IOITC 2019
Team Selection Test 3

Labelled Tree

You are given an undirected, unweighted tree T of N nodes. All the nodes are numbered from 1 to N. Each node in the tree also has a label associated with it, which is denoted by $A_1, A_2, \ldots, A_N$. It is guaranteed that for any two nodes u, v where $u \neq v$, if they have the same label (ie. if $A_u = A_v$), then there is at least one node, x, in the simple path between them with a smaller label than them. That is, $A_x < A_u$.

For every pair of vertices (u, v), we define a cost function $C(u, v)$ to be $C(u, v) = \text{dist}(u,\ x) * \text{dist}(x,\ v)$, where x is the node in the simple path between u and v with the smallest label. $\text{dist}(u,\ v)$ denotes the number of edges on the simple path between u and v.

Calculate

$$\sum_{\substack{u,v \in T \\ u \neq v}} C(u, v) \tag{1}$$

Since the answer can be large, output the summation, modulo $10^9 + 7$.

Note: We are taking the sum over ordered pairs, so $C(u, v)$ and $C(v, u)$ should both be considered when $u \neq v$.

Input

- The first line contains a single integer, N denoting the number of nodes in the tree.
- The i^{th} of the next $N - 1$ lines contains two integers, u_i, v_i denoting that there is an edge between nodes u_i and v_i.
- The $(N + 1)^{th}$ line contains N integers: $A_1, A_2, \ldots, A_N$.

Output

Output a single integer in a new line, which should be the summation of the costs modulo $10^9 + 7$.

Constraints

- $1 \leq N \leq 10^5$
- $1 \leq u_i, v_i \leq N$
- $1 \leq A_i \leq 200$, for all $1 \leq i \leq N$.
- The given graph is a tree.

Subtasks

- Subtask 1: 23%: $1 \leq N \leq 1000$
- Subtask 2: 77%: Original Constraints

Sample Input 1

```
4
4 1
1 3
2 1
3 4 2 1
```

Sample Output 1

```
0
```

Explanation 1

The various costs are as follows:

- $C(1,2) = dist(1,1) * dist(1,2) = 0 * 1 = 0$
- $C(1,3) = dist(1,3) * dist(3,3) = 1 * 0 = 0$
- $C(1,4) = dist(1,4) * dist(4,4) = 1 * 0 = 0$
- $C(2,1) = dist(2,1) * dist(1,1) = 1 * 0 = 0$
- $C(3,1) = dist(3,3) * dist(3,1) = 0 * 1 = 0$
- $C(4,1) = dist(4,4) * dist(4,1) = 0 * 1 = 0$
- $C(2,3) = dist(2,3) * dist(3,3) = 2 * 0 = 0$
- $C(2,4) = dist(2,4) * dist(4,4) = 2 * 0 = 0$
- $C(3,2) = dist(3,3) * dist(3,2) = 0 * 2 = 0$
- $C(4,2) = dist(4,4) * dist(4,2) = 0 * 2 = 0$
- $C(3,4) = dist(3,4) * dist(4,4) = 2 * 0 = 0$
- $C(4,3) = dist(4,4) * dist(4,3) = 0 * 2 = 0$

Their sum is 0, and hence the answer is 0.

Sample Input 2

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

Sample Output 2

```
12
```

Explanation 1

The non-zero costs are as follows:

- $C(3,5) = dist(3,1) * dist(1,5) = 2 * 1 = 2$
- $C(4,5) = dist(4,1) * dist(1,5) = 2 * 1 = 2$
- $C(2,5) = dist(2,1) * dist(1,5) = 1 * 1 = 1$
- $C(3,4) = dist(3,2) * dist(2,4) = 1 * 1 = 1$

- $C(5,3) = dist(5,1) * dist(1,3) = 1 * 2 = 2$
- $C(5,4) = dist(5,1) * dist(1,4) = 1 * 2 = 2$
- $C(5,2) = dist(5,1) * dist(1,2) = 1 * 1 = 1$
- $C(4,3) = dist(4,2) * dist(2,3) = 1 * 1 = 1$

Their sum is 12, and hence the answer is 12.