CPS 470/570: Exam 2 **Name:**____

Instructor: Dr. Clark October 31, 1995

This test is closed book and closed notes. You may use a calculator. Answer the questions in the space provided. When answering questions, please state any and all assumptions you are making. For questions involving calculation, indicate your final answer by circling it.

Part 1 (20 points)

You are to design a multiplexer to combine 10 lines at 9600 bps, 2 lines at 19,200 bps, and 1 line at 38,400 bps into a single shared line. The multiplexer will use Synchronous Time-Division Multiplexing with character interleaving.

1. Ignoring overhead from synchronization and framing, what is the minimum required data rate for the shared trunk?

2. Draw a framing pattern for carrying the input data over the shared channels. Show the entire frame and indicate the number of bits in each frame element.

3. You observe that several of the inputs are often idle and the shared line does not transmit data all of the time. In fact, the shared line is only experiencing about 50% effective utilization. How could you change the multiplexer to accommodate more input lines over the same channel? What would this require? What are the potential drawbacks?

Part 2 (20 points)

1. Develop a Huffman coding tree to encode the message: *arangutang*. Show your coding tree. Show the final bitstream that would be generated to send the message.

2. Your encoded message uses a variable number of bits for each character. How does the receiver know how to decode this message? How does it know when one character stops and another starts?

Part 3 (20 points)

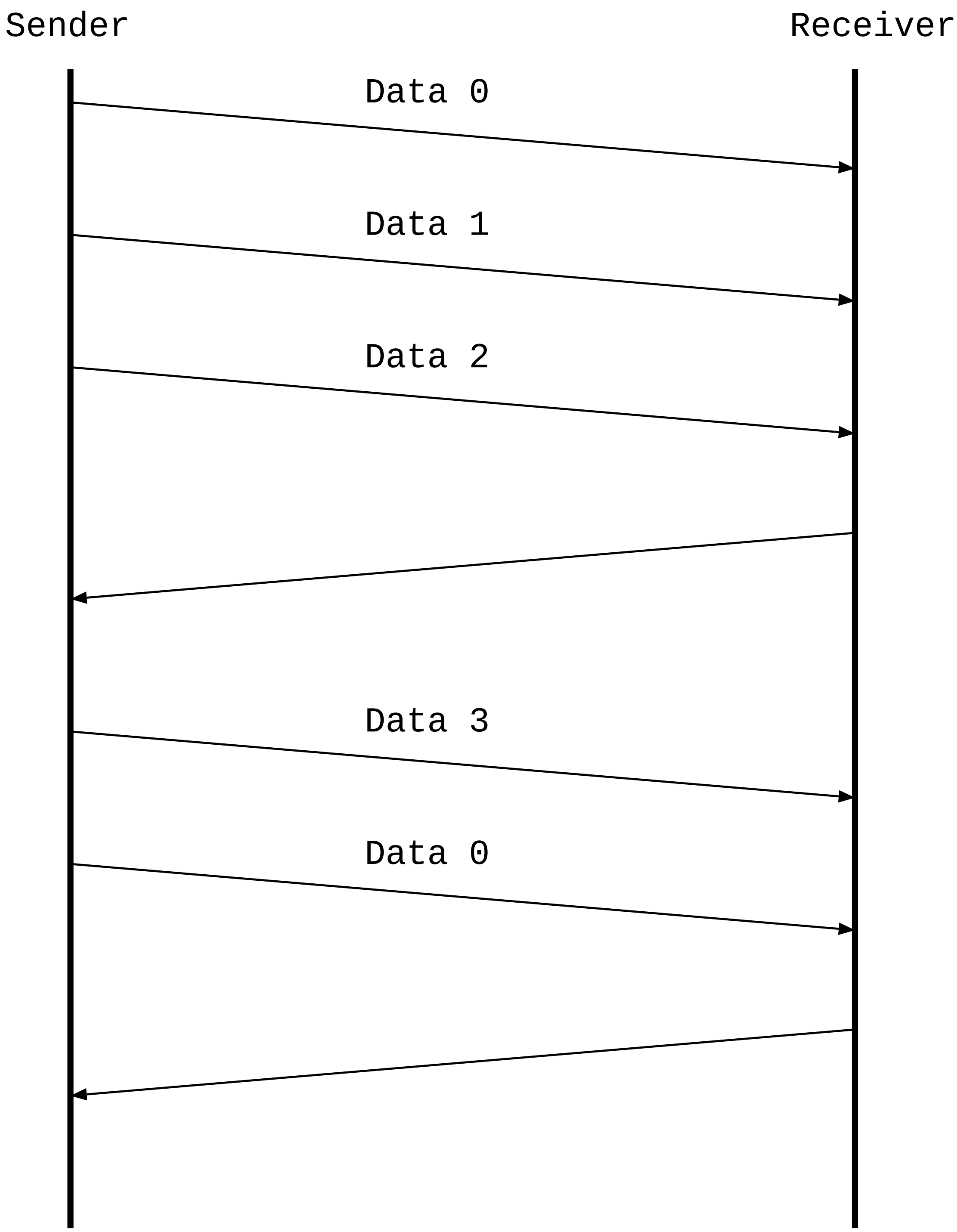
1. When is addressing needed in a data-link protocol?

2. The Stop-and-Wait ARQ protocol is beautiful in its simplicity. It is certainly easier to implement than Go-Back-N or Selective-Reject. So, why don't we use it everywhere? What is wrong with it? When is it especially bad and when is it appropriate to use?

3. The HDLC protocol uses a control packet called RNR - Receive Not Ready. What does this packet mean? How is it used? Be specific about when and where the packet is sent.

Part 4 (20 points)

Consider the following Go-Back-N flow diagram with data going from left to right. The messages from left to right are labelled with the data sequence numbers being sent. **Fill in the labels for the return messages** with labels that make sense in the current scenario. Also, **show the sliding windows at the sender and receiver after every send and receive event.**



Part 5 (20 points)

1. We discussed three types of switching: Circuit Switching, Virtual Circuit Packet Switching and Datagram Packet Switching. Which type of switching should one use to build a network for the following applications? Briefly justify your choice.

   (a) A 1 hour voice/video teleconference.

   (b) An electronic mail messaging system that sends lots of short messages.

2. Explain the term *store-and-forward* with respect to switching. To which switching technique(s) does it apply?

3. Virtual Circuit Packet Switching can be described as having the **worst** features of both of the other two forms of switching. First, what is meant by this? Second, if its so bad then why is it used? What are the good points?