



Dynamic Summation

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Problem

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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]

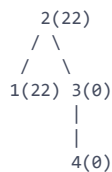
The first query is U 3 2 2 2. Here, tree is rooted at 3. It looks like



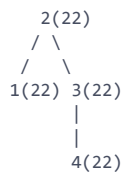
For the sub tree rooted at 2 (nodes 2 and 1), we add $a^b + (a+1)^b + (b+1)^a = 2^2 + 3^2 + 3^2 = 22$. After first update operation, nodes 1, 2, 3, and 4 will have values 22, 22, 0 and 0 respectively.



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



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.



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



```

\
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](#).

[f](#) [t](#) [in](#)

Submissions: [252](#)

Max Score: 150

Difficulty: Hard

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Java 7



```

1 import java.io.*;
2 import java.util.*;
3 import java.text.*;
4 import java.math.*;
5 import java.util.regex.*;
6
7 public class Solution {
8
9     public static void main(String[] args) {
10         /* Enter your code here. Read input from STDIN. Print output to STDOUT. Your class should be named Solution. */
11     }
12 }

```

Line: 1 Col: 1

[📁 Upload Code as File](#) ☐ Test against custom input

Run Code

Submit Code

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