

Homework Exercise #4
Due: 11:30 a.m., October 8, 2014

1. 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 $\Omega(n^2)$. In other words, for *every* n , construct a network graph G_n that has n nodes and weighted edges such that the MST algorithm sends $\Omega(n^2)$ messages when executed on G_n .
2. 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 $n + 1$. Prove 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.)