1 a) Suppose that you want to post a tweet using your computer that is connected to the Internet over an Ethernet network. Assume that Twitter/X posts tweets through HTTP requests. Draw a diagram of an Ethernet frame carrying your tweet as it appears on the wire. In your diagram, show the location of 1) various protocol headers, 2) application-layer payload (tweet), 3) start of the frame, 4) end of the frame. It is OK if you don't know the particular protocol in use at each layer, but you should indicate to which layer each header corresponds.

b) For the Ethernet frame you drew in 1a), which is the first header that your computer added to your tweet? Which is the last header that your computer added?
2. Given your understanding of the HDLC protocol (which employs frame delimiters and bit stuffing), assume that the following bit stream arrives at the receiver:

```
0111 1110 1110 1100 0111 1111 0000 1100
0011 1110 0111 0111 1100 0001 0111 1101
1011 1001 0111 0000 1011 1111 0110 0000
1100 1111 1100 0010 0111 1100 0000 0011
1110 0111 0101 0111 0111 1110 0011 0001
0110 1001
```

Highlight (e.g., circle, underline, or otherwise indicate above) and calculate the total number of:

a) Frame delimiters  
b) Stuffed 0’s  
c) Received errors

3. Consider a code on six-bit strings that contains (only) the following four codewords:

```
000000, 000011, 001111, 111111
```

a) What is the Hamming distance of this code?

b) What is the rate of this code if we use it to encode two-bit strings? Is it efficient? If it is not efficient, please explain.

c) How many bit flips can be detected using this code? How many bit flips can be corrected?
4. Consider a sender and receiver that implement a sliding window protocol using selective retransmission, as described in Section 2.5 of the textbook. Assume that:
   - The frame sequence number space ranges from 0 to 6
   - The sender window and receive window size are 3.
   - The receiver sends a cumulative ACK each time it receives a frame from the sender
   - The one-way delay between sender and receiver is slightly less than 1ms
   - The sender sends packets no faster than once per millisecond
   - The sender uses a timeout of 5 ms.

The figure below shows a series of packet exchanges between the sender and receiver.
a) As you can see, the transmission of Frame 2 was lost. You should extend the diagram above until the sender receives the ACK for Frame 4 assuming no further packet losses.

The Figure below depicts the state of the sender and receiver at t=3ms.

Where LAR stands for Last Acknowledgement Received, LFS is Last Frame Sent, LFR is Last (in-order) Frame Received, and LAF is Largest Acceptable Frame.

b) Using your extended trace from the prior question, draw a similar state diagram for the Sender and Receiver at t=6.5ms. Include arrows for LAR, LFS, LFR, and LAF.

c) And, finally, draw a similar diagram at the end of the trace above (i.e., the moment after the Sender receives the ACK for Packet 4 but before it sends anything further).