DMOPC '16 Contest 1 P4 - Tree Appraisal

Time limit: 1.8s   **Memory limit:** 256M

Suppose there is a tree with N nodes (numbered from 1 to N), which is a graph with N nodes, $N-1$ edges, no cycles, and exactly one available path to travel between any pair of nodes. In this tree, each node is made of something which is probably really valuable, and therefore node i has a value of K_i.

You are interested in inspecting the tree in a specific way in order to extract its monetary value. A path is a sequence of nodes such that each node after the first is connected to the previous node by an edge, and no node is visited more than once. Suppose that there is a path from a to b in the tree. The appraised value, in unmarked moneys, of that path will be equal to:

the path's length (equal to one less than the number of nodes included in the path)

...multiplied by:

the sum of the values of all nodes included in the path

In order to determine how many unmarked moneys you can get from a tree, you must find the sum of the appraised values of all distinct pairwise paths in the tree. A path going from a to b is not considered distinct from one which goes from b to a. Formally, find the total of $appraise(a, b)$ across all pairs (a, b), where $1 \le a < b \le N$, and the $appraise$ function is as described.

Input Specification

On the first line, there will be one integer N.
On the second, there will be N space separated integers from K_1 to K_N. These indicate the values of nodes of the tree in increasing order.
On the subsequent $N-1$ lines, there will be two integers, a_j and b_j, such that a_j is not equal to b_j. This indicates an **undirected** edge going between a_j and b_j.

Constraints

$1 \le N \le 200\,000$

$0 \le K_i \le 1000$

It is recommended to use 64-bit integers. It is guaranteed that the answer will not exceed the upper limit of a 64-bit signed integer. ($2^{63} - 1$)

Subtask 1 [20%]

$1 \le N \le 100$

Subtask 2 [35%]

$1 \le N \le 2000$

Subtask 3 [45%]

No additional constraints.

Output Specification

Print a single integer, the sum of the appraisal values of all distinct paths in the tree.

Sample Input 1

```
2
3 4
1 2
```

Sample Output 1

```
7
```

Sample Input 2

```
4
618 843 585 569
3 2
1 4
2 4
```

Sample Output 2

```
19926
```

Explanation for Sample Output 2

The tree has four nodes, connected in a line: $3 - 2 - 4 - 1$, and the values have been assigned as 585 for node 3, 843 for node 2, 569 for node 4, and 618 for node 1. Therefore, there are six paths we must consider:

- $3 \rightarrow 2$ with sum 1428 and length 1;
- $3 \rightarrow 4$ with sum 1997 and length 2;
- $3 \rightarrow 1$ with sum 2615 and length 3;
- $2 \rightarrow 4$ with sum 1412 and length 1;
- $2 \rightarrow 1$ with sum 2030 and length 2;
- $4 \rightarrow 1$ with sum 1187 and length 1.

Thus, the answer is the following: $1428 * 1 + 1997 * 2 + 2615 * 3 + 1412 * 1 + 2030 * 2 + 1187 * 1$, which is equal to $19\,926$.

Sample Input 3

```
5
0 1 1 1 1
1 2
1 3
1 4
1 5
```

Sample Output 3

```
28
```