Communication Protocols and Internet Architectures
Harvard University, CSCI S-40, Summer 2018
Homework Assignment #1 due by 1:00 PM (Boston time) on July 2, 2018

Please submit your homework on the day it is due using the homework submission tool on the course website. Please do not email your homework to a TA or the instructor.

Your homework must use text format, PDF or MS Word. Do not use any fancy layout and do not use macros of any type. In other words, the simpler the format the better.

The file name for your homework must include your name and the specific hw# and the file name must not contain any spaces. In addition, you must always include your name and your email address as part of the document. We will not grade homework that does not follow these naming conventions.

There is a penalty for late homework and homework will not be accepted once the solutions are available. Graded homework will be posted on the course website or emailed back to you. Please note that the point assignment included next to each question might change as we refine the answer key for the assignment.

Your homework must be your own work, in your own words. The use of material from other sources, even when it is properly quoted and cited, should be limited. Please see*, Writing with Sources: A Guide for Harvard Students* if you have questions. We realize that some of the homework questions (or comparable questions) have been asked in previous terms but it is important that you learn the material covered by the question; it is never acceptable to copy an answer directly from another source. The teaching staff and the University take the issue of Academic Honestly very seriously.

Please note that the answer to a homework question is rarely longer than three or four paragraphs in length (plus any diagrams.) If your answer is more than a page long, it means that you are probably not answering the question we asked, or your answer is not as concise as it should be. In either case, you will not receive full credit for your answer. Finally, note that some of this homework requires that you do additional background reading and research.

HOMEWORK #1 QUESTIONS

Note: Your answer to a question should rarely be longer than three or four paragraphs. If your answer is more than a page long, it means that you are probably not answering the question we asked, or your answer is not as concise as it should be. In either case, you will not receive full credit for your answer.

1.) Imagine that a bicycle messenger is given three (3) USB memory sticks, each of which contains 64 gigabytes of data. Given that the courier can travel at 20 km per hour through traffic, for what range of distance does the courier have a higher data rate than a transmission line whose data rate (excluding overhead) is 150 Mbps? Provide the details that support your answer. *[2 points]*

2.) Assume that you are viewing a web page on the course website from a computer located at your home or your office. Research and describe the network connectivity (referred to as the network topology) and the network architecture between your computer and the server at Harvard where the web page is located. If you are not able to get specific information on how your machine is connected to the Internet, describe how machines in comparable environments would be connected. You can assume for this question that the web server at Harvard is connected directly to the Harvard backbone network. *[2 points]*

3.) Join three different IETF mailing lists of your choice. Tell us which groups you joined. (You receive 3 points for joining the lists.)

4.) Explain the use of the sliding window for both flow control and error control. Show how the same sequence numbers that are used for flow control can also be used for error control. Illustrate your answer using time sequence diagrams. *[3 points]*

5a.) Research the network architecture and technology of cable modems and xDSL service for providing access to the Internet from your home. Describe in detail the **technical features of the transmission and multiplexing schemes** used by each of these services. **Your answer should focus on the coax or twisted pair technology used in these services rather than the use of fiber optics, and your answer should concentrate on the transmission and multiplexing used by these systems.** You will find a lot of material available on the web to help you answer this question but please note that your answer should be in your own words, and that your answer should include proper citations.
5b.) Spend some time researching new technology that is being developed to provide high-speed Internet service to residential customers. Describe a new development in this area. (Make sure to provide the appropriate citations for your answer.) How fast do you expect residential users where you live to be able to access the Internet two years from today? *[4 points for entire question]*

6.) Note that your answer to this question, and all of the questions on a homework assignment, should be in your own words: it cannot be a definition or a description copied from a resource on the web.
6a.) What is a virtual circuit? How does it compare to a physical or "real" circuit?
6b.) Describe, compare and contrast, connection-oriented communication and connectionless communication. Focus your answer on the protocols at layer 3 (IP) and layer 4 (TCP or UDP).
6c.) It is very common to hear folks say that connection-oriented communications is the same as circuit switching or circuit-switched communication. Does this statement make sense? How are the two concepts and technologies related to each other, and/or how are they different? HINT: Consider the physical characteristics of a network versus the logical view of the network.
[3 points for entire question]

7.) Submit your homework via the course website. Make sure that your name is on your homework assignment, and also confirm that your last name and the hw# are a part of the file name (as described above.) We know it seems foolish to mention that you have to put your name on your homework but we always have a few students that do not do this.