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In graph theory, a tree is an undirected graph in which any two nodes are connected by exactly one simple path, or equivalently a connected acyclic undirected graph.

Mohsin lives in a city that can be modeled as a tree with n nodes, numbered from 1 to n, with $a[i]$ people living at node i. The tree has $n-1$ edges, each of length 1; edge i ($1 \le i \le n-1$) connects nodes $u[i]$ and $v[i]$.

Suppose, Mohsin has a tea stall (also known as *tong er dokan*) at node x. Everyone in the city comes to his stall, so he is planning to open another stall at a different node. He knows that a person will go to the nearest – or any of the nearest in case of tie – stall if more than one stall sells tea. He will open the new stall at such a node y which minimizes the sum of the distances traveled by the people. Let us call this minimum sum as $D[x]$.

You are not given any specific node x. Instead, your task is to calculate $D[x]$ for each x from 1 to n.

Input

Read the input from the standard input in the following format:

- line 1: n
- line 2: $a[1]$ $a[2]$ $\ldots$ $a[n]$
- line $2+i$ ($1 \le i \le n-1$): $u[i]$ $v[i]$

Output

Write the output to the standard output in the following format:

- line i ($1 \le i \le n$): $D[i]$

Constraints

- $2 \le n \le 100\,000$
- $0 \le a[i] \le 1\,000\,000$ (for all $1 \le i \le n$)
- $1 \le u[i], v[i] \le n$ and $u[i] \ne v[i]$ (for all $1 \le i \le n-1$)
- The set of edges describe a tree.

Subtasks

1. (3 points) $n \leq 300$
2. (4 points) $n \leq 2000$, and the maximum degree of any node is 2. In other words, the tree is a line graph.
3. (23 points) The maximum degree of any node is 2. In other words, the tree is a line graph.
4. (19 points) $n \leq 2000$
5. (51 points) No further constraints.

Examples

Example 1

```
6
0 0 10 0 0 4
1 2
2 3
2 4
4 5
5 6
```

The correct output is:

```
16
10
0
8
4
0
```