

## Problem Set 7, Part a

**Due:** Tuesday, December 13, 2005

### Reading:

Chapters 17 and 21. Lamport's "The Part-Time Parliament". Begin Chapter 22.

### Reading for next week:

Finish Chapter 22. Dijkstra's paper on self-stabilization. Dolev's book on self-stabilization (skim).

### Problems:

1. Exercise 17.5. You should use the TIOA front-end to check your code.
2. Exercise 17.10.
3. In the first phase of the Paxos consensus algorithm, a participating process  $i$  performs a step whereby it abstains from an entire group of ballots at once, namely, the set  $B$  of all ballots whose identifiers are less than some particular proposed ballot identifier  $b$ , and that  $i$  has not already voted for. This set  $B$  may include ballots that have not yet been created.  
Suppose that, instead, process  $i$  simply abstained from all ballots in the set  $B$  that it knows have already been created. Does the algorithm still guarantee the agreement property? If so, give a convincing argument. If not, give a counterexample execution.
4. Consider how to use a Paxos consensus subroutine to implement a replicated state machine. Try to achieve good fault-tolerance and timing properties.
  - (a) Describe your algorithm carefully (using TIOA code). You should use the TIOA front-end to check your code.
  - (b) State a theorem that captures the key guarantees of your algorithm.
  - (c) Sketch a proof of your theorem.
5. Exercise 22.9.