

IOITC 2016 TST Day 3

Decomposing Tree

You are given a tree of N vertices, rooted at 1. The parent of vertex i is p_i .

Find the minimum number k , such that the tree can be decomposed into k simple edge-disjoint paths. i.e., find the minimum k such that we can find k simple paths, such that each edge in the tree appears in exactly one of the paths. A simple path is a path in which no vertex appears twice. Note that a vertex can appear in multiple paths though it cannot appear multiple times in one path.

Now you have Q updates of the form $v\ u$, meaning you have to change the parent of v to u . i.e., set p_v to u . It is guaranteed that doing so will not produce a cycle or a self-loop. Also, $v \neq 1$, i.e. 1 will always be the root of the tree and will not be assigned a parent. After each update, you have to output the minimum value of k for the new tree obtained by applying all updates so far.

Input

The first line contains N , the number of vertices in the tree.

The next line contains $N - 1$ integers p_2, p_3, \dots, p_N , where p_i is the parent of vertex i in the tree. 1 is the root of the tree and hence has no parent.

The next line contains Q , the number of updates.

Each of the following Q lines is of the form $v\ u$, indicating that you should change the parent of v to u .

Output

Output $Q + 1$ lines.

On the first line, print the answer for the initial tree.

Then, for each update, print the answer for the new tree in a separate line.

Test Data

For every update, $2 \leq u \leq N$, $1 \leq v \leq N$, and $u \neq v$.

Subtask 1 (9 Points):

$$1 \leq N \leq 10^3$$

$$Q = 0$$

Subtask 2 (19 Points):

$$1 \leq N \leq 10^5$$

$$Q = 0$$

Subtask 3 (72 Points):

$$1 \leq N \leq 10^5$$

$$0 \leq Q \leq 10^5$$

Sample Input

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

Sample Output

```
2
2
2
1
```

Explanation

For the initial tree, you can achieve answer 2 by taking the two paths as 1-3-5 and 2-3-4. Note that 3 occurs in two paths, which is okay.

Limits

Time: 1 second

Memory: 256 MB