22C:166: Solution keys to Homework 3

Answer 1. No. As discussed in the class, the receiver will not be able to distinguish between m’.k and m” .k where m’ is a retransmitted version of m and m” is a new message using the same sequence number k of m.k. The receiver can legally accept m’, but then it can accept m” too. What if m” is an old message? FIFO property is lost!

Answer 2. The minimal subgraph will be one in which every pair of nodes will be contained in a simple cycle. Here are the steps to construct such a subgraph where any node can be designated as the root node:

   Construct a DFS tree and mark the root. The root will send out a probe down the tree using DFS traversal. When a node receiving the probe has a marked node as the non-tree neighbor, it marks itself and sends an ack to its parent. When a node receives an ack from every child, it sends an ack to its parent. If the root receives an ack from every child, it confirms the bi-connectivity property.

Answer 3(a). Process Q will buffer whatever it receives, but will deliver it to the application only after it receives or the next expected packet in sequence. It needs an infinite buffer.

Answer 3(b) {This uses a variation of Stenning’s protocol}

{program for process P}

define ok : boolean; next : integer;
initially seq = 0, ok = true, and both channels are empty;
do ok [] send (m[seq], seq); ok:= false
    (ack, seq) is received [] ok:= true; seq := seq + 1
od

{program for process Q}
define r : integer;
initially r = 0;
do (m[ ], s) is received [] s=r [] accept m (and save in the only buffer);
    send (ack, r); r:= r+1
    (m[ ], s) is received [] s≠r [] send (ack, r-1)
od
**Answer 4.** Each node has two variables: (1) a label $L$ that is its distance from the root, and (2) a parent $P$. Due to failure, one or more processes may lose their parents in the spanning tree. Each process $j$ executes the step

$$
P(j) := \{k : k \in N(i) \land k \text{ is non-faulty} \land L(k) \text{ is smallest label}\};
$$

$$L(j) := L(P(j) + 1)$$

Often local recovery is possible.

**Answer 5.**

Best case: leader elected after one round.

Worst case: leader elected after $\log_2 16 = 4$ rounds.