CSS 432, HW4, Spring 2018

Name:

1. Consider two hosts, ***A*** and ***B***, connected by a single link of rate ***R*** bps. Suppose that the two hosts are separated by ***m*** meters, and suppose the propagation speed along the link is ***s*** meters/sec. Host ***A*** is to send a packet of size ***L*** bits to Host ***B***.
   a. Express the propagation delay, d_{prop}, in terms of m and s.
   b. Determine the transmission time of the packet, d_{trans}, in terms of ***L*** and ***R***.
   c. Ignoring processing and queueing delays, obtain an expression for the end-to-end delay.
   d. Suppose Host ***A*** begins to transmit the packet at time $t = 0$. At time $t = d_{trans}$, where is the last bit of the packet?
   e. Suppose d_{prop} is greater than d_{trans}. At time $t = d_{trans}$, where is the first bit of the packet?
   f. Suppose d_{prop} is less than d_{trans}. At time $t = d_{trans}$, where is the first bit of the packet?

2. Suppose within your Web browser you click on a link to obtain a Web page. Further suppose that the Web page associated with the link consists of a small amount of HTML text and refers eight very small objects on the same server. Neglecting transmission times, how much time elapses with
   a. Non-persistent HTTP with no parallel TCP connections?
   b. Non-persistent HTTP with the browser configured for 5 parallel connections?
   c. Persistent HTTP?

3. Compare Go-Back-N (GBN), Selective-Repeat (SR), and TCP (no delayed ACK). Assume that the timeout values for all three protocols are sufficiently long such hat 5 consecutive data segments and their corresponding ACKs can be received (if not lost in the channel) by the receiving host (Host ***B***) and the sending host (Host ***A***) respectively. Suppose Host A sends 5 data segments to Host ***B***, and the 2^{nd} segment (sent from A) is lost. In the end, all 5 data segments have been correctly received by Host ***B***.
    a. How many segments has Host ***A*** sent in total and how many ACKs has Host ***B*** sent in total? What are their sequence numbers? Answer this question for all three protocols.
    b. If the timeout values for all three protocol are much longer than 5 RTT, then which protocol successfully delivers all five data segments in shortest time interval?

4. Consider ***Figure 1***. Assuming TCP Reno is the protocol experiencing the behavior shown by it, answer the following questions. In all cases, you should provide a short discussion justifying your answer.
    a. Identify the intervals of time when TCP slow start is operating.
    b. Identify the intervals of time when TCP congestion avoidance is operating.
    c. After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
    d. After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
    e. What is the value of *ssthresh* at the 18th transmission round?

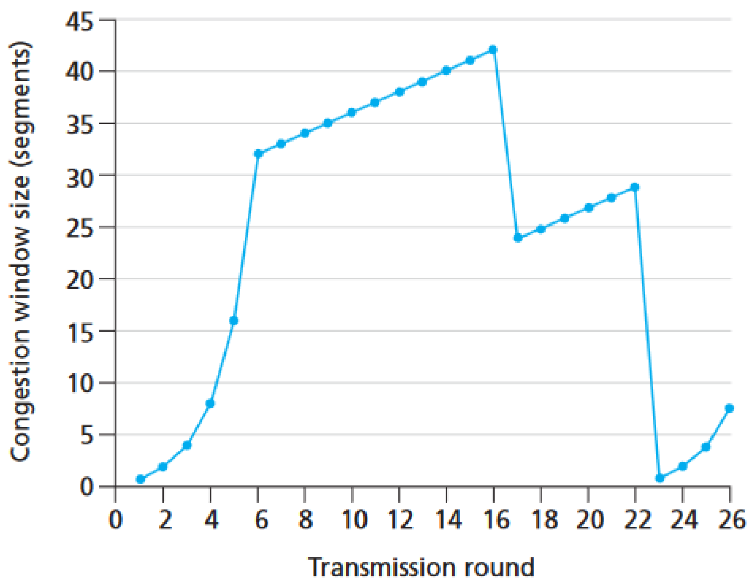

Figure 1. TCP window size as a function of time

5. Consider a datagram network using 8-bit host addresses. Suppose a router uses longest prefix matching and has the following table:

Prefix Match	Interface
00	0
010	1
011	2
10	3
11	4

For each of the five interfaces, give the associated range of destination host addresses and the number of addresses in the range.

6. Consider the network shown in ***Figure 2***, and assume that each node initially knows the costs to each of its neighbors. Consider the distance-vector algorithm and show the distance table entries at node ***z***.

