Problem Set 1, Part a

Due: Thursday, September 22, 2005
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. (a) Exercise 3.2, part (a).
   (b) Exercise 3.2, part (b).
   (c) Exercise 3.2, part (c).
   (d) Give a UID assignment for which $\Theta(n \log n)$ messages are sent.
2. Exercise 3.7.
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? Prove carefully.
4. Exercise 3.9. Prove correctness and prove the complexity bound. (You may find this hard.)
5. Consider the problem of determining the number of processes in a synchronous bidirectional ring, using a comparison-based algorithm. Each process i should end up with an estimate, est_i, of the total number of processes. All processes' estimates should be correct.
   (a) Find the best *upper bound* you can on the worst-case number of messages required to solve this problem; that is, devise a communication-efficient algorithm to solve it and analyze the communication complexity.
   (b) Prove the best *lower bound* you can on the number of messages required to solve this problem, in the worst case.