

# 22C: 196: 001 Peer-to-peer Networks

## Spring 2009, Assignment 2

### 50 points

Assigned March 24, 2009, Due March 31, 2009, in class

Please submit the answers in a typewritten form. Good documentation is essential. Your solution should only reflect your own thoughts, not someone else's ideas. It is ok to consult other papers, but please cite them at the end of the answer.

- (4+8+8+5 = 25 points) Consider Kleinberg's small world model on a (100 x 100) grid topology. Let each node have short-range links to every node at lattice distance 1, and one long-range link.
  - How many nodes will be there at lattice distance 40?
  - What is the probability that a node will have a link to a *specific node* at lattice distance 40? An approximate upper bound should be sufficient.
  - What would be the probability that a node will have a link to a *specific node* at lattice distance 40 if the long distance neighbor is chosen with uniform random probability?
  - How will you apply Kleinberg's results to a one-dimensional torus (i.e a ring topology)
- (10+5 = 15 points) Consider the search and replication model introduced in the paper by Cohen and Shenker for unstructured networks. Let  $p_i$  be the fraction of the total space allocated to the replicas of object  $i$ , and  $q_i$  be the normalized query rate for object  $i$ . Also assume that the query rates are ordered as  $q_1 > q_2 > q_3 > \dots > q_m$ 
  - What happens when  $p_{i+1}/p_i$  gradually increases from  $q_{i+1}/q_i$  to 1?
  - What is the most surprising result of this paper?
- (5+5 = 10 points) Consider a Content Addressable Network (CAN) with  $N$  nodes on a 2D torus topology.
  - What is the size of the routing table for each process?
  - What is the maximum distance between a pair of nodes?