Massachusetts Institute of Technology — Handout 4
6.852: Distributed Algorithms
Prof. Nancy Lynch — September 4, 2003

Problem Set 1, Part a

Due: Thursday, September 18, 2003
Problem sets will be collected in class. Please hand in each problem on a separate page.
Students who would like their writeups to be handed out can help us by writing elegant and concise solutions and formatting them using LaTeX.

Reading:

Skim Chapters 1 and 2 of *Distributed Algorithms*.
Read Chapter 3 carefully, skipping Section 3.7.
(Optional) Attiya-Welch, Chapters 1 and 2.

Reading for next week: Sections 4.1-4.4 and 5.1 of *Distributed Algorithms*.
(Optional) Attiya-Welch, Chapter 2.

Problems:

Note: In all homework problems, you are free to invoke theorems proved in the book without re-proving them.

1. Exercise 3.2, parts (a), (b).
2. Exercise 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. 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?
4. Exercise 3.9 (You may find this hard.)
5. Consider the problem of estimating the number of processes in a synchronous bidirectional ring, 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, est_i, has to be at least as large as the correct number, and smaller than twice the correct number ($n \leq est_i < 2n$).
   (a) Prove a lower bound on the number of messages required to solve this problem.
   (b) Prove that the lower bound of (a) is tight (i.e., it is the largest lower bound). If it is not, repeat (a) in order to find a tight lower bound.