INFORMATIK

Universität des Saarlandes
FR 6.2 Informatik

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Exercises for Parallel and Distributed Algorithms

3. Assignment Due 17. Nov. 2003

Exercise 1 ($3 + 2^*$ *Points*)
(List ranking) Let the input consist of a list of length n, which contains each element of $\{1, \ldots, n\}$ exactly once. The list is represented in an array $A[1..n]$ as follows: for each $i \in \{1, \ldots, n\}$ not being the last list element let $A[i]$ ($\neq i$) be the successor of i in the list; if i_0 is the last element in the list then $A[i_0] = i_0$. Consider the following *link ranking* problem: for each $i \in \{1, \ldots, n\}$ compute the distance $D[i]$ from i to the end of the list (for example $D[i_0] := 0$).

a) Show that the problem can be solved in $O(\log n)$ time on a CREW PRAM with n PUs.

b) Can you achieve something better? (Less PUs and same time bound or a weaker PRAM model.)

Exercise 2 (2 *Points*)
For which max. number of PUs p is it possible to search with optimal speed-up in a sorted sequence of n elements?

Exercise 3 (1 *point*)
Show that the input of a merging problem can be modified such that all input elements are different without changing the relative order of those elements that were already different before.

Exercise 4 ($2 + 2$ *Points*)
(Sorting small numbers)

a) Show that n numbers from the set $\{1, \ldots, m\}$ can be sorted on an EREW PRAM in time $O(m + \log n)$ with optimal speedup. *Hint:* Divide in groups of size $\Theta(m + \log n)$, solve the subproblems sequentially, and work with prefix sums.

b) Show that the running time can be reduced to $O(m^\epsilon + \log n)$ for each constant $\epsilon > 0$. *Hint:* Radix sort.