CSIT 5610 Computer Networks: An Internet Perspective
Homework 1 Fall 2022

Problems:

1) (20pts) Consider two hosts, A and B, connected by a single link of rate R bps. Suppose that the two hosts are separated by m metres, and suppose the propagation speed along the link is s metres/sec. Host A is to send a packet of size L bits to host B.

   a) (2pts) Express the propagation delay, d_{prop}, in terms of m and s.

   b) (2pts) Determine the transmission time of the packet, d_{trans}, in terms of L and R.

   c) (2pts) Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.

   d) (2pts) Suppose host A begins to transmit the packet at time $t = 0$. At time $t = d_{trans}$, where is the last bit of the packet?

   e) (2pts) Suppose d_{prop} is greater than d_{trans}. At time $t = d_{trans}$, where is the first bit of the packet?

   f) (2pts) Suppose d_{prop} is less than d_{trans}. At time $t = d_{trans}$, where is the first bit of the packet?

   g) (2pts) Suppose $s = 2.5 \times 10^8$, $L = 1500$ bytes, and $R = 6$ Mbps. Find the distance m so that d_{prop} equals d_{trans}.

   h) (6pts) Assume now that the two hosts A and B are connected indirectly via a single router. The link from host A to the router has a rate of R bps and the link from the router to host B has a rate of R/2 bps. The distance from A to the router is m meters and the distance from the router to B is 2m meters. After receiving a packet, the router processes it for t seconds before it forwards it. Assuming the router to be underloaded (i.e., there is no queueing), how long would it take the packet to reach host B. Illustrate your answer by drawing an annotated time-space diagram for this scenario.

2) (10pts) Suppose you would like to urgently deliver one thousand terabytes of data between Hong Kong and Los Angeles. You have a dedicated reliable link of 10 Gbps for data transfer between the two sites.

   a) Would you prefer to transmit the file via this link or instead use FedEx to carry a disk with the file on it, which will take between 1 day and 1 week (at most)? Explain.

   b) What if the file was only 100 terabytes in size, while FeDex guarantees delivery in 1 day?

3) (40pts) The text below shows the reply sent from a web server in response to an HTTP Get message. Answer the following questions, indicating where in the message below you find the answer. Note that <cr><lf> in italic represent the characters carriage return and linefeed respectively

```
HTTP/1.1 200 OK<cr><lf>
Server: Apache/2<cr><lf>
Vary: Accept-Encoding<cr><lf>
Cache-Control: no-cache<cr><lf>
Content-Type: text/html<cr><lf>
Date: Fri, 28 Sep 2012 06:16:38 GMT<cr><lf>
ETag: "2403f5-5797-4c894fe021a42"<cr><lf>
Last-Modified: Fri, 31 Aug 2013 19:42:29 GMT<cr><lf>
Transfer-Encoding: chunked<cr><lf>
Connection: Keep-Alive<cr><lf>
Set-Cookie: __rb_webperf=52fd0d7b; domain=wireshark.org;
path=/<cr><lf>
<cr><lf>
3fb0<cr><lf>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01//EN"
"http://www.w3.org/TR/html4/strict.dtd"> …
```

a) Was the server able to successfully find the document or not? What time was the document reply provided?

b) When was the document last modified?

c) Does the server consider the request to be from a new user and why?

d) For the Set-cookie header line, we can see a list of statements separated by semicolons. Using Wikipedia or RFC7231, explore briefly and understand quickly what is contained in a cookie?

e) Using Wikipedia or RFC7231, explore briefly and understand quickly when and how the so-called “Chunked Transfer encoding” works. Deduce the number of bytes received in this web object (if there is an object in this reply)?

f) What are the first ten bytes of the entity body being returned? Did the server agree to a persistent connection?

g) Using the Internet/Wikipedia or RFC7231, explain what is the VARY header line and give a Scenarios when it is used?

h) Using the Internet/Wikipedia or RFC7231, explain what is the ETag header line and give a Scenarios when it is used?

4) (10pts) Using the Internet/Wikipedia Answer the following questions about the DNS system in your own words. (Not by copy/paste). (For this you can explore information bases such as Wikipedia, the RFCs, or Cloudflare's education materials)

   a) In addition to A, NS, CNAME and MX, DNS includes many other types of records. Explain what the AAAA and the PTR resource record are and how they are used.

   b) Explain what DNS poisoning is and describe a method to tackle this problem.

5) (20pts) Explain in your own words, what are the reasons that lead to the development of HTTP/2 then HTTP/3, and what improvements are brought about by HTTP/3 with respect to HTTP/1.1. (For this you can explore information sources such as Wikipedia, the RFCs, or Cloudflare's education materials)

Practical Exercises: (you do not need to submit this part; it is not graded, but you may have to answer questions in the mid-term/final exam about it)

1) Wireshark Packet Sniffer: Check the course website under Labs to find instructions for Wireshark Lab 1. Follow the instructions given there.
2) Wireshark HTTP Lab: Check the course website under Labs to find instructions for Wireshark HTTP Lab. Follow the instructions given there.