1. Consider the following network topology where some residential hosts connect to the Internet via NAT devices:

(a) Host A has an active SSH connection (Port 22) to Host E. Give a plausible value for the (source address, destination address, source port, destination port) 4-tuple for packets in this connection as they exit Host A’s computer. Indicate what elements of the tuple would be assigned at connection time (pick whatever value you want for these ephemereral ports).

(b) What is a plausible value for the (source address, destination address, source port, destination port) 4-tuple for packets for the connection in (a) when they arrive at Host E? Again, indicate what elements would be assigned at connection time.

(c) Suppose Host D wishes to serve web pages (on port 80) to the Internet. What must happen in order for devices on the Internet to access the server on Host D?

(d) Host B attempts to connect Host D (i.e. by sending a packet to D). List out how the (source address, destination address, source port, destination port) 4-tuple evolves as it traverses the network from B to D. Indicate what elements would be assigned at connection time.

(e) Host A and Host C have the same IP address. Is this an issue? Explain why it is or isn’t.

2. Using a timing diagram to track the sequence of sent messages and acknowledgements, show that if messages can be reordered (i.e., a packet might be
delayed and received after a packet that is subsequently sent), the rdt 3.0 state machine using alternating bits will not work as designed.

3. rdt3.0 seems to have solved all of the key problems that result in unreliable data transfer (e.g., packet corruption, packet loss).
   
   (a) What is the main reason of introducing sliding windows on top of the stop-and-wait approach that rdt3.0 uses?
   
   (b) Give a couple of special situations where stop-and-wait might perform similarly to a sliding-window approach.

4. For TCP, the lecture notes (slide 112) make the following statement: ”receivers can buffer out of sequence packets”.
   
   (a) Why might a receiver choose NOT to do this?
   
   (b) Does a sender need to know whether a receiver buffers out of sequence packets? Why? Why not?

5. Please refer to the computer networking handout for this year. https://www.cl.cam.ac.uk/teaching/2223/CompNet/files/compnet-exercises-student.pdf. Please do problems 16(b) and 16(c).

6. When TCP implementations measure the RTT, what problem are they trying to solve? What does the value $\alpha$ in the exponential averaging function control?