CSc72010

Homework (Thursday March 10)

1. Prove the following invariant for OptFloodMax:
For any round r and any i,j where j is an out-nbr of i, then if $\text{max-uid}_j < \text{max-uid}_i$ after r rounds, then $\text{new}_i = \text{true}$.
2. Prove the following invariant for SynchBFS:
After d rounds, every node within d of that start node has a parent node.

For the following questions, assume a bidirectional network (undirected network graph).
3. Write the Cisco Spanning Tree Algorithm (STA) using the model in the book. The algorithm is described below.
4. Prove that the choice of root node by the STA is correct in each process *(i.e., the node of the graph with the lowest uid).*
5. Prove that no messages are forwarded forever (assuming that blocked ports ignore all messages on the attached network segment).

Cisco Spanning Tree

Background: At every round, every process sends its own id; the id of the process it believes to be the root; and its distance from the supposed root process.
Suggestions for notation: *You may use a type* bpdu *for messages. The type has three fields:* id, root, *and* cost. *If message* v *of type* bpdu *arrives, you may refer to the fields as* v.id, v.root, *and* v.cost. *This is defined by the following statement in the model:*
type bpdu = tuple of id:Int, root:Int, cost:Int
Strictly speaking, when we talk about in-nbr i *of a node* v, *the index* i *belongs to some arbitrary numbering scheme that we have created for the network graph; but, you may treat* i *as if it is the uid of the in-neighbor, i.e., either* i *or* v.id *could be used in the code.*

Spanning tree: Initially, each process considers *itself to be the root* and all ports are designated and in listening state.
Whenever a process *in listening state* receives a message with a lower id for the root process, the port on which the new root process came in is the new root port.
After diam rounds, all ports move to learning state.
At each round, a process in learning state checks the message on each connected channel. If the process is closer to the root than any neighbor process on the channel, the port on the channel is a designated port. If the process is the same distance as some neighbor processes on the channel, but has a lower id, then the port is a designated port.
After diam more rounds, some ports move to forwarding and some to blocking. Every port that is either a root port or a designated port moves to forwarding state. Every other port moves to blocking state.