Cat in a tree
Problem ID: catinatree

A cat lives in a tree that has N nodes. She will demarcate her territory by "marking" some of the tree nodes. Marked nodes may not be closer to each other than distance D. Find the maximum number of nodes that the cat can mark.

Input

First line has two integers, N and D. The 0'th node is the root node of the tree. Then follows $N-1$ lines, the i-th of which contain a single integer x_i with $0 \leq x_i < i$ (starting with $i = 1$). This means that node x_i is connected to node i.

Constraints We always have $1 \leq N, D \leq 2 \cdot 10^5$. For subcases, the inputs have these further restrictions:

- **Group 1: 11 points** $N \leq 18$
- **Group 2: 40 points** $N \leq 1\,500$
- **Group 3: 49 points** No further restrictions.

Output

Output should contain one integer: the maximum number of nodes that can be marked.

Sample Input 1

```
4 3
0
0
1
```

Sample Output 1

```
2
```

Sample Input 2

```
3 1000
0
0
```

Sample Output 2

```
1
```

Friends
Problem ID: friends


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High school is all about being in the coolest group of friends. Headmistress Umbridge knows this, and she also knows that knowledge is power. She has collected data on all of the n students at the school, asking each of them who they are friends with. Now she has a list of responses, but she is suspicious that some of the students might not have been entirely truthful during the questioning.

From anonymous (but highly reliable) sources, Headmistress Umbridge knows that the friendships at her school satisfy the following properties:

- If a is friends with b then b is also friends with a.
- The set of students can be partitioned into groups, such that every student participates in exactly one group, where
  - each group has at least one and at most p students, and
  - for each group there are at most q pairs of friends with the first one in the group, and the second one outside of it.

Note that two students in the same group do not have to be friends.

Umbridge has hired you to figure out whether it is possible that all students are telling the truth, or whether she can be sure that at least one student is lying, and that she therefore should put everyone in detention. Is this morally questionable? Probably.

(In case the students may be telling the truth, you are worried that her suspicion might fall on you instead; thus you will also want to provide evidence of a valid partition if there is one.)

Input

First a single line with three non-negative integers n, p and q as described above. Next follow n lines, one for each student, starting with student $i = 0$. Each such line starts with an integer m_i, denoting the number of friends student number i claims that she has. Then follow m_i distinct integers between 0 and $n - 1$, indicating who those friends are (the students are numbered from 0 to $n - 1$).

Constraints

We always have $1 \leq n \leq 2\,500$, and $p + q \leq 15$. Furthermore, it is guaranteed that $m_0 + m_1 + \ldots + m_{n-1} \leq 30\,000$. A student never lists herself as one of her friends. For subcases, the inputs have these further restrictions:

- **Group 1: 20 points** $n \leq 16$
- **Group 2: 37 points** $n \leq 250$ and $q \leq 2$
- **Group 3: 12 points** $q \leq 2$
- **Group 4: 31 points** No further restrictions.

Output

If Dolores can be certain someone did't tell the truth, output "detention". Otherwise, output "home". If you output home on the first line, then you should prove your claim by outputting a partition of the students into groups such that the requirements above hold (if there are several, any one will do): The second line should then contain a positive

integer G, the number of groups. The following G lines should each begin with a positive integer g_i, the number of students in the i-th group. Then on the same line, g_i integers indicating the students in this group.

Sample Input 1

```
4 2 1
1 1
2 0 2
2 1 3
1 2
```

Sample Output 1

```
home
2
2 0 1
2 2 3
```

Sample Input 2

```
5 2 1
1 1
2 0 2
2 1 3
2 2 4
1 3
```

Sample Output 2

```
detention
```

Sample Input 3

```
3 3 3
2 1 2
2 0 2
1 0
```

Sample Output 3

```
detention
```

Plus Minus
Problem ID: plusminus

Matthew the physicist studies the quantum electro-dynamics of a silicon-based rectangular microchip. The microchip consists of a very large $N \times M$ grid of electrons. Each electron has either positive (up) or negative (down) spin, denoted by $+$ and $-$ respectively.

Matthew does not know the spin of all the electrons, but he has done K measurements. In the i-th measurement, he discovered that the electron at position (y_i, x_i) has a given spin s_i. He also knows that in each 2×2 subgrid, there are equally many electrons with positive and negative spin. He wants to know whether he can recover the state of every electron based on his measurements. If not, he would like to know how many possible states are consistent with his measurements. For classified reasons, he wants the answer modulo $10^9 + 7$.

Input

The first line contain three numbers N, M and K: the height of the grid, the width of the grid and the number of measurements. The next K lines contain a spin s_i where s_i is either $+$ or $-$, and two numbers $1 \leq y_i \leq N$ and $1 \leq x_i \leq M$ – the coordinates of the electron. Matthew never did two measurments at the exact same location.

Constraints

We always have $1 \leq N, M \leq 10^9$ and $0 \leq K \leq 100\,000$. For subcases, the inputs have these further restrictions:

- **Group 1: 12 points** $N, M \leq 5$
- **Group 2: 42 points** $N, M \leq 1\,000$
- **Group 3: 46 points** No further restrictions.

Output

Output the total number of valid states consistent with Matthew' measurements modulo $10^9 + 7$.

Explanation of sample 1

The only two valid grids are
+-+-
+-+-
and
+-+-
-+-+

Sample Input 1	Sample Output 1
2 4 4 + 1 1 - 1 2 + 1 3 - 1 4	2

Sample Input 2	Sample Output 2
3 3 3 - 2 1 + 2 3 + 3 3	0