

## Homework 6

*Assigned: October 14**Due: October 21*

1. You can find a copy of the TCP connection management diagram on the class webpage. Give a timing diagram (similar to those used in class with one vertical line for the client and one for the server) that shows the exchange of packets between a client and server that causes the client to go from the state ESTABLISHED to FIN-WAIT-1 to TIMED-WAIT to CLOSED.
2. Write a routine that maintains the right and left boundaries of the TCP sending window dynamically. Your routine should take as input a sequence of pairs of values for the acknowledgement field and the flow control window field. (I have used the variables  $a$  and  $b$  to denote these fields in class.) The idea is that this sequence of pairs represents the content of a sequence of packets that the TCP sender has gotten back from the TCP receiver.

Your routine should print the range of **new** bytes that can be sent after each  $(a, b)$  pair is processed. Assume that there is no congestion control in place, so only flow control determines the window size. Be sure to include a check that the sequence of  $(a, b)$  pairs are valid; if an invalid pair is detected, your code should complain. Assume the initial sending window size is 2048 bytes and that the first byte has sequence number 0.

Show the operation of your routine for the following sequence of pairs:  $(512, 1536)$ ,  $(1024, 1024)$ ,  $(1536, 1024)$ ,  $(2560, 512)$ ,  $(3072, 2048)$ ,  $(3584, 1024)$

3. Suppose you are running TCP with a maximum segment size of 1500 bytes. Assume the last acknowledgement received had an acknowledgement field of 500. Give the (new) value of the TCP sending window under the following conditions:
  - (a) The current congestion window is 3000 bytes, and the current threshold is 4000 bytes. An acknowledgement has just been received with an acknowledgement field of 2000 and a window field of 5000.
  - (b) Same conditions as part (a) except the current threshold is 2000 bytes.
4. Consider the effect of using slow start on a line with a 10-msec round-trip time and no congestion. The receive window is 24 KB and the maximum segment size is 2 KB. How long does it take before the first full receive window can be sent?