EXAM (11/03/99)

COP 6617 Distributed System Design

(Open books and notes)

1. (20 pts) Demonstrate that the snapshot algorithm (p.84) works correctly when all processes invoke the algorithm at the same time. Use Figure 3.11 as an example.

2. (20 pts) Given a precedence graph $G = (E, V)$, with $V = \{1, 2, 3, 4, 5, 6\}$ and $E = \{(1, 2), (1, 3), (1, 4), (2, 5), (4, 5), (5, 6)\}$, express this graph using

   - parbegin/parend statements, and
   - fork/join statements.

3. (30 pts) Lee and Hayes (1992) gave the following safe and unsafe node definition for hypercubes: A nonfaulty node is unsafe if and only if there are two faulty or unsafe neighbors, assuming that nonfaulty nodes are initialized to safe.

   (a) Consider a 4-cube with faulty nodes 0100, 0010, 0101, 1111, and 0011. Find out the safety status (safe or unsafe) of each node.

   (b) Show a 4-cube with faulty nodes that is safe under Wu's safety level definition but unsafe under Lee and Hayes' safe/unsafe definition.

   (c) Prove that if a node is safe in a given cube, then there exists a Hamming distance path (shortest path) from the node to any other node in the cube. (Hint: Prove by mathematical induction on the distance between the source and destination nodes.)

4. (30 pts) There are two long tapes, each containing a list of characters in alphabetical order. Use **two processes** written in DCDL, one for each tape, to find out the smallest character that appears only in one tape. Use **read** and **write** commands for interprocess communication. Demonstrate the correctness of your algorithm by applying it to the following example, where character c is the smallest character that appears only in one tape:

$$Tape\ A : aaabcccdd...$$

$$Tape\ B : abbbbbdee...$$