

**CSCI 466 Midterm  
Networks  
Fall 2012**

**Name:** \_\_\_\_\_

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

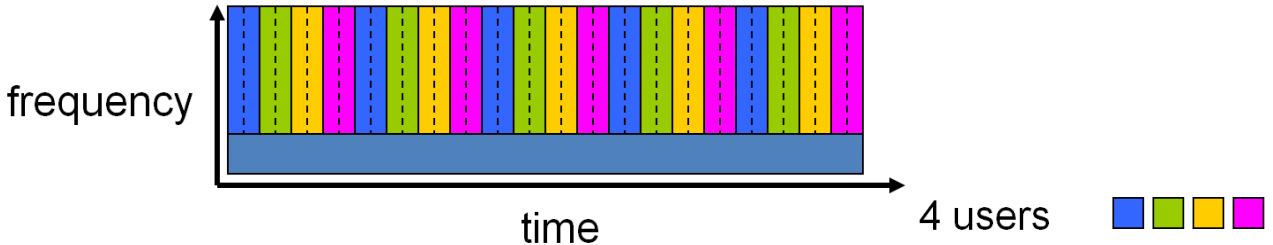
You may use your single-sided hand-written 8 ½ x 11 note sheet and a calculator during the exam. No computers or communication devices of any kind are permitted.

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.**

<b>Problem</b>	<b>Points</b>	<b>Score</b>
<b>1</b>	<b>18</b>	
<b>2</b>	<b>12</b>	
<b>3</b>	<b>6</b>	
<b>4</b>	<b>6</b>	
<b>5</b>	<b>12</b>	
<b>6</b>	<b>9</b>	
<b>Total</b>	<b>63</b>	

**1) Multiple choice** (18 points total, 2 points each). Circle the **best** single answer.

- I. You have cable Internet at home and your neighbor has DSL. Around lunch, you can download a 2GB movie in 5 minutes while it takes your neighbor 20 minutes. Around dinner however, it takes you 40 minutes to download a 2GB movie while your neighbor still only requires 20 minutes. Which of the following is the most likely explanation?
  - a) DSL connections typically provide more consistent and lower network jitter.
  - b) Colder temperatures in the evening tend to attenuate the signal on coax cable causing more bit errors and thus more packet retransmissions.
  - c) All your neighbors with DSL Internet are currently on vacation.
  - d) All your neighbors with cable Internet are currently also downloading a movie.
  
- II. Two regional Internet Service Providers (ISPs) are both connected to the same Tier-1 ISP. Why might both regional ISPs want to be connected to the same Internet Exchange Point (IXP)?
  - a) The regional ISPs can route traffic destined to a host connected to the other regional ISP via the IXP rather than via the Tier-1 ISP. This avoids paying the Tier-1 ISP for routing the traffic.
  - b) The Tier-1 ISP can route traffic through the IXP to avoid paying the regional ISPs for the traffic.
  - c) The IXP can be multi-homed in order to prevent worm attacks on the regional ISPs.
  - d) The IXP can be multi-homed in order to prevent IP spoofing by customers of the regional ISPs.
  
- III. The diagram below is an example of which of the following?

