D. Arpa's letter-marked tree and Mehrdad's Dokhtar-kosh paths

time limit per test: 3 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

Just in case somebody missed it: we have wonderful girls in Arpa's land.

Arpa has a rooted tree (connected acyclic graph) consisting of n vertices. The vertices are numbered 1 through n, the vertex 1 is the root. There is a letter written on each edge of this tree. Mehrdad is a fan of *Dokhtar-kosh* things. He call a string Dokhtar-kosh, if we can shuffle the characters in string such that it becomes palindrome.

He asks Arpa, for each vertex v, what is the length of the longest simple path in subtree of v that form a Dokhtar-kosh string.

Input

The first line contains integer n ($1 \le n \le 5 \cdot 10^5$) — the number of vertices in the tree.

$(n - 1)$ lines follow, the i-th of them contain an integer p_{i+1} and a letter c_{i+1} ($1 \le p_{i+1} \le i$, c_{i+1} is lowercase English letter, between `a` and `v`, inclusively), that mean that there is an edge between nodes p_{i+1} and $i+1$ and there is a letter c_{i+1} written on this edge.

Output

Print n integers. The i-th of them should be the length of the longest simple path in subtree of the i-th vertex that form a Dokhtar-kosh string.

Examples

input
4 1 s 2 a 3 s

output
3 1 1 0

input
5 1 a 2 h 1 a 4 h

output
4 1 0 1 0