To students:

Please take note that our **Mid-term assessment** covers everything taught before recess week. Two practice papers will be uploaded to Canvas Files in recess week.

1. **[KR, Chapter 3, R6]** Is it possible for an application to enjoy reliable data transfer even when the application runs over UDP? If so, how?

    Note: this is exactly what you are supposed to do in Assignment 2. ☺

2. Show an example that if the communication channel between the sender and receiver can reorder messages (i.e., two messages are received in different order they are sent), then protocol `rdt3.0` will not work correctly.

3. **[KR, Chapter 3, P29]** It is generally a reasonable assumption, when sender and receiver are connected by a single wire, that packets cannot be reordered within the channel between the sender and receiver. However, when the "channel' connecting the two is a network, packet reordering may occur. One manifestation of packet reordering is that old copies of a packet with a sequence or acknowledgement number of x can appear, even though neither sender's nor receiver's window contains x. With packet reordering, the channel can be thought of as essentially buffering packets and spontaneously emitting these packets at any point in the future. What is the approach taken in practice to guard against such duplicate packets?

4. **[Modified from KR, Chapter 3, P37]** Host A is sending data segments to Host B using a reliable transport protocol (either GBN or SR). Assume timeout values are sufficiently large such that all data segments and their corresponding ACKs can be received (if not lost in the channel) by Host B and the Host A respectively. Suppose Host A sends 5 data segments to Host B and the 2nd data segment is lost. Further suppose retransmission is always successful. In the end, all 5 data segments have been correctly received by Host B.

How many segments has Host A sent in total and how many ACKs has Host B sent in total if either GBN or SR protocol is used? What are their sequence numbers? Answer this question for both protocols.

5. **[KR, Chapter 3, R15]** Suppose Host A sends two TCP segments back to back to Host B over a TCP connection. The first segment has sequence number 65; the second has sequence number 92.

   a) How much data is in the first segment?

   b) Suppose that the first segment is lost but the second segment arrives at B. In the acknowledgment that Host B sends to Host A, what will be the acknowledgment number?

6. **[KR, Chapter 3, P26]** Consider transferring an enormous file of 2^{32} bytes from Host A to Host B. Assume an MSS of 536 bytes. Also assume a total of 66 bytes of transport, network, and link layer header are added to each packet before the resulting packet is sent out over a 155 Mbps link. Ignore flow control, congestion control and assume Host A can pump out all segments back to back and continuously. How long does it take for Host B to receive this file?

7. Wireshark: TCP

   Do the following:
   1. Start up your web browser. Go the http://gaia.cs.umass.edu/wiresharklabs/alice.txt and retrieve an ASCII copy of Alice in Wonderland. Store this file somewhere on your computer.
   2. Next, go to http://gaia.cs.umass.edu/wireshark-labs/TCP-wireshark-file1.html.
   3. Use the Browse button to enter the full path name on your computer containing Alice in Wonderland. Don't yet press the "Upload alice.txt file" button.
   4. Startup Wireshark and begin packet capture.
   5. Returning to your browser, press the "Upload alice.txt file" button. Once the file has been uploaded, a short congratulations message will be displayed in your browser window.
   6. Stop Wireshark packet capture.

   Answer the following questions:

1. What is the IP address and TCP port number used by the client computer (source) that is transferring the file to gaia.cs.umass.edu?
2. What is the IP address of gaia.cs.umass.edu? On what port number is it sending and receiving TCP segments for this connection?