

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_ `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 23 - 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 22 - 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 <= n <= 30` * `m == queries.length` * `1 <= m <= 105` * `queries[i].length == 2` * `1 <= ai, bi <= 2n - 1` * `ai != bi`

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]:
```