Homework Assignment #3
Due: February 5, 2008

3. Recall from class the algorithm by Gallager, Humblet and Spira which constructs a minimum spanning tree in a connected network. We assumed that processes have unique ids and run synchronously without any failures. Let n be the number of nodes in the system. Show that the number of messages used by the algorithm may be $\Omega(n^2)$ if the number of edges in the network is $\Omega(n^2)$.

4. Consider an anonymous model where processes are arranged in a ring. Each process receives an input bit (0 or 1). The goal is to compute the xor of all the bits.

(a) Suppose processes do not know the exact size of the ring, but they know that it is either n or $n + 1$. Show that it is impossible to solve the problem, even if the system is synchronous.

(b) Now suppose processes know that the size of the ring is exactly n. Give an algorithm to compute the xor in an asynchronous system. How many messages does your algorithm use in the worst case? (The fewer, the better.)