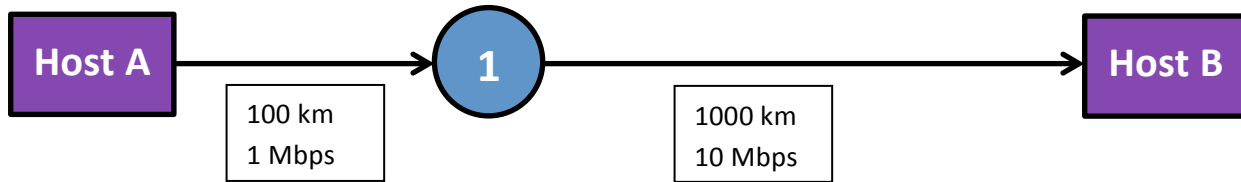


- a) Circuit switching
  - b) Packet switching
  - c) Frequency Division Multiplexing (FDM)
  - d) Time Division Multiplexing (TDM)
- 
- IV. Which of the following is **TRUE** about the Domain Name System (DNS)?
    - a) Establishes a series of TCP connections between 1 or more intermediate DNS servers.
    - b) A DNS response contains at most one IP address for a given domain.
    - c) A global distributed database that provides the sequence of routers that two end-hosts must use in order to communicate.
    - d) DNS queries may need to be resent since the query or the response can be lost by the network.

- V. In order to achieve **reliable** and **efficient** data transport, the **minimum** set of things required is:
- a) acknowledgements (ACKs), error detection, sequence numbers
  - b) acknowledgements (ACKs), error detection, sequence numbers, timers
  - c) acknowledgements (ACKs), error detection, sequence numbers, timers, pipelining
  - d) acknowledgements (ACKs), error detection, sequence numbers, timers, pipelining, negative acknowledgements (NACKs)
- VI. HTTP is by design a *stateless* protocol. Which of the following HTTP header fields helps in providing for a *stateful* web experience (e.g. shopping carts):
- e) Host, Content-Length
  - f) Last-Modified, Last-Modified-Since
  - g) Set-Cookie, Cookie
  - h) ETag, If-No-Match
- VII. In the original deployment of TCP, the sender could immediately send as much data as allowed by the receiver's window size. This resulted in which of the following?
- a) Widespread server outages due to exposure to SYN flooding attacks.
  - b) A high percentage of corrupted packets due to Silly Window Syndrome.
  - c) A catastrophic decrease in network goodput (i.e. congestion collapse).
  - d) Increased packet round trip times due to reduced pipelining.
- VIII. You are transmitting messages that only contain 1 byte of payload. Assuming a **completely reliable** network, which **transport** layer protocol provides the best ratio of useful delivered payload versus overhead?
- a) TCP
  - b) HTTP
  - c) UDP
  - d) SSH
- IX. Which of the following is **TRUE** about the Peer-to-Peer (P2P) BitTorrent protocol?
- a) Requires a Distributed Hash Table (DHT) to track the chunks currently needed by each peer.
  - b) A peer periodically randomly chooses another peer to send chunks to.
  - c) A peer only exchanges chunks with the 4 peers it has gotten chunks from the fastest.
  - d) Similar to client-server distribution, download times increases linearly with the number of peers in a torrent.

**2) Network performance** (12 points).

You are sending a data packet from Host A to Host B via a network with a single switch (labeled 1). The distance and transmission rate of each link is shown in the following diagram:



Data packet size is 1500 bytes.

Propagation speed on both links is  $2.0 \times 10^8$  m/s.

a) A stopwatch is started when you first start sending the data packet from A. At what time in seconds has the entire packet left host A?

b) At what time has the entire packet arrived at switch 1?

c) Once the entire packet has arrived at the switch, assume there is a 20 millisecond processing and queuing delay. At what time has the entire packet finally left switch 1?

d) Finally, at what time does the entire packet arrive at host B?

**3) TCP** (6 points).

a) Suppose Host A sends two TCP segments back to back to Host B over a TCP connection. The first segment has sequence number 90; the second has sequence number 110. How much data is in the first segment?

b) Suppose that the first segment is lost but the second segment arrives at B. In the acknowledgement that Host B sends to Host A, what will be the acknowledgement number?

