MIDTERM EXAM (10/14/96)

COP 6617 Distributed System Design

1. (20 pts) Consider a system where processes can be **dynamically created** (or terminated). A process can generate a new process. For example, in Figure 1 P_1 generates both P_2 and P_3. Modify the happened-before relation and the linear logical clock scheme for events in such a dynamic set of processes.

2. (40 pts) Assume that up to **two processes** can enter a critical section simultaneously. Provide possible extensions to Lamport and the simple token-ring-based algorithms. (Do not write code.)

3. (40 pts) You are required to evaluate a polynomial

$$a_0 + a_1 x^1 + ... + a_{n-1} x^{n-1}.$$

Design a DCDL algorithm with **n processes**. Assume that initially P_i $(0 \leq i < n)$ has a_i and x. The final evaluation result should be placed in P_{n-1}. Try to minimize the number of multiplications.

EXTRA POINTS:

4. (10 pts) To apply the Chang and Roberts's election algorithm to a hypercube, one can first generate a spanning ring in the given hypercube (see Figure 2 for a 3-dimensional hypercube example.)

   Assume that one process initiates an election process at a time. In the worst case, almost 2 rounds are needed to elect a winner. Enhance Chang and Robert's algorithm to obtain a faster election process for the hypercube topology by using **multiple paths** provided by the hypercube. Assume that each node can send a message to multiple neighbors simultaneously. Only high-level description of your algorithm is needed. Use the 3-dimensional hypercube example to illustrate your approach.

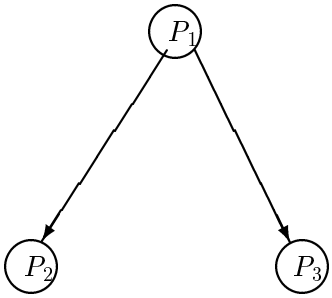

Figure 1: P_1 generates P_2 and P_3

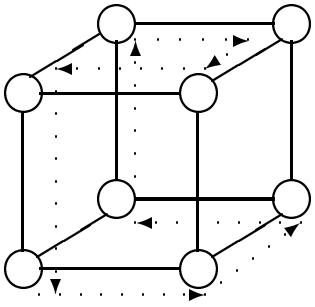

Figure 2: A spanning ring in a 3-dimensional hypercube