

Problem Set 6, Part a

Due: Thursday, May 8, 2008

Reading:

Borowsky, Gafni, Lynch, Rajsbaum paper. Attiya, Welch, Section 5.3.2 (optional). Attie, Guerraoui, Kouznetsov, Lynch, Rajsbaum paper

Reading for next week:

Chapter 9 from the Herlihy, Shavit book. (See course web site.)
Herlihy, Luchango, Moir, and Schere paper on Software Transactional Memory.
Dice, Shalev, and Shavit paper on Transactional Locking.

Problems:

1. As noted in class, the BGLR paper has a liveness bug in the main protocol. Namely, a simulating process i may repeatedly decide to select the same process j to perform a snapshot, using safe-agreement, neglecting some other process j' .
 - (a) Why doesn't the task structure of process i , which has a separate task for each simulated process, ensure progress for all the simulated processes?
 - (b) Give a simple modification to the given code that would fix this problem, and guarantee that all the simulated processes get fair turns.
2. Consider the *approximate agreement* problem, expressed as a decision problem as follows: The value domain V is the set of rational numbers. For any input vector I of elements of V , the allowable output vectors are those for which (a) every element is in the range of the values in I , and (b) the difference between any two output values is at most one.

Suppose we are given a 10-process, 2-fault-tolerant asynchronous shared memory algorithm A that solves approximate agreement, using read/write shared registers. Describe clearly how we can use algorithm A and the BG-simulation results to obtain a 3-process wait-free asynchronous shared memory algorithm to solve approximate agreement, again using read/write shared registers.
3. For each of the following pairs of resilient (fault-tolerant) atomic objects, A and B , say whether or not A can be implemented using an unlimited number of B 's, plus an unlimited number of reliable read/write registers. Prove your answers.
 - (a) A is an 8-process 3-resilient consensus atomic object, and B is a 4-process 2-resilient consensus atomic object.
 - (b) A is an 8-process 4-resilient 2-consensus (AKA 2-set-consensus) atomic object, and B is a 4-process 3-resilient consensus atomic object. (For this part and the next, it will prove useful to consult Section 5 of the AGKLR paper.)
 - (c) A is an 8-process 4-resilient 4-consensus atomic object, and B is a 4-process 2-resilient consensus atomic object. (Hint: you may find it helpful to connect processes to more than one object.)