

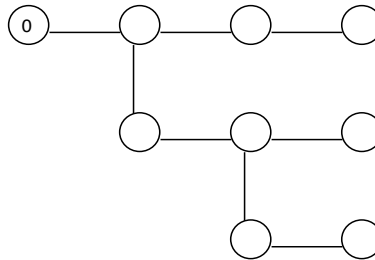
22C: 166 Distributed Systems and Algorithms

Homework 3, Total points = 60

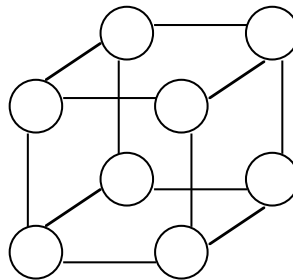
Assigned 10/7/11 due 10/19/11

Question 1 (10+10 points)

(a) Label the ports and the nodes of the following graph for the purpose of interval routing:

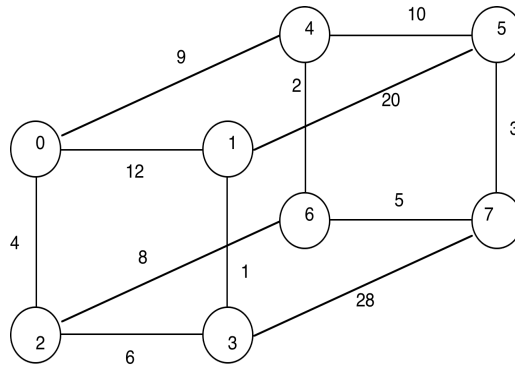


(b) Propose an *optimal interval routing scheme* for the following 3-cube. You may have to do some trial and error to generate the correct answer.



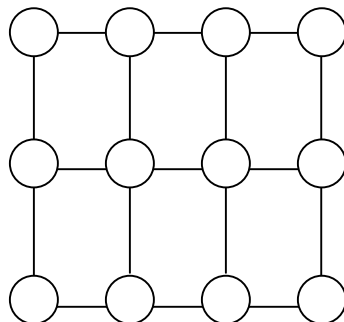
Question 2 (20 points) Devise a distributed algorithm for computing a spanning tree of a connected undirected graph in which no root is designated. You can assume that the nodes have unique names. Explain the main steps, and reason about why it will work.

Question 3 (15 points) The exact spanning tree of a network generated by an algorithm is determined by the signal propagation delays along the different edges. In the following network, the propagation delays of the different edges are shown as edge labels. With node 0 as the *root*, compute the spanning tree using *Chang's algorithm*. Assume that *probes* or *echoes* spend negligible amount of time at the various nodes.



Question 4. (15 points)

In the following network, a synchronous distributed algorithm takes 10 rounds. The edges are full duplex. The *first round* begins with each process sending a message to its neighbors. Thereafter, in each round, every process executes an action (*receive message, update a local variable, send message*), until at the end of the last round, every process receives the messages from its neighbors, updates its local state, and then the computation terminates.



Assume that you are using an **alpha-synchronizer** to run the same algorithm on an asynchronous version of the system where message delays and processor speeds are arbitrary but finite and messages are never lost.

- (a) How many *asynchronous rounds* will the algorithm need to complete?
- (b) How many messages will be used in the synchronous version of the algorithm?
- (c) How many messages will be used in the asynchronous version of the algorithm?

Briefly justify your calculations.