4723 - Ducci Sequence

Asia - Seoul - 2009/2010

A Ducci sequence is a sequence of n-tuples of integers. Given an n-tuple of integers $(a_1, a_2, \cdots, a_n)$, the next n-tuple in the sequence is formed by taking the absolute differences of neighboring integers:

$$(a_1, a_2, \cdots, a_n) \rightarrow (|a_1 - a_2|, |a_2 - a_3|, \cdots, |a_n - a_1|)$$

Ducci sequences either reach a tuple of zeros or fall into a periodic loop. For example, the 4-tuple sequence starting with 8,11,2,7 takes 5 steps to reach the zeros tuple:

$$(8, 11, 2, 7) \rightarrow (3, 9, 5, 1) \rightarrow (6, 4, 4, 2) \rightarrow (2, 0, 2, 4) \rightarrow (2, 2, 2, 2) \rightarrow (0, 0, 0, 0).$$

The 5-tuple sequence starting with 4,2,0,2,0 enters a loop after 2 steps:

$$(4, 2, 0, 2, 0) \rightarrow (2, 2, 2, 2, 4) \rightarrow (\mathbf{0, 0, 0, 2, 2}) \rightarrow (0, 0, 2, 0, 2) \rightarrow (0, 2, 2, 2, 2) \rightarrow (2, 0, 0, 0, 2) \rightarrow$$

$$(2, 0, 0, 2, 0) \rightarrow (2, 0, 2, 2, 2) \rightarrow (2, 2, 0, 0, 0) \rightarrow (0, 2, 0, 0, 2) \rightarrow (2, 2, 0, 2, 2) \rightarrow (0, 2, 2, 0, 0) \rightarrow$$

$$(2, 0, 2, 0, 0) \rightarrow (2, 2, 2, 0, 2) \rightarrow (0, 0, 2, 2, 0) \rightarrow (0, 2, 0, 2, 0) \rightarrow (2, 2, 2, 2, 0) \rightarrow (\mathbf{0, 0, 0, 2, 2}) \rightarrow \cdots$$

Given an n-tuple of integers, write a program to decide if the sequence is reaching to a zeros tuple or a periodic loop.

Input

Your program is to read the input from standard input. The input consists of T test cases. The number of test cases T is given in the first line of the input. Each test case starts with a line containing an integer n ($3 \leq n \leq 15$), which represents the size of a tuple in the Ducci sequences. In the following line, n integers are given which represents the n-tuple of integers. The range of integers are from 0 to 1,000. You may assume that the maximum number of steps of a Ducci sequence reaching zeros tuple or making a loop does not exceed 1,000.

Output

Your program is to write to standard output. Print exactly one line for each test case. Print `LOOP' if the Ducci sequence falls into a periodic loop, print `ZERO' if the Ducci sequence reaches to a zeros tuple.

The following shows sample input and output for four test cases.

Sample Input

```
4
4
8 11 2 7
```

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

Sample Output

```
ZERO
LOOP
ZERO
LOOP
```

Seoul 2009-2010