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

2. Assignment Due 10. Nov. 2003

Exercise 1 (2 *Points*)
Consider the problem of identifying the first 1 in a bit sequence: given n bits $x_1, \dots x_n$; compute $\min(\{i : 1 \leq i \leq n \text{ and } x_i = 1\} \cup \{n+1\})$. Show that the problem can be solved in constant time on a PRAM with n PUs. Which PRAM model do you use? *Hint:* Subdivide into groups of about $\sqrt{n}$.

Exercise 2 (2 *Points*)
Show that the following problem can be solved in constant time on an CRCW PRAM with n PUs: Given n numbers $x_1, \dots, x_n$ in the range $\{1, \dots, n\}$; compute $\min\{x_1, \dots, x_n\}$.
Can you extend your solution to a range $\{1, \dots, n^c\}$ where $c \in I\!N$ is some constant?

Exercise 3 ($2 + 2^*$ *Points*)
Sorting with many PUs.

a) Show that a CREW PRAM with n^2 PUs can sort n numbers in $O(\log n)$ time.

b) Achieve the same bound for an EREW PRAM.

Exercise 4 ($2 + 2$ *Points*)
(Prefix-Minima) Consider the following generalization of the minimum problem: Given n numbers $x_1, \dots, x_n$; compute $\min\{x_1, \dots, x_i\}$ for $1 \leq i \leq n$.

a) Show that an CRCW PRAM with n^3 PUs can solve this problem in constant time.

b) Show that it can also be solved in $O(\log \log n)$ time with just n PUs. *Hint:* Use part a) in a recursive algorithm.