

CSE 123 Fall 2026

Homework 1, Due 10am October 7

Submit by uploading a PDF to Canvas. Homework will be graded for completion only.

1 a) Suppose that you want to send a (short) Slack message using your computer that is connected to the Internet over an Ethernet network. Assume that Slack sends messages using HTTP requests. Draw a diagram of an Ethernet frame carrying your message as it appears on the wire. In your diagram, show the location of 1) various protocol headers, 2) application-layer payload (message), 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 the receiving host will process? Which is the first header that your computer added?

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

0001, 1101, 0110, 1011

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?

3. Suppose you are transmitting a 16-bit message using a protocol that protects the payload with a CRC defined by the polynomial $C(x) = x^8 + x^5 + x^4 + 1$.

a) How many bits are actually required to transmit the message and the frame check sequence? How many bits correspond to the frame check sequence?

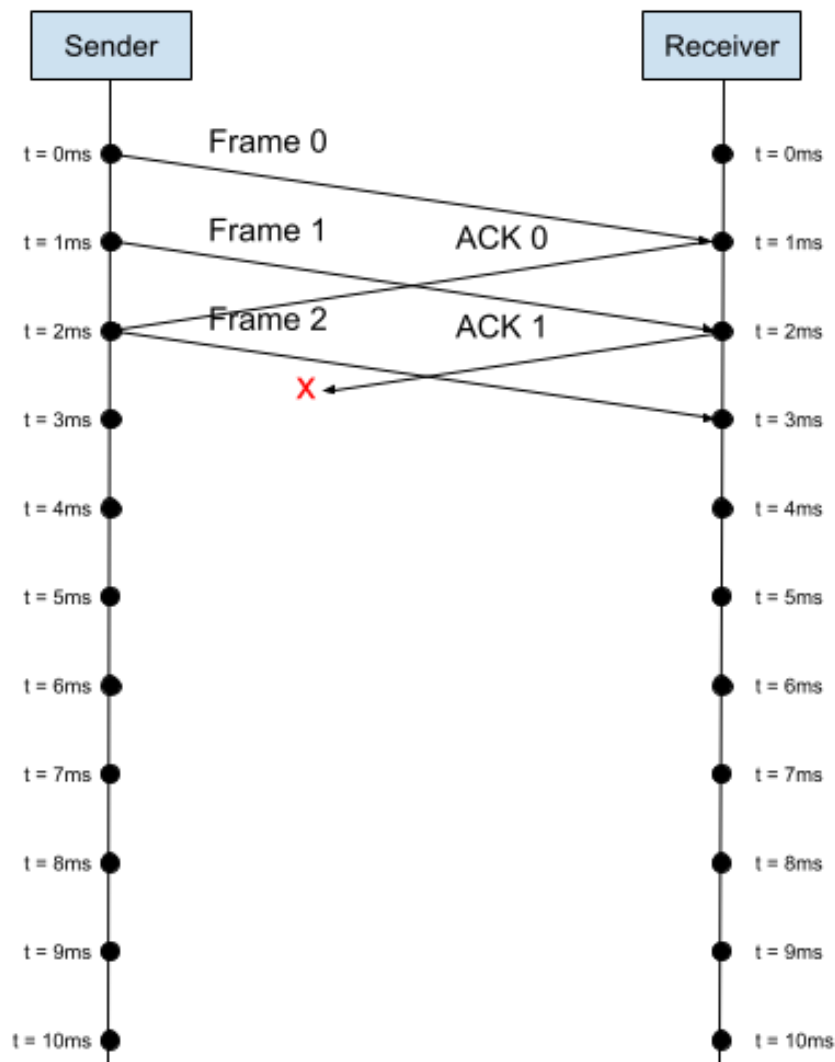
b) Suppose that exactly one bit error occurred during transmission. Will the receiver be able to detect it? Why or why not?

c) On the contrary, suppose the receiver received the following bits without error: 010101011010101011111111. What was the payload?

4. Consider a sender and receiver that implement a sliding window protocol using selective retransmission, as described in Section 12.4 of the textbook. Assume that:

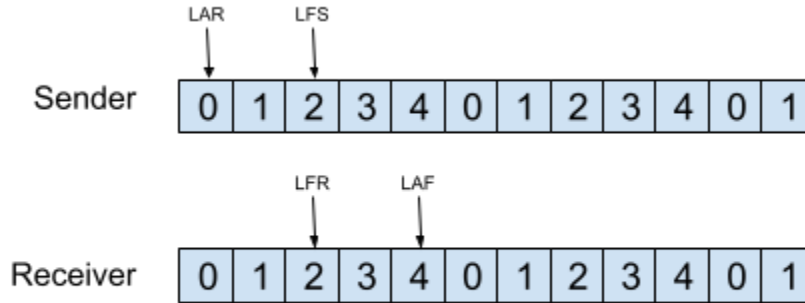
- The frame sequence number space ranges from 0 to 4
- The send window and receive window size are 2.
- The receiver sends a cumulative ACK each time it receives a frame from the sender
- The one-way delay between sender and receiver is *slightly less* than 1ms
- The sender sends frames no faster than once per millisecond
- The sender uses a timeout of 4 ms.

The Figure below shows a series of frame exchanges between the sender and receiver



a) As you can see, the transmission of ACK 1 was lost. You should extend the diagram above until the sender receives the ACK for Frame 4 assuming no further frame (or ACK) losses.

The Figure below depicts the state of the sender and receiver at $t=3\text{ms}$.



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 $t=4.5\text{ms}$. Include arrows for LAR, LFS, LFR, and LAF.

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