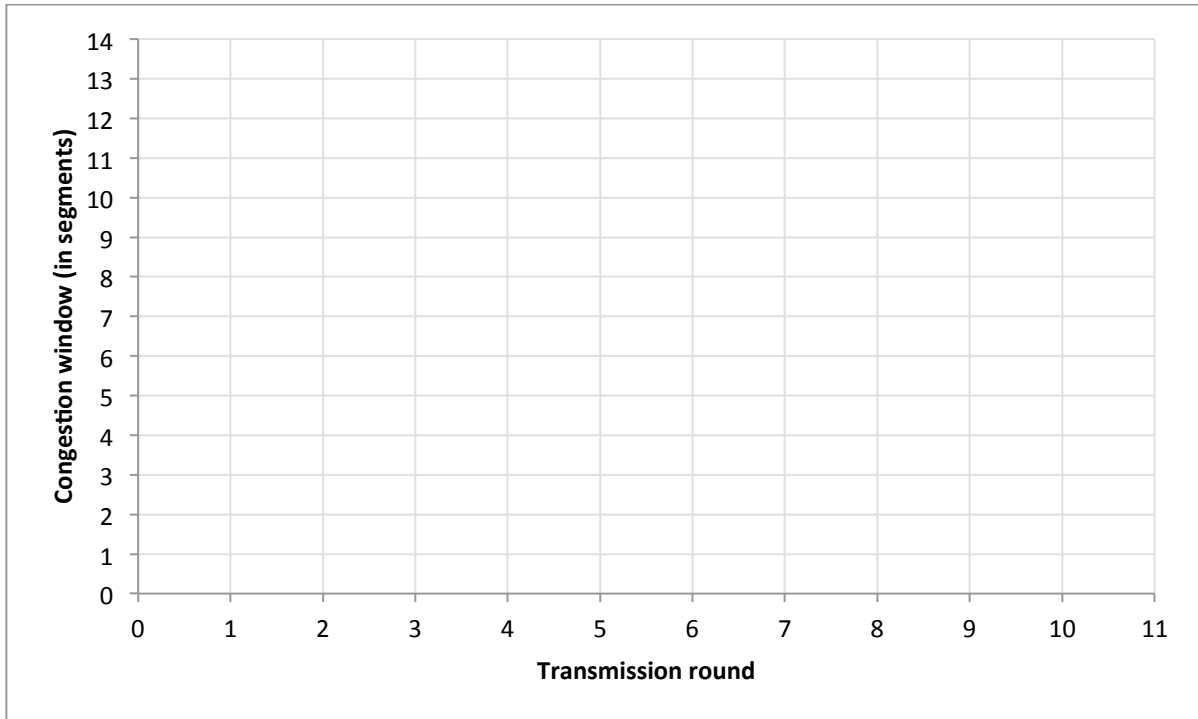
**4) Email** (6 points)

a) Describe the different roles played by SMTP and POP3/IMAP in the process of providing Internet email services.

b) Describe two advantages of IMAP over the POP3 protocol.

**4) TCP Congestion Control (10 points).**

a) Complete the graph below for transmission rounds 1-11, showing the progression of congestion window size for a new TCP connection using TCP Tahoe congestion control (slow start with congestion avoidance and fast retransmit). The initial congestion threshold is set at 8 segments. Assume a triple duplicate ACK occurred in transmission round 8. Draw two horizontal dashed lines to indicate the congestion threshold before and after round 8. Label the portion(s) of the graph that correspond to slow start and the portions(s) that correspond to congestion avoidance.



b) Assume TCP Reno with fast recovery was being used instead. Describe in relative terms (without worrying about exact numbers), how the congestion window size progression would compare to the above graph from round 9 onwards.

**5) HTTP (9 points)**

A web page is retrieved via HTTP. The page contains links to two image files. Assume the web page and images fit within a single network packet. Neglecting transmission time, give the number of RTTs (Round Trip Times) required for a browser to get the page and both images. Assume the HTTP request can be piggybacked on the final part of any TCP handshake. You may want to draw a timeline diagram (but aren't required to).

a) Non-persistent HTTP with no parallel TCP connections.

b) Non-persistent HTTP with the browser configured for 2 parallel TCP connections.

c) Persistent HTTP with no parallel TCP connections.