

Homework 1

*Due on Mon Feb 5 - Beginning of Class**Spring 2018*

Please type or write neatly and clearly. Note that textbook questions come from the 7th edition of Kurose - Ross.

1. (5 points) What is a network protocol? What is a network service? What is the difference between a service interface and implementation of a service? Discuss these concepts in the context of layered network architecture.
2. (5 points) What is a network architecture? What are the main differences between the ISO/OSI and the TCP/IP architectures?
3. (10 points) Answer Problem P23 from chapter 1 in your Kurose - Ross textbook.
4. (10 points) Answer Problem P29 from chapter 1 in your Kurose - Ross textbook. (Hint: Recall that a geostationary satellite is 36,000 kilometers away from earth surface).
5. (10 points) Suppose that a certain communications protocol involves a per-packet overhead of 100 bytes for headers. We send 1 million bytes of data using this protocol; however, when one data byte is corrupted, the entire packet containing it is lost. Give the total number of overhead + loss bytes for packet data sizes (i.e. the size of only the data portion of the packet) of 1000, 5000, 10000, and 20000 bytes, assuming a) the connection loses a single byte of data, and b) the sender does not retransmit lost packets. Which of these sizes is optimal? Please show your work.
6. (30 points) Please read the position paper: **End-to-End Arguments in System Design** by J.H. Saltzer, D.P. Reed and D.D. Clark.
<http://cs.slu.edu/~espositof/teaching/3650/endtoend.pdf>
Write a small essay of about 250-300 words describing what is the end-to-end principle, why is it useful, and why, in your opinion, very recent work is questioning its value. See, *e.g.*, DAIET, a system proposed in this very recent paper appeared at ACM HotNets in November 2017.
<http://cs.slu.edu/~espositof/teaching/3650/p150-Sapio.pdf>

Question 7 (15 points): Getting familiar with Wireshark (and netcat)

The purpose of this question is to have you setup Wireshark on your personal computer (or figure out how to get access to it on a lab computer), and to give you some familiarity with using Wireshark. For the following questions, you will record some basic information to show you have completed the assigned tasks using Wireshark.

(a) **5 points.** Follow the instructions at <https://www.wireshark.org/download.html> to download and setup Wireshark. Once you have Wireshark setup, start it and select an interface on which to record. What is the interface on which you are recording traffic? Why did you choose the interface that you did?

(b) **5 points.** While Wireshark is recording a trace, open an Internet browser and load the webpage `www.nytimes.com`. After the webpage has loaded, stop the trace recording.

- i. List the different protocols that you see.
- ii. In which layer of the network protocol stack does each protocol belong? Are there protocols for which you cannot determine the appropriate layer? If so, which protocols?

(c) **5 points.** Start Wireshark recording a trace. Enter the display filter `tcp.port==80` and `http` into Wireshark. While Wireshark is running, open a terminal. Type `nc www.google.com 80` at the terminal prompt.

From the `nc` manual page (type `man nc` in a Linux or MAC terminal) we know that:

The nc (or netcat) utility is used for just about anything under the sun involving TCP or UDP. It can open TCP connections, send UDP packets, listen on arbitrary TCP and UDP ports, do port scanning, and deal with both IPv4 and IPv6. Unlike telnet, nc scripts nicely, and separates error messages onto standard error instead of sending them to standard output, as telnet does with some.

As the `nc` command hangs, type the following HTTP GET request. Make sure to press enter twice after typing it.

```
GET / HTTP/1.0
Host: www.google.com
```

Take a screenshot of the packet you see in Wireshark that is generated by this command, and include the screenshot in your homework assignment.

Question 8 (15 points): Playing with traceroute

The goal of this question is to use traceroute to collect some round-trip time (RTT) delays. To find more information about traceroute, type `man traceroute` at a terminal prompt. For this question you probably should be on a network outside slu.edu since the firewall may block traceroute.

- (a) **5 points.** Briefly describe how traceroute works. What exactly is being blocked within hopper.slu.edu that prevents traceroute to work?
- (b) **5 points.** Use traceroute to connect to `www.stanford.edu`, at 3 different times of day. Run traceroute 5 times at each time of day, to collect 15 sets of measurements of the round-trip time (RTT) delay to reach `www.stanford.edu` (ignore the other RTT measurements from the intermediate devices). Give the 15 measurements for each time of day and calculate the average and standard deviation for each set of 15 measurements. How many routers are in the path at each time of day? Did the set of routers or the number of routers ever change? Do you ever see the delay to reach a closer host exceed the delay to reach a farther away host? If so, what do you hypothesize that the variation is due to?
- (c) **5 points.** For one of your times of day in part (b), list out the names of intervening routers. Based on these names, can you identify the ISPs in the path from source to destination? There is no right or wrong answer for this question, just see what you can find out.

How to Submit

Please leave a printed or (neatly) handwritten copy of your solutions on the instructor's desk at the beginning of class on Mon Feb 5th. At the top of the first page (together with your name), please write how long it took you to complete this assignment and when you started working on it; for example: *John Smith: 7 hours. Started on Tue Jan 24th.*

If for some reason you have to submit a printed or handwritten assignment late (please read the late submission policies on the syllabus), please submit it in person to the instructor's office (RTH 217). If the instructor is not in his office, please have the department's main office (RTH 103) sign and timestamp your submission, and then leave your submission under the instructor office's door. If a submission does not have a signed date and time, the instructor will assume the maximum late penalty.