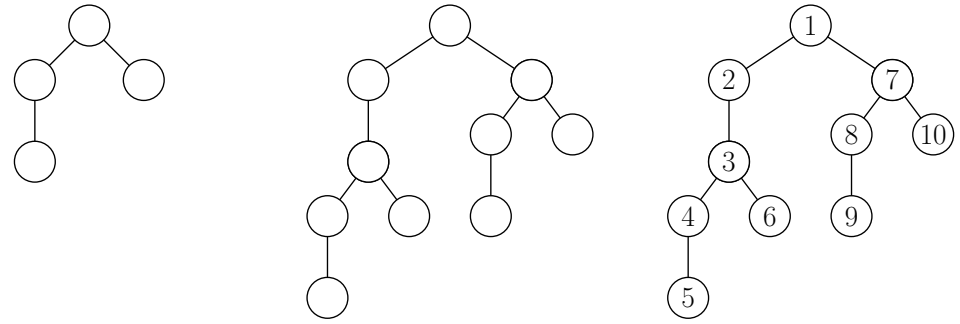
Problem F
Fractal Tree
Problem ID: fractaltree
Time limit: 7 seconds

A fractal tree F_i is defined in the following way. First, a rooted tree F_0 is given, which contains at least 2 vertices. F_i is then defined recursively in the following manner. Consider the set of vertices S which are leaves in F_{i-1}. For each vertex v in S, we replace it with a copy of F_0, such that v corresponds to the root of F_0.

Now, consider the tree F_k, for a given k. In this tree, we perform a depth-first search, where we visit all vertices of the tree recursively. At a certain vertex, we first recurse into the subtree of the leftmost child of the vertex, then the second leftmost child, and so on, until we have visited all the vertices in the subtree of the vertex. Assign integer labels to the vertices in the order they were visited, starting at 1. See Figure F.1 for an example.



(a) The tree F_0. (b) The tree F_1. (c) The depth first search labelling of F_1.

Figure F.1: Illustration of Sample Input 1.

Given a set of queries consisting of pairs of vertices, your task is to find the distance between the two vertices. The distance is defined as the number of edges on the (unique) simple path between the two vertices.

Input

First, the tree F_0 is given. The first line of input contains the number of vertices $2 \leq n \leq 100\,000$ in F_0. The vertices are numbered 0 to $n-1$, with 0 being the root vertex. Then follows a line containing $n-1$ integers $p_1, \ldots, p_{n-1}$. For each $1 \leq i \leq n-1$, the parent of node i in F_0 is p_i. It holds that $p_i < i$. Within the tree, the left-to-right ordering of the vertices correspond to their numbering, in ascending order (i.e. the lowest-numbered child is the leftmost child).

The third line of input contains an integer $0 \leq k < 2^{30}$. Then follows a line containing an integer q, $1 \leq q \leq 100\,000$, the number of queries. Finally, there are q lines containing the queries. Each query is given by two distinct integers a and b, the labels of two vertices of F_k. You may assume that a and b are valid labels (i.e., they are between 1 and the number of vertices of F_k), and that they are at most 2^{30}.

Output

For each query (a, b), in the same order as given in the input, output the distance in F_k between the vertices labelled a and b.

Sample Input 1	Sample Output 1
4 0 1 0 1 10 1 2 1 4 1 6 1 8 1 10 5 10 6 8 9 3 7 10 8 9	1 3 3 2 2 6 5 5 1 1