

Problem 7: +9QH

5 Points

Problem ID: plus9qh

Rank: 2

Introduction

You are a small vocaloid producer just starting out in the music industry. With the help of the one-and-only virtual pop sensation Hatsune Miku herself, you release your debut single to show the world what you're made of. But when you come back from the grocery store to buy [leeks for your Miku shrine](#), you return to find that [Cliff L. Biffle](#) has hacked into your Miku voicebank and now she only sings [99 Bottles of Beer on the Wall](#) instead of your new song [Hello, world!](#) What on earth did Cliff L. Biffle do to Miku?!?!?!

Problem Statement

You're given N lines of text X_1, X_2, \dots, X_N . Find the *shortest* HQ9+ program that outputs exactly the given text, or determine that no such program exists.

An HQ9+ program is a string consisting of the following single-character instructions:

Instruction	Description
H	Output a single line containing <code>Hello, world!</code>
Q	Output a single line containing all of the instructions of the current program being executed (a quine).
9	Output the first six lines of 99 Bottles of Beer on the Wall (see sample input for examples).
+	Increment the accumulator, a variable that is never used. This instruction outputs nothing.

When an HQ9+ program is executed, instructions are executed from left to right.

Input Format

The first line of the input contains a single integer **T** denoting the number of test cases that follow. For each test case:

- The first line contains a single integer **N** denoting the number of lines of text.
- The next **N** lines each contain one line of text, **X₁**, **X₂**, ..., **X_N**.

Output Format

For each test case, output the *shortest* HQ9+ program that outputs exactly the given text. If there are multiple solutions, output any of them. If there are no solutions, output `IMPOSSIBLE`

Constraints

$$1 \leq T \leq 10$$

$$1 \leq N \leq 1000$$

$$1 \leq |X_i| \leq 1000 \text{ (Lines contain at most 1000 characters)}$$

Lines will contain only [ASCII printable characters](#) and spaces.

Lines will not begin or end with space characters.

Lines will not be empty.

Sample Test Cases

Sample Input

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```
6
1
Hello, world!
9
Hello, world!
H++QH9
Hello, world!
99 bottles of beer on the wall, 99 bottles of beer.
Take one down and pass it around, 98 bottles of beer on the wall.
98 bottles of beer on the wall, 98 bottles of beer.
Take one down and pass it around, 97 bottles of beer on the wall.
97 bottles of beer on the wall, 97 bottles of beer.
Take one down and pass it around, 96 bottles of beer on the wall.
7
69 bottles of beer on the wall, 69 bottles of beer.
Take one down and pass it around, 68 bottles of beer on the wall.
68 bottles of beer on the wall, 68 bottles of beer.
Take one down and pass it around, 67 bottles of beer on the wall.
67 bottles of beer on the wall, 67 bottles of beer.
Take one down and pass it around, 66 bottles of beer on the wall.
Hello, world!
10
We're no strangers to love.
You know the rules, and so do I.
A full commitment's what I'm thinking of.
You wouldn't get this from any other guy.
I just wanna tell you how I'm feeling.
Gotta make you understand.
9Q++QHH
9Q++QHH
Never gonna give you up, never gonna let you down.
Never gonna run around and desert you.
7
QQQQQQQ
QQQQQQQ
QQQQQQQ
QQQQQQQ
QQQQQQQ
QQQQQQQ
QQQQQQQ
3
Hello, world!
HQ+Q
H+QQ
```

Sample Output

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```
H
H++QH9
IMPOSSIBLE
IMPOSSIBLE
QQQQQQQ
IMPOSSIBLE
```

Sample Explanations

Test Case #1:

The HQ9+ program with the single instruction `H` causes `Hello, world!` to be outputted, matching the text given. `H` is also the shortest program that outputs `Hello, world!`

Test Case #2:

The only HQ9+ program that produces this text is `H++QH9`. The program is executed as follows:

1. `H` outputs `Hello, world!`
2. `+` increments the accumulator, which has no effect on the output.
3. `+` increments the accumulator again, which has no effect on the output.
4. `Q` outputs the source code of the HQ9+ program, which is `H++QH9`
5. `H` outputs `Hello, world!` again.
6. `9` outputs the first six lines of *99 Bottles of Beer*.

Test Case #3:

The output is impossible because the numbers in the verses do not match what is expected.

Test Case #4:

<https://www.youtube.com/watch?v=cvh0nX08nRw>

Test Case #6:

The quines in the text suggest two conflicting sets of instructions, but a program can only have one set of instructions. Thus, there is no solution.