FDA125 Advanced Parallel Programming February 2007

Exercises for Topic X (Realization of PRAMs)

Exercise X.1

Explain how to compute the parallel prefix sums of n numbers on a distributed system with a binary tree topology, with n processors at the leaves and $n-1$ switches at inner nodes, in time $\Theta(\log n)$. Assume that switches can locally store data and do arithmetic operations on incoming values. (Hint: Use a modification of odd-even parallel prefix).

Exercise X.2

Show that there is a unique path of length l (edges) between any two nodes in the first and the last level of a $(l+1)2^l$-node butterfly network.

Exercise X.3

Read in Chapter 3 of *Practical PRAM Programming* about the details of the routing and combining mechanism in Ranade's PRAM emulation algorithm, and of its implementation in the SB-PRAM in Chapter 4.1–4.3.

What is the justification for using a non-work-optimal parallel algorithm for sorting the requests in phases 1 and 6?

Exercise X.4

A simple hash function h_1 to use in Ranade's PRAM emulation algorithm could be

$$h_1(x) = x \bmod p$$

for p memory modules. Why is it not advisable to use the least significant bits of the memory address to determine the memory module address?