

## 2323 Modular multiplication of polynomials

Consider polynomials whose coefficients are 0 and 1. Addition of two polynomials is achieved by ‘adding’ the coefficients for the corresponding powers in the polynomials. The addition of coefficients is performed by addition modulo 2, i.e.,  $(0 + 0) \bmod 2 = 0$ ,  $(0 + 1) \bmod 2 = 1$ ,  $(1 + 0) \bmod 2 = 1$ , and  $(1 + 1) \bmod 2 = 0$ . Hence, it is the same as the exclusive-or operation.

$$(x^6 + x^4 + x^2 + x + 1) + (x^7 + x + 1) = x^7 + x^6 + x^4 + x^2$$

Subtraction of two polynomials is done similarly. Since subtraction of coefficients is performed by subtraction modulo 2 which is also the exclusive-or operation, subtraction of polynomials is identical to addition of polynomials.

$$(x^6 + x^4 + x^2 + x + 1) - (x^7 + x + 1) = x^7 + x^6 + x^4 + x^2$$

Multiplication of two polynomials is done in the usual way (of course, addition of coefficients is performed by addition modulo 2).

$$(x^6 + x^4 + x^2 + x + 1)(x^7 + x + 1) = x^{13} + x^{11} + x^9 + x^8 + x^6 + x^5 + x^4 + x^3 + 1$$

Multiplication of two polynomials  $f(x)$  and  $g(x)$  modulo a polynomial  $h(x)$  is the remainder of  $f(x)g(x)$  divided by  $h(x)$ .

$$(x^6 + x^4 + x^2 + x + 1)(x^7 + x + 1) \bmod (x^8 + x^4 + x^3 + x + 1) = x^7 + x^6 + 1$$

The largest exponent of a polynomial is called its degree. For example, the degree of  $x^7 + x^6 + 1$  is 7.

Given three polynomials  $f(x)$ ,  $g(x)$ , and  $h(x)$ , you are to write a program that computes  $f(x)g(x) \bmod h(x)$ . We assume that the degrees of both  $f(x)$  and  $g(x)$  are less than the degree of  $h(x)$ . The degree of a polynomial is less than 1000.

Since coefficients of a polynomial are 0 or 1, a polynomial can be represented by  $d+1$  and a bit string of length  $d+1$ , where  $d$  is the degree of the polynomial and the bit string represents the coefficients of the polynomial. For example,  $x^7 + x^6 + 1$  can be represented by

8 1 1 0 0 0 0 0 1.

### Input

The input consists of several test cases. The number of test cases ( $T$ ) is given in the first line of the input file. Each test case consists of three lines that contain three polynomials  $f(x)$ ,  $g(x)$ , and  $h(x)$ , one per line. Each polynomial is represented as described above.

### Output

The output should contain the polynomial  $f(x)g(x) \bmod h(x)$ , one per line. The output must be written to standard output.

**Sample Input**

```
2
7 1 0 1 0 1 1 1
8 1 0 0 0 0 0 1 1
9 1 0 0 0 1 1 0 1 1
10 1 1 0 1 0 0 1 0 0 1
12 1 1 0 1 0 0 1 1 0 0 1 0
15 1 0 1 0 1 1 0 1 1 1 1 1 1 0 0 1
```

**Sample Output**

```
8 1 1 0 0 0 0 1
14 1 1 0 1 1 0 0 1 1 1 0 1 0 0
```