Solutions to Fall 2020 Practice midterm Exam

Question 1. Quicksies. These questions (1a - 5g) are relatively simple, independent, multiple choice question. (3 points each; 15 minutes total).

1a. Consider a scenario in which 5 users are being multiplexed over a channel of 10 Mbps. Under the various scenarios below, match the scenario to whether circuit switching or packet switching is better?

- Each user generates traffic at an average rate of 1 Mbps, but generates traffic at rate of 15 Mbps when transmitting
  - Packet switching
- Each user generates traffic at an average rate of 1 Mbps, but generates traffic at rate of 1 Mbps when transmitting
  - Circuit switching
- Each user generates traffic at an average rate of 1 Mbps, but generates traffic at rate of 8 Mbps when transmitting
  - Packet switching

1b. Consider the scenario shown below, with 10 different servers (three shown) connected to 10 different clients over ten three-hop paths. The pairs share a common middle hop with a transmission capacity of $R = 300$ Mbps. The four links from the servers to the shared link have a transmission capacity of $R_S = 90$ Mbps. Each of the four links from the shared middle link to a client has a transmission capacity of $R_C = 50$ Mbps.

![Network diagram]

Select one:
- a. 300 Mbps
- b. 90 Mbps
- c. 50 Mbps
- d. 30 Mbps
- e. 440 Mbps
1.c. Consider the network shown in the figure below, with three links, each with a transmission rate of 1 Mbps, and a propagation delay of 1 msec per link. Assume the length of a packet is 1000 bits.

What is the end-end delay of a packet from when it first begins transmission on link 1, until it is received in full by the server at the end of link 3. Assume store-and-forward packet transmission.

Select one:
- a. 1 msec
- b. 2 msec
- c. 3 msec
- d. 6 msec
- e. 12 msec

1.d. What is meant by the term "encapsulation"?

Select one:
- a. Computing the sum of all of the bytes within a packet and placing that value in the packet header field
- b. Determining the name of the destination host, translating that name to an IP address and then placing that value in a packet header field
- c. Tailing data from the layer above, adding header fields appropriate for this layer, and then placing the data in the payload field of the “packet” for that layer
- d. Receiving a “packet” from the layer below, extracting the payload field, and after some internal actions possibly delivering that payload to an upper layer protocol
- e. Starting a transport layer timer for a transmitted segment, and then if an ACK segment isn’t received before the timeout, placing that segment in a retransmission queue

1.e. True or false: when a packet is detected as lost by a TCP sender, the congestion window is always reduced to 1.

Select one:
- a. True
- b. False

1.f. Check all of the phrases that state a true property of a local DNS server

Select one or more:
- a. The local DNS server record for a remote host is sometimes different from that of the authoritative server for that host.
- b. The local DNS server is only contacted by a local host if that local host is unable to resolve a name via iterative or recursive queries into the DNS hierarchy
- c. The local DNS server holds hostname-to-IP translation records, but not other DNS records such as MX records
- d. The local DNS server can decrease the name-to-IP-address resolution time experienced by a querying local host over the case when a DNS is resolved via querying into the DNS hierarchy.
To think about the answers to the questions below, you need to count the number of “swares” – units of time involved.

a: 9, because the distance between the start of the black curve at 10 and the start of the blue curve at 19 is 9

b: a shorter playout delay would move the blue playout curve to the left. How far left can you move the blue curve before the black and blue curves touch? 2. [Aside – when those curve just touch, you could argue that they touch at the end of a black horizontal segment and the beginning of a blue horizontal segment so that bits at the beginning of the black curve had already arrived before their playout time. In this case, the answer would be 4. I think that was an ambiguously worded question. Sorry!]

c: the buffering at the client at any point is time the horizontal difference between the blue and black curves at a given time (x-axis value). The answer is 2, which occurs at t=21.
Question 2 HTTP. [15 points, 10 minutes]

The following set of questions have to do with HTTP and in a number of cases, the GET request shown to the left. The diagram will be repeated on later pages as needed.

Suppose the client-to-server HTTP GET message is the following:

```
GET /urose_ross_sandbox/interactive/quotatation6.htm HTTP/1.1
Host: gaia.cs.umass.edu
Accept: text/plain, text/html, text/xml, image/png, image/jpeg, audio/basic, audio/vnd.rnfl.wave, video/mpeg, video/wmv.
Accept-Language: en-us, en-gb;qt=0.9, en;q=0.5, fr, fr-fr, da, de, ar
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.7.3)
AppleWebKit/534.53.11 (KHTML, like Gecko) Version/5.1.3
Safari/534.53.10
```

2.a. Suppose the client has never before requested the base object, nor has it communicated recently with the gaia.cs.umass.edu server. You can assume, however, that the client host or its local DNS knows the IP address of gaia.cs.umass.edu. How many round trip times (RTTs) are needed from when the client first makes the request to when the base page is completely downloaded, assuming the time needed by the server to transmit the base file is equal to 1/2 RTT?

