CS118 Homework 2

1. **True or False**
   a. A user requests a web page that consists of some text and three images. For this page, the client will send one request message and receive four response messages.
   b. Two distinct Web pages (e.g. www.ucla.edu/research.html and www.ucla.edu/students.html) can be sent over the same persistent connection.
   c. With nonpersistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.
   d. The 'Date:' header in the HTTP response message indicates when the object in the response was last modified.
   e. HTTP response messages never have an empty message body.

Solution: 25

a) F
b) T
c) F
d) F
e) F

2. Suppose you wanted to do a transaction from a remote client to a server as fast as possible. Would you use TCP or UDP? Why? (Book: Chapter 2, Question 6)

Solution: 10

You would use UDP. With UDP, the transaction can be completed in one roundtrip time (RTT) - the client sends the transaction request into a UDP socket, and the server sends the reply back to the client's UDP socket. With TCP, a minimum of two RTTs are needed - one to set-up the TCP connection, and another for the client to send the request, and for the server to send back the reply.

3. Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that n DNS servers are visited before your host receives the IP address from the DNS; the successive visits incur a RTT of $RTT_1, \ldots, RTT_n$. Further suppose that the Web page associated with link contains exactly one object, consisting of a small amount of HTML text. Let RTT_0 denote the RTT between the local host and the server containing the object. Assuming zero transmission time of the object, how much

time elapses from when the client clicks on the link until the client receives the object? (Book: Chapter 2, Problem 7)

Solution: 10

The total amount of time to get the IP address is

$$RTT_1 + RTT_2 + \cdots + RTT_n .$$

Once the IP address is known, RTT_O elapses to set up the TCP connection and another RTT_O elapses to request and receive the small object. The total response time is

$$2RTT_o + RTT_1 + RTT_2 + \cdots + RTT_n$$

4. Referring to the previous problem, suppose the HTML file references eight very small objects on the same server. Neglecting transmission times, how much time elapses with (Book: Chapter 2, Problem 7)
   a. Non-persistent HTTP with no parallel TCP connections?
   b. Non-persistent HTTP with the browser configured for 5 parallel connections?
   c. Persistent HTTP?

Solution:

a) 9

$$RTT_1 + \cdots + RTT_n + 2RTT_o + 8 \cdot 2RTT_o$$
$$= 18RTT_o + RTT_1 + \cdots + RTT_n .$$

b) 8

$$RTT_1 + \cdots + RTT_n + 2RTT_o + 2 \cdot 2RTT_o$$
$$= 6RTT_o + RTT_1 + \cdots + RTT_n$$

c) 8

$$RTT_1 + \cdots + RTT_n + 2RTT_o + RTT_o$$
$$= 3RTT_o + RTT_1 + \cdots + RTT_n .$$

5. Consider a short, ten-meter link over which a sender can transmit at a rate of 150 bits/sec in both directions. Suppose that packets containing data are 100,000 bits long, and packets containing only control (e.g. ACK or handshaking) are 200 bits long. Suppose that *N* parallel connections get *1/N* of the link bandwidth. Now consider the HTTP protocol and suppose that each downloaded object is 100Kbits long, and that the initial downloaded file contains 10 referenced objects from the same sender. Would parallel downloads via parallel instances of non-persistent HTTP make sense in this case? Now consider persistent HTTP. Do you except significant gains over the non-persistent case? Justify and explain your answer. (Book: Chapter 2, Problem 10)

Solution: **20+10**

Note that each downloaded object can be completely put into one data packet. Let Tp denote the one-way propagation delay between the client and the server.

First consider parallel downloads via non-persistent connections. Parallel download would allow 10 connections share the 150 bits/sec bandwidth, thus each gets just 15 bits/sec. Thus, the total time needed to receive all objects is given by:

(200/150+Tp + 200/150 +Tp + 200/150+Tp + 100,000/150+ Tp)
+ (200/(150/10)+Tp + 200/(150/10) +Tp + 200/(150/10)+Tp + 100,000/(150/10)+ Tp)
= 7377 + 8*Tp (seconds) 122.95min

Then consider persistent HTTP connection. The total time needed is give by:

(200/150+Tp + 200/150 +Tp + 200/150+Tp + 100,000/150+ Tp)
+ 10*(200/150+Tp + 100,000/150+ Tp)
=7351 + 24*Tp (seconds) 122.52min

Assume the speed of light is $300*10^6$ m/sec, then $Tp=10/(300*10^6)=0.03$ microsec. Tp is negligible compared with transmission delay.

Thus, we see that the persistent HTTP does not have significant gain (less than 1 percent) over the non-persistent case with parallel download.