Homework Assignment 1, Part a

Due: Thursday, September 23, 1999

Reading:

Skim Chapters 1 and 2 of *Distributed Algorithms*. Read Chapter 3 carefully, but skip 3.7.

Problems:

1. Consider the problem of electing a leader in a synchronous ring of known size n, where the processes all have UIDs, but where the only operations available to the processes for manipulating these ids are (equals, unequals) comparisons. Is this problem solvable or unsolvable? Why?

2. Ex. 3.8.

   To clarify the statement in the book: The modification is that each process initiates sending tokens in one direction only; however, responses travel back to the process in the opposite direction.

3. Ex. 3.9 (You may find this hard.)

4. Consider the problem of estimating the number of processes in a synchronous ring network, using a comparison-based algorithm. Every process should end up with an estimate of the total number of processes. Each process may wind up with a different estimate. However, each estimate has to be *at least as large* as the correct number, and *no more than twice as large* as the correct number.

   (a) Describe an algorithm that does this, and give time and message complexity upper bounds.

   (b) Prove a lower bound on the number of messages required to solve this problem. Of course, try to get the best (largest) lower bound you can. Prove this bound as carefully as you can. Be sure to state any not-completely-obvious assumptions you are using in your proof.

   (Here and in other homework problems, you are free to invoke theorems proved in the book without re-proving them.)