CSE 123: Computer Networks
Homework 2
Out: 10/18, Due: 10/25

Instructions
1. Turn in a physical copy at the beginning of the class on 10/25
2. Ensure the top page of the HW has the following information clearly written
   a. Name
   b. UCSD email
   c. PID

Problems

1. The Sliding Window Protocol

   Assume that the sender’s window size is 3. If we have to send 10 frames in total, and the channel of transmission is such that every 5th transmission is lost (but no ACKs), how many data transmissions (including both original transmissions and any necessary retransmissions) does the sender make in total if:-

   a. The go-back-N protocol is followed
   b. The selective repeat protocol is followed

   Also, calculate the ratio of the effective number of frames sent to the total number of frames sent in each of the above cases.

2. Learning Bridges

   Consider the following topology, consisting of hosts A-H attached to learning bridges B1-B3, with their corresponding port numbers marked as shown

   ![Diagram of network topology]

   A  B  C
   ↓  ↓  ↓
   B1  B2  B3
   1  2  3
   ↓  ↓  ↓
   D  E  F
   4  5  6
   ↓  ↓  ↓
   G  H
   7

   B1  B2  B3
   2  3  6
If the following sequence of steps is followed, identify all the hosts that receive each message, assuming that the tables are empty for all bridges in the initial state.

a. A sends a message to B  
b. B sends a message to A  
c. D sends a message to G  
d. E sends a message to D  
e. G sends a message to D  
f. H sends a message to F  
g. F sends a message to B

Also, draw a simple forwarding table for each bridge after the above messages have been sent.

3. **The Spanning Tree Protocol**  
Consider the following network topology, where B1-B5 represent bridges with their corresponding ports numbers marked as shown.

![Network Topology Diagram]

Using the spanning tree algorithm, find out the ports that will remain and the ports that will be turned off, and draw the resultant spanning tree. Provide an explanation for how the tree is formed; including — selecting the root node, sending configuration messages to its neighbors, and the cascading of messages between the bridges. Make sure to show the final configuration message each bridge will send, and explain which ports will be switched off.
4. **Fragmentation**

Suppose a router receives an IP packet of 552 bytes, and has to fragment the packet and forward the fragments across a network with an MTU of 300 bytes. Then, a subsequent router has to further forward the packet (and/or any resulting fragments) onto another network that has an MTU of 100 bytes. Here, the MTU refers to the size of the largest packet that can be carried in a link-layer frame. If the size of the TCP header is 20 bytes and that of the IP header is also 20 bytes (i.e., there are no options), compute the values for the following fields in the IP headers for all of the fragments that traverse each network:-

a. Length  
b. MF  
c. Offset

5. **Sequence Number Wraparound**

Assuming that the Transmission Control Protocol (TCP) layer operates over a 2 Gbps link:-

a. If TCP could utilize the full bandwidth of the link, assume that it chooses to send segments of 20B of data each, back-to-back without any delay whatsoever. Also assume that there is no error in the channel, and there is no retransmission of packets. Taking into account that the size of the TCP header is 20 bytes, and ignoring other packet/frame headers or any other overhead from the network and link layers, how long would it take for the TCP sequence space to wrap around completely?  
b. If the maximum segment lifetime (MSL) is 2 minutes for the network, is there a potential for TCP to operate incorrectly? Why?