CIS 432/532 Introduction to Computer Networks   Name:

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Midterm

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Instructions

Show your work for all problems. Be direct and convincing with your written answers.

Section A: Questions (10 points each)

1. Why is it important for a DNS root name server to implement recursive rather than iterative queries?

2. Why is persistent HTTP, without pipelining, faster than non-persistent HTTP? Why is HTTP with pipelining faster than HTTP without pipelining? Assume in both cases that the objects being transferred are small.

3. Give an example of when it would be faster to use web caching rather than a CDN. Why would a content provider pay a lot of money to set up a CDN when web caching (which is paid for by the users and not the content provider) also places content near the users?

4. In what two ways can a TCP sender detect loss? How could the network give an explicit signal that congestion is occurring?

5. Explain how TCP slow start works when a connection is first started. In your explanation, describe how TCP uses the Threshold and CongWin variables. Why is this considered "slow?"

6. What is the difference between a cumulative acknowledgement and a selective acknowledgement? Give a simple example of when it would be preferable to use a selective acknowledgement.

Section B: Problems (20 points each)

1. The diagrams below show the buffers of a TCP sender and TCP receiver. Each buffer contains a 1000 byte packet. The sequence number of the first segment in both buffers is 0.

ACK'd

sent, but
not ACK'd

Sender

ACK'd

Receiver

out of
order
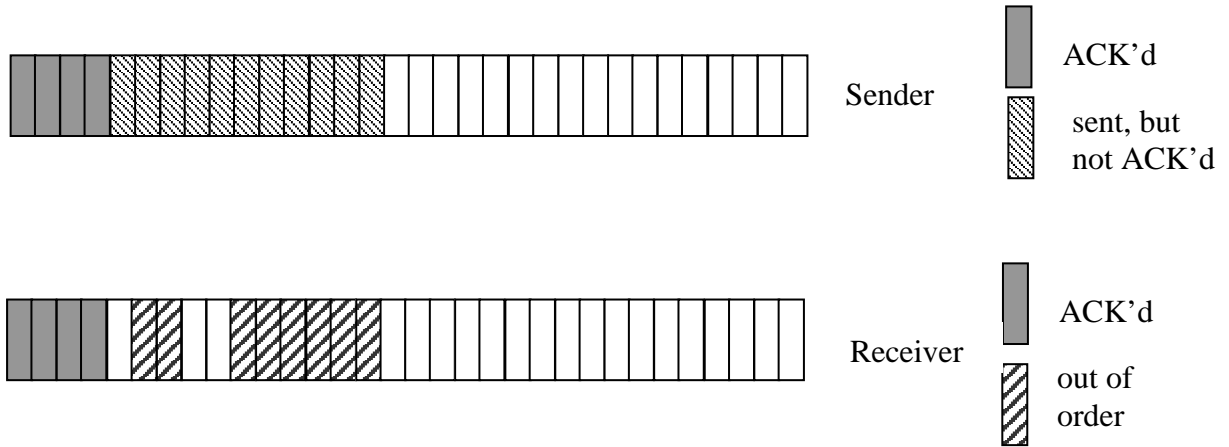
a. Assuming the sender has sent as many packets as it can, what is its window size? Which segment starts the base of the window? What is the next sequence number that the sender can transmit?

b. Assume the receiver sends an acknowledgement for every segment it receives. What acknowledgements has it sent to the sender? Will this cause the sender to retransmit a segment? Why or why not?

c. The sender retransmits the first segment that the receiver is missing. What sequence number will the receiver send in its acknowledgement? How many additional segments can the application now read? When the sender gets this acknowledgement, how will it change the base of its window? How many additional packets may it now send?

2. Two machines, A and B, are connected by a router. The link from A to the router is 10 Mbps and has a propagation delay of 10 ms. The link from B to the router is 100 Mbps and has a propagation delay of 30 ms. The router uses store-and-forward switching and imposes an average queuing delay of 20 ms. Packets sent between the two machines contain 1 KB of data.

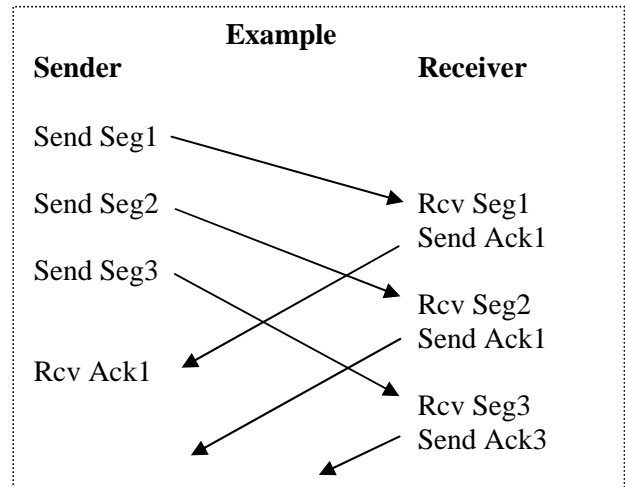   a. How long does it take to transmit a 10 KB file from machine A to machine B?

   b. How large does a file need to be before transmission delay begins to be larger than propagation delay? How does this change if both links are 100 Mbps?

Section C: <u>Graduate Students Only</u>: Problems (20 points each)

1. The STCP protocol is a version of TCP that uses selective acknowledgements rather than cumulative acknowledgements. With selective acknowledgements, duplicate acks are generally not received, so packet loss can only be detected by a timeout.

   a. Draw a diagram of the interaction between an STCP sender and receiver, using the timeline format shown at right. Assume that STCP uses a static window size of 4 segments. The entire window can be sent before any acknowledgments are received.

   A total of 8 segments need to be sent. Segment #2 and segment #5 are lost the first time they are sent. The first Ack for segment #7 is lost. No other segments are lost.

Example

Sender	Receiver
Send Seg1	
Send Seg2	Rcv Seg1
	Send Ack1
Send Seg3	Rcv Seg2
	Send Ack1
Rcv Ack1	
	Rcv Seg3
	Send Ack3

b. Invent a rule for when STCP should send a negative acknowledgment. Give an example of how this would help to improve the protocol.