CMPSC 381
Data Communications and Networks
Fall 2012
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Lab 3
13 September 2012
Due Thursday, 20 September, 1:30 pm,
in your Sakai dropbox

I strongly suggest that you create a new subdirectory called "lab3" or something similar and place all your files from this lab in that directory. At the end of the assignment I'll show you how to create a "zip" file to upload to the Sakai drop box.

Part 1: Some Pencil-and-Paper Problems

All of these should be answerable using just straightforward reasoning—no tricks. However, do watch out for things like bytes vs. bits in the questions, and above all, *do* ask questions if you don't understand!

1. See Figure 1. I grabbed this off the interactive book site—please show all work, step by step, including units. Use "$\times 10^3$" or "$\times 10^6$" instead of "K" and "M" (so don't just write "4000" or "3Km"—instead, write "4000 bits" or "3×10^3 meters". You can use some abbreviations, of course—"s" or "sec" for seconds, "m" for meters, "b/s" for "bits/second." I just don't want you to abbreviate kilo and mega, I want to see things in units of bits, meters, and seconds. (Your final answer should be expressed in milliseconds, however, as the problem requires.)

2. Problem P7, page 72. (The encoding rate and the decoding rate are identical.) It might be easier for you to answer the question for the *first* bit of the data. Is the answer different for the other bits? Explain.

3. Problem P12, page 73.

4. (The next several problems refer to material from section 1.4.4 in the book.) Problem P20, page 75.

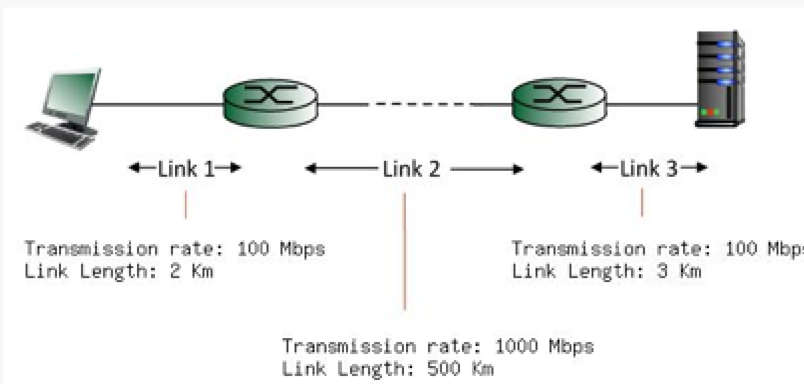
5. Problem P23, page 75.

6. Problem P24, page 75. When it says "Explain," it means provide numbers and explanations of how you obtained them.

7. **Bonus—not required!** Find a misspelled word in section 1.4.4 of the *online* chapter. (It doesn't occur in the print edition.)

Computing end-end delay (transmission and propagation delay)

Consider the figure below, with three links, each with the specified transmission rate and link length.



Find the end-to-end delay (including the transmission delays and propagation delays on each of the three links, but ignoring queueing delays and processing delays) from when the left host begins transmitting the first bit of a packet to the time when the last bit of that packet is received at the server at the right. The speed of light propagation delay on each link is 3x10**8 m/sec. Note that the transmission rates are in Mbps and the link distances are in Km. Assume a packet length of **4000** bits. Give your answer in milliseconds.

Figure 1: Problem 1

Part 2: Python

Files `iodemo.py`, `loopdemo.py`, and `listdemo.py` show basic techniques for working with integer, float, and string input/output, writing "`for`" loops, and working with array-like objects called lists. Lists are more like Java `ArrayLists`; to increase the size of a list you `append` something to it; you can iterate through a list either by index or by enumerating its elements; file `listdemo` shows both ways.

8. Create a Python program to solve problems similar to those of the first interactive problem given in the interactive chapter 1, section 1.4.3. Your program should generalize by asking for information about any number of links, not just three. In particular, your program should:

   - prompt the user to enter the number of links, the packet size (in bits), and the propagation speed (in meters/sec)
   - for each link, ask the user for the transmission rate (in bits/second) and the length of the link (in meters)
   - print out the end-to-end delay, in milliseconds, of sending a packet of the specified size through all the links

   Run it on at least two sample problems generated by the page (all of these will have $n = 3$); you can verify the result by clicking on "show me the solution." Run it on a problem of your own devising that has more than three links. Copy and save the sample outputs to a file (or tack them onto the end of the Python program file).

Part 3: Throughput Experiment

I have never tried this in a class before, so I don't have any idea if there will be any meaningful results! I've identified a web site that has sample "large files" for download: `http://www.thinkbroadband.com/download.html`. I'm interested in seeing if there is any detectable difference in throughput when several users are downloading simultaneously versus single-user downloads. Obviously we can have no idea how many other people are using this service or how many servers there are or much else, so it is highly likely we won't see anything of interest, but it's worth a shot.

9. Get together with at least three other people in the class (preferably more) and try the following. It's probably best if you read through all the instructions before starting so you'll know what to do.

   - Each of you open a terminal window and then *simultaneously* enter the command:

     ```
     wget http://download.thinkbroadband.com/100MB.zip
     ```

   - As the file downloads, watch the "instantaneous throughput" indicator and try to write down the extremes (slowest and fastest rates)—you might not get it exactly since the numbers change fast, but try your best.
   - Write down the final average throughput that is displayed at the end of the file transfer.
   - **Important!** Delete the file `100MB.zip` when you are done!

- Now do the experiment on your own, trying to stagger it so you aren't doing it at the same time as anyone else. Again note instantaneous extremes and final throughput. Is there any difference?

Hand In

Move up one level from your `lab3` directory (e.g., "`cd ..`") and type "`zip -r lastnamelab3.zip lab3`" (if you named it something else, use the something else). Now upload this to your drop box.

Be sure your name appears *in every document* so that when I print it out I'll know who owns that document!