Electrical, Computer, and Systems Engineering

ECSE 4760: Computer Communication Networks

Homework set 3. Due Dates:

For On-Campus and Live Students Due Friday, October 19
For Tape-delayed Students Due Wednesday, October 24

Notes:

1. Be brief.
2. **SUBMIT THIS HOMEWORK USING WEBCT DROP BOX.**
3. 4000 level students need to answer only Reading Assignment question 1 and Homework Problems 1, 2 and 3.
4. 6000 level students need to answer all questions.
5. All papers for the reading assignment are available from the course web page.

Reading Assignment

1. Read and summarize Jacobson's paper on "Congestion Avoidance and Control," which is the seminal paper on TCP congestion control. Your summary should not exceed one page. The paper is available at: http://www.ecse.rpi.edu/Homepages/shivkuma/teaching/sp2001/readings/congavoid.pdf (15 pts)

Homework Problems

1. Recall the efficiency and fairness analysis of the additive increase/multiplicative decrease (AIMD) in slide set 4 (slides 42-44). This analysis is based upon the Chiu/Jain paper: "Analysis of Increase/Decrease Algorithms for Congestion Avoidance...," which analyzes different congestion avoidance policies. Based upon a quick reading of the paper, explain why

alternative policies like "additive increase/additive decrease (AIAD)" and "multiplicative increase/multiplicative decrease (MIMD)" do not converge to fairness. The Chiu/Jain paper is available at:
http://www.ecse.rpi.edu/Homepages/shivkuma/teaching/sp2001/readings/chiujain.pdf
(20 pts)

2. **Concepts: RTT Estimation** Suppose that TCP used a different procedure to set timeout where it estimates AverageRTT and just sets timeout to 2 x AverageRTT. Give a counterexample where this technique will lead to a spurious timout. Argue why this procedure would lead to more spurious timeouts *in general* compared to the TCP procedure of setting timeout based upon *both* AverageRTT and Deviation (i.e. AverageRTT + 4 x Deviation). (25 pts)

3. **Concepts: TCP Latency Analysis with Dynamic Windows** Do Problem 26, Pg 266, Chapter 3 of the Kurose/Ross textbook. It asks you to redo the dynamic window analysis for T links between the server and client, i.e. even though packets are back-to-back, they have to experience additional transmission times at each link. Now, into your final expressions, assume T = 5; S = 536 bytes. For the following combinations of (O, R, RTT) = (100Kbytes, 28 Kbps, 100 msec), (100Kbytes, 10Mbps, 100msec), (5Kbytes, 28Kbps, 1 sec), (5Kbytes, 1Mbps, 1 sec) find the minimal latency and latency with slow start. [Hint: see pg 257-258]. Comment on the implications of the results. (40 pts)

Additional questions for 600 level students

1. Solve Problem 21(a) and (b) in Chapter 3, pg 265 of the Kurose/Ross textbook. This question refers to the "idealized model" which is the "additive increase/multiplicative decrease (AIMD)" scheme we learnt in class and also is briefly discussed in pages 243-248 of the textbook. You are asked to derive the average loss rate (L) as a function of window size, and the average bandwidth of TCP achieved by AIMD congestion control as a function of loss rate (L) and round trip time (RTT). (30 pts)

2. Read and summarize Bansal/Balakrishnan's paper on " Binomial Congestion Control Algorithms" which represents a generalization of AIMD type policies and a discussion of "TCP Compatible Congestion Control". The paper is available at:
http://www.ecse.rpi.edu/Homepages/shivkuma/teaching/sp2001/readings/binomial.pdf
Submit a one page summary of the paper. (20 pts)