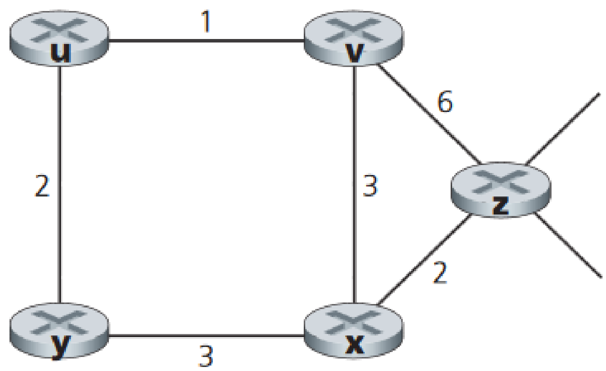

Figure 2. A simple network graph

7. Consider the network shown in ***Figure 3***. Suppose ***AS3*** and ***AS2*** are running OSPF for their intra-AS routing protocol. Suppose ***AS1*** and ***AS4*** are running RIP for their intra-AS routing protocol. Suppose eBGP and iBGP are used for the inter-AS routing protocol. Initially suppose there is no physical link between ***AS2*** and ***AS4***.
    a. Router 3c learns about prefix *x* from which routing protocol: OSPF, RIP, eBGP, or iBGP?
    b. Router 3a learns about *x* from which routing protocol?
    c. Router 1c learns about *x* from which routing protocol?
    d. Router 1d learns about *x* from which routing protocol?

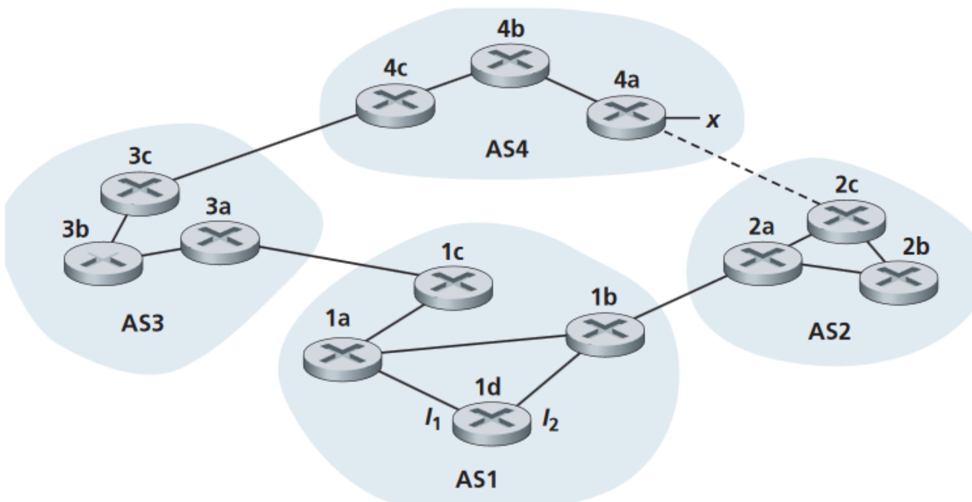

Figure 3. A complex network graph

8. Suppose four active nodes – nodes ***A***, ***B***, ***C*** and ***D*** – are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probability p. The first slot is numbered slot 1, the second slot is numbered slot 2, and so on.
    a. What is the probability that node ***A*** succeeds for the first time in slot 5?
    b. What is the probability that some node (***either A, B, C or D***) succeeds in slot 4?
    c. What is the probability that the first success occurs in slot 3?

9. Let's consider the operation of a learning switch in the context of a network in which 6 nodes labeled ***A through F*** are star connected into an Ethernet switch. Suppose that *(i)* ***B*** sends a frame to ***E***, *(ii)* E replies with a frame to ***B***, *(iii)* ***A*** sends a frame to ***B***, *(iv)* ***B*** replies with a frame to ***A***. The switch table is initially empty. Show the state of the switch table before and after each of these events. For each of these events, identify the link(s) on which the transmitted frame will be forwarded, and briefly justify your answers.

10. Suppose there are two ISPs providing Wi-Fi access in a particular café, with each ISP operating its own AP and having its own IP address block.
    a. Further suppose that by accident, each ISP has configured its AP to operate over channel 11. Will the 802.11 protocol completely break down in this situation? Discuss what happens when two stations, each associated with a different ISP, attempt to transmit at the same time.
    b. Now suppose that one AP operates over channel 1 and the other over channel 11. How do your answers change?