Fibonacci Numbers Tree

by ma5termind

Shashank loves trees and math. He has a rooted tree, T, consisting of N nodes uniquely labeled with integers in the inclusive range $[1, N]$. The node labeled as 1 is the *root* node of tree T, and each node in T is associated with some positive integer value (all values are initially 0).

Let's define F_k as the k^{th} Fibonacci number. Shashank wants to perform 2 types of operations over his tree, T:

1. $U\ X\ k$
   Update the subtree rooted at node X such that the node at level 0 in subtree X (i.e., node X) will have F_k added to it, all the nodes at level 1 will have F_{k+1} added to them, and so on. More formally, all the nodes at a distance D from node X in the subtree of node X will have the $(k+D)^{th}$ Fibonacci number added to them.
2. $Q\ X\ Y$
   Find the sum of all values associated with the nodes on the unique path from X to Y. Print your sum modulo 10^9+7 on a new line.

Given the configuration for tree T and a list of M operations, perform all the operations efficiently.

Note: $F_1 = F_2 = 1$.

Input Format

The first line contains 2 space-separated integers, N (the number of nodes in tree T) and M (the number of operations to be processed), respectively.
Each line i of the $N-1$ subsequent lines contains an integer, P, denoting the parent of the $(i+1)^{th}$ node.
Each of the M subsequent lines contains one of the two types of operations mentioned in the *Problem Statement* above.

Constraints

- $1 \leq N, M \leq 10^5$
- $1 \leq X, Y \leq N$
- $1 \leq k \leq 10^{15}$

Output Format

For each operation of type 2 (i.e., Q), print the required answer modulo 10^9+7 on a new line.

Sample Input

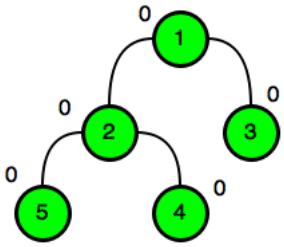
```
5 10
1
1
2
2
Q 1 5
U 1 1
Q 1 1
Q 1 2
Q 1 3
Q 1 4
Q 1 5
U 2 2
Q 2 3
Q 4 5
```

Sample Output

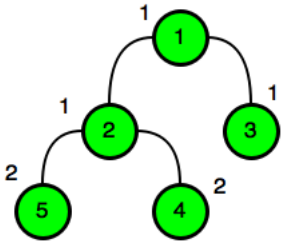
```
0
1
2
2
4
4
4
10
```

Explanation

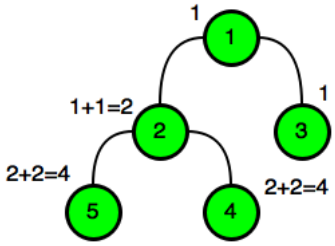
Intially, the tree looks like this:



After update operation `1 1`, it looks like this:



After update operation `2 2`, it looks like this:



Submissions:89

Max Score:100
Difficulty: Expert

Rate This Challenge:

More

Current Buffer (saved locally, editable) 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