CS4/531
Spring 1997
Homework #3

(No credit will be given for unsupported answers.)

1. Define an X-tree to be a tree machine in which neighboring nodes on a level are connected. That is, each interior node has 2 additional links, one two each of its left and right neighbors. Nodes on the outer edge of the tree (with the exception of the root) have one additional link, to its neighboring node in its level. Define the communication diameter, bisection width, and a lower bound on sorting for the X-tree.
2. [Quinn] Given a CRCW PRAM algorithm to solve problem *A* in $O(t(n))$ time, what is the upper bound on the running time to solve problem *A* on a CREW PRAM.
3. [Quinn] Given a CREW PRAM algorithm to solve problem *A* in $O(t(n))$ time, what is the upper bound on the running time to solve problem *A* on an EREW PRAM.
4. [Quinn] Why is it unrealistic to expect to solve an *NP*-complete problem on the PRAM in polylogarithmic time using a polynomial number of processors.
5. Give an efficient algorithm to sum *n* values on a mesh of size $n^{2/3}$, where each processor initially contains $n^{1/3}$ items.
6. Give an efficient algorithm to sum *n* values on a 3-dimensional mesh. Define the model of computation you assume.
7. Give an efficient algorithm to sum *n* values on a hypercube. Define the model of computation you assume.
8. Define a *linear array with bus of size n* to be a 1-dimensional mesh computer of size *n* augmented with a single global bus. Every processor is connected to the bus and in each unit of time, one processor can write to the bus and all processors can read from the bus (i.e., the bus is an CREW bus).
   a) Give an efficient algorithm to sum *n* values, initially distributed one per processor.
   b) Give an efficient algorithm to compute the parallel prefix of *n* values, initially distributed one per processor.