

**CS 428/528 Instructor:  
Anand Seetharam Homework 2:  
Application Layer**

**Problem 1 (30 points)**

Consider the following string of ASCII characters that were captured by Wireshark when the browser sent an HTTP GET message (i.e., this is the actual content of an HTTP GET message). Answer the following questions, indicating where in the HTTP GET message below you find the answer.

```
GET /kurose_ross/interactive/quotation6.htm HTTP/1.1
Host: gaia.cs.umass.edu
Accept: text/plain, text/html, image/jpeg, image/png, audio/mp4, audio/mpeg, video/mp4,
video/wmv, application/*, */*
Accept-Language: en-us, en-gb;q=0.9, en;q=0.7, fr, fr-ch, zh, da, fi, ar
If-Modified-Since: Tue, 10 Jan 2017 05:02:03 -0800
User Agent: Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/535.11 (KHTML, like Gecko)
Chrome/17.0.963.56 Safari/535.11
```

**a. What is the URL of the document requested by the browser?**

This can be found after the GET:  
/kurose\_ross/interactive/quotation6.htm

**b. What version of HTTP is the browser running?**

This is found in the GET line after the requested URL:  
HTTP/1.1

**c. What is the IP address of the host on which the browser is running?**

IP address can't be found here

**d. When was the last update made to this file?**

This can be found in the If-Modified-Since header:  
Tue, 10 Jan 2017 05:02:03 -0800

**e. What type of browser initiates this message?**

This can be found in the user agent header. In this case the user is using Google Chrome:  
Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/535.11 (KHTML, like Gecko)  
Chrome/17.0.963.56 Safari/535.11

**Problem 2 (30 points)**

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 DNS; the successive visits incur an RTT of  $RTT_1, \dots, RTT_n$ . Further suppose that the Web page associated with the 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?

Explanation: Your local DNS server is contacted by each other server that is visited and each other server is visited exactly once in order to do host IP resolution. So, you have  $n$  visits to your local DNS server and the sum of all the other servers RTTs. Then you also have to account for the time to open a TCP connection ( $RTT_0$ ) and then again to propagate the HTML text ( $RTT_0$ ). Thus, we have the equation:

$$Elapsed\ Time = 2(RTT_0) + \sum_{i=1}^n (RTT_i)$$

**Problem 3 (40 points)**

Referring to Problem P2, suppose the HTML file references eight very small objects on the same server. Neglecting transmission times, how much time elapses with

a. Non-persistent HTTP with no parallel TCP connections?

$$Elapsed\ Time = 8(2 * RTT_0) + 2(RTT_0) + \sum_{i=1}^n (RTT_i)$$

b. Non-persistent HTTP with the browser configured for 5 parallel connections?

$$Elapsed\ Time = 4(RTT_0) + 2(RTT_0) + \sum_{i=2}^n (RTT_i)$$

c. Persistent HTTP?

$$Elapsed\ Time = RTT_0 + 2(RTT_0) + \sum_{i=2}^n (RTT_i)$$