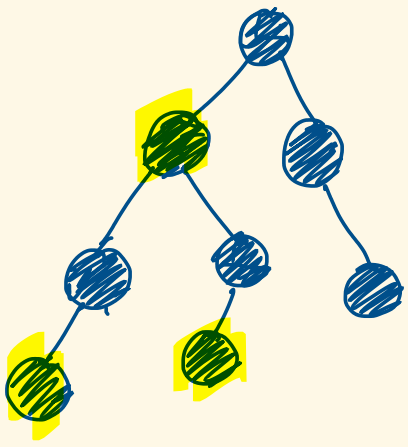
Lowest common ancestor

Thursday, October 26, 2023 2:09 PM

- Ancestors are everything in the path to root.
- LCA is the first ancestor in the path

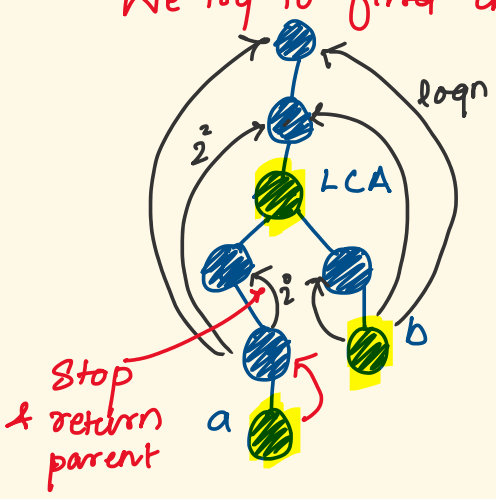


Types of algorithms to find LCA
- Can do a traversal to root for both nodes.
  ↳ O(n) time.
- Can use binary lifting → move by powers of 2.
- Tarjan's offline LCA algo.
- Heavy lifting decomposition.

* Using Binary lifting
↳ we can achieve O(logn) time for answering queries
+ O(nlogn) time for preprocessing.

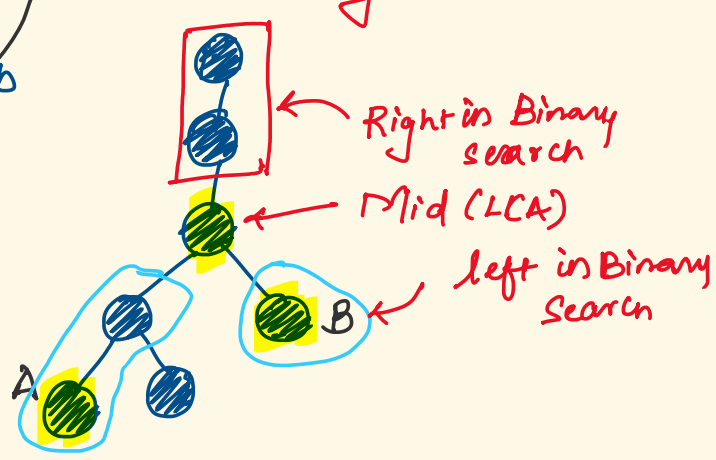
- Preprocess 2^kth ancestor of every single node.
- Get the difference in depth of both nodes
  ↳ call this k.
- Move only the node 'a' by powers of 2 using k. (Get a to the same level as 'b'.)
- Move both a & b up by powers of 2. (start from bigger powers of 2)

We try to find child of LCA. Root



start with Log(n) (Depth of the tree)

This is just like binary search



* Using Eulerian tour + Range Min Query (RMQ)
↳ we can answer queries in O(1) time
+ O(nlogn) preprocessing time.
↳ Can be made O(n)

- Start the Eulerian tour at the root.
- Index each node (store them) ← there can be multiple indexes to a node.
- Also track the depth of each node.
- Given a query LCA(2,3)
  ↳ we find the index of range(5,6) in the depth Array.