Problem F. Turtle Soup

Time limit: 1 second
Memory limit: 256 megabytes

A company consists of n members with employee IDs $1, 2, \ldots, n$. Member 1 is the boss, and every other member i ($2 \le i \le n$) has a direct supervisor f_i ($1 \le f_i < i$). The company structure forms a rooted tree with member 1 at the root.

In this company, member a **knows** member b if and only if at least one of the following conditions is satisfied:

- $a = b$.
- b is an **ancestor** of a. In other words, there exists a sequence $u_1, u_2, \cdots, u_k$ ($2 \le k$) such that $u_1 = a$, $u_k = b$, and $u_i = f_{u_{i-1}}$ for all $2 \le i \le k$.
- b is a **direct** child of a (b is a **direct** subordinate of a). In other words, $f_b = a$.

Note that the acquaintance relationship is not necessarily symmetric; a knowing b does not imply that b knows a.

Now, members are playing a game. In each round, a specific member m acts as the **guesser**, and another member p is the **target**. It is guaranteed that p is a member whom m **does not know**.

To identify p, m asks a sequence of questions. For each question, m chooses an ID x and asks: "Does p know member x?" Member p always answers truthfully. Additionally, if $x = p$, p will specifically reveal that they are member x, at which point the game ends.

Each question carries a travel cost based on the company tree. If the i-th question concerns member x_i, the cost of that question is $dis(x_{i-1}, x_i)$, where $dis(a, b)$ is the number of edges on the unique path between a and b in the tree. For the first question ($i = 1$), the cost is $dis(m, x_1)$.

Member m is extremely clever and uses an optimal strategy to minimize the total cost required to guarantee the completion of the game in the **worst-case scenario**. Your task is to calculate this minimum worst-case cost for every possible guesser $m \in \{1, 2, \ldots, n\}$.

If a member m already knows everyone in the company, the answer for that m is 0.

Input

The first line of the input contains an integer n ($1 \le n \le 10^5$), representing the total number of members in the company.

The second line contains $n - 1$ integers, representing $f_2, f_3, \cdots, f_n$. It satisfies $1 \le f_i < i$.

Output

Output a single line containing n integers, representing the answers for the cases where $m = 1, m = 2, \cdots, m = n$. The integers should be separated by spaces.

Examples

standard input	standard output
3 1 1	0 2 2
5 1 1 3 2	4 3 3 4 4
6 1 1 2 2 3	4 3 5 4 4 6

Note

To explain the case of $m = 4$ in sample 3: First, as shown in the diagram, member m does not know membes $\{3, 5, 6\}$. One possible optimal strategy is to first ask if member 2 is known by p, costing 1. If so, it indicates that $p = 5$, and the next step is to ask about member 5 to end the game, with a total cost of 2. Otherwise, continue to ask if member 3 is known by p, costing 2. If $p = 3$, the game ends at a total cost of 3. Otherwise, it indicates that $p = 6$, and the next step costs 1 to ask about member 6, ending the game with a total cost of 4. Therefore, this strategy requires a worst-case cost of 4. It can be proven that no other strategy can reduce the worst-case inquiry cost further.