1. IPv6 Addresses
   (a) Write the following IPv6 address in shortened form:
       2041:0000:140F:0000:0000:0000:875B:131B
   (b) Suppose the network interface has hardware id 00:e0:4c:53:44:58. What
       should the link-local IPv6 address for that interface be? Explain why on
       Windows and Mac OS X the address the computer picks might not match
       the address specified in the RFC.
   (c) BT, my ISP, provides each customer a /56 IPv6 network block. If my
       IP is 2a00:23c4:bfb9:6801:a58f:b33f:26ad:d13c, what is the routing
       prefix? How many subnets can I have on my network?

2. Questions about DHCP and SLAAC
   (a) When a host first joins an IPv4 network, to obtain an IP address via
       DHCPv4, what IP address does it need to send a packet to?
   (b) What key pieces of information is provided to a newly connected host in
       a DHCPv4 offer?
   (c) When joining an IPv6 network, how does a host know whether to use
       SLAAC or DHCPv6?
   (d) DHCPv6 messages differ from DHCPv4 messages in that they no longer
       require information about DNS servers and gateway IPs. Where do hosts
       obtain this information from instead?

3. Consider the following network topology where some residential hosts connect
to the Internet via NAT devices:

```
E: 4.3.2.1

NAT 1.2.3.4
  A: 10.0.0.2

Internet

NAT 5.6.7.8
  B: 10.0.0.4
  C: 10.0.0.2
  D: 10.0.0.3
```
(a) Host A has an active SSH connection (Port 22) to Host E. Give a plausible value for the (source address, destination address, source port, destination port) 4-tuple for packets in this connection as they exit Host A’s computer. Indicate what elements of the tuple would be assigned at connection time (pick whatever value you want for these ephemeral ports).

(b) What is a plausible value for the (source address, destination address, source port, destination port) 4-tuple for packets for the connection in (a) when they arrive at Host E? Again, indicate what elements would be assigned at connection time.

(c) Suppose Host D wishes to serve web pages (on port 80) to the Internet. What must happen in order for devices on the Internet to access the server on Host D?

(d) Host B attempts to connect Host D (i.e. by sending a packet to D). List out how the (source address, destination address, source port, destination port) 4-tuple evolves as it traverses the network from B to D. Indicate what elements would be assigned at connection time.

(e) Host A and Host C have the same IP address. Is this an issue? Explain why it is or isn’t.

4. 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.

5. For TCP, the lecture notes (slide 89) 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?


7. When TCP implementations measure the RTT, what problem are they trying to solve? What does the value $\alpha$ in the exponential averaging function control?