Concordia University
Department of Computer Science & Software Engineering

Comp 445, Fall 2017
Instructor: Aiman Hanna
Time: 60 minutes

Mid-term Exam

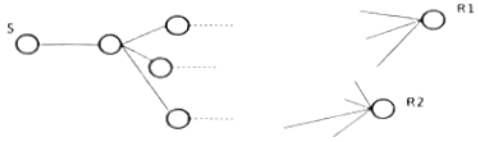
Keep your answers organized and clean.
This exam has **5** pages. Answer all questions.
Exam will be marked out of 20.

Name: _____

ID #: _____

Question 1 (5 marks)

Assume a communication network between one sender and two receivers, where the sender needs to transmit a massive number of individual, but different, messages to each of the receivers. These messages however have a relatively small amount of data. Further, each of these receivers has multiple incoming links, but the sender has one outgoing link. Both the receivers are capable of handling out-of-order arrivals but this process takes a long time, which is considered to be significant. The image shows a partial view of the network.



i) Under these conditions, which of the following network core is preferred: *Circuit Switching*, *Message Switching* or *Datagram Packet Switching*?

☐ *Circuit Switching* ☐ *Message Switching* ☐ *Datagram Packet Switching*

ii) Explain the reasons behind your answer (do not exceed provided space)?

iii) Would you change your answer if the receivers are modified so that they are capable of handling out-of-order arrivals relatively fast? Why or why not? If so, what is your new choice? Explain your answer (do not exceed provided space)?

☐ *No change to my answer* ☐ *My answer changes to:* _____

Explanation:

Question 2 (5 marks)

A) A protocol uses checksum for error detection, where it breaks the bits that need to be transmitted into 16-bit chunks, then calculates the checksum. Assume that the following bits need to be transmitted, show clearly what the checksum value is. Also indicate what the sender will actually be transmitting for the checksum verification to be performed successfully by the receiver.

0 0 1 1 0 1 1 0 1 1 1 0 1 1 0 1 0 1 0 0 0 1 0 0 1 0 0 0 1 0 1 0

Checksum value/sequence is:

Explanation/indication of what will be transmitted:

B) Give 2 of the main functionality that are provided by each of the following OSI layers:

i) Transport layer

1)

2)

ii) Application layer

1)

2)

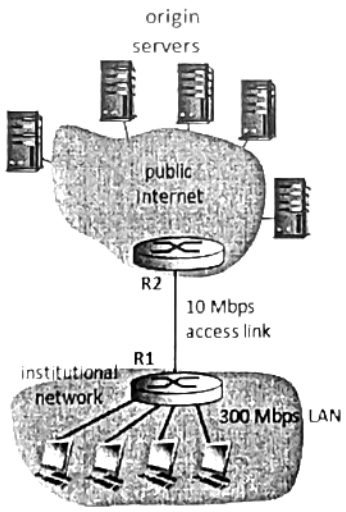
Question 3 (4 marks)

A) Explain how *Denial of Service* attack (DoS) can be achieved through either *bandwidth flooding* or *connection flooding*. You only need to explain one of the two attacks; do **NOT** describe both. You can explain that through sketching a diagram and providing very brief explanation afterwards.

B) Assume a TDM network, with 192 channels, and a bit rate of 134.4 Mbps. Further assume 160ms is needed for end-to-end circuit establishment. How much time is needed to send a file of size 12.6 Mbits over this network?

Question 4 (4 marks)

a) Assume the network shown in the figure, where an institutional network has a speed 300Mbps. The hosts on the network are mainly using HTTP, where the average requests from all hosts is 60Mbps. The link between the institution router, R1, and the router connecting it to the Internet, R2, has a rate of 10Mbps. Further, Internet delay (to obtain HTTP objects from the web servers to R2) is 6 seconds. The round trip delay between R1 and R2 is 40 milliseconds when the traffic intensity on the link is below 75%. The delay averages to 14 minutes when traffic intensity exceeds 75%. Finally, the round trip delay between the hosts and R1 is 3 milliseconds. All other delays are negligible.



Under these conditions, what is the total delay needed for the hosts to receive their HTTP requests?

b) Now, assume that the institution installed a local web cache and that in average, 80% of the requests are handled by the cache. Requests from the cache take an average of 1 millisecond. This time is considered negligible for cache misses (i.e. lost time due to cache misses can be discarded).
Under these conditions, what is the total delay needed for the hosts to receive their HTTP requests?

Question 5 (4 marks)

Assume the *Selective-Repeat Sliding-windows* protocol (as discussed in class). Assume further that the number of bits used for the sequence number, k, is equals to 3, and consequently the frames are numbered F_0, F_1, … to F_7, then F_0, F_1, etc. Further, assume that both windows at the sender and the receiver are set correctly (so, each is set to $\frac{1}{2}\ 2^k$; which means that each of them has a window of size 4).

A) Assume that only delays and corruptions are possible, but no loss (i.e. frames will always arrive). Under these conditions, will the protocol succeed or fail? If it succeeds, explain why it is not possible under these conditions for the protocol to fail. If it fails, provide, through a sketch, a **detailed** and specific scenario that shows the failure.

B) Now, assume that loss is also possible (that is loss, delay and corruption are all possible). Under these new conditions, will the protocol succeed or fail? If it succeeds, explain why it is not possible under these conditions for the protocol to fail. If it fails, provide, through a sketch, a **detailed** and specific scenario that shows the failure.