

E. ELCA

time limit per test: 8 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

You have a root tree containing n vertexes. Let's number the tree vertexes with integers from 1 to n . The tree root is in the vertex 1.

Each vertex (except for the tree root) v has a direct ancestor p_v . Also each vertex v has its integer value s_v .

Your task is to perform following queries:

- **P** v u ($u \neq v$). If u isn't in subtree of v , you must perform the assignment $p_v = u$. Otherwise you must perform assignment $p_u = v$. Note that after this query the graph continues to be a tree consisting of n vertexes.
- **V** v t . Perform assignment $s_v = t$.

Your task is following. Before starting performing queries and after each query you have to calculate expected value written on the lowest common ancestor of two equiprobably selected vertices i and j . Here lowest common ancestor of i and j is the deepest vertex that lies on the both of the path from the root to vertex i and the path from the root to vertex j . Please note that the vertices i and j can be the same (in this case their lowest common ancestor coincides with them).

Input

The first line of the input contains integer n ($2 \leq n \leq 5 \cdot 10^4$) — the number of the tree vertexes.

The second line contains $n - 1$ integer p_2, p_3, \dots, p_n ($1 \leq p_i \leq n$) — the description of the tree edges. It is guaranteed that those numbers form a tree.

The third line contains n integers — s_1, s_2, \dots, s_n ($0 \leq s_i \leq 10^6$) — the values written on each vertex of the tree.

The next line contains integer q ($1 \leq q \leq 5 \cdot 10^4$) — the number of queries. Each of the following q lines contains the description of the query in the format described in the statement. It is guaranteed that query arguments u and v lie between 1 and n . It is guaranteed that argument t in the queries of type **V** meets limits $0 \leq t \leq 10^6$.

Output

Print $q + 1$ number — the corresponding expected values. Your answer will be considered correct if its absolute or relative error doesn't exceed 10^{-9} .

Examples

input
5 1 2 2 1 1 2 3 4 5 5 P 3 4 P 4 5 V 2 3 P 5 2 P 1 4
output
1.6400000000 1.8000000000 2.2800000000 2.3200000000

2.800000000
1.840000000

Note

Note that in the query $\mathbf{P} \ v \ u$ if u lies in subtree of v you must perform assignment $p_u = v$. An example of such case is the last query in the sample.