22C: 166 Distributed Systems and Algorithms

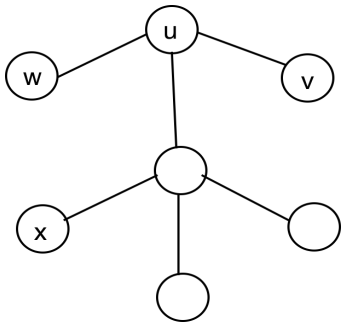
Homework 3, Total points = 60

Assigned 10/18/12 due 10/25/12

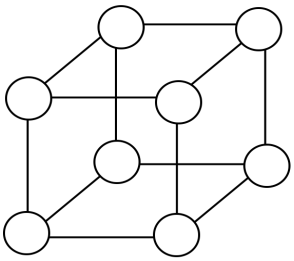
Please submit typewritten solutions through ICON, preferably in the pdf format. Late assignments will not be accepted without prior approval. In the world of distributed algorithms, the burden of proving (or arguing) that your solution will work is on you, and not on the reader.

Question 1 (10+10 points)

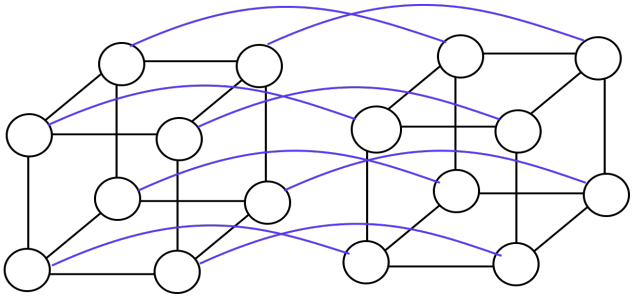
(a) Produce two different labeling of the nodes and the ports of following graph for the purpose of interval routing. In the first, begin by labeling node u as 0, and in the second, start with labeling node v as 0. Check the correctness of these labels by verifying the routes between different pairs of nodes



(b) Propose a *prefix routing scheme* for the following two networks. In each case, you have to label the nodes (not the ports) of the graph in such a way that a message can be routed from node X to node Y by forwarding it to the neighbor that has the largest prefix match with the destination node.



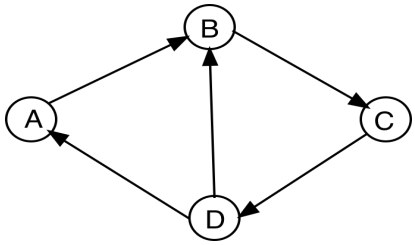
(a) 3-cube



(b) 4-cube

Question 2 (15 points) Devise a distributed algorithm for computing a spanning tree of a connected undirected graph in which no root is designated. You can assume that the nodes have unique names. You must explain the steps, and reason about why it will work.

Question 3 (15 points) Consider the following network where every link is unidirectional and FIFO, and messages always propagate along the direction of the links.



To record the global state, node A decided to send a robot. The robot will carry a briefcase, and will visit the processes in the order A-B-C-D-A. At each node, the robot will record the local state, and put it in its briefcase. When the robot returns to node A, the briefcase will contain the global state of the system.

Will the recorded snapshot be correct? Briefly justify your answer. If your answer is no, then how will you modify the algorithm so that the recorded snapshot is correct?

Question 4. (10 points) Consider a network whose topology is an undirected graph $G = (V, E)$. Each node $i \in V$ stores an integer $x(i)$. Design a probe-echo algorithm to compute the smallest value of x. The algorithm starts when an *initiator node* sends out a *probe* to each of its neighbors, and ends when the initiator receives an *echo* from each neighbor. When the algorithm terminates, the initiator of the algorithm should know the smallest x. Briefly argue why your solution will work.