C3. Brain Network (hard)

Breaking news from zombie neurology! It turns out that – contrary to previous beliefs – every zombie is *born* with a single brain, and only later it evolves into a complicated brain structure. In fact, whenever a zombie consumes a brain, a new brain appears in its nervous system and gets immediately connected to one of the already existing brains using a single brain connector. Researchers are now interested in monitoring the brain latency of a zombie. Your task is to write a program which, given a history of evolution of a zombie's nervous system, computes its brain latency at every stage.

Input

The first line of the input contains one number n – the number of brains in the final nervous system ($2 \leq n \leq 200000$). In the second line a history of zombie's nervous system evolution is given. For convenience, we number all the brains by $1, 2, ..., n$ in the same order as they appear in the nervous system (the zombie is born with a single brain, number 1, and subsequently brains $2, 3, ..., n$ are added). The second line contains n - 1 space-separated numbers $p_2, p_3, ..., p_n$, meaning that after a new brain k is added to the system, it gets connected to a parent-brain .

Output

Output n - 1 space-separated numbers – the brain latencies after the brain number k is added, for $k = 2, 3, ..., n$.

Example

input

```
6
1
2
2
1
5
```

output

```
1 2 2 3 4
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