2024 Canadian Computing Olympiad
Day 2, Problem 3
Telephone Plans

Time Limit: 4 seconds

Problem Description

The "Dormi's Fone Service" is now the only telephone service provider in CCOland. There are N houses in CCOland, numbered from 1 to N. Each telephone line connects two distinct houses such that all the telephone lines that ever exist form a forest.

There is an issue where the phone lines are faulty, and each phone line only exists for a single interval of time. Two houses can call each other at a certain time if there is a path of phone lines that starts at one of the houses and ends in the other house at that time.

We would like to process Q queries of the following forms:

- `1 x y`: Add a phone line between houses x and y. It is guaranteed that a phone line between houses x and y was never added before.
- `2 x y`: Remove the phone line between houses x and y. It is guaranteed that a phone line currently exists between houses x and y.
- `3 t`: Compute the number of pairs of different houses that can call each other at some time between the current query and t queries ago. To be more clear, let G_q be the state of CCOland after the q-th query, where G_0 is the state of CCOland before any queries. If this is the s-th query, then count the number of pairs of houses that are connected in at least one of $G_{s-t}, G_{s-t+1}, \ldots, G_s$.

Also, some test cases may be encrypted. For the test cases that are encrypted, the arguments `x`, `y`, or `t` are given as the bitwise xor of the true argument and the answer to the last query of type `3` (if there have been no queries of type `3`, then the arguments are unchanged).

Input Specification

The first line of input will contain E ($E \in \{0, 1\}$). $E = 0$ denotes that the input is not encrypted, while $E = 1$ denotes that the input is encrypted.

The second line contains two space-separated integers N and Q, representing the number of houses in CCOland and the number of queries, respectively.

The next Q lines contain queries as specified above (queries are encrypted or not depending on E).

For the q-th query ($1 \leq q \leq N$), it is guaranteed that (after decrypting if $E = 1$) $1 \leq x, y \leq N$ for type `1` and `2` queries and $0 \leq t \leq q$ for type `3` queries.

Marks Awarded	Bounds on N	Bounds on Q	Encrypted?
3 marks	$1 \le N \le 30$	$1 \le Q \le 150$	$E = 0$
2 marks	$1 \le N \le 30$	$1 \le Q \le 150$	$E = 1$
4 marks	$1 \le N \le 2\,000$	$1 \le Q \le 6\,000$	$E = 0$
2 marks	$1 \le N \le 2\,000$	$1 \le Q \le 6\,000$	$E = 1$
4 marks	$1 \le N \le 100\,000$	$1 \le Q \le 300\,000$	$E = 0$
5 marks	$1 \le N \le 100\,000$	$1 \le Q \le 300\,000$	$E = 1$
5 marks	$1 \le N \le 500\,000$	$1 \le Q \le 1\,500\,000$	$E = 1$

Output Specification

For each query of type `3`, output the answer to the query on a new line.

Sample Input 1

```
0
4 12
3 0
1 1 2
3 0
1 1 3
3 0
3 5
2 2 1
3 0
3 8
1 1 4
3 0
3 11
```

Output for Sample Input 1

```
0
1
3
3
1
3
3
5
```

Explanation of Output for Sample Input 1

This test case is not encrypted.

For the 1st query, no pairs of different houses could have called each other.

For the 3rd query, only houses 1 and 2 could have called each other.

For the 5th query, $\{(1,2),(1,3),(2,3)\}$ is the set of pairs that could have called each other. The 6th query is the same.

For the 8th query, only houses 1 and 3 could have called each other.

For the 9th query, there is a point in time where $\{(1,2),(1,3),(2,3)\}$ could have called each other.

For the 11th query, the set of pairs that could have called each other is $\{(1,3),(1,4),(3,4)\}$.

For the 12th query, the set of pairs that could have called each other at any previous time is $\{(1,2),(1,3),(1,4),(2,3),(3,4)\}$.

Sample Input 2

```
1
4 12
3 0
1 1 2
3 0
1 0 2
3 1
3 6
2 1 2
3 3
3 9
1 2 7
3 3
3 8
```

Output for Sample Input 2

```
0
1
3
3
1
3
3
5
```

Explanation of Output for Sample Input 2
Encrypted version of sample 1.