CSCI 466 Midterm **Name: _____**
Networks
Fall 2013

This exam consists of 6 problems on the following 7 pages.

You may use your single-sided hand-written 8 ½ x 11 note sheet and a calculator during the exam.
No computers or communication devices of any kind are permitted.

If you have a question, raise your hand and I will stop by. Since partial credit is possible, **please write legibly and show your work**.

Problem	Points	Score
1	20	
2	8	
3	10	
4	12	
5	10	
6	10	
Total	70	

1) Multiple choice (20 points total, 2 points each). Circle the ***best*** single answer.

I. The TCP and UDP protocols are in which layer of the five-layer Internet protocol stack?
   a) Application
   b) Transport
   c) Network
   d) Link
   e) Physical

II. Which of the following is ***true*** about the HTTP protocol?
   a) HTTP is a binary encapsulated RPC protocol optimized for web content delivery.
   b) HTTP is a simple request-response protocol operating in plaintext over TCP.
   c) HTTP clients request page elements using parallel UDP messages. Servers may or may not consolidate the results into a single UDP response.
   a) HTTP/1.1 must establish and tear down a TCP connection for every page element retrieved.

III. All the following HTTP header fields are involved in caching web pages ***except***:
   a) Set-Cookie
   b) If-No-Match
   c) Last-Modified
   d) If-Modified-Since
   e) ETag

IV. Which of the following ***true*** about the BitTorrent protocol?
   a) A peer X participating in a swarm may occasionally send data to a peer Y even though Y has never sent data to X.
   b) BitTorrent is an example of a transport-layer protocol that provides reliable, in-order delivery of a byte stream to various application-layer protocols.
   c) BitTorrent is an example of a network-layer protocol that provides distributed hash table (DHT) services to various transport-layer protocols.
   d) If none of the peers in a swarm for file F have a particular chunk of F, peers fallback to contacting the tracker which always has a complete copy of F.

V. What is the problem with implementing a reliable data transport protocol using a single bit field for packet sequence numbers?
   a) The receiver will not be able to detect packets that are reordered inside the network.
   b) The sender will not be able to detect if the network is congested.
   c) Will cause the sender to occasional overrun the buffer capacity of the receiver.
   d) Will cause severe under-utilization of high bandwidth, high delay network links.

VI. Which of the following is a ***disadvantage*** of a Go-Back-N (GBN) reliable data transport protocol?

a) The receiver must maintain a buffer to store received data. This is required since the receiver may have to wait to deliver data to its application-layer due to a corrupt or missing packet.
b) Only allows a single packet in-flight at any point in time.
c) If just a sender's first packet in a pipelined series of sends gets corrupted or goes missing, all packets in the series must be resent.
d) Negative acknowledges need to be implemented to ensure reliable data transport.

VII. Which of the following is a ***disadvantage*** of a Selective Repeat (SR) reliable data transport protocol?

a) The receiver must maintain a buffer to store received data. This is required since the receiver may have to wait to deliver data to its application-layer due to a corrupt or missing packet.
b) Only allows a single packet in-flight at any point in time.
c) If just a sender's first packet in a pipelined series of sends gets corrupted or goes missing, all packets in the series must be resent.
d) Negative acknowledges need to be implemented to ensure reliable data transport.

VIII. During the slow-start phase of a TCP connection, the sending rate

a) remains the same every RTT.
b) increases by one segment every RTT.
c) doubles every RTT.
d) is reduced to the previously found threshold prior to congestion.

IX. During the congestion-avoidance phase of a TCP connection, the sending rate

a) remains the same every RTT.
b) increases by one segment every RTT.
c) doubles every RTT.
d) is reduced to the previously found threshold prior to congestion.

