



USACO 2022 US OPEN CONTEST, GOLD PROBLEM 2. PAIR PROGRAMMING

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English (en) ▾

A program consists of a sequence of instructions, each of which is of one of the following forms:

1. $\times d$, where d is a digit in the range $[0, 9]$
2. $+s$, where s is a string denoting the name of a variable. Within a program, all variable names must be distinct.

The result of executing a program is defined to be the expression that results after applying each instruction in order, starting with 0. For example, the result of executing the program $[\times 3, +x, +y, \times 2, +z]$ is the expression $(0 \times 3 + x + y) \times 2 + z = 2 \times x + 2 \times y + z$. Different programs, when executed may produce the same expressions; for example, executing $[+w, \times 0, +y, +x, \times 2, +z, \times 1]$ would also result in the expression $2 \times x + 2 \times y + z$.

Bessie and Elsie each have programs of N ($1 \leq N \leq 2000$) instructions. They will interleave these programs to produce a new program of length $2N$. Note that there are $\frac{(2N)!}{N! \times N!}$ ways to do this, but not all such programs, when executed, will produce distinct expressions.

Count the number of distinct expressions that may be produced by executing Bessie and Elsie's interleaved program, modulo $10^9 + 7$.

Each input contains T ($1 \leq T \leq 10$) test cases that should be solved independently. It is guaranteed that the sum of N over all test cases does not exceed 2000.

INPUT FORMAT (input arrives from the terminal / stdin):

The first line of the input contains T , the number of test cases.

The first line of each test case contains N .

The second line of each test case contains Bessie's program, represented by a string of length N . Each character is either a digit $d \in [0, 9]$, representing an instruction of type 1, or the character $+$, representing an instruction of type 2.

The third line of each test case contains Elsie's program in the same format as Bessie's.

Within a test case, the variable names among all instructions are distinct. Note that their actual names are not provided, as they do not affect the answer.

OUTPUT FORMAT (print output to the terminal / stdout):

The number of distinct expressions that may be produced by executing Bessie and Elsie's interleaved programs, modulo $10^9 + 7$.

SAMPLE INPUT:

```
4
1
0
1
3
12+
+02
3
0++
++9
4
5+++
```

+6+1

SAMPLE OUTPUT:

1
3
9
9

For the first test case, the two possible interleaved programs are $[\times 1, \times 0]$ and $[\times 0, \times 1]$. These will both produce the expression 0 when executed.

For the second test case, executing an interleaving of $[\times 1, \times 2, +x]$ and $[+y, \times 0, \times 2]$ could produce one of the expressions 0, x , or $2 \times x$.

SCORING:

- Input 2 satisfies $N \leq 6$.
- In inputs 3-5, the sum of all N is at most 100.
- In inputs 6-8, the sum of all N is at most 500.
- Inputs 9-16 satisfy no additional constraints.

Problem credits: Benjamin Qi

Contest has ended. No further submissions allowed.