MCS-377 Intra-term Exam 1

Serial #:

This exam is closed-book and mostly closed-notes. You may, however, use a single 8 1/2 by 11 sheet of paper with *hand-written* notes for reference. (Both sides of the sheet are OK.)

Please write your name only on this page. Be sure to look at all problems before deciding which one to do first. Some problems are easier than others, so plan your time accordingly. You have 90 minutes to work.

Write the answer to each problem on the page on which that problem appears. You may also attach additional paper, which should be labeled with your test number and the problem number.

You must sign the honor pledge below and abide by it. This includes abiding by the limit to 90 minutes and the use of only one sheet of notes.

Printed name: _____

On my honor, I pledge that I have not given, received, nor tolerated others' use of unauthorized aid in completing this work.

Signature for above honor pledge: _____

Problem	Page	Possible	Score
1	2	10	
2	2	10	
3	3	10	
4	3	10	
5	4	9	
6	4	9	
7	5	8	
8	5	10	
9	6	8	
10	6	8	
11	6	8	
Total		100	

1. [**10 Points**]

   (a) List the five layers used in the Internet in order from highest to lowest. For each one, you are to give the general name of the layer, not the name of a specific protocol at that layer.

   (b) SMTP, POP3, and IMAP are all at the same layer of the protocol stack, and beyond that, they all share some further degree of commonality of purpose. What layer are they at? In what further way are they similar? And how does each of them differ from the others?

   (c) Give a specific example of a protocol used at a different layer from SMTP, POP3, and IMAP. Give the name of the protocol, the layer it is at, and a few additional words of description.

2. [**10 Points**] Suppose a computer is transmitting 500-byte packets on a 500 kb/s network, with a fixed congestion window size of four packets. What is the absolute maximum RTT that might allow transmission to continue steadily, without any pauses to wait for an ACK?

3. [**10 Points**]

   (a) A 1000-byte packet is transmitted on a 10 Mb/s network with propagation delay 0.5 ms. Calculate the total latency, ignoring all delays except for transmission and propagation.

   (b) In this calculation, you were told to ignore all other delays. Give one example of a category of delay you ignored.

4. [**10 Points**]

   (a) What two numbers are used to identify a UDP destination?

   (b) Given that UDP is connectionless, how can a UDP server that receives a request from a client process running on another computer arrange for a response to get back to the client process?

   (c) Why might a web browser keep several TCP connections open to the same web server?

   (d) Suppose a web browser does keep several TCP connections open to the same web server. When packets from the client arrive at the server, what field in the headers is used to distinguish the packets that belong to one connection from those that belong to the other?

   (e) What are two reasons why a web browser can obtain higher performance by keeping several TCP connections open, each to a different server, even if it only uses one of them at a time?

5. [**9 Points**] Each Resource Record (RR) stored in the Domain Name System associates some piece of information (a value) with a domain name. The type of information can vary; for example, sometimes it is another domain name and other times it is an IP address. For each of RR types A, CNAME, and your choice of either MX or NS, state whether the associated value is a domain name or an IP address and also briefly indicate the meaning of the RR. (In one case, the associated value actually contains a priority number as well as the main information of an IP address or domain name; you can ignore this detail.)

6. [**9 Points**] What layer of protocol is BitTorrent? What purpose does it serve? What aspect of the protocol design attempts to prevent freeloaders? Why do clients nonetheless sometimes send data to others who have not yet proven themselves to be worthy? Why is it that a large proportion of the uploading that low-bandwidth clients do is altruistic? What decentralized technique is now taking the place of centralized trackers?

7. [**8 Points**] What are two ways that a TCP sender can detect the loss of a segment? Which one is likely to be used to detect a loss near the beginning of a TCP connection, and why? How does the choice of queue space management policy in a router influence the relative frequency of the two TCP loss detection methods for TCP senders that are passing traffic through the router? Also, why does TCP employ both mechanisms rather than only one?

8. [**10 Points**] Two hosts have established a TCP connection. The current sequence number for the left-hand host is 2000, while that of the right-hand host is 500. The left-hand host sends a 1000-byte segment to the right-hand host. After receiving acknowledgment of that segment, the left-hand host sends a second 1000-byte segment, which the right-hand host echos back. When an ACK needs to be sent, if data also needs to be sent in the same direction as the ACK, the two are combined in a single segment. No segments are lost, corrupted, or unreasonably delayed. Draw a diagram of the segments exchanged, labeling each with sequence number, ack number, and length.

9. [**8 Points**] Suppose a TCP sender uses exclusively 500-byte segments, and has a current congestion window of 5000 bytes. How many bytes does the congestion window expand by if one non-duplicate acknowledgment is received and the current mode is

   (a) slow start

   (b) congestion avoidance

10. [**8 Points**] Microsoft's CTCP variant of TCP embodies some of the principles of TCP Vegas. What additional sign of congestion does this entail using? Why would that provide performance advantages over the means that TCP traditionally has had available for detecting congestion? In what regard is ECN similar, and in what regard different?

11. [**8 Points**] Mark each of the following as being true of TCP's slow-start mode (SS), congestion-avoidance mode (CA), or both.

   (a) The congestion window size increases by one maximum segment size (MSS) for each acknowledgment received.

   (b) When the congestion window size reaches the current threshold, this mode is ended and the other mode started.

   (c) This mode is used for newly opened connections.

   (d) This mode is used after a packet loss is detected by timeout.

   (e) This mode is used after a packet loss is detected by triple-duplicate acknowledgment.

   (f) When this mode is entered after a packet loss, the congestion window is typically equal to the threshold.

   (g) When this mode is entered after a packet loss, the congestion window is typically cut in half.

   (h) When this mode is entered after a packet loss, the threshold is typically set to half the prior congestion window.