X. All the following are approaches used to detect network congestion ***except***:

a) Sender observes repeated cumulative acknowledgements (ACKs) of the same packet.
b) Sender observes a packet has timed out without any acknowledgement (ACK).
c) Sender observes receiver is only transmitting a cumulative ACK every other packet.
d) A congested router between the sender and receiver sets a bit in the in-flight packet and this information is echoed back to the sender in the receiver's ACK.
e) A congested router between the sender and receiver sends a choke packet to the sender.

2) Email (8 points).

a) Suppose Alice, with a Web-based email account (such as Hotmail or gmail), sends a message to Bob, who accesses his mail from his mail server using POP3. Discuss how the message gets from Alice's host to Bob's host. Be sure to list the series of application-layer protocols that are used to move the message between the two hosts.

b) Bob decides to switch to using IMAP instead of POP3. Describe two features that IMAP provides that Bob previously lacked using POP3.

Feature 1:

Feature 2:

3) **Network performance** (10 points)

a) You record a 2 second video on your phone. The video is 320 x 240 resolution, 3 bytes/pixel, 15 frames per second. Assume no data compression. Calculate the file size in bytes.

b) Assume you can transmit the video continuously with no connection setup and no other overhead. Your phone's network connection has a bandwidth of 512 Kbps and the Round Trip Time (RTT) to the destination server is 200 ms. How long will it take for the entire video to reach their server?

c) Instead of being able to send packets continuously, assume a stop-and-wait protocol with 1KB packets and no packet overhead and no transmission errors. How many total packets are required ?

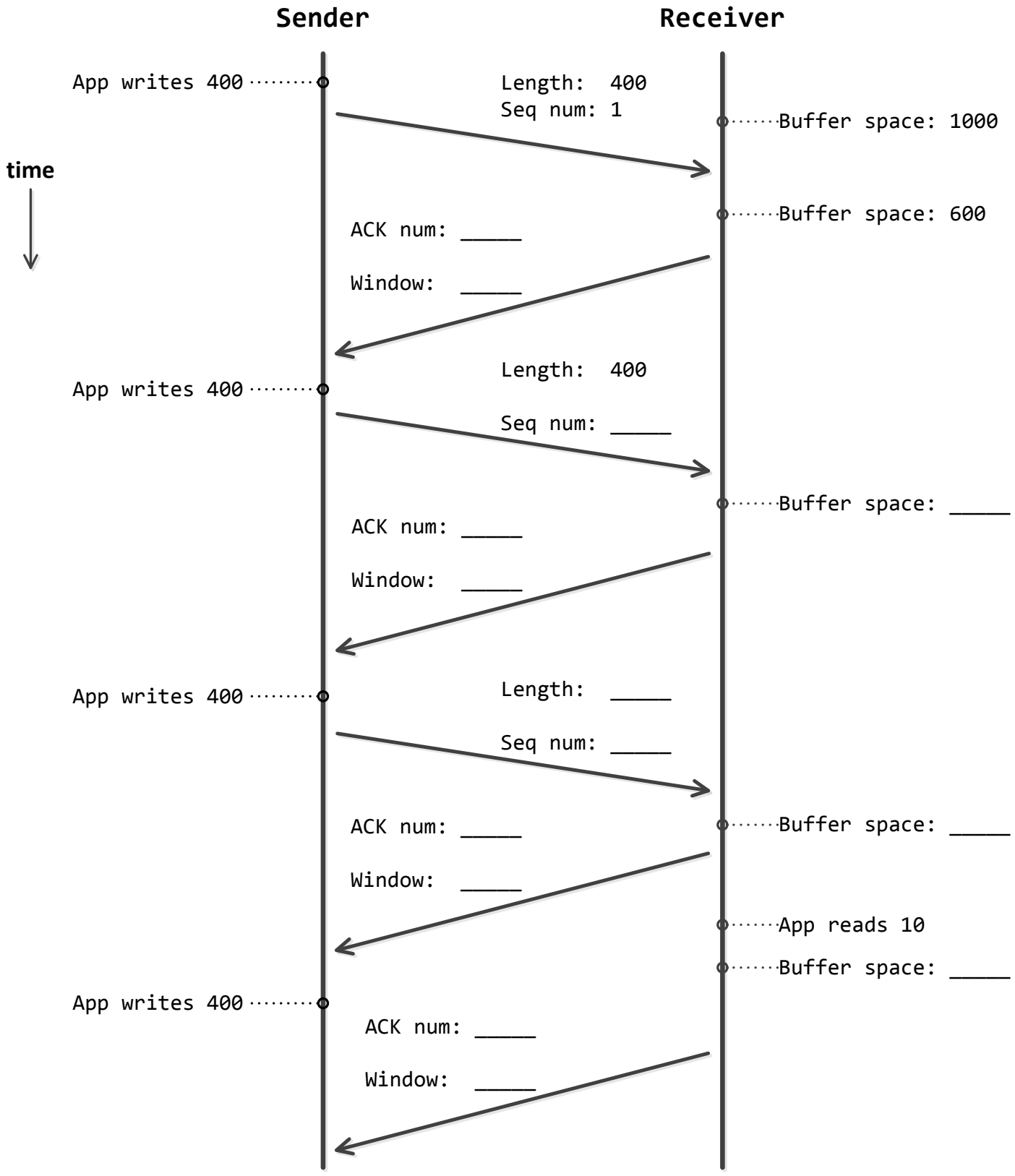
4) **Matching** (12 points)

