I N F O R M A T I K

Universität des Saarlandes

FR 6.2 Informatik

Dr. Ulrich Meyer **WS 2003/4**

Exercises for Parallel and Distributed Algorithms

6. Assignment Due 08. Dec. 2003

Exercise 1 ($2 + 1$ *Points*)
(JaJa 2.39) You are given a sorted array $A = (a_1, a_2, \ldots, a_n)$ such that each a_i is labeled with some integer $l_i \in \{1, \ldots, m\}$, where $m = O(\log n)$.

(a) Provide an $O(\log n)$ time CREW PRAM algorithm to determine, for each $1 \leq i \leq m$, the minimum element of A with label l_i. Your algorithm must use $O(n)$ operations. Do not use any sorting algorithms.

(b) Try to achieve $O(\log \log)$ time and linear work for $m = O(\log \log n)$. Which PRAM model do you need?

Exercise 2 (1 *Points*)
Show how to compute the prefix minima of n elements whose order is given by a list.

Exercise 3 ($2 + 1$ *Points*)
(JaJa 2.43) Let $T = (V, E)$ be a rooted tree specified by the pairs $(i, p(i))$, $1 \leq i \leq n$, where $p(i)$ is the parent of i. Show that T can always be 2-colored.

(a) Develop an $O(\log n)$ time CREW PRAM algorithm to find such a coloring.

(b) Can you achieve $O(\log n)$ time with linear work?

Exercise 4 (2^* *Points*)
Show that list-ranking problems of size n cannot be solved faster than $\Theta(\log n)$ on a CREW PRAM.
Hint: Reduction OR-problem.