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:

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.
5. Exercise 10.3.