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15-418/618 Exercise 4 Answer Sheet

Problem 1: Lock Implementations

A. Direct.

B. Test.

C. Backoff.

Problem 2: Memory Consistency

A. Explain why these two fence operations have such different relative performance.

B. Explain why the local version has performance that improves with the number of threads.

C. For each of the five functions, determine where fence operations must be inserted to guarantee the ordering properties. You should insert only a minimum set of fences. Justify why these particular fences are required and why no others are.

Problem 3: Interconnection Networks



Figure 1: Fat-tree network, showing the recursive structure

- A. Identify the k/2 subnetworks of type N(k, 2) for k = 4 in Figure 1. You can do this by modifying the diagram in Figure 1. Use different colors for the switches to indicate the different subnetworks and the additional switches.
- B. Derive a closed-form formula for P(k, l).

C. Show that you could set up the eight links forming a *mirror permutation*, mapping port *i* to port N-i-1 for $0 \le i < N/2$. You can do this by modifying the diagram in Figure 2. Use different colors to illustrate the different links.



Figure 2: Fat-tree network with links for mirror permutation