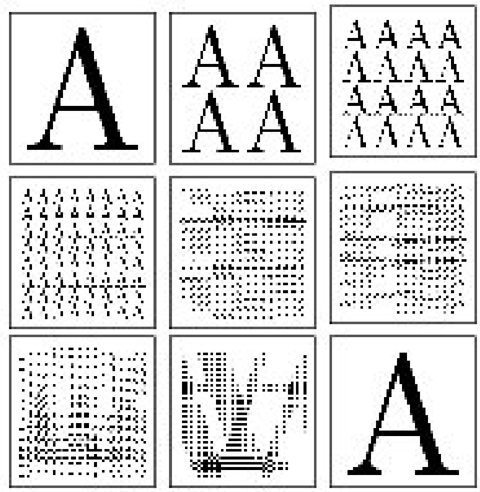
3510 – Pixel Shuffle

Europe – Southwestern – 2005/2006

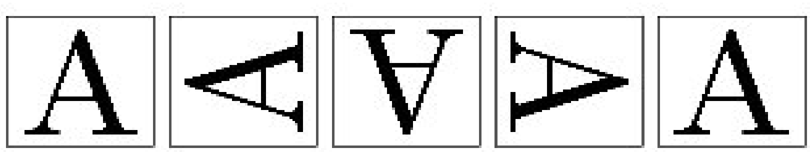


Shuffling the pixels in a bitmap image sometimes yields random looking images. However, by repeating the shuffling enough times, one finally recovers the original images. This should be no surprise, since ``shuffling'' means applying a one–to–one mapping (or permutation) over the cells of the image, which come in finite number.

Problem

Your program should read a number n , and a series of elementary transformations that define a ``shuffling'' ϕ of $n \times n$ images. Then, your program should compute the minimal number m $(m > 0)$, such that m applications of ϕ always yield the original $n \times n$ image.

For instance if ϕ is counter–clockwise 90° rotation then $m = 4$.



Input

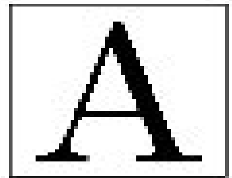
The input begins with a single positive integer on a line by itself indicating the number of the cases following, each of them as described below. This line is followed by a blank line, and there is also a blank line between two consecutive inputs.

Input is made of two lines, the first line is number n ($2 \leq n \leq 2^{10}$, n even). The number n is the size of images, one image is represented internally by a $n \times n$ pixel matrix (a^j_i), where i is the row number and j is the column number. The pixel at the upper left corner is at row 0 and column 0.

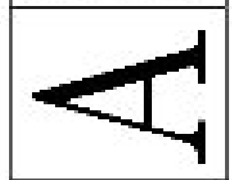
The second line is a non−empty list of at most 32 words, separated by spaces. Valid words are the keywords id, rot, sym, bhsym, bvsym, div and mix, or a keyword followed by ``−". Each keyword key designates an elementary transform (as defined by Figure 1), and key− designates the inverse of transform key. For instance, rot− is the inverse of counter−clockwise 90° rotation, that is clockwise 90° rotation. Finally, the list k_1, k_2,..., k_p designates the compound transform $\phi = k_1 \circ k_2 \circ \cdots \circ k_p$. For instance, ``bvsym rot−" is the transform that first performs clockwise 90° rotation and then vertical symmetry on the lower half of the image.

Figure 1: Transformations of image (a^j_i) into image (b^j_i)

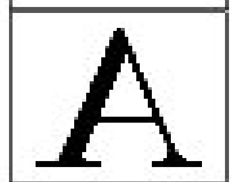
id , identity. Nothing changes : $b_i^j = a_i^j$.



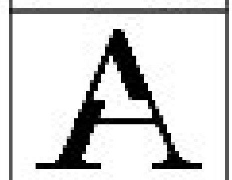
rot , counter-clockwise 90^o rotation



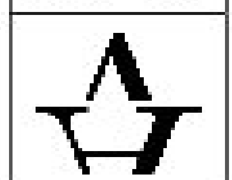
sym , horizontal symmetry : $b_i^j = a_i^{n-1-j}$



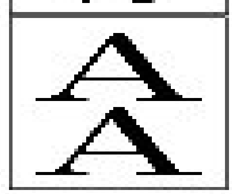
bhsym , horizontal symmetry applied to the lower half of image : when $i \geq n/2$, then $b_i^j = a_i^{n-1-j}$. Otherwise $b_i^j = a_i^j$.



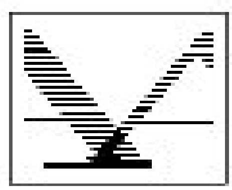
bvsym , vertical symmetry applied to the lower half of image $(i \geq n/2)$



div , division. Rows $0, 2, \ldots, n-2$ become rows $0, 1, \ldots n/2-1$, while rows $1, 3, \ldots n-1$ become rows $n/2, n/2+1, \ldots n-1$.



mix , row mix. Rows $2k$ and $2k+1$ are interleaved. The pixels of row $2k$ in the new image are $a_{2k}^0, a_{2k+1}^0, a_{2k}^1, a_{2k+1}^1, \cdots a_{2k}^{n/2-1}, a_{2k+1}^{n/2-1}$, while the pixels of row $2k+1$ in the new image are $a_{2k}^{n/2}, a_{2k+1}^{n/2}, a_{2k}^{n/2+1}, a_{2k+1}^{n/2+1}, \cdots, a_{2k}^{n-1}, a_{2k+1}^{n-1}$.



Output

For each test case, the output must follow the description below. The outputs of two consecutive cases will be separated by a blank line.

Your program should output a single line whose contents is the minimal number m ($m > 0$) such that ϕ^m is the identity. You may assume that, for all test input, you have $m < 2^{31}$.

Sample Input

```
2

256
rot- div rot div

256
bvsym div mix
```

Sample Output

```
8

63457
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