CS164 Final Exam
Winter 2013

Name: ______________________ Last 4 digits of Student ID: ______________________

Problem 1. State whether each of the following statements is **true** or **false**.
(**Two points for each correct answer, –1 point for each incorrect answer.**)

____ A Local Area Network constructed from Layer-2 bridges connected by wired Ethernet links is allowed to deliver packets in the wrong order so it can *guarantee* that every packet will reach its destination.

____ TCP connection establishment uses a *three-way handshake* so the TCP sender, the TCP receiver and the sender's Internet Service Provider can all agree on a common set of options to be used for this session.

____ If Alice and Bob belong to different VLANs, they cannot establish a Layer-2 connection between themselves.

____ Neither TCP nor UDP headers include any addresses, since they were designed to run on top of IP.

____ Even though the world is running out of IPv4 addresses, the number of Internet users is still growing because Internet Service Providers don't need a separate IPv4 address for each residential customer.

____ In TCP, the receiver (and *only* the receiver) has a timer, which it uses to ask the sender to retransmit a packet that fails to arrive on schedule.

____ Three IP routers forming a triangle can send packets over all three links even though they form a cycle.

____ In TCP congestion control, the *sender* is responsible for telling the *receiver* when to drop a packet.

____ Transport layer protocols, such as TCP and UDP, can *demultiplex* network traffic belonging to different socket connections that enters the host through a single network interface.

____ If a layer-2 bridge sends a PAUSE frame to one of its neighbors, that node cannot send any packets to the bridge for some period of time.

____ The *subnet mask* is a network security feature, which is used to prevent private services from being accessed by computers in the rest of the Internet.

____ A Transit AS belonging to the Internet Core needs much larger routing tables than a Stub AS because it cannot handle unrecognized addresses by forwarding the traffic to some higher-level service provider through a default route.

____ If Alice has a valid IP address in which the last eight bits are all 1's, we can conclude that Alice's networks uses *at least* nine bits for the host field.

____ In networking, "best effort" service means the same thing as "reliable" service (as provided by TCP, for example), in contrast to "reasonable effort" service where there are no guarantees that the data will ever reach the destination.

____ If Alice and Bob belong to *different IP subnets*, Alice's 48-bt MAC address will never reach Bob even if every hop along the path is an Ethernet link.

Problem 2. Suppose Alice lost the slip of paper that contained the information about setting up the network address for her computer. In each of the following situations briefly explain what happens.

a Suppose Alice lost the 48-bit Ethernet (MAC) address for the network interface card in her computer. What happens if she randomly generates a different 48-bit value and instructs the device driver for her network card to use her bogus value instead of the correct value? (Assume Alice knows enough to skip the multicast address bit in her bogus MAC address.) If she sends Ethernet frames (with her bogus return address) to another host on the same Ethernet broadcast domain, will that host be able to receive them? If so, will she be able to receive the responses?

b What happens to Alice's (improperly-addressed) Ethernet frames when they pass through a layer 2 bridge? Can the bridge tell that Alice is using a bogus address? Can it (or should it) do anything about this issue?

c This time, suppose Alice uses the correct Ethernet MAC address but has lost the 32-bit IP address that was assigned to her computer. What happens if she randomly generates a different 32-bit value and configures the protocol stack to use her bogus value? Will she be able to send IP datagrams to another host? Will she be able to receive the responses? Does your answer depend on whether the other host is on the same IP subnet?

d What happens to Alice's (improperly-addressed) IP datagrames when they pass through an IP router? Can the router tell that Alice is using a bogus address? Can it (or should it) do anything about this issue?

d Briefly explain the difference between class A, class B and class C IP addresses. Using the standard "a.b.c.d" notation for expressing IP addresses as a sequence of four numbers, explain how a *subnet mask* is used to partition an IP address into the network number and host number components.

e Finally, suppose Alice uses the correct Ethernet MAC address and IP address, but lost her subnet mask. Briefly explain what sorts of problems she will experience if she decides to use a class B subnet mask when it should have been class C. What happens if she uses a class C subnet mask when it should have been class B?

Problem 3. In TCP flow control, state which entity (the transmitter or the receiver) controls each of the following variables. Does its value need to be communicated to the other entity, and if so how? What is its purpose?

a The initial sequence number.

b The advertised window.

c The congestion window.

d The next byte expected.

e The number of out-of-order segments at the receiver.

Problem 4. The HTTP protocol, which is used for Web pages, runs on top of TCP. Originally, HTTP required the web browser to establish a *separate* TCP connection with the web server to retrieve *each object* (URL) on the same page. However, the HTTP 1.1 standard changed the protocol to allow the web browser to retrieve *all objects* on the same web page through a single *persistent* TCP connection. For the purposes of this question, assume that Alice's web browser already knows the IP address of Bob's web server and the MAC address of her default gateway, that the RTT between Alice's web browser and Bob's web server is 100 milliseconds, and that the data rate on every link is so high that we can neglect the transmission time for data packets and/or ACKs.

a Draw and label a space-time diagram to show the sequence of packets sent by Alice and Bob to establish new TCP session initiated by Alice.

b Draw and label a space-time diagram to show the sequence of packets sent by Alice and Bob to close an existing TCP session.

c Now suppose it takes 10 TCP data segments to send a single web object from Bob to Alice. Draw and label a space-time diagram to show how long it takes to complete the transfer assuming Alice's advertized window is 4 segments and Bob uses slow start. How many RTTs are required to complet the transfer?

d Finally, suppose the complete web page contains a total of 20 objects. How much time is saved and how many packets are eliminated by using a single persistent connection to retrieve the entire page? [HINT: remember that Bob only uses slow start during the transfer of the first object.]