1. Course Handout: Topic 5, Question 15, 16, 17

2. For TCP, the lecture notes (slide 87) make the following statement: "receivers CAN buffer out of sequence packets".

   (a) Why might a receiver choose not to do this?

   (b) Does a sender need to know whether a receiver buffers out of sequence packets? Why? Why not?

3. Using a timing diagram to track the sequence of sent messages and acknowledgements, show that if messages can be reordered (i.e. a packet might be delayed and received after a packet that is subsequently sent), the rdt 3.0 state machine using alternating bits will not work as designed.

4. (This is P19 in K&R) Hosts A, B, and C share a broadcast channel. Host A needs to send a copy of the same data to two hosts, B and C.

   The channel can lose and corrupt packets to the destinations independently. For example, in addition to both B and C both not receiving a message from A there might be situations where B receives the message but C does not, and vice versa.

   Design a reliable data transfer protocol that ensures that A does not send out data from upper layers until it is sure that both B and C have successfully received the packet it is sending. Draw the state machine for this system and explain what information needs to travel with the data packet.

5. Derive the TCP throughput equation on slide 182. Why is it important for TCP to measure the round trip time?

6. TCP has a few problems areas (slide 187)

   (a) Why are non-congestion losses bad for TCP? Give examples of how non-congestion losses might arise.

   (b) TCP has a tendency to fill up buffers. What problem do backed up queues present?

   (c) Give two reasons why short flows are inefficient for TCP. What kind of Internet activity can result in many short flows?