Note: In all written assignments, please show as much of your work as you can. Even if you get a wrong answer, you can get partial credit if you show your work. If you make a mistake, it will also help the grader show you where you made a mistake. Your submitted homework should be printed out (i.e., please don’t hand in hand-written answers, unless you need to hand-annotate the printed text, or draw a figure). See the class web-page for more information about handing in homework assignments.

This is a relatively simple and short assignment!

**Problem 1. Flow Control versus congestion control.** Consider the following scenarios and indicate whether this is a flow control or a congestion control problem. In all cases, the solution is for the sender(s) to “slow down.” Indicate the mechanism used by the TCP sender to know that it should “slow down” its transmission rate.

a) Alice is sending to Bob, and her TCP are arriving so fast that Bob’s memory space for holding TCP segments that have not been delivered to the application is running out.

b) Alice is sending to Bob, and Ted is sending to Mary, and a number of other sender/receiver pairs are sending TCP segments over a common link where the router’s buffer space for that outgoing link is overflowing due to all of the TCP segments being sent over that link.

c) Alice is sending to Bob, and Ted is sending to Mary. As in a), her TCP are arriving so fast that Bob’s memory space for holding TCP segments that have not been delivered to the application is running out. Similarly, Ted’s segments are arriving at Mary so fast that Mary’s memory space for holding TCP segments that have not been delivered to the application is running out.

d) Alice, Ted, and Mary are all sending to Bob. Collectively, their TCP segments are arriving so fast that Bob’s memory space for holding TCP segments that have not been delivered to the application is running out. None of Alice, Ted, and Mary’s segments are lost at routers in the network.

**Problem 2. TCP Fairness.** Consider our discussion on notes page 3-44 in 290_Module4 (“Why is TCP Fair”) where we showed graphically how TCP’s additive increase multiplicative decrease (AIMD) congestion control algorithm led to a fair allocation of connection throughput between the two receivers. Now consider a congestion control algorithm where each sender additively increases its sending rate (as in TCP), but additively decreases its sending rate as well (e.g., having each receiver decrease its sending rate by the
same amount) – AIAD. Would this new approach provide an allocation of connection throughput? Explain your answer.

Problem 3. What IP addresses do you use during the day? In this question, you’ll be asked to record the IP address of two different devices that you use at 4 different times. Do the following:

a) For your laptop or computer or tablet, determine and write down its IP address at four different times. Use the whatismyipaddress.com site (see notes page 4-15 in 290_Module4a (“IPv4 addressing: more”) to determine your IP address. Space your measurements apart by at least an hour, and try to take them at different physical locations. Also, make sure you have powered down your computer between measurements to make sure that your DHCP protocol has obtained a new IP address from the local DHCP server.

b) For each of these four IP addresses:
   1. indicate any common structure that you see.
   2. Use whois.net site to determine the owner of the network that owns the IP address you are using.
   3. What is the range of addresses owned by this network?

c) Repeat a) and b) above for but a second device, e.g. a smartphone.

Problem 4. Router quickies. Answer each of the question below in just a few sentences.

a) We’ve seen throughout the course that packets can be lost in the Internet on their way from source to destination. Explain where this loss occurs within a router, and what causes loss to occur.

b) Suppose that a router has 5 input links, and five output links, each operating at a speed of 1 Gbps (i.e., the rate at which the bits in packets can arrive to the router is 5 times 1,000,000,000 in aggregate). Suppose that the router’s internal switch fabric can forward from input ports to output ports at an aggregate rate of 10 Gbps. Will queues for at the input ports? Explain.

c) Consider the same scenario as b), but now suppose that the router’s internal switch fabric can forward from input ports to output ports at an aggregate rate of 1 Gbps. Can queues for at the input ports? Explain.

d) Suppose again that a router has 5 input linkseach operating at a speed of 1 Gbps (i.e., the rate at which the bits in packets can arrive to the router is 5 times 1,000,000,000 in aggregate) but that the output links operate at 10Gbps. Will queues for at the output ports? Explain.

EXTRA CREDIT. Addresses of the form 10.x.x.x, 192.168.x.x, and 172.16.0.0 - 172.31.255.255 are known as private IP addresses. Search around the web for information on private IP addresses and write three paragraphs on what you’ve learned. Make sure you address the following in your short writeup (i) what is the purpose of private IP addresses, (ii) can two computers at different points in the world and attached to different networks have the same private IP address, and if so, how is a host outside the private network able to route to that private IP address (hint: you will also have to learn a little bit about network address translation, or NAT to answer this second question).