Problem Set 4, Part a

Due: Thursday, October 31, 2013

Readings:
Mattern paper
Chapter 19

Next week: Chapter 9 (skim); Sections 10.1-10.8 in detail; 10.9 (skim). Sections 11.1-11.3.

Problems:

1. The Mattern paper describes a distributed algorithm 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: A “point” for process $i$ in an execution is a position between two consecutive events of process $i$ in the execution, and is specified by a natural number representing the number of previous events at process $i$. A “cut” in an execution 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 $\forall i : V(i) = V_i(i)$.

   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 $C$ 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 $M \leq C$ of the execution of $A$. “Maximal” here means that there should not be another consistent cut $M'$ such that $M < M' \leq C$.

2. Exercise 19.5.

3. Exercise 19.11.

4. Think about your project. The proposal is due on Thursday, Oct. 31, the same date as this homework assignment.

   The proposal should be only a page long (or two at most). Say who is working on the project. Describe clearly what you are planning to do, and which type of project (of the three we mentioned earlier—reading project, theoretical research project, or experimental research project) you are planning to carry out. Include relevant references.