Problem Set 4, Part b

Due: Thursday, Nov. 3, 2005

Reading:

Mattern paper, Chapter 19, Chapter 9, Sections 10.1-10.5.

Reading for next week:

Finish Chapter 10. Chapter 11 (skim). Chapter 12.

Problems:

1. Exercise 18.10. ("Illogical time" refers back to Exercise 18.4.)

2. In the Mattern paper, a distributed algorithm is described that associates "weak logical times" with events of an underlying algorithm A, by maintaining and sending around vector timestamps.

   Recall the following definitions from class: Consider an execution. A "point" for process i is a position between two consecutive events of process i in the execution, and is modeled as a natural number representing the number of previous events at that process. A "cut" is a vector of points, one for each process. For cuts C, C', we say $C \leq C'$ if, for each i, $C(i) \leq C'(i)$. We say $C < C'$ if $C \leq C'$ and $C(i) < C'(i)$ for at least one i.

   Now fix a cut C, and let V_i be the timestamp vector of process i at point $C(i)$. Define a new cut V such that $V(i) = \max(V_1(i), \ldots, V_n(i))$ for each i. We then say that cut C is "consistent" iff $\forall i : V(i) = V_i(i)$.

   (a) Describe how to use Mattern's algorithm to solve the "maximal consistent cut" problem, defined as follows:

   After algorithm A has been executing for a while, each process receives the same (not necessarily consistent) cut k of the current execution of algorithm A as input. Each process i is required to return its own entry $m(i)$ in a maximal consistent cut $m \leq k$ of the execution of A. That is, there should not be another consistent cut m' such that $m < m' \leq k$.

   (b) Describe an application for maximal consistent cuts.

3. Exercise 19.5.

4. Exercise 19.13.

5. Exercise 10.3.