Pan African Olympiad in Informatics Team Selection Test 2025

Beautiful Garden

Time limit: 2 seconds **Memory limit: 512 MB**

For her photography project, Chadha went on a trip to Valencia, to visit and photograph a medieval-era castle repurposed into a museum. The museum guide took her to a beautiful garden, where she could see the palace's many gardeners at work: these workers are trained to diligently preserve the ancient gardening style first developed for the palace nearly ten centuries ago.

Although she finds all parts of the garden delightful, Chadha is mostly interested by the work they do on the garden's trees, plants represented as an acyclic connected graph of N nodes and $N-1$ edges, where the root of the plant is marked as node 0 by convention. She observes that these gardeners are tasked with trimming the trees in such a way as to make all leaves equally distanced (of equal distance) from the root, where a leaf is represented by any node besides the root that is only connected to only one other node, and distance to the root is given by the amount of nodes one has to traverse from a given node to reach the root. As the trees are rather delicate, the branches can only be cut at the leaves, and since the garden has hundreds upon hundreds of trees, these gardeners must have developped an efficient strategy to trim them quickly.

Chadha, interested in learning more, made her way to the palace library, where she found a copy of the castle's official botany book translated to English. She reads: "Gardeners first start by writing down a list P of N numbers, where the first entry is always -1, to indicate that the first node is the root of the tree, and every subsequent entry $P[i]$ indicates that node i is connected to node $P[i]$ by a branch. The gardeners then-"

Hmm... it seems the remaining pages have been torn off. Chadha believes however, that with the information we already have, we could deduce how the gardeners keep the trees evenly trimmed so efficiently. She has asked you to help her figure it out.

Problem Description

You are given an array P of N integers used to define a tree, which is an acyclic connected graph of N nodes and $N-1$ edges, rooted at 0. Let a leaf node be any node that is only connected to one other node, and the distance of a node to the root be the amount of nodes one must traverse to go from this node to the root. Find the minimum amount of operations needed to make all leaves of the tree P equidistant (of equal distance) to the root, where an operation consists of deleting any leaves and the edge between them and their parent.

Input

Input is formatted as follows:

```
N
P[0] P[1] P[2] ...  P[N-1]
```

Output

Output is expected as follows:

```
C
```

Constraints

- $2 \leq N \leq 3 * 10^5$
- $P[0] = -1$ and $0 \leq P[i] < N$ $(1 \leq i < N)$

Subtasks

Subtask	Points	Constraints
1	5	$C \leq 1$
2	18	$N \leq 2000$, Only 0 appears more than once in P
3	11	Only 0 appears more than once in P
4	17	$N \leq 2000$
5	16	There are at most 10 leaves initially
6	33	No additional constraints

Examples

Example 1

```
7
-1 0 0 1 1 3 3
```

Output:

```
2
```

Example 2

```
8
-1 0 0 0 1 2 4 6
```

Output:

```
3
```

Example 3

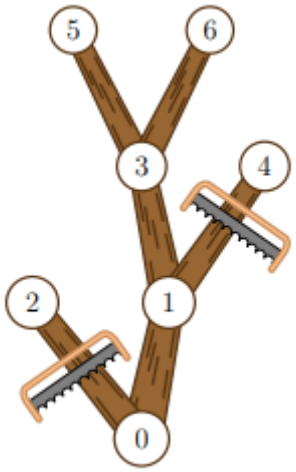
```
15
-1 6 4 0 12 0 7 0 11 5 8 13 5 5 12
```

Output:

```
5
```

Explanation

In the first example, we can remove the leaves 4 and 2 to make all other leaves equidistant from the root. Since we can already observe that there exists no strategy with one cut, and that the tree isn't initially balanced, we can conclude that 2 is the answer.



In the second example, we can remove the nodes 3, 6 and 7 to give all other leaves a distance of 2 from the root.