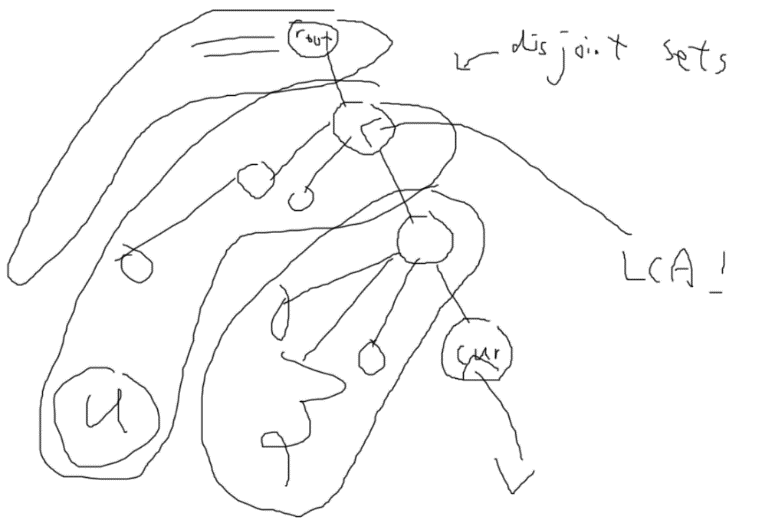
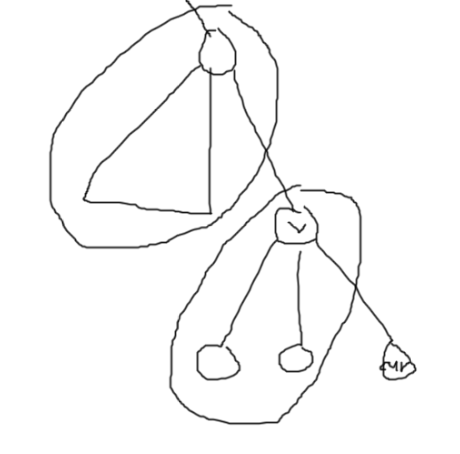
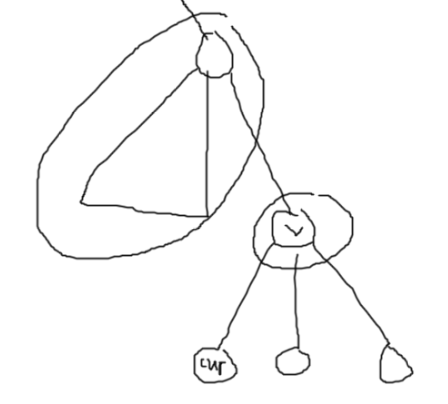
Offline LCA queries

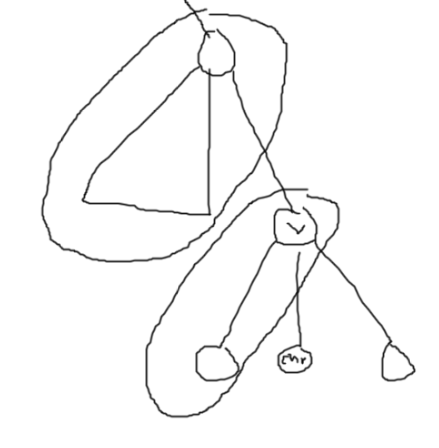
tree with nodes, queries of the form , for each query find the LCA of vertices and



We are currently at . LCA of and is either or its ancestor. For a fixed the visited nodes of the tree split into a set of disjoint sets, where each ancestor of has its own set containing itself and children who are not part of the path from to the root. The root of the set containing is the LCA of and .

The algorithm answers all queries with 1 DFS, and answers a query at node if is visited.

How to maintain the sets? disjoint set union! Let’s say we are at . We make a new set with only in it, then recursion to the children. After that, add the set of the children to the set of .



After adding all the sets of the children, answer the queries.

Why does this work? Won’t some queries be missed due to the parent’s set being incomplete? No! Because if it was incomplete, the query can be answered later when we are processing the other node!

<https://cp-algorithms.com/graph/lca_tarjan.html>