Pointer-based Data Structures (3/5)

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PDMI CS Club,
Sep-Oct 2019

Link-Cut Tree

	BST	Link-Cut Tree
MAKE-TREE(v)	$O(1)$	$O(\log n)$
LINK(v,w)	$O(1)$	$O(\log n)$
CUT(v)	$O(1)$	$O(\log n)$
FIND-ROOT(v)	$O(1)$	$O(\log n)$
FIND-MIN-COST(v)	$O(h)$	$O(\log n)$
ADD-COST(v,x)	$O(h)$	$O(\log n)$

— worst-case time

— amortized worst-case time

Exercises

- How will the data structure change if we want to answer max cost, or total cost instead of min cost?
- How one can answer the following query using link-cut trees: given two nodes in a tree, what is their lowest common ancestor? How long will this query take?

Reading on Link-Cut trees

- (amortized analysis) Cormen et al, Chapter 17
- Erik Demaine's lecture notes and video: https://courses.csail.mit.edu/6.851/spring12/scribe/L19.pdf and video https://courses.csail.mit.edu/6.851/fall17/lectures/L19.html
- Robert E. Tarjan. Data Structures and Network Algorithms. CBMS-NSF Reg. Conference Series in Appl. Math. 44. SIAM, 1983.
- original: Daniel D. Sleator and Robert E. Tarjan. A Data Structure for Dynamic Trees, Journal. Comput. Syst. Sci., 28(3):362-391, 1983.