CMPT 371: Data Communication and Networking
Summer 2019
Midterm Exam (June 25, 2019)

First Name:
Last Name:
Student Number:

Instructions:

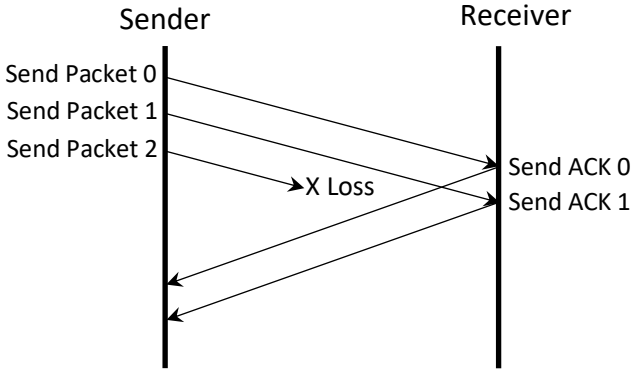
1. This is a closed book examination.
2. No electronic devices may be used.
3. Please write down your answers using a pen.
4. Exam duration is 120 minutes (5:40 – 7:40pm)
5. This exam includes 15 question. Answer all the questions.
6. Answer each question in the space provided. You should not need more space.
7. The exam is 8 (eight) pages. Make sure you have all of the pages.

Question	**Mark**	**Question**	**Mark**
1 (10 points)		9 (10 points)	
2 (5 points)		10 (5 points)	
3 (3 points)		11 (10 points)	
4 (3 points)		12 (5 points)	
5 (5 points)		13 (10 points)	
6 (4 points)		14 (10 points)	
7 (5 points)		15 (10 points)	
8 (5 points)		**Total (100)**	

Q1 (10 points). TCP and UDP provide two very different service models. Suppose that an application wants all of the functionality provided by UDP, but only high-performance reliable transfer, and flow control (but no congestion control) from what TCP provides. How would an application get this different service in today's Internet? Mention all the elements required to provide high-throughput reliable transfer and flow control.

Q2 (5 points). Describe the process of a client obtaining the IP address for the hostname www.cnn.com under the assumption that (1) it is not cached at the local DNS server and (2) the local DNS server has not cached an entry for the .com DNS server. Please describe the recursive process.

Q3 (3 points). Consider the sliding window protocol in the figure below. Does this figure indicate whether Go-Back-N or Selective Repeat is being used? If not, what is being used, and how did you come to that conclusion?



Q4 (3 points). Suppose you would like to urgently deliver 40 tera bytes data from Boston to Los Angeles. You have a 100Mbps dedicated link for data transfer. Would you prefer to transmit the data via this link or instead use FedEx overnight delivery? Explain.

Q5 (5 points). Suppose N packets arrive simultaneously to a link at which no packets are currently being transmitted or queued. Each packet is of length L and the link has transmission rate R. What is the average queueing delay for the N packets?

Q6 (4 points). Suppose Alice and Bob are sending packets to each other over a computer network. Suppose Trudy positions herself in the network so that she can capture all the packets sent by Alice and send whatever she wants to Bob; she can also capture all the packets sent by Bob and send whatever she wants to Alice. List some of the malicious things Trudy can do from this position. Can encryption enhance the situation? How?

Q7 (5 points). What is an overlay network? Does it include routers? What are the edges in the overlay network?

Q8 (5 points). In our TCP discussion, we assumed that the TCP sender always had data to send. Consider now the case that the TCP sender sends a large amount of data and then goes idle (when the data to send finishes) at t_1. TCP remains idle for a relatively long period of time and then wants to send more data at t_2. What are the advantages and disadvantages of having TCP use the `cwnd` and `ssthresh` values from t_1 when starting to send data at t_2?

Q9 (10 points). Please refer to the figure below, depicting the change of TCP congestion window size over transmission rounds, and answer the following questions.

