Be neat and concise. **One point will be deducted for each incorrect spelling of the word receiver!** Show your work. Good luck.

Name: _____

Problem	Points	Score
1	20	
2	15	
3	25	
4	15	
5	10	
6	15	
Total	100	

1. Consider three name servers with the following content. All of the name servers use iterative resolution.

Name Server `foo.bar.edu`:

Name	Value	Type
"root"	rootserver.bar.edu	NS
apple.bar.edu	buzz.apple.bar.edu	NS
pear.bar.edu	130.208.8.16	A
grape.bar.edu	130.208.8.15	A
banana.bar.edu	130.208.8.17	A
rootserver.bar.edu	130.208.15.20	A
buzz.bar.edu	130.208.15.10	A

Name Server `buzz.bar.edu`:

Name	Value	Type
"root"	rootserver.bar.edu	NS
pear.apple.bar.edu	130.208.10.10	A
banana.apple.bar.edu	130.208.10.15	A
rootserver.bar.edu	130.208.15.20	A

Name Server `rootserver.bar.edu`:

Name	Value	Type
bar.edu	foo.bar.edu	NS
foo.bar.edu	130.208.7.12	A

(a) Suppose a client `banana.apple.bar.edu` with local name server `buzz.bar.edu` makes the call `gethostbyname('`pear.bar.edu'')`. Give the sequence of actions by stating which name servers are contacted at each step and which particular records are accessed.

(b) Suppose that immediately after the access from part (a) the client `banana.apple.bar.edu` makes the call `gethostbyname(``grape.bar.edu'')`. Give the sequence of actions by stating which name servers are contacted at each step and which particular records are accessed.

(c) Suppose a client `banana.bar.edu` with local name server `foo.bar.edu` makes the call `gethostbyname(``pear.apple.bar.edu'')`. Give the sequence actions by stating which name servers are contacted at each step and which particular records are accessed.

2. **Link State Routing.** State whether each of the following is True or False.

(a) Link state routing must use Dijkstra's algorithm.

(b) A router can simultaneously receive a link state update from router A that lists neighbors B and C, and an update from router B that lists neighbors D and E.

(c) A router can receive the same link state update message more than once, without the network duplicating a message.

(d) Link state routing has a counting-to-infinity problem.

3. **TCP Flow and Congestion Control.** Suppose you are running TCP with a maximum segment size of of 1000 bytes. The initial value of ssthresh is 2000, and the receiver has advertised a window of 4000 bytes. Assume the initial sequence number on the data bytes at the sender is 0.

Give the range of sequence numbers in the sending window after each of the following (cumulative) events at the sender:

(a) Initially

(b) After receiving an ACK with Acknowledgement value 1000 and Window value 4000.

(c) After receiving an ACK with Acknowledgement value 3000 and Window value 4000.

(d) After a timeout on the next packet sent.

(e) Draw a sender-receiver timing diagram (as in class, with one vertical line for the sender and one for the receiver) that illustrates the packet exchanges that for the sequence of events listed above.

4. **Sockets Programming.** Consider the following code:

```
struct {
  u_char a;
  u_char b;
  u_short c;
  u_long d;
} msg;

msg.a = 0x64; msg.b = 0x75; msg.c = 0x1234; msg.d = 0x98765432;
```

(a) If `msg` is sent from a big-Endian machine to a little-Endian machine without doing any byte swapping on either end, what will the values be of each field at the receiving machine? (Recall that big-Endian puts the most significant byte in the lowest address location, while little-Endian puts the most significant byte in the highest address location.)

(b) Give the code fragment for each end (sender and receiver) needed to do the necessary byte swapping. You can use the conversion routines available in the system.

5. **Sockets Programming.** Explain briefly what happens in the network when the `connect()` command is called for a socket of type:

   (a) `SOCK_STREAM`

   (b) `SOCK_DGRAM`

6. **Short Answer.** Give concise answers to the following questions:

   (a) Will TCP ever deliver segments to the application that are out of order? (State yes or no with a brief explanation.)

   (b) When does DNS use TCP?

   (c) The command `gethostbyaddr()` takes an IP address and returns the host name. Can this be efficiently implemented using the DNS?