7/3/2013 Exam in Distributed Algorithms

2nd term (Moed Bet)

Solve 3 questions out of 4.

Exam's duration: 2 and half hours.

1) a) Describe Luby's reduction from $(\Delta+1)$-coloring to the MIS problem. Prove its correctness.

Analyze it. (Given an alg' that solves MIS in graphs with n vs and max'm degree Δ within $T(n,\Delta)$ time, how much time will one need to solve $(\Delta+1)$-coloring in such graphs?)

b) Suppose we have an MIS algorithm for unoriented trees that solves the problem in n-vertex trees with maximum degree Δ in $T(n,\Delta)$ time. Can it be used in conjunction with Luby's reduction to solve $(\Delta+1)$-coloring

in unoriented trees?
Explain your answer.

2) Describe a construction of n-vertex graphs G with $girth(G) = \Omega(k)$ and with $\Omega(n^{1+1/k})$ edges, for an arbitrary positive integer parameter k. Prove its correctness.
What are the implications of this construction to lower bounds for spanners? Prove these implications.

3) Given an n-vertex graph with arboricity a. Describe an algorithm that computes a $((2a) + O(a^{2/3}))$-coloring of this graph as efficiently as possible. Analyze your algorithm and its running time.
(The algorithm should be distributed.)

4) In a weighted graph $G=(V,E)$, $w: E \to \mathbb{R}^+$ is a weight function, for a spanning tree T, the <u>bottleneck</u> of T is the weight of its heaviest edge. The <u>min-bottleneck-spanning tree</u> of G is the spanning tree with minimum bottleneck.

Describe a time- and communication-efficient distributed algorithm for computing a min-bottleneck-spanning tree of G. Prove its correctness and analyze its running time.

Good Luck!