow 2, 3 \leftrightarrow 4, 5 \leftrightarrow 6, 7 \leftrightarrow 8$
	1 9 4 2 3 5 8 7 6		5 8 7 6 4 1 3 9 2
	2 8 6 7 4 9 5 1 3		4 2 6 9 3 8 5 7 1
	3 5 7 8 1 6 2 4 9		9 3 1 5 2 7 8 6 4
	4 1 5 6 9 7 3 8 2		1 7 4 8 9 5 6 2 3
	8 6 3 1 5 2 7 9 4		3 9 8 1 6 2 4 5 7
	7 2 9 3 8 4 1 6 5		6 5 2 3 7 4 9 1 8
	6 4 2 5 7 1 9 3 8		7 4 9 2 8 6 1 3 5
	9 3 1 4 2 8 6 5 7		8 6 5 7 1 3 2 4 9
	5 7 8 9 6 3 4 2 1		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 $\{1, 2, 3, 4, 5, 6, 7, 8, 9\} \rightarrow \{2, 9, 3, 7, 8, 6, 1, 5, 4\}$, 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	P_2
9 1 3 5	4 9 3 8 5 6 2 1 7
5 2 8	5 2 8 9 1 7 6 3 4
6	1 6 7 3 4 2 5 8 9
8 9 1	6 4 5 1 2 9 3 7 8
4 3 6 1 5 9 7 2 8	9 7 2 4 8 3 1 5 6
5 8 3 4 9 1 6	8 3 1 6 7 5 4 9 2
1 5 4 7	3 5 4 7 6 8 9 2 1
6	7 1 9 2 3 4 8 6 5
8 2	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.

Example

standard input	standard output
3	EGI
0 7 4 5 2 3 0 9 8	LEL
0 0 0 7 9 8 1 4 0	IGE
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	