

ICS 443: Parallel Algorithms

Homework 6

Due: Wednesday, November 29, 2017, 9am

Instructions: You may discuss the problems with other students in the class, but you must write up the solutions on your own and give credit to the students with whom you discussed each problem.

You will receive BONUS 10 pts if you turn in your homework in lecture on Monday, November 27 at 9am.

1 Tree traversal (40 pts)

You are given a binary tree $T = (V, E)$ rooted at vertex r . Let $n = |V|$.

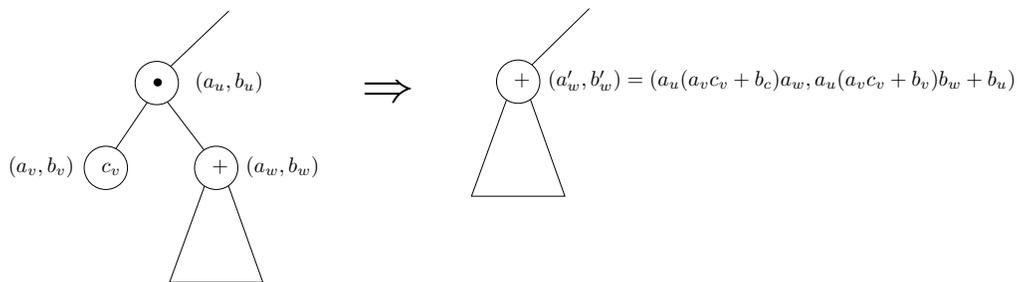
- (a) (20 pts) The *preorder traversal* of T consists of traversal of r , followed by the preorder traversal of the left subtree of r and followed by the preorder traversal of the right subtree of r . Design an $O(\log n)$ -time CREW PRAM algorithm that computes the preorder number of each vertex v . Analyze the work and time complexity of your algorithm
- (b) (20 pts) The *inorder traversal* of T consists of inorder traversal of the left subtree of r , followed by the traversal of r and followed by the inorder traversal of the right subtree of r . Design an $O(\log n)$ -time CREW PRAM algorithm that computes the inorder number of each vertex v . Analyze the work and time complexity of your algorithm

2 Finding the order of the leaves (30 pts)

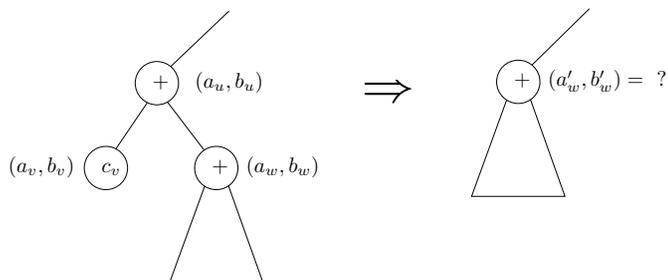
Given a binary tree T , design an algorithm that labels the leaves consecutively in order from left to right and places them into contiguous array A . *Hint: use Euler Tour technique.*

3 Expression tree evaluation (30 pts)

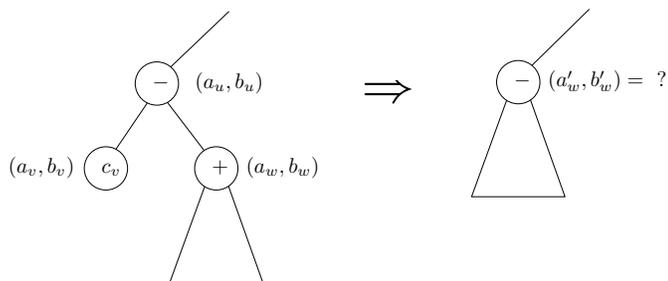
Let $T = (V, E)$ be an expression tree and let v be a leaf, with value c_v , parent u and sibling w . In lecture we saw that each tree vertex x is labeled with a pair of integers (a_x, b_x) . We also saw that if the operation at vertex u is multiplication, then if we rake v , the new label at w is modified to (a'_w, b'_w) , where $a'_w = a_u(a_v c_v + b_c) a_w$ and $b'_w = a_u(a_v c_v + b_v) b_w + b_u$.



- (a) (10 pts) What is the new label at u if the operation at vertex u is addition? Show your work. Does it matter if v is the left child of u or the right child of u ? Explain why or why not.



- (b) (10 pts) What is the new label at u if the operation at vertex u is subtraction and v is the left child of u ? Show your work.



- (c) (10 pts) What is the new label at u if the operation at vertex u is subtraction and v is the right child of u ? Show your work.

