

**Practice Problems: P1, P2, P3, P4, P7, P8, P11, P13, P22, P23, P24, P25, P33**

**Assignment to Hand-in: P1, P7, P11, P13, P24, P33**

P1. 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 (for example, `www.mit.edu/research.html` and `www.mit.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.

P2. Read RFC 959 for FTP. List all of the client commands that are supported by the RFC.

P3. Consider an HTTP client that wants to retrieve a Web document at a given URL. The IP address of the HTTP server is initially unknown. What transport and application-layer protocols besides HTTP are needed in this scenario?

P4. 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). The characters `<cr>``<lf>` are carriage return and line-feed characters (that is, the italicized character string `<cr>` in the text below represents the single carriage-return character that was contained at that point in the HTTP header). Answer the following questions, indicating where in the HTTP GET message below you find the answer.

```
GET /cs453/index.html HTTP/1.1<cr><lf>Host: gai
a.cs.umass.edu<cr><lf>User-Agent: Mozilla/5.0 (
Windows;U; Windows NT 5.1; en-US; rv:1.7.2) Gec
ko/20040804 Netscape/7.2 (ax) <cr><lf>Accept:ex
t/xml, application/xml, application/xhtml+xml, text
/html;q=0.9, text/plain;q=0.8,image/png,*/*;q=0.5
<cr><lf>Accept-Language: en-us,en;q=0.5<cr><lf>Accept-
Encoding: zip,deflate<cr><lf>Accept-Charset: ISO
-8859-1,utf-8;q=0.7,*;q=0.7<cr><lf>Keep-Alive: 300<cr>
<lf>Connection:keep-alive<cr><lf><cr><lf>
```

- a. What is the URL of the document requested by the browser?
- b. What version of HTTP is the browser running?
- c. Does the browser request a non-persistent or a persistent connection?
- d. What is the IP address of the host on which the browser is running?
- e. What type of browser initiates this message? Why is the browser type needed in an HTTP request message?

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- P7. 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?
- P8. Referring to Problem P7, suppose the HTML file references eight very small objects on the same server. Neglecting transmission times, how much time elapses with
- Non-persistent HTTP with no parallel TCP connections?
  - Non-persistent HTTP with the browser configured for 5 parallel connections?
  - Persistent HTTP?
- P11. Consider the scenario introduced in the previous problem. Now suppose that the link is shared by Bob with four other users. Bob uses parallel instances of non-persistent HTTP, and the other four users use non-persistent HTTP without parallel downloads.
- Do Bob's parallel connections help him get Web pages more quickly? Why or why not?
  - If all five users open five parallel instances of non-persistent HTTP, then would Bob's parallel connections still be beneficial? Why or why not?
- P13. What is the difference between MAIL FROM: in SMTP and From: in the mail message itself?

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- P22. Consider distributing a file of  $F = 15$  Gbits to  $N$  peers. The server has an upload rate of  $u_s = 30$  Mbps, and each peer has a download rate of  $d_i = 2$  Mbps and an upload rate of  $u$ . For  $N = 10, 100$ , and  $1,000$  and  $u = 300$  Kbps,  $700$  Kbps, and  $2$  Mbps, prepare a chart giving the minimum distribution time for each of the combinations of  $N$  and  $u$  for both client-server distribution and P2P distribution.
- P23. Consider distributing a file of  $F$  bits to  $N$  peers using a client-server architecture. Assume a fluid model where the server can simultaneously transmit to multiple peers, transmitting to each peer at different rates, as long as the combined rate does not exceed  $u_s$ .
- Suppose that  $u_s/N \leq d_{\min}$ . Specify a distribution scheme that has a distribution time of  $NF/u_s$ .
  - Suppose that  $u_s/N \geq d_{\min}$ . Specify a distribution scheme that has a distribution time of  $F/d_{\min}$ .
  - Conclude that the minimum distribution time is in general given by  $\max\{NF/u_s, F/d_{\min}\}$ .
- P24. Consider distributing a file of  $F$  bits to  $N$  peers using a P2P architecture. Assume a fluid model. For simplicity assume that  $d_{\min}$  is very large, so that peer download bandwidth is never a bottleneck.
- Suppose that  $u_s \leq (u_s + u_1 + \dots + u_N)/N$ . Specify a distribution scheme that has a distribution time of  $F/u_s$ .
  - Suppose that  $u_s \geq (u_s + u_1 + \dots + u_N)/N$ . Specify a distribution scheme that has a distribution time of  $NF/(u_s + u_1 + \dots + u_N)$ .
  - Conclude that the minimum distribution time is in general given by  $\max\{F/u_s, NF/(u_s + u_1 + \dots + u_N)\}$ .
- P25. Consider an overlay network with  $N$  active peers, with each pair of peers having an active TCP connection. Additionally, suppose that the TCP connections pass through a total of  $M$  routers. How many nodes and edges are there in the corresponding overlay network?
- P33. Can you configure your browser to open multiple simultaneous connections to a Web site? What are the advantages and disadvantages of having a large number of simultaneous TCP connections?