Problem E. Cyan White Tree

Time limit: 4 seconds
Memory limit: 1024 megabytes

Given a tree with n vertices, each vertex is colored either cyan or white. For a simple path in the tree, let c be the number of cyan vertices and w be the number of white vertices in the path. The value of the path is $(c + w) - 2 \times |c - w|$, where $|c - w|$ is the absolute value of $(c - w)$.

Define the depth of a vertex u to be the number of edges on the shortest path from vertex 1 to vertex u. Define the key vertex of a simple path to be the vertex with minimum depth among all vertices in the path. It can be proven that the key vertex for a simple path is unique.

For each $1 \le i \le n$, calculate the maximum value among all simple paths whose key vertex is i.

Recall that a path in the tree is a nonempty sequence of vertices $p_1, p_2, \ldots, p_k$ such that each pair of adjacent vertices in this sequence is connected by an edge. A simple path is a path where all vertices in it are distinct. A single vertex can also form a simple path.

Input

There are multiple test cases. The first line of the input contains an integer T ($1 \le T \le 10^5$) indicating the number of test cases. For each test case:

The first line contains an integer n ($2 \le n \le 4 \times 10^5$) indicating the number of vertices.

The second line contains a `01`-string of length n, indicating the color of each vertex. If the i-th character is '`0`', the i-th vertex is colored cyan; otherwise, the i-th vertex is colored white.

For the following $(n - 1)$ lines, the i-th line contains two integers u_i and v_i ($1 \le u_i, v_i \le n$), indicating an edge connecting vertices u_i and v_i. It's guaranteed that the given edges form a tree.

It is guaranteed that the sum of n of all test cases does not exceed 4×10^5.

Output

For each test case output n lines, each containing one integer. The i-th line is the maximum value among all simple paths whose key vertex is i.

Example

standard input	standard output
3 8 00101110 1 2 1 3 3 4 3 5 5 6 5 7 7 8 2 01 1 2 2 00 1 2	6 -1 3 -1 1 -1 2 -1 2 -1 -1 -1