Given a tree of N nodes, where each node is uniquely numbered in between *[1, N]*. Each node also has a value which is initially 0. You need to perform following two operations in the tree.

1. Update Operation
2. Report Operation

Update Operation

```
U r t a b
```

Adds $a^b + (a+1)^b + (b+1)^a$ to all nodes in the subtree rooted at `t`, considering that tree is rooted at `r` (see explanation for more details).

Report Operation

```
R r t m
```

Output the sum of all nodes in the subtree rooted at `t`, considering that tree is rooted at `r`. Output the sum modulo `m` (see explanation for more details).

Input Format

First line contains N, number of nodes in the tree.
Next $N-1$ lines contain two space separated integers x and y which denote that there is an edge between node x and node y.
Next line contains Q, number of queries to follow.
Next Q lines follow, each line will be either a report operation or an update operation.

Output Format

For each report query output the answer in a separate line.

Constraints

$1 \leq N \leq 100000$
$1 \leq Q \leq 100000$
$1 \leq m \leq 101$
$1 \leq r, t, x, y \leq N$
$x \neq y$
$1 \leq a, b \leq 10^{18}$

Notes

1. There will be at most one edge between a pair of nodes.
2. There will be no loop.
3. Tree will be completely connected.

Sample Input

```
4
1 2
2 3
3 4
4
U 3 2 2 2
U 2 3 2 2
R 1 2 8
R 4 3 9
```

Sample Output

```
2
3
```

Explanation

Initially Values in each node : [0,0,0,0]
The first query is `U 3 2 2 2`. Here, tree is rooted at 3. It looks like

```
    3(0)
   / \
  /   \
 2(0)  4(0)
 |
 |
 1(0)
```

For the sub tree rooted at 2 (nodes 2 and 1), we add $a^b + (a+1)^b + (b+1)^a = 2^2 + 3^2 + 3^2 = 22$. After first update operation, nodes 1, 2, 3, and 4 will have values 22, 22, 0 and 0 respectively.

```
    3(0)
   / \
  /   \
 2(22) 4(0)
 |
 |
 1(22)
```

The second query is `U 2 3 2 2`. Here, tree is rooted at 2. It looks like

```
    2(22)
   / \
  /   \
 1(22) 3(0)
       |
       |
       4(0)
```

For the sub tree rooted at 3 (nodes 3 and 4), we add $a^b + (a+1)^b + (b+1)^a = 2^2 + 3^2 + 3^2 = 22$. After second update operation, nodes 1, 2, 3, and 4 each have values 22,22,22,22 respectively.

```
    2(22)
   / \
  /   \
 1(22) 3(22)
       |
       |
       4(22)
```

The first report query is `R 1 2 8` asks for the sum modulo 8 of the subtree rooted at 2, when the tree is rooted at 1. The tree looks like

```
1(22)
 \
  \
   2*(22)
   |
   |
   3*(22)
   |
   |
   4*(22)
```

The sum of the values of nodes 2, 3 and 4 are

```
(22 + 22 + 22) % 8 = 2
```

The second report query is `R 4 3 9` asks for the sum modulo 9 of the subtree rooted at 3 when the tree is rooted at 4. The tree looks like

```
4(22)
 \
  \
   3*(22)
   |
   |
   2*(22)
   |
   |
   1*(22)
```

The sum of the values of nodes 3, 2 and 1 are

```
(22 + 22 + 22) % 9 = 3
```

Time Limits:
C, C++: 4s | Java and other JVM based languages: 10s | Python, Python3 = 45s | Other interpreted Language: 30s | C#, Haskell: 10s | Rest: 3 times of default.