Problem F. Count on the Path

Input file:	*standard input*
Output file:	*standard output*
Time limit:	5 seconds
Memory limit:	**128 mebibytes**

You are given a tree with n vertices conveniently labeled with $1, 2, \ldots, n$.

Let $f(a, b)$ be the minimum label of a vertex that is **not** on the path between vertices a and b.

You must answer q queries of the form (u_i, v_i) for the value of $f(u_i, v_i)$.

Input

The first line of the input contains two integers n and q ($4 \le n \le 10^6, 1 \le q \le 10^6$). Each of the following $(n-1)$ lines contains two integers a_i, b_i denoting an edge between vertices a_i and b_i ($1 \le a_i, b_i \le n$). Each of the following q lines contains 2 integers u'_i, v'_i ($1 \le u_i, v_i \le n$).

The queries are encrypted in the following manner.

- $u_1 = u'_1, v_1 = v'_1$.
- For $i \ge 2$, $u_i = u'_i \oplus f(u_{i-1}, v_{i-1}), v_i = v'_i \oplus f(u_{i-1}, v_{i-1})$.

Here $\oplus$ denotes bitwise exclusive-or.

It is guaranteed that $f(a, b)$ is defined for all a, b.

Output

For each query, print a single integer — an answer to this query.

Examples

standard input	standard output
4 1 1 2 1 3 1 4 2 3	4
5 2 1 2 1 3 2 4 2 5 1 2 7 6	3 1