Select one:
- a. 0 RTT
- b. 0.5 RTT
- c. 1.5 RTT
- d. 2.5 RTT
- e. 3.5 RTT

2.b. Suppose now that after downloading the base file, the browser encounters a jpeg object in the base html file that is stored on gaia.cs.umass.edu. Assume that the server would need 0.5 RTT to transmit that jpeg object. How many round trip times (RTTs) are needed to retrieve that jpeg object?

Select one:
- a. 0.5 RTT
- b. 1.0 RTT
- c. 1.5 RTT
- d. 2.0 RTT
- e. 2.5 RTT
- f. 3.0 RTT
2.e. Suppose now that a day later, the user again requests the same base file at
galax, not having communicated with the gala.cs.unauss.edu server since the day
before. The file has not changed at the server.

How many round trips times (RTTs) are needed from when the client first makes the
request to when the base page is completely downloaded, assuming the time
needed by the server to transmit the base file is equal to 1/2 RTT, and assuming
there are no DNS delays?

Select one:
- a. 0.5 RTT
- b. 1.0 RTT
- c. 1.5 RTT
- d. 2.0 RTT
- e. 2.5 RTT

2.d. Now consider the server’s response message to the HTTP GET (any of the GETs
in parts 2a, 2b, 2c; the answer is the same).

Which of the following pieces of information will appear in the server’s application-
level HTTP reply message (check all that will appear in the reply)?

Select one or more:
- a. A response code
- b. A response phrase associated with the code
- c. A checksum
- d. A sequence number
- e. The server’s IP address
- f. The name of the IP server

Question 3. TCP [20 points total; 15 minutes]

The following set of questions have to do with TCP reliable data transfer and in a
number of cases, the figure shown to the left, in which a TCP sender and receiver
communicate over a connection in which the segments can be lost. The diagram
will be repeated on future pages as needed. The TCP sender wants to send a total of 10
segments to the receiver and sends an initial window of 5 segments at t = 1, 2, 3, 4,
and 5, respectively. Suppose the initial value of the sequence number is 50 and
every segment sent to the receiver contains 1000 bytes. The delay
between the sender and receiver is 7 time units, and so the first segment arrives at
the receiver at t = 8, and an ACK for this segment arrives at t = 15.

As shown in the figure, one of the five segments is lost between the sender and the
receiver, one of the ACKs is lost.

Assume there are no timeouts.
3.a. What is the sequence number of the segment sent at t=1?

Select one:
- a. 0
- b. 1
- c. 50
- d. 100
- e. 1050
- f. 2000

3.b. What is the sequence number of the segment sent at t=2?

Select one:
- a. 1
- b. 2
- c. 100
- d. 1050
- e. 2000
- f. 2050
3.c. What is the ACK value carried in the ACK send at t=9?

Select one:
- a. 0
- b. 1
- c. 1050
- d. 1051
- e. 2000

3.d. What is the ACK value carried in the ACK send at t=9?

Select one:
- a. 2
- b. 2000
- c. 2000
- d. 2000
- e. 3001

3.e. What is the ACK value carried in the ACK send at t=12?

Select one:
- a. 5
- b. the same value sent in the ACK sent at t=9
- c. The same value sent in the ACK sent at t=10
- d. the same value sent in the ACK sent at t=9 plus 2000
- e. 12

3.f. What action is taken by the TCP sender at t=15?

Select one:
- a. no action taken, since the window remains at 5
- b. send a new segment's worth of data
- c. retransmit the segment sent at t=4
- d. retransmit the next 5 segments of data

3.g. What action is taken by the sender when the ACK arrives at t=17, assuming it has pending data to send?

Select one:
- a. no action taken
- b. send a new segment's worth of data
- c. retransmit the segment sent at t=4
- d. retransmit the next 5 segments of data

Problem 5.
The sender A and B FSM is the same as in the case of our stop-and-go RDT 3.0 except that we do not have to worry about corrupted packets. So no checksum is needed, nor do we have to check for corrupted packets in the FSM. So the A FDM is:

For C, we’ll need to remember (i.e., encode in C’s state) whether C is waiting for a message from A or a message from B. Since both A and B are sending 0/1-numbered data packets, C will also need to remember (i.e., encode in C’s state) whether C is waiting for a 0 or a 1 message for them. So we’ll need 4 states.

Because of timeout/retransmits at A or B, C can possibly receive repeat data messages for a message that it has already acknowledged. But since that previous ACK could have been lost, C will need to re-ACK this (old) data message. With these considerations, here is the FSM for the C: