

## **HW 2**

## ECE 356/ COMPCSI 356: Computer Network Architectures:

## Homework must be done individually. The homework is due at 11:59pm on 04/10/24. Please submit your solutions as a single PDF file via Gradescope. Show all steps of your derivations.

- 1. (3 pts) Suppose host A is sending to a multicast group; the recipients are leaf nodes of a tree rooted at A with depth n and with each nonleaf node having m children; there are thus m^n recipients.
  - a. How many individual link transmissions are involved if A sends a multicast message to all recipients? (1pt)

b. How many individual link transmissions are involved if A sends a unicast message to each individual recipient? (1pt)

c. Suppose A sends to all recipients, but some messages are lost and retransmission is necessary. Unicast retransmissions to what fraction of the recipients is equivalent, in terms of individual link transmissions, to a multicast retransmission to all recipients? (1pt)

- 2. (3 pts) Hosts A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 132. Suppose Host A then sends two segments to Host B back-to-back. The first and second segments contain 80 and 40 bytes of data, respectively. In the first segment, the sequence number is 133, the source port is 204, and the destination port number is 80. Host B sends an acknowledgement whenever it receives a segment from Host A.
  - a) In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number? (1pt)

b) If the first segment arrives before the second segment, in the acknowledgement of the first arriving segment, what is the acknowledgement number, the source port number, and the destination port number? (1pt)

c) If the second segment arrives before the first segment, in the acknowledgement of the first *arriving* segment, what is the acknowledgement number? (1pt)

3. (2 pts) Suppose we are using the Jacobson/Karels algorithm to estimate the TimeOut in TCP, where  $\mu=1$ ,  $\phi=4$ , and  $\delta = 0.1$ . The current EstimatedRTT and Deviation are 110 ms and 10 ms, respectively. Suppose the measured SampleRTT is 80 ms for a new segment. Compute the updated EstimatedRTT, Deviation, and TimeOut.

**4.** (2 pts) Suppose a congestion-control scheme results in a collection of competing flows that achieve the following throughput rates: 100 KBps, 260 KBps, 310 KBps, 85 KBps, and 120 KBps. Calculate the fairness index for this scheme.