# Computer Networks Homework 2

Fall 2019

Due: 24 February 2020

1. (6 points) List at least three responsibilities of the Transport Layer.

2. (5 points) A sequence of UDP packets addressed to ports 1979, 8854, 9000, 1979, and 9000 arrive at a host (in that order). Draw a simple diagram that shows how these packets enter the demux service and then how they are distributed to the processess.

3. (9 points) Use RFC1700 to find the well-known port numbers for the following services: SMTP, HTTP, Kerberos, POP3, BGP, WHOAMI, LDAP, and RPC (remote process execution). Be careful, RPC has multiple port assignments; list at least two and the associated application or algorithm.

4. (16 points) A UDP segment has the payload "MTU!" as a string of four ASCII charaacters. It is being delivered to an application on port 5272 from an application on port 8888. Show the full UDP header for this segment.

   Clearly mark each field with it's purpose and represent the value of each field in binary. Use an 8 b representation for the ASCII characters (a convenient ASCII table is available at `www.asciitable.com`). Show all 1s Complement arthmetic for the checksum calculation, remembering that the checksum is based on 16-bit chunks. As a "real" checksum would require information from the IP packet you should just use the information from UDP and ignore the pseudoheader when calculating your checksum.

5. (4 points) Find at least two other important UDP applications besides DHCP, DNS, and QUIC. Provide a citation which proves the application uses UDP.

6. (8 points) List the two components of any protocol that adheres to the precepts of Automatic Repeat Requests. How do these two components work together to provide reliable delivery of packets?

7. (2 points) What problem is solved by adding a single-bit sequence number to packets using the Stop-and-Wait protocol?

8. (5 points) You are designing a protocol that uses the sliding window protocol. You have targeted a window size of 16 frames. What is the minimum number of bits needed in the header field for packets of this protocol?

9. (3 points) TCP uses a 32 b sequence number. What is the maximum window size that could be used?

10. (12 points) Show the states the TCP state machine moves through in the following situations:
    (a) The client initiates a connection, then changes its mind with a `close()` function.
    (b) A standard closing of the connection from the `Established` state by the client.
    (c) The client initiates a new connection, but the server never responds.

11. (4 points) They may sound similar, but explain the differences between the `PUSH` and the `URGENT` flags in a TCP segment.

12. (6 points) Several segments are sent by a client containing 852 b, 777 b, and 212 b. Prior to these transmissions, the last ACK received by the client was for sequence number `0x001109AB`. What are the sequence numbers and ACKs for these segments?

13. (10 points) A TCP host is using the original timeout equations and 10 packets arrive with the following RTT values: 145 ms, 145 ms, 155 ms, 144 ms, 100 ms, 255 ms, 200 ms, 185 ms, 166 ms, 145 ms. Show how the value of the value of EstRTT changes as each packet arrives. Start with a 100 ms value for EstRTT.

14. (10 points) Repeat the previous question using the Jacobson/Karels equations. Let the important values be: EstimatedRTT = 100 ms, Deviation = 0, $\mu = 1$, $\gamma = 4$, $\delta = 0.875$.