Match the networking concept/protocol/data format with the letter that ***best*** describes it. Letters may be used ***at most once***.

____ MIME ____ SSH ____ Base64 ____ Timer ____ FTP ____ HTTP ____ Telnet ____ Checksum ____ Port number ____ IP address ____ Domain name ____ SYN cookies	A. A pull-protocol that resolves domain names to IP addresses. B. Protocol that uses two concurrent TCP connections operating on different port numbers. C. A stateless request/response application-layer protocol. D. Used to protect a server against an attacker who only completes the first part of a TCP handshake. E. Allows binary data to be encapsulated in an email message . F. Allows an email message to contain attachments. G. Used to construct a distributed hash table in a P2P network. H. A push-protocol that sends email from one mail transfer agent to another. I. Allows senders and receivers to detect when a packet has been corrupted. J. Numeric address uniquely specifying an end-system on the Internet. K. Friendly human-readable name for a specific end-system on the Internet. L. Allows senders to detect when a packet has been dropped by a router with a full buffer. M. Allows remote access to servers, passwords are encrypted during login. N. Allows remote access to servers, passwords are sent as plaintext during login. O. Transport-layer protocol that provides a header field for flow control. P. Helps direct incoming transport-layer segments to the appropriate socket program. Q. Used to discover the maximum transmission unit (MTU) of the network.

5) **TCP** (10 points)

A sender and receiver have just started a TCP conversation. The sender is eager to send lots of data but the receiver's application layer is slow in consuming data and the receiver's TCP buffer is only 1000 bytes. Fill in the missing numbers in the following timeline diagram:



6) **Domain Name System** (10 points)

You are using the computer `museum.mtech.edu`. Your computer is configured to use Tech's local DNS server: `dns.mtech.edu`. You open a browser to the web site `www.csail.mit.edu`. Assume all DNS servers in the following diagram have just rebooted and thus have nothing in their DNS caches. Further assume your computer makes a recursive DNS query to Tech's local DNS server and all subsequent queries are iterative. Assume the CSAIL lab at MIT runs its own DNS server to resolve things in the `csail` subdomain of `mit.edu`.

Draw arrows showing the sequence of queries and responses made between hosts. Number all arrows showing the order in which they occur. Additionally, label DNS responses with the part of the domain name that had been resolved at that point (i.e. some part of `www.csail.mit.edu` or perhaps the whole thing).

MIT name server

CSAIL MIT name server

museum.mtech.edu
(you)

dns.mtech.edu
(local name server)

edu name server

a.root-servers.net