

Problem 2509: Cycle Length Queries in a Tree

Problem Information

Difficulty: Hard

Acceptance Rate: 59.48%

Paid Only: No

Tags: Array, Tree, Binary Tree

Problem Description

You are given an integer n . There is a **complete binary tree** with $2n - 1$ nodes. The root of that tree is the node with the value 1 , and every node with a value val in the range $[1, 2n - 1 - 1]$ 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 i th 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 $2n - 1$ 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 $2n - 1$ 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:

$2 \leq n \leq 30$, $m == \text{queries.length}$, $1 \leq m \leq 105$, $\text{queries}[i].\text{length} == 2$, $1 \leq a_i, b_i \leq 2n - 1$, $a_i \neq b_i$

Code Snippets

C++:

```
class Solution {
public:
    vector<int> cycleLengthQueries(int n, vector<vector<int>>& queries) {

    }
};
```

Java:

```
class Solution {
    public int[] cycleLengthQueries(int n, int[][] queries) {
```

```
}  
}
```

Python3:

```
class Solution:  
    def cycleLengthQueries(self, n: int, queries: List[List[int]]) -> List[int]:
```