

2509. Cycle Length Queries in a Tree

Description

You are given an integer `n`. There is a **complete binary tree** with $2^n - 1$ nodes. The root of that tree is the node with the value `1`, and every node with a value `val` in the range $[1, 2^{n-1} - 1]$ has two children where:

- The left node has the value $2 * val$, and
- The right node has the value $2 * val + 1$.

You are also given a 2D integer array `queries` of length `m`, where `queries[i] = [ai, bi]`. For each query, solve the following problem:

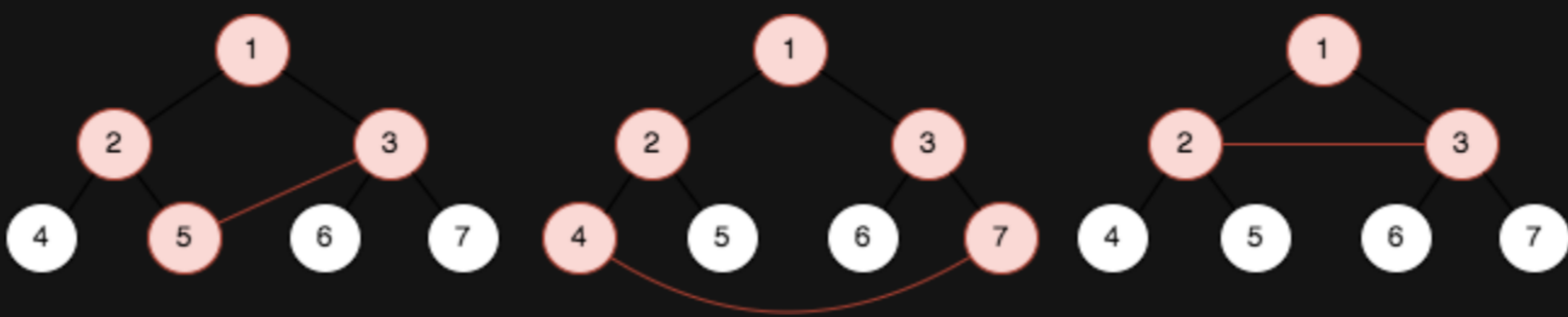
1. Add an edge between the nodes with values `ai` and `bi`.
2. Find the length of the cycle in the graph.
3. Remove the added edge between nodes with values `ai` and `bi`.

Note that:

- A **cycle** is a path that starts and ends at the same node, and each edge in the path is visited only once.
- The length of a cycle is the number of edges visited in the cycle.
- There could be multiple edges between two nodes in the tree after adding the edge of the query.

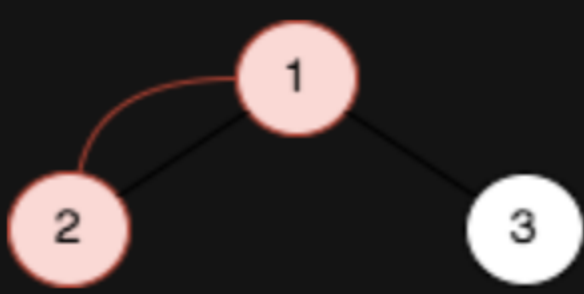
Return *an array* `answer` *of length* `m` *where* `answer[i]` *is the answer to the* `ith` *query.*

Example 1:



Input: `n = 3, queries = [[5,3],[4,7],[2,3]]`
Output: `[4,5,3]`
Explanation: The diagrams above show the tree of $2^3 - 1$ nodes. Nodes colored in red describe the nodes in the cycle after adding the edge.
– After adding the edge between nodes 3 and 5, the graph contains a cycle of nodes `[5,2,1,3]`. Thus answer to the first query is 4. We delete the added edge and process the next query.
– After adding the edge between nodes 4 and 7, the graph contains a cycle of nodes `[4,2,1,3,7]`. Thus answer to the second query is 5. We delete the added edge and process the next query.
– After adding the edge between nodes 2 and 3, the graph contains a cycle of nodes `[2,1,3]`. Thus answer to the third query is 3. We delete the added edge.

Example 2:



Input: `n = 2, queries = [[1,2]]`
Output: `[2]`
Explanation: The diagram above shows the tree of $2^2 - 1$ nodes. Nodes colored in red describe the nodes in the cycle after adding the edge.
– After adding the edge between nodes 1 and 2, the graph contains a cycle of nodes `[2,1]`. Thus answer for the first query is 2. We delete the added edge.

Constraints:

- $2 \leq n \leq 30$
- `m == queries.length`
- $1 \leq m \leq 10^5$
- `queries[i].length == 2`
- $1 \leq a_i, b_i \leq 2^n - 1$
- $a_i \neq b_i$