(a) What has happened between transmission rounds 1 and 4? **(1 point)**

(b) What has happened at transmission round 4? **(1 point)**

(c) What is the value of `ssthresh`? **(2 points)**

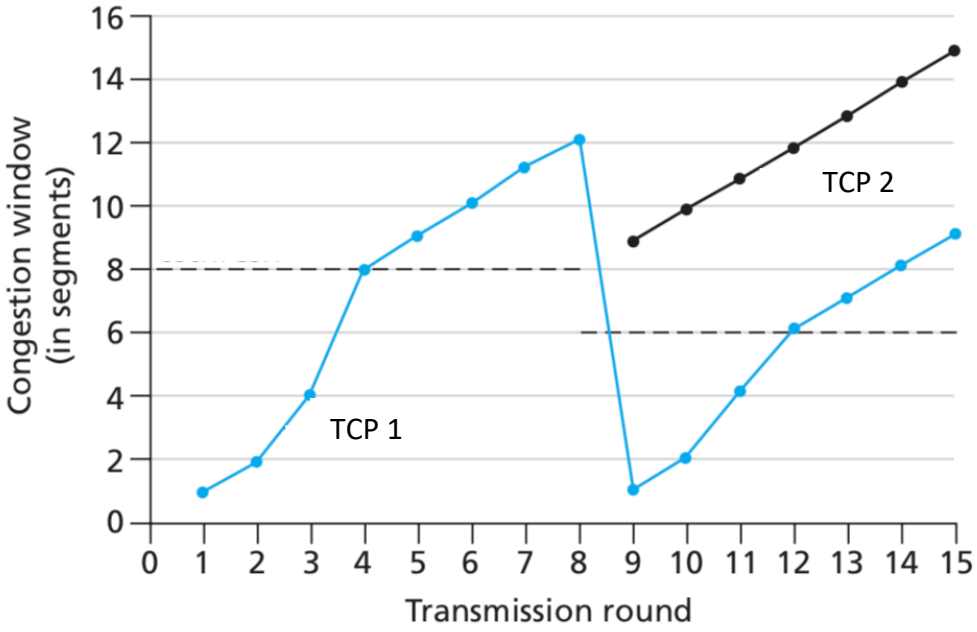
(d) What has happened between transmission rounds 4 and 9? **(1 point)**

(e) What has happened at transmission round 9? **(1 point)**

(f) Which curve is depicting TCP Reno? **(1 point)**

(g) Which curve is depicting TCP Tahoe? **(1 point)**

(h) What mechanism is different among TCP 1 and TCP 2? **(2 points)**



Q10 (5 points). What inefficiencies are addressed by the persistent connection feature of HTTP/1.1? How it can be effective in addressing them? Why?

Q11 (10 points). For each of the following pairs of terms, specify the context, define each term, and make sure to clarify the key differences between the two terms. Give an example for each.

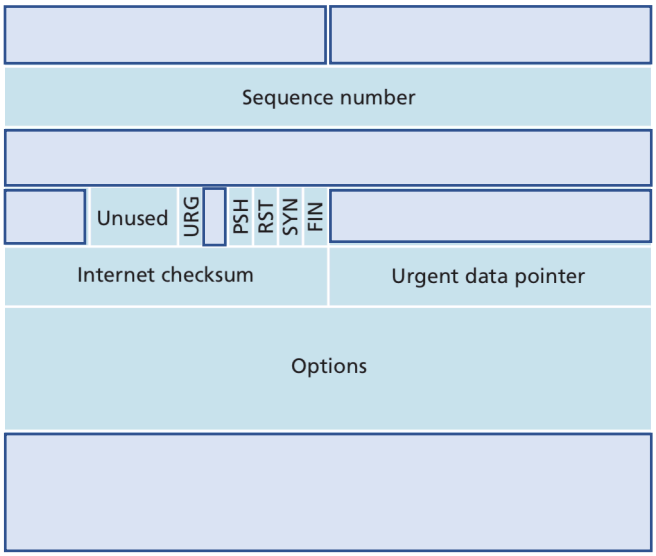
(a) Circuit-switching and packet-switching **(5 points)**

(b) Connection-less and connection-oriented **(5 points)**

Q12 (5 points). Host A and B are directly connected with a 100Mbps link. There is one TCP connection between the two hosts, and Host A is sending to Host B an enormous file over this connection. Host A can send its application data into its TCP socket at a rate as high as 120Mbps but Host B can read out of its TCP receive buffer at a maximum rate of 50Mbps. Describe the effect of TCP flow control.

Q13 (10 points). Describe each of SMTP, POP3, and IMAP protocols, and indicate how their functionalities provide a complete application/service when put together. What is the application/service they provide? Describe what is provided by each of these protocols, and how? What are the similarities and differences among them?

Q14 (10 points). Specify the name of 5 of the blank TCP protocol fields in the TCP segment structure below and write down a short description of what is the purpose for that field.



Q15 (10 points). Now suppose that there are M client-server pairs in the figure below. Denote R_S, R_C, and R for the rates of the server links, client links, and network link. Assume all other links have abundant capacity and that there is no other traffic in the network besides the traffic generated by the M client-server pairs. Derive a general expression for throughput in terms of R_S, R_C